Online Dance versus Online Therapeutic Exercise on Quality of Life - A Study Protocol for a Randomized Controlled Trial Investigating Social Telerehabilitation Efficacy in Parkinson's Disease.

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Abstract

Background: Social telerehabilitation delivers rehabilitation services over online video conferencing within a social context. Multimodal therapeutic exercises are the most used rehabilitation strategies for individuals with PD. Dance is considered a multimodal category with an art-based background. Results from our prior feasibility study revealed that social telerehabilitation with dance is feasible, safe, and enjoyable for older adults with and without PD. To the best of our knowledge, this is the first protocol for an online randomized controlled trial investigating the efficacy of dance compared to multimodal therapeutic exercise delivered by social telerehabilitation.

Methods: This is a protocol for a randomized controlled trial. Forty individuals diagnosed with PD will be randomly allocated to one of the two social telerehabilitation groups: (1) dance and music or (2) multimodal therapeutic exercise and music. Interventions will occur twice a week for three months. Each session will last 60 minutes. Tele assessments will be conducted pre, post, and one-month follow-up. Primary outcomes will be quality of life and well-being. Secondary outcomes will include motor severity, upper and lower limbs' function, non-motor symptoms (such as memory, attention, and anxiety), and participants' perceptions of technology usability, enjoyment, and socialization.

Discussion: The study's aim is to determine the effectiveness of social telerehabilitation on a biopsychosocial view of PD aspects that impact the quality of life and well-being. We hypothesize that both interventions would effectively ameliorate motor symptoms. However, we expect that dance will be more enjoyable and induce a greater improvement of non-motor symptoms, quality of life, and well-being.

Keywords: Parkinson's disease, physiotherapy, dance, telehealth, telerehabilitation

Background

The prevalence of Parkinson's disease (PD) is rapidly increasing, with more than 1.6 million people projected to be affected by 2037 in the U.S. Such an increase in PD cases is expected to result in an economic burden exceeding $79 billion[1]. Dopaminergic medication and deep brain surgery alone are insufficient to overcome the entire symptom complex of PD [2]. Hence, a wide range of multidisciplinary therapies is broadly recommended for PD [1,3] to maintain well-being and manage motor and non-motor symptoms during the course of the disease[1,3]. Given the wide range of biopsychosocial aspects that are impacted, patients with PD require specialized healthcare, which can be expensive for individual treatment. As a result, many patients cannot receive the necessary multidisciplinary care[4].

Thus, there is a call for innovative, scalable, and affordable strategies to improve financial and operational processes when treating people with PD, without compromising care quality[4]. Telerehabilitation is considered a field of telehealth that provides rehabilitation services over online video conferencing[5], thereby overcoming geographical barriers and facilitating access to healthcare services[6]. Regarding the expenses, the total cost of telerehabilitation for patients with PD is nearly half of the cost of in-clinic rehabilitation, but with comparable effectiveness in addressing postural instability and satisfaction levels[7].

One important aspect for individuals with PD is social connection. Telerehabilitation can also meet the need for social connection. Social isolation is frequently reported by PD patients and is related to disease worsening and mortality[8]. Importantly, being part of a PD support group brings a bond connection that shares the sense of patients' purpose in society [8], improving patients'

motivation and well-being due to social support[9]. Thus, social telerehabilitation may be a cost-effective solution to enhance motivation and treatment adherence for people with PD.

In-person dance is a form of multimodal exercise that combines artistic expression with physical activity, catering to the physical, emotional, and social needs of individuals with PD[10,11]. As dance is usually performed in a group setting, studies have shown high levels of adherence and positive results on the severity of motor symptoms of PD[12,13]. Dance allows the use of external and internal cues that may facilitate the movement. First, incorporating music in a rhythmic and well-structured pattern serves as an external auditory cue and guides movement sequence. Second, the distinct steps pattern of each dance style can serve as a novel locomotion pattern with internal cues that triggers the corticalization/awareness in movement generation[14]. Although fewer studies investigate the impact of dance on non-motor symptoms, a recent meta-analysis compared more than thirty-five non-pharmacological interventions for people with PD, and dance was the most effective for depression[15]. The rationale is that dance provides an environment of emotional release and joyfulness where movement choreographies instructed within storytelling behind are guided by music. Therefore, dance may benefit emotional and cognitive functions in individuals with PD.

Multimodal therapeutic exercise is a modality that encompasses a wide range of activities, including agility and change of direction, balance, aerobic conditioning, multitasking, motor coordination, and compensatory strategies (clues)[5,16]. The mixed and challenging elements involved in multimodal training bound the needs of people with PD[16], but it does not necessarily play a direct role in emotional aspects, such as dance. Exercises can also be performed with music at gyms, but exercises/movements are not created to follow music or with storytelling/art behind them. Although in-person therapeutic exercises and dance[17] have shown significant benefits in PD, the effectiveness of these strategies through social telerehabilitation (i.e., online video

conferencing) is still lacking. More than that, studies fail to investigate the whole biopsychosocial aspects involved in individuals living with PD[5,18] and how dance can underpin especially the non-motor symptoms of PD.

Therefore, this randomized clinical trial protocol aims to compare the effectiveness of two online exercise-based interventions, dance and multimodal therapeutic exercise, on quality of life and well-being in individuals with PD. To comprehensively understand the biopsychosocial aspects involved, we will investigate body functions, activities, and participation according to the Classification of Functioning, Disability, and Health (ICF). Thus, the effects on motor symptoms severity, upper and lower limb functions, and non-motor symptoms (such as memory, attention, and anxiety) will be investigated. Participants' perceptions about technology usability, enjoyment, and socialization will also be explored through a structured interview and feasibility questions. Our hypothesis is that both social telerehabilitation strategies will have similar effects on improving motor symptoms, but dance will be more effective and enjoyable in addressing non-motor symptoms, quality of life, and well-being compared to multimodal therapeutic exercises.

Methods

This research project was approved at the Universidade Federal de Ciências da Saúde de Porto Alegre, Brazil (CAAE: 58321322.80000.5345). The researchers will ensure the anonymity of participants by a code and so the participants' identities will not be revealed in future publications or presentations of the research findings. The data collected by clinical records and research instruments that contain data from the participants will remain anonymous. All the data will be stored in a secure single folder dedicated to this research.

The trial registration is under revision at ClinicalTrials.gov (Protocol ID: OnlineRehabPD). We followed the Guideline SPIRIT (Standard Protocol Items: Recommendations for Interventional Trials) to report the content of this randomized controlled trial (RCT) protocol[19] (Appendix 1). In the future, authors will follow the CONSORT (Consolidated Standards of Reporting Trials) statement for reporting RCT results.

Study Design

Our study is a randomized clinical trial protocol for a future RCT regarding a home-based social telerehabilitation intervention. Participants with PD will be randomly allocated into two online groups:

Group 1 - Social Telerehabilitation with Dance and Music

Group 2 - Social Telerehabilitation with Multimodal Therapeutic Exercise and Music

Eligibility

Individuals who present the following characteristics will be included: clinical diagnosis of idiopathic PD according to the clinical criteria of the London Brain Bank Criteria (2006)[20]; age between 18-90 years; a minimum score of 18 in the Montreal Cognitive Assessment[21], drug therapy/exercise stable for at least four weeks before the study starts, agreement to participate in the study according to the Informed Consent Form. Individuals will be excluded if they present auditory and/or visual disturbances that compromise understanding simple commands. In addition, participants must have access to the internet, a device to access online classes, and a house member and/or caregiver at home to supervise them during the entire experiment, including evaluations

and interventions. For patients scoring less than 2.5 points on the modified Hoehn and Yahr Scale (indicating mild disease impairment, independence in daily living activities, and no risk of falls), the requirement for household member supervision may be waived.

Sample and Settings

The sample will be selected for convenience. Recruitment will be carried out through telephone calls, electronic messages, and online posting on social media and websites of university centers, communities, and organizations of people with PD in Brazil. Art media will contain researchers' contact, a link, and a QR code so that individuals can fill out a simple online form. After this first screening, individuals interested in participating will be contacted by telephone call for the first baseline screening to verify eligibility criteria, such as demographic data, drug therapies, regular exercise, and physical activities (using the International Physical Activity Questionnaire (IPAQ) - short version), dance experience (using The Goldsmiths Dance Sophistication Index (Gold-DSI)[22], cognition (using the Montreal Cognitive Assessment), diagnosis exams, risk of falls and scores for Hoehn and Yahr and Unified Parkinson's Disease Rating Scale (UPDRS). Importantly, the scores for the last two scales will be obtained by a physician or health professional in person during participants' regular appointments. Those who meet the eligibility criteria will receive an invitation to participate and the Informed Consent Form to read and sign. Participants who agree to the Informed Consent Form will be instructed to maintain their dopaminergic medication and exercise routine during the study period.

Participants will be randomly assigned to the dance or multimodal therapeutic exercise groups (1:1 allocation). After initial screening procedures, a randomization sequence will be

generated using Microsoft Excel by a blinded researcher (ASP). The randomization will be stratified according to the modified Hoehn & Yahr scale scores of those who were at mild (scores ranging from 1.0 to 2.5), moderate (score 3.0), and severe (scores ranging from 4.0 to 5.0) stage of disease severity[23]. The participant's allocation will be concealed sequentially numbered and sealed in opaque envelopes prepared before the experiment starts. Afterward, the therapist will open the envelopes and contact participants regarding the group assignment. Participants will be instructed not to reveal their assignment to the blinded researchers involved in the study. Due to the nature of the interventions, it is impossible to blind participants and therapists. Importantly, the researcher (RSM) responsible for all the pre and post-evaluations will be blinded to group allocation. Interventions will be administered to a group of participants simultaneously (i.e., not individually), so participants will start the intervention they were allocated when the whole recruitment is completed. The flow diagram of the study can be seen in Figure 1. The time schedule is available in Supplementary Material 1.

Interventions

General aspects

Social telerehabilitation (dance or multimodal therapeutic exercise) will be carried out in an online synchronous format using the *Zoom* video call platform. Both interventions will be performed in a group/social setting, meaning that participants allocated to Group 1, for example, will receive the intervention together and simultaneously in the same virtual group environment. Group 2 will receive the intervention separately. Half of the intervention will be conducted with participants seated on a chair, while the other half will be conducted with participants standing. Standing position will require rising from the chair, moving around behind the chair, and then

keeping the position using the chair as support for hands. Lower-limb exercises will be performed with the participant in a sitting position. Participants who are at moderate or severe stages of the disease will receive the treatment under the supervision of a household member. Before the study starts, participants will receive instructions (via phone calls and emails/messages with text and video tutorials). These instructions will cover downloading and accessing the Zoom platform and preparing their device (e.g., computer, notebook, tablet) and room for the online classes. Before the start of each class, participants will receive a notification (via phone message) with a class reminder. The link will be the same throughout the duration of the study.

It will be emphasized at the beginning of the class that participants should perform the movements respecting their limits, modify movements if something causes discomfort (i.e., half range of motion, slow down, half time), and prioritize their safety. Additional instructions will be provided, including checking if participants have enough room and clear space to move without obstructions. Participants will also have the option to remain seated if they feel unsafe standing up on that particular day. During each class, the instructor will offer options to perform the movements while seated, if necessary. Participants will also be instructed to make a "T sign" with their hands in front of their cameras if they need support from the research team. Importantly, classes will be supervised by at least two additional researchers to monitor and assist participants during interventions.

Intervention Groups

The protocols of this research followed the recommendations of the checklist Template for Intervention Description and Replication (TIDieR)[24] to optimize the description of interventions

carried out in randomized clinical trials. The periodicity, elements, and progression of each intervention are detailed in Table 1.

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TABLE 1 HERE

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Group 1 - Social Telerehabilitation with Dance & Music (Online): The dance intervention will be instructed by a physiotherapist and dance professional, who will follow a structure based on the materials of the Dance for Parkinson's (USA) ® method (Table 2). This protocol is based on Pinto et al. 2023, in-press.

Group 2 - Social Telerehabilitation with Multimodal Therapeutic Exercise & Music (Online): The intervention with multimodal therapeutic exercise will be instructed by a physiotherapist, who will follow a structure based on a previous study and Physical Therapy Guidelines for People with PD [5,25–27] (Table 3). Depending on each participant's ability to stand up, the class can be adapted to be held in a chair for both groups.

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TABLES 2 AND 3 HERE

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The intervention protocols have similarities and differences. Group 1 will focus on particular aspects of dance, such as artistic form, imageries using scenic arts, imageries using aspects of theater and storytelling, movement improvisation, choreography and sequence of

movements, complex dance movements, fluidity of movement or connection between one movement and another, rhythmicity and/or movement built with music[13,28]. The beat/rhythm within the music will be emphasized as a motion booster. In contrast, exercises for participants in Group 2 will not include these aspects. Rather, they will be restricted to executing movements within series and standardized and fixed repetitions, accompanied by background music. The music selection will be familiar and previously selected with participants before starting the intervention. Both groups will listen to the same playlist of songs (approximately ten songs). All sequences of movements will be set following a specific music tempo (i.e., beat per minute) - Allegro (120-168 bpm), Moderato (108-12 bpm), Andante (76-108 bpm), Adagio (66-76 bpm). Importantly, the playlist of songs will change every three weeks to motivate participants with new songs and create new advanced movements and skills. Thus, the three-month intervention will be divided into four blocks (three weeks for each block). The first block will consist of simple movements and skills with the same playlist of songs for three weeks, and so on for blocks two, three and four.

Three factors will be controlled to be similar for both interventions: instructions and cues, music, and socialization. Classes will be led using a combination of verbal instructions and visual cues. The basic principles of motor learning will be followed. For example, verbal instructions will be based on three pillars: external focus (directing the learner's attention towards the effects of their movements rather than on movements themselves or body parts involved), use of imagination or environment to facilitate movements (creating mental images or using cues from the surrounding environment to guide movement sequences and facilitate movement understanding), enhance expectations (positive affect to increase confidence and motivate), and autonomy support (providing learners with choices, supporting their decision-making, and encouraging self-directed

learning). Analogy learning (visual and metaphor imageries) will also be used as another element for motor learning. In addition, visual cues will also be used to favour the activation of mirror neurons - activated when someone observes the action of another person[28–30]. Thus, the instructor will continuously execute and repeat the movements during the class so that the participants can observe the motor actions and copy them when necessary.

At the end of the class, the instructor will display Borg's perceived exertion rating scale (which ranges from 6 to 20) on the screen to help participants identify the exercise intensity. Additionally, participants will be asked to write down their perception of effort on a piece of paper. The instructor will contact participants individually after the end of the class to collect the number noted on the paper without influencing the other participants[31,32]. Researchers will record all the classes and compute the adherence and attendance, the barriers to accessing the online class, and any adverse events during the intervention, such as falling from a chair or height, visible musculoskeletal injuries, or cardiovascular events. Moreover, the researchers' team will follow a safety protocol in case of any adverse events, which includes a telephone call to the family member/caregiver to verify the need to call the rescue service.

Outcomes

Primary Outcomes

Quality of Life and Well-being - *Parkinson's Disease Questionnaire (PDQ-39) and Positive and Negative Affect Scale (PANAS).*

Secondary Outcomes

Motor symptoms severity - *Unified Parkinson's disease rating scale, motor subscale (UPDRS III);*

Manual dexterity - *Dual-Task Finger Tapping Test;*

Functional lower extremity strength - *Five times sit-to-stand test (FTSTS);*

Anxiety - *Parkinson Anxiety Scale (PAS);*

Executive functions such as attention and memory recognition - *Online Attention Test (OAT) and Recognition Memory Test (RMT);*

Feasibility (adherence and attendance and participants' self-perceptions about technology usability, enjoyment, and socialization) and safety (adverse events) - *Structured Interview and Researchers' Observation.*

Instruments and Procedures

All teleassessments will be carried out remotely and online over videoconferencing at three different time points: PRE (up to four days before the interventions start), POST (up to four days after the end of the interventions), and FOLLOW-UP (one month after the end of the last intervention); except for the FOLLOW-UP which will only include the assessments of the quality of life, well-being, and motor symptoms severity. The videoconferencing will be performed using the *Zoom* platform. Participants will be required to perform the evaluations during the ON phase of dopaminergic medication (up to 1 hour after drug administration and confirmed by the patient's perception of their ON state). The blinded researcher (RSM) will conduct all the teleassessments. To ensure safety, participants who cannot stand up or walk, and scored equal to or higher than four on the H&Y scale, will not be asked to perform evaluations requiring standing up from a chair or walking. The evaluator will be responsible for contacting participants beforehand to provide preliminary instructions on how to prepare their home environment for the evaluation. The

assessment will last approximately 90 minutes, and the outcomes and instruments will include the following:

Quality of life and Well-being* using *Parkinson's Disease Questionnaire (PDQ-39) and Positive and Negative Affect Scale (PANAS);

The quality of life of people with PD will be assessed using the Parkinson's Disease Questionnaire (PDQ-39), which is validated for people with PD through an online electronic form (Morley et al., 2014). PDQ-39 consists of 39 questions separated into eight domains: mobility (ten items); activities of daily living (six items); emotional well-being (six items); social support (three items); bodily discomfort (three items); stigma (four items); cognition (four items); and communication (three items). Each item is answered with five responses: never; rarely; sometimes; often; and always. The score ranges from zero to four points for each answer, and the final score ranges from zero to 100 points. The lower the score, the greater the person's quality of life in the last month.

Subjective well-being consists of two general components: life satisfaction and experience of positive and negative affections. We chose the last component that is measured with a Brazilian-validated tool called the Positive and Negative Affect Scale (PANAS). The scale contains 20 words about positive/negative feelings and emotions that are rated on a 4-Likert scale. Higher scores represent higher levels of affect[33]. People who have high negative affect scores tend to be more dissatisfied with their lives, have more negative expectations about the future, and report low levels of self-esteem and well-being. This scale was previously used in people with PD (Fontanesi 2021).

Motor symptoms severity*: *Movement Disorder Society, Unified Parkinson's Disease Rating Scale (MDS-UPDRS) Part III

Part III of MDS-UPDRS assesses the severity of motor symptoms. Motor aspects related to facial expression, posture, hand movements, leg agility, gait, and others will be evaluated through clinical observation, except for rigidity and postural testing, which will not be assessed because they require manual contact. The remote administration of the adapted MDS-UPDRS III has already been demonstrated to be feasible[34].

Manual dexterity: Dual-Task Finger Tapping Test

Manual dexterity and bradykinesia during a dual task will be assessed using the Dual-Task Finger Tapping Test. After finishing MDS-UPDRS III, participants will repeat item 3.4 (Finger Tapping Subtest)[35] while performing a cognitive task. They will be instructed to tap the index finger against the thumb as quickly as possible and with the largest amplitude possible. The Subtraction by Three Test will be used as a cognitive demand. Participants will be required to subtract 3's (aloud) from a random 3-digit number (between 280 and 320) while performing the Finger Tapping Subtest. The test will be performed three times for each hand, with a different number chosen for each repetition. The number of tapping will be counted for 15 seconds. The movement (speed, number of times that amplitude reduced, and number of pauses in finger taps) will be analyzed in the first ten taps of each trial.

Functional lower extremity strength*: *Five Times Sit to Stand Test

The Five Times Sit to Stand test accesses the functional lower extremity strength and requires a firm chair with back support, and armrests. The chair should be positioned against a wall or supported by someone so that it does not move. The participant will be instructed to sit with the spine resting on the back of the chair (can be adapted to sit in the front half of the chair to provide mechanical advantage), arms crossed over the chest (can be adapted for hands on the chair or auxiliary device) and feet resting on the floor in a comfortable way for the individual to stand up. Subjects will be asked to stand up and sit down five times from the chair as quickly as possible. The instruction to the patient will be, "I want you to stand up and sit down from the chair five times as fast as you can when I say Go." The time starts with the verbal command "Go" and ends when the buttocks touch the chair's seat after the fifth repetition. It will be emphasized that the individual stands up in orthostasis with full amplitude and does not rest his back against the back of the chair during the repetitions. The participant will perform a first familiarization with the test and then perform it effectively for three series. The evaluator will record the time the individual stands up and sits down on the chair five times.

Anxiety* using *Parkinson's Anxiety Scale

Anxiety related to PD symptoms will be assessed using the Parkinson Anxiety Scale - Brazilian version. The instrument can be divided into three different parts: (a) persistent anxiety (5 items), which measures generalized anxiety disorders; (b) episodic anxiety subscale (4 items), which assesses panic disorder; and (c) avoidance behaviour (3 items), which assesses the anxiety symptoms of agoraphobia and social phobia. Each question is scored from zero to four points,

329 totaling a maximum of 48 points. The higher the score, the more anxious the person is classified
330 by the scale[36].

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332 ***Attention and Memory Recognition*** **by means of** ***Online Attention Test (BPA-2) and***
333 ***Recognition Memory Test (TEM-R-2)***

334 The executive function will be assessed from two specific constructs that include (a)
335 focused, alternating, and divided attention and (b) recognition memory.

336 The first one is the online attention test (BPA-2), composed of alternating online attention,
337 concentrated/focused online attention, and divided online attention. The digital format allows
338 recording the reaction time and the sequence in which the stimuli are selected, with different scores
339 being attributed according to the task execution order. In addition, tests have three random and
340 parallel response models for each type of test, which are presented randomly and with a different
341 number of target stimuli per line. Through the videoconferencing chat, participants will receive a
342 link to access both tests. Tests require a desktop or notebook with a monitor of at least 14 inches
343 (with a resolution of 1010x620) with an operating system Windows 7 or higher with internet access
344 (broadband). The online attention test's application time is approximately seven minutes.

345 The Recognition Memory Test (TEM-R-2) evaluates mnemonic aspects in several areas,
346 such as in traffic, organizational and clinical contexts, as well as in personnel selection, in
347 neuropsychological assessments, among others. There are application standards, scoring based on
348 the number of hits and misses, and general or age performance standards. It has a fixed time, and
349 the entire process of instruction and application lasts approximately ten minutes[37].

Feasibility and Safety - Participant's self-perceptions

Firstly, feasibility and safety will be tracked during the live sessions by researchers' observation. Outcomes such as adherence, attendance, and adverse events (e.g. near-falls or falls from chair or height) will be systematically tracked, and data will be logged into a spreadsheet for later analysis. Secondly, participants will be evaluated regarding their self-perceptions of technology usability, enjoyment, and socialization based on a structured interview. Responses will follow a Likert rating scale in which the number of choice points ranges from 1 to 5 points in descending order (for example, strongly agree to strongly disagree). An additional open question (qualitative) will address the participants' self-perception regarding the barriers and facilitators of social telerehabilitation.

Data management and analysis

The sample was calculated to estimate an effect size measure of the group*assessment interaction of f=0.25 (corresponding to an average effect size). Considering two groups and pre-post evaluations, a significance level of 0.05, and a power of 80%, 17 participants will be needed in each group (20 if 15% is added for eventual losses). The sample was calculated using the G*Power 3.1.9.7 software.

Data will be analyzed using the Statistical Package for Social Sciences (SPSS), version 21.0. The significance level will be 5% ($p<0.05$). Shapiro-Wilk test will verify the normality of the data, and Levene tests the homogeneity of the variances. Generalized Linear Models (GEE) analysis will investigate time, group, and time group interaction effects, followed by Bonferroni

posthoc, when appropriate. Pearson and Spearman correlations for motor and non-motor symptoms will verify parametric and non-parametric data. For participants that discontinue the intervention protocol, we will contact them to perform the analysis on post and follow-up assessments. If participants refuse to participate, we will use intention-to-treat analysis to analyze dropouts or missing data.

Discussion

Results from our previous feasibility study (Pinto et al. 2023 in-press) showed that social telerehabilitation with dance is feasible and safe for thirty older adults with and without PD. Moreover, recent case series found that online dance is safe and feasible, with a potential sense of achievement and enjoyment based on self-perceptions of individuals with PD[28,38–40]. However, the efficacy and long-term effects on PD symptoms are not known. Nonetheless, the International Classification of Functioning, Disability and Health (ICF), endorsed by the World Health Organization (WHO) in 2001, recognizes not only the physical aspects restricted to the disease but advances in the cognition, emotional and social domains. We understand that biopsychosocial aspects when assessing motor and non-motor symptoms of PD are a way to comprehend the individual more integratively. Anxiety, for example, can significantly influence functional movements in PD and vice-versa[41]. Therefore, we propose a prospective RCT to investigate the effectiveness of social telerehabilitation on biopsychosocial aspects of the person diagnosed with PD, comparing dance to multimodal therapeutic exercises as the most used non-pharmacological interventions in PD[5,16].

In-person clinical trials have found similar effects when comparing in-person dance to therapeutic exercises[25,42,43] for motor symptoms, although investigations lack understanding of its comparison on other aspects. We included outcomes that are not usually investigated in PD and that can be potentially modified by dance intervention, such as manual dexterity, anxiety, attention, and memory. The rationale is that dance includes different types of movement qualities, such as fluidity, accuracy, stability, smoothness, and relaxation that are required for upper limbs and hands. The joyfulness, the emotional release, and the movement guided by music added to the social aspect would potentially reduce anxiety symptoms. Dance also tailors a range of creative possibilities that request participants to pay attention, memorize choreography and sequence of movements with music, and motivate corporal and facial expressions due to the storytelling element. We hypothesize that social telerehabilitation with dance would bind the individual more integratively.

Although no previous RCT compares two social tele rehabilitation in PD, we eliminate some possible biases found in previous in-person clinical studies. Factors such as instructions for motor learning, music, and socialization will be controlled. Prior in-person RCT[43] included only 9/10 participants for the tango and exercise groups, did not control the music element, and detailed intervention progression was also missing. Moreover, multimodal training is a strongly recommended modality for PD, and the term "conventional physiotherapy" used in several previous studies must be abandoned[44]. Dance is also characterized as a multimodal exercise approach, so it might be interesting to compare to similar multimodal exercise programs other than aerobic or stretching. For example, previous in-person RCT compared dance to other types of exercise modalities, such as treadmill training or stretching[45]. More than that, no previous study investigated how people's prior engagement with dance can be a source of treatment effectiveness.

We will investigate previous dance experience using a proper tool, The Goldsmiths Dance Sophistication Index (Gold-DSI)[22], and so contribute to this understanding. We expect that, depending on individual preferences and previous experiences, patients would choose which strategy is more affordable on their own.

Dance is culturally well-integrated and long-term adhered to in-person PD communities all over the world[46]. Considering the elements of rhythmic timing, skilled movements, and storytelling, dance might improve PD symptoms in a more integrative way than multimodal therapeutic exercise, positively impacting the quality of life and well-being. Nonetheless, this RCT is crucial to provide robust evidence of the efficacy of social telerehabilitation with the most used non-pharmacological interventions for the PD population. This research aims to cross geographical barriers to provide effective and joyful social telerehabilitation strategies for people with PD, thus overcoming inactivity, social isolation, worsening of PD symptoms, and low quality of life.

Trial status

Researchers already performed a pilot experiment with one patient, including the assessments and interventions by videoconferencing described in this protocol. After the pilot trial, all the adjustments were made and described in this document with no modification to the originally approved project. The total experiment period will last approximately one year, including the recruitment period and researchers' training (three to four months), pre-post assessments with interventions (three to four months), and follow-up assessment (one month). Any modifications in this protocol will be reported to relevant parties.

List of abbreviations

PD – Parkinson's disease

RCT - Randomized controlled trial

CONSORT - Consolidated Standards of Reporting Trials

SPIRIT - Standard Protocol Items: Recommendations for Interventional Trials

ICF - Classification of Functioning, Disability, and Health

GOLD-DSI - The Goldsmiths Dance Sophistication Index

IPAQ - International Physical Activity Questionnaire

TIDieR - Template for Intervention Description and Replication

PDQ-39 - Parkinson's Disease Questionnaire

PANAS - Positive and Negative Affect Scale

UPDRS III - Unified Parkinson's disease rating scale, motor subscale

FTSTS - Five times sit-to-stand test

PAS - Parkinson Anxiety Scale

OAT - Online Attention Test

RMT - Recognition Memory Test

Declarations

Ethics approval and consent to participate: This research project was approved at the Universidade Federal de Ciências da Saúde de Porto Alegre, Brazil (CAAE: 58321322.80000.5345).

Consent for publication: Not applicable.

Availability of data and materials: The authors declare that the data supporting the findings of the study will be available within the paper.

Competing interests: The authors declare no conflict of interest.

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Authors' contributions: C.P. conceived the presented idea and wrote the project and the first draft of the manuscript, with the supervision and guidance of the advisor A.S.P. Authors R.S.M. and F.P. contributed to the manuscript preparation. R.S.M. and A.N.H. helped to shape the structure of the intervention protocol. C.R. and G.O. contributed to the definition of physiological outcome measurements. All authors read, contributed and approved the final manuscript.

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