Original Article

Journals BAHIANA
SCHOOL OF MEDICINE AND PUBLIC HEALTH

Telerehabilitation exercise program in elderly people with Parkinson's disease: an experimental study

Programa de exercícios físicos por telerreabilitação em idosos com doença de Parkinson: um estudo experimental

Janine Brasil de Araújo Moraes[1]
Breno Caldas Ribeiro[2]
Letícia de Cássia Tavares Nunes[3]
Brunna Gabrielli Freitas da Costa[4]
Caio Geovanni Reis Silva[5]
Carina Alves Costa[6]
Renato da Costa Teixeira[7]
Saul Rassy Carneiro[8]
Mellina Monteiro Jacob[9]

[1]Corresponding author. Universidade Federal do Pará (Belém). Pará, Brazil. jani.brasil.jb@gmail.com
[2-9]Universidade Federal do Pará (Belém). Pará, Brazil. bcaldas1.9@gmail.com, leticiatvrs03@gmail.com, brunna.freitas54@gmail.com, caiogeovanni14@gmail.com, costaalvescarina@gmail.com, renatocteixeira@uepa.br, saulfisio@gmail.com, mellinajacob@ufpa.br

ABSTRACT | INTRODUCTION: Restrictions during the COVID-19 pandemic limited access to specialized rehabilitation centers for physical therapy treatment of people with Parkinson's disease (PD). It is known that lack of exercise can worsen health conditions, lead to worsening typical signs of the disease, and promote functional decline. Telerehabilitation is a strategy that can restore access and facilitate the continuity of physical therapy care. **OBJECTIVES:** To evaluate the effects of a telerehabilitation exercise program on the level of physical activity, functional capacity of lower limbs, performance of activities of daily living (ADLs) and quality of life (QoL) in elderly patients with PD. **MATERIALS AND METHODS:** This is an experimental, descriptive, exploratory, longitudinal study, in which the effects of intervention by telerehabilitation were evaluated, the program was composed of 12 sessions of 1 hour, 3 times a week. Analytical statistics was done for comparative purposes by Student's t test. **RESULTS**: 22 participants completed the study. Significant change was observed in physical activity level (IPAQ initial 0.18 ±0.39 and final 1.0 ± 0, p = 0.0001), in the functional capacity of lower limbs (5 times sit and stand test (TSLCV) mean time pre 16.22 ± 7.41, and post 12.26 ± 2. 83, p= 0.0197), in the performance in the activities of daily living (Brazilian OARS Multidimensional Functional Assessment Questionnaire (BOMFAQ) of 26.13 ± 6.31 and after of 35.45 ± 5.16, p = 0.0001) and in the QL of the elderly with PD (PDQ-39 initial of 45.92 ±15.36 and final of 23.63 ± 10.19, p = 0.0001). **CONCLUSION:** We conclude that there was a change in the level of physical activity, in the functional capacity of lower limbs, in the performance of ADLs and in QL.

KEYWORDS: Parkinson Disease. Telerehabilitation. Exercise. Physical Functional Performance. Quality of Life.

RESUMO | INTRODUÇÃO: As restrições durante a pandemia do COVID-19 limitaram o acesso a centros de reabilitação especializados para tratamento fisioterapêutico de pessoas com Doença de Parkinson (DP). Sabe-se que a falta de exercícios físicos pode agravar as condições de saúde, levar à piora dos sinais típicos da doença e promover o declínio funcional. A telerreabilitação é uma estratégia que pode restaurar o acesso e facilitar a continuidade de assistência fisioterapêutica. **OBJETIVOS:** Avaliar os efeitos de um programa de exercícios físicos por telerreabilitação no nível de atividade física, no desempenho funcional de Membros Inferiores (MMII), no desempenho nas atividades de vida diária (AVD's) e na qualidade de vida (QV) em idosos com DP. **MATERIAIS E MÉTODOS:** Trata-se de um estudo experimental, descritivo, longitudinal, em que foram avaliados os efeitos da intervenção por telerreabilitação composta por 12 sessões de 1 hora, feitas 3 vezes/semana, realizada estatística analítica para fins comparativos pelo Teste t de Student. **RESULTADOS:** 22 participantes concluíram o estudo. Foi observada mudança significativa no nível de atividade física (IPAQ inicial de 0,18 ±0,39 e final de 1,0 ± 0, p = 0,0001), no desempenho funcional dos MMII (teste de sentar e levantar cinco vezes (TSLCV) tempo médio pré 16,22 ± 7.41, e após 12.26 ± 2.83, p= 0,0197), no desempenho nas atividades de vida diária (*Brazilian OARS Multidimensional Functional Assessment Questionnaire* (BOMFAQ) de 26,13 ± 6,31 e após de 35,45 ± 5,16, p = 0,0001) e na QV dos idosos com DP (PDQ-39 inicial de 45,92 ±15,36 e final de 23,63 ± 10,19, p = 0,0001). **CONCLUSÃO:** Conclui-se que houve mudança no nível de atividade física, no desempenho funcional de MMII, no desempenho nas AVD's e na QV.

PALAVRAS-CHAVE: Doença de Parkinson. Telerreabilitação. Exercício Físico. Desempenho Físico Funcional. Qualidade de Vida.

Submitted 09/09/2022, Accepted 01/25/2023, Published 04/04/2023
J. Physiother. Res., Salvador, 2023;13:e4829
http://dx.doi.org/10.17267/2238-2704rpf.2023.e4829
ISSN: 2238-2704
Assigned editors: Victor Hugo, Cristiane Dias

How to cite this article: Moraes JBA, Ribeiro BC, Nunes LCT, Costa BGF, Silva CGR, Costa CA, et al. Telerehabilitation exercise program in elderly people with Parkinson's disease: an experimental study. J Physiother Res. 2023;13:e4829. http://dx.doi.org/10.17267/2238-2704rpf.2023.e4829

Introduction

Parkinson's disease (PD) is a progressive neurological condition characterized by degeneration of the Central Nervous System (CNS) caused by pathophysiological loss or degeneration of dopaminergic neurons in the substantia nigra of the midbrain.[1]

Many signs characterize the disease: tremors at rest, rigidity, bradykinesia, balance changes, postural instability, and gait disorders.[2] Among the treatment techniques used in PD, there is an association between drug administration to replace dopamine and physiotherapeutic treatment, based on physical exercise, which is efficient in reducing symptoms.[3]

Due to the global health scenario characterized by the confrontation of the pandemic caused by the Sars-Cov-2 virus (COVID-19), there were limitations to the practice of physical exercises and the displacement of individuals with PD to specialized rehabilitation centers.[4] It is known that the lack of physiotherapeutic treatment in these individuals can aggravate their health conditions, and cause the worsening of the typical signs of the disease, in addition to promoting functional decline.[5]

Because of this, there was a need to seek alternative forms of specialized rehabilitation, so the Conselho Federal de Fisioterapia e Terapia Ocupacional – COFFITO (Federal Council of Physical Therapy and Occupational Therapy), through Resolution nº 516, of March 20, 2020, allowed the Physical Therapist to perform non-face-to-face care on the modalities: telerehabilitation, teleconsulting, and telemonitoring.[6]

Telerehabilitation is a helpful and essential strategy to continue treatment even at home and delay the functional decline of individuals with PD, as it uses telecommunication technologies to bring health care to patients who are far from a professional.[7] It is not superior to the quality of traditional face-to-face care, but it is associated with comparable results.[8]

The evidence for the use of telerehabilitation in PD is growing. Recently published studies evaluate the effects of telerehabilitation programs in people with PD using different methodologies, both concerning the selection of physiotherapeutic approaches and the clinical aspects evaluated.[9,10]

Among the aspects evaluated after the telerehabilitation programs, clinical features such as balance and gait, measured by several instruments, are more frequently observed, in addition to the quality of life, often accessed by the PDQ-39 scale.[10]

However, so far, few studies have specifically evaluated parameters such as the level of physical activity of elderly with PD, or the Lower Limbs (LL) performance after participating in physical therapy programs through telerehabilitation.[11] Considering the access limitations to physiotherapeutic rehabilitation centers during the COVID-19 pandemic, a reduction in functionality was observed in elderly with PD. Thus, we hypothesized that there might be a decline in the level of physical activity, in the LL functional performance, in functional independence to perform activities of daily living (ADLs), and Quality of Life (QoL) in elderly with PD.

Thus, the main objective of the present study was to evaluate the effects of a Physical Exercise Program for telerehabilitation on the level of physical activity, on the functional performance of the lower limbs, on the performance in ADLs, and on the QoL of elderly with PD, during a period of social isolation, imposed by the COVID-19 pandemic in Brazil.

Method

Study Design and Record

This is an experimental, descriptive, cross-sectional study, which evaluated the effects of physical therapy intervention by telerehabilitation in elderly with PD, being carried out from March to November 2021.

Ethical Aspects

The study complied with the rules of the Conselho Nacional de Saúde - CNS (National Health Council) under resolutions nº 466/2012 and 510/2016 and was approved by the Ethics Committee in Research with Human Beings of the Instituto de Ciências da Saúde - ICS (Institute of Health Sciences) of the Universidade Federal do Pará – UFPA (Federal University of Pará), under opinion nº 4,477,037. All participants signed the Free and Informed Consent Form, presented electronically via *Google forms*.

Participants

Individuals with PD assisted by the Physical Exercises Laboratory (LAERF/ICS) at UFPA were recruited by convenience, based on telephone contact. Were included individuals with a clinical diagnosis of PD, aged between 60 and 80 years of both genders, classified from 1 to 3 on the Hoehn and Yahr scale[12], who presented family members/caregivers with a mobile phone device, as well as stable internet access (Wi-fi or mobile data). The Elderly with cognitive disorders were excluded, based on the cutoff points of the Mini-Mental State Examination (MMSE).[13] Also, through collected information, patients with Diabetes Mellitus and other uncontrolled metabolic diseases were excluded; severe comorbidities such as heart disease and uncontrolled arterial hypertension; those hospitalized at least six months before the study; individuals with decompensated musculoskeletal disorders and other neurological diseases; those who were using mobility devices, or restricted to wheelchairs.

Data Collection Protocol

The assessment and reassessment were carried out via video call on free *WhatsApp*. It was applied before and after the intervention, and an evaluation form was elaborated by the researchers (supplement 1) to record the clinical data, identification, and evaluation parameters of the participants in the pre and post-intervention periods.

Level of Physical Activity

The level of physical activity was assessed by the International Physical Activity Questionnaire (IPAQ), which was adapted for the elderly and validated in Brazil.[14] It evaluates five sections regarding physical activity in the following domains: work, means of transport, housework, recreation, exercise, sport and leisure, and sitting time. How many days and time in minutes were verified for each question in that section. The result was classified as "active" the elderly who practiced a volume of physical activity (at least moderate) with time >150 minutes per week (min/week), and "sedentary" the one who did not perform physical activity for at least 10 continuous minutes during the week.

Functional Performance of Lower Limbs

The Five Times sit-to-stand test (FTSTS) assessed the functional performance of the lower limbs.[15] The participant was instructed to position the telephony device on a flat surface, with a sufficient distance and height for complete visualization by the evaluator; to sit on a chair, leaning against the wall, with your back resting on the backrest, cross your arms in front of your body and perform the movement of getting up and sitting down from the chair for five repetitions as quickly as possible. All assessments were performed only by a trained evaluator, who demonstrated the test for a better understanding of the participant, including the standing posture, defined with the trunk erect with hips and knees extended, before starting the test. The timer started when the evaluator spoke the word "go" and stopped when the participant's buttocks reached the seat after the fifth repetition. Test performance was based on its duration in seconds; consequently, the shorter the time spent, the better their functional condition. A cut-off point of 16 seconds was determined to identify the functional performance of reduced lower limbs.[15]

Performance in Activities of Daily Living

The 4th section of the *Brazilian OARS Multidimensional Functional Assessment Questionnaire* (BOMFAQ), validated in Brazil, assessed ADL's performance.[16] It evaluated the degree of self-reported difficulty to perform 15 activities, divided into seven basic activities of daily living - ABVD (getting in and out of bed, eating, combing hair, walking, going to the bathroom on time, showering, getting dressed), and eight instrumental activities of daily living – IADL (taking medication at the right time, climbing stairs, walking close to home, shopping, preparing meals, cleaning the house and cutting toenails, and driving). For each of the activities, the participant answered: "I do it without difficulty", "with difficulty", "I do it with the help of other people", or "I can't do it". In each activity, the participant was classified with 0 (zero) when he/she mentioned not performing a certain activity, 1 (one) when he/she mentioned doing it with great difficulty/with someone's help, 2 (two) doing it with some difficulty/without help and 3 (three) without difficulty. The test score was the sum of all activities performed with or without difficulty, or with the need for help, ranging from 0 to 45 points.

The results obtained through this scale can be interpreted considering the proximity to the maximum or minimum scores. Thus, a higher score would indicate less reported difficulty in performing ADLs and IADLs, while a score closer to the minimum value would indicate greater difficulty.[16]

Quality of Life

The *Parkinson Disease Questionnaire* 39 (PDQ-39) assessed QoL. This instrument was translated into Brazilian Portuguese at the *Health Services Research Unit* in 2005.[17] It comprises 39 questions divided 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 was answered according to five predetermined answers: never, occasionally, sometimes, often, and always. The total score for each individual was calculated according to the following formula: 100 x (sum of the patient's scores on the 39 questions/4 x39). The total score ranged from 0 (no problem) to 100 (maximum problem level). That is, a low score indicated a better perception of QoL.

Telerehabilitation Physical Exercise Program

The Program (supplement 2) was based on the recommendations of the European *Guideline* for Conventional Physiotherapeutic Interventions in PD[18], consisting of 12 sessions of 1 hour, carried out over 4 weeks, at a frequency of 3 times a week, containing the following steps: warm-up (stretching and mobility exercises), exercises for muscle strengthening, gait training and cool down (relaxation), with the progression of exercises/increase in workload, after 6 sessions.

Participants received a digital booklet, formulated by the researchers, in PDF format (supplement 3) via WhatsApp® containing: general guidelines regarding care before and during the Program; as well as a detailed description, with illustrative images of each exercise, the frequency and how to perform them; also, the weekly planning, containing a table that the participant can mark the completed sessions. This document was printed for better handling.

The participants were instructed to perform the exercises in a large, well-lit, and unhindered place at home. Follow-up was done weekly through messages/calls to alleviate possible doubts and difficulties regarding the execution of the Program's exercises. Concerning the guidelines given: the mandatory full-time presence of the caregiver when performing the exercises; stipulation of session time (with the possibility of taking place in the morning (between 8 am and 11 am) or afternoon (between 2 pm and 6 pm) depending on the availability of participants/caregivers; adequate nutrition beforehand; adequate use of medication for PD always made before starting the exercises; use of suitable clothes for the practice of exercises and not wearing shoes during the session.

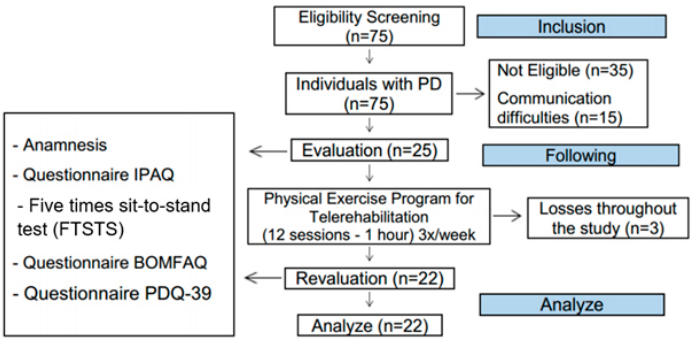
Data Analysis

To present the data extracted from the research, the technique of descriptive and analytical statistics was used. The sample characterization information was calculated and entered into a spreadsheet prepared in Microsoft Office Excel® 2016 software. In the application of Descriptive Statistics, the statistical measures were calculated: arithmetic mean, standard deviation, minimum and maximum value. Analytical statistics evaluated the results of the variables: 5xSST, IPAQ, BOMFAQ, and PDQ-39 before and after the intervention, using the Student's t-test after verifying the normality of the data using the Lilliefors test. For the treatment of categorical data, the binomial test for binomial variables was used. Descriptive and analytical statistics were performed using the BioEstat® 5.4, software. For decision-making, a significance level of $p \leq 0.05$ was adopted, indicating significant values with an asterisk (*).

Results

The researchers contacted 75 participants with PD by telephone. Of these, 50 were excluded due to communication difficulties, older age, and cognitive alterations. As for losses throughout the study, three participants did not complete the proposed program. Therefore, 22 participants completed the evaluations proposed in this study. The flowchart of participants is shown in Figure 1.

Figure 1. Flowchart of study participants



IPAQ: International Physical Activity Questionnaire; BOMFAQ: Brazilian OARS Multidimensional Functional Assessment Questionnaire; PDQ-39: Parkinson Disease Questionnaire-39.
Source: The authors (2023).

Table 1 shows the clinical characteristics of the research participants. The mean age found was 67.77±7.44 years, 12 of whom were male. The mean weight of participants was 65.77 ± 14.59 kg, the mean height was 1.59 ± 0.08 cm, the mean BMI was 25.83 ± 4.65, the mean time of illness was 6.5 ± 3.52 years old, regarding classification on the Hoehn and Yahr scale: one participant was classified as stage 1; eleven were classified as stage 1.5; three in stage 2; four at stage 2.5; three in stage 3. The mean MMSE score was 28.23 ± 2.2 points, and the drugs used by the participants were: Prolopa (86.36%), Mantidan (13.63%), Parkidopa (4.54%), Stabio (13.63%), Cinetol (9.09%), Amytril (4.54%) and Biperiden (4.54%), of which some drugs were used in combination.

Table 1. Clinical characteristics of study participants (to be continued)

Characteristics	PT (n=22)	V_{Max}	$V_{mín}$
Age (years)	67.77 ± 7.44	80	60
Female (n / %)	10 (45%)	-	-
Male (n / %)	12 (54%)	-	-
Weight (Kg)	65.77 ± 14.59	108	41
Height (cm)	1.59 ± 0.08	1.72	1.43
BMI	25.83± 4.65	33.7	17.64
Disease duration (years)	6.5 ± 3.52	15	2
Hoehn and Yahr scale (points)	1.93 ± 0.60	3	1
Stage 1 (n / %)	1 (4.54%)	-	-
Stage 1,5 (n / %)	11 (50%)	-	-
Stage 2,0 (n / %)	3 (13.63%)	-	-
Stage 2,5 (n / %)	4 (18.18%)	-	-
Stage 3,0 (n / %)	3 (13.63%)	-	-
Mini Mental State Examination (scores)	28.23 ± 2.2	30	21

Table 1. Clinical characteristics of study participants (conclusion)

Characteristics	PT (n=22)	V_{Max}	$V_{mín}$
Medicines		-	-
Prolopa (n / %)	19 (86.36%)	-	-
Mantidan (n / %)	3 (13.63%)	-	-
Parkidopa (n / %)	1 (4.54%)	-	-
Stabio (n / %)	3 (13.63%)	-	-
Cinetol (n / %)	2 (9.09%)	-	-
Amytril (n / %)	1 (4.54%)	-	-
iperideno (n / %)	1 (4.54%)	-	-

PT: Physical exercise program by Telerehabilitation, Vmax: maximum value, Vmin: minimum value; n: number, %: percentage.
Source: The authors (2023).

Table 2 shows the sociodemographic data of the study participants. It is noted that the Program enabled people from the Metropolitan Region and the countryside of the State of Pará to participate in the study in their town, with 9.09% of the cities in the Metropolitan Region and 31.81% in the country.

Table 2. Demographic characteristics of study participants (to be continued)

Characteristics (n=22)	Number (%)
Origin	
Capital (n /%)	13 (59.09%)
Metropolitan Region (n/ %)	2 (9.09%)
Countryside (n/ %)	7 (31.81%)
Color	
White (n/ %)	5 (22.72%)
Brown (n/ %)	17 (77.27%)
Civil Status	
Single (n/ %)	2 (9.09%)
Married (n/ %)	16 (72.72%)
Divorced (n/ %)	3 (13.63%)
Widower (n/ %)	1 (4.54%)

Table 2. Demographic characteristics of study participants (conclusion)

Characteristics (n=22)	Number (%)
Scholarity	
Incomplete Elementary School (n/ %)	2 (9.09%)
Complete Elementary School (n/ %)	5 (22.72%)
Incomplete High School (n/ %)	3 (13.63%)
Complete High School (n/ %)	9 (40.9%)
Higher Education Completed (n/ %)	3 (13.63%)
Occupation	
Autonomous (n/ %)	1 (4.54%)
Retiree (n/ %)	15 (68.18%)
Pensionary (n/ %)	3 (13.63%)
Housewife (n/ %)	3 (13.63%)

n: number of participants, %: percentage.
Source: The authors (2023).

Table 3 shows the analyzes corresponding to the questionnaires and tests applied in the research, before and after the intervention period. The score of the IPAQ questionnaire applied before the intervention obtained a score of 0.18 ± 0.39 points and after 1.0 ± 0 (p=0.0001). The FTSTS test showed an evaluation time of 16.22 seconds ± 7.41, and after 12.26 seconds ± 2.83, (p=0.0197). The BOMFAQ, in the evaluation 26.13 ± 6.31 points, and after 35.45 ± 5.16 points (p=0.0001). Finally, regarding the PDQ-39, in the evaluation 45.92 ±15.36 points and after 23.63 ± 10.19 (p=0.0001).

Table 3. Analysis of the questionnaires and tests applied in the study before and after the intervention

Tests	PRE	POST	P
IPAQ	0.18±0.39	1.0± 0	0.0001*
FTSTS	16.22±7.41	12.26±2.83	0.0197*
BOMFAQ	26.13±6.31	35.45±5.16	0.0001*
PDQ-39	45.92±15.36	23.63±10.19	0.0001*

IPAQ: International Physical Activity Questionnaire, FTSTS: Five times sit-to-stand test, BOMFAQ: Multidimensional Functional Assessment Questionnaire, PDQ-39: Parkinson Disease Questionnaire 39. Statistical test: Student's t-test.
Source: The authors (2023).

Discussion

This study observed that the Physical Exercise Program for Telerehabilitation in the elderly with PD, during a period of social isolation imposed by the COVID-19 pandemic in Brazil, influenced the significant improvement in the level of physical activity, the functional performance of the lower limbs, the performance in ADL's and QoL of the elderly.

It can be highlighted that the proposed Program provided relevant results regarding the level of physical activity, evidencing the change in the classification of participants from sedentary to active. This result may have been achieved by the fact that the program included regular physical activities in the participants' routine, and proposed a pleasant, safe moment, adapted to the reality of individuals with PD and including social involvement, with the participation of family members and/or caregivers, a fact that agrees with the study by Zaman et. al. (2019)[19] who researched the behavioral determinants for the practice of physical exercises in individuals with PD and concluded that individual exercise programs for Parkinson's must meet these requirements to achieve the desired goal.

The increase in the BOMFAQ score and the reduction in the execution time of the FTSTS functional test may mean an increase in lower limb mobility and performance. This can be explained by the fact that the proposed program emphasizes lower limb work and daily functional activities. Similar results can be seen in the randomized clinical trial by Vieira de Moraes Filho et al. (2020)[20] in which they evaluated the short-term effects of Progressive Resistance Training in people with PD, in which a reduction in the time to perform all applied functional tests was observed.

Regarding the results related to QoL, with a reduction in the score of the PDQ-39 questionnaire, it is observed in a Systematic Review by Wu et al. (2017)[21] that physiotherapeutic treatment based on physical exercise in PD can alleviate the degeneration of motor skills and depression, as well as increase QoL. The results also corroborate with the study by Silva et al. (2020)[22], carried out in a period of social isolation during the COVID-19 pandemic, which shows that people with PD can adhere to and remain motivated to participate in an exercise program based on telerehabilitation and that such a strategy can improve self-perception of QoL of these people.

Digital technology allows for innovative forms of rehabilitation and care for chronic neurological diseases, physiotherapeutic approaches through telerehabilitation, including virtual reality resources, with the use of video game consoles, dance, functional activities training such as sitting and standing, cognitive training, gait and balance training, in addition to lower limb stretching and strengthening exercises. The results of this study agree with a systematic review on the subject[23], which showed in its meta-analysis that training based on telerehabilitation in patients with PD significantly improved balance, QoL, ADLs, and depressive symptoms compared to the control group.

Furthermore, it is important to point out that telerehabilitation enabled a greater territorial coverage, as it provided access to the physiotherapist and rehabilitation, not only for individuals with PD from the capital but also from the metropolitan region and the countryside of the State of Pará. In a recent study[24] on the perspectives of people with PD on this modality of virtual rehabilitation, it was observed that 76% indicated high interest, 29% reported previous experience in this modality, 62% the advantage of access to a specialist, 60% convenience and 59% economy of time; on the other hand, the most common disadvantages were: lack of practical care (69%), lack of intimacy (43%) and technical difficulties (37%). Disadvantages that, despite not having been evaluated in this study, were observed during the research, such as the considerable number of exclusions due to communication difficulties or refusal to participate.

In addition, it is observed that telerehabilitation was safe and feasible, as it did not present any adverse effects or intercurrences during the period of carrying out the exercises at home, which corroborates the study by Ypinga et al. (2018)[25] who evaluated the effectiveness and costs of specialized physical therapy offered digitally (*ParkinsonNet* approach), in their retrospective analysis, followed a total of 2,129 patients for three years and concluded that this modality is safe and is associated with fewer complications related to the disease Parkinson's disease and lower costs in real-world practice.

Furthermore, the results of this study reinforce the evidence on the safety and feasibility of telerehabilitation as an alternative for monitoring people with PD, with an impact on the performance

of basic and instrumental activities of daily living, as well as on the quality of life. In most studies with telerehabilitation aimed at the elderly with PD, positive results are observed in clinical aspects such as balance and gait.[9,10]

Regarding the generalization, applicability, and external validity of our experimental study, the study showed a good adherence rate (88%) for elderly people with PD, demonstrating that telerehabilitation can also be a useful tool to avoid a sedentary lifestyle in these people, as it pointed out the improvement of physical capacity related to the level of physical activity and lower limb performance of elderly with PD.

Despite the relevance of the results, the present study had some limitations, among which we can mention: the remote assessment, which made data collection somewhat difficult and made it impossible to apply other functional tests; the lack of a control group that did not participate in the physical exercise program, in order to compare with the results obtained in the collection variables after applying the protocol proposed in this research, and also the absence of the qualitative evaluation of the participants.

Still, the absence of sample calculation would allow reaching a minimum quantity for more concrete interpretations about the data analysis of this study, thus not being able to be generalized. Thus, future studies should be encouraged to minimize the limitations mentioned here and to broaden the perspectives of this study, in order to consolidate telerehabilitation strategies as a form of physiotherapeutic care.

Conclusion

It is concluded that with the application of the Physical Exercise Program for telerehabilitation in elderly with PD there was a change in the post-test to the pre-test, in the level of physical activity, in the functional performance of lower limbs, in the performance in ADL's and in QoL, during a period of social isolation in the COVID-19 pandemic in Brazil.

Author contributions

Moraes JBA participated in the conception of the study, in data collection, as well as the formulation of research materials, instruments and writing of the article. Ribeiro BC participated in data collection and helped write the article. Nunes LCT, Costa BGF, Silva CGR e Costa CA participated in the research data collection. Teixeira RC participated in the co-supervision of the research, carried out biostatistics, and helped in the construction of the writing of the work. Carneiro SR participated in the writing of the work. Jacob MM participated in the conception of the study, and the orientation of the research, helping in the construction of the writing of the work.

Conflicts of interest

No financial, legal, or political conflicts involving third parties (government, companies, and private foundations, etc.) have been declared for any aspect of the submitted work (including, but not limited to, grants and funding, participation in advisory boards, study design, preparation manuscript, statistical analysis, etc.).

Indexers

The "Journal of Physiotherapy Research" Journal is indexed in DOAJ, EBSCO, LILACS, and Scopus.

References

1. Fiusa JM, Zamboni JW. Atualizações na doença de Parkinson através do tratamento com realidade virtual em 2018/2019. Rev Neurociências. 2020;1(28):1-8. https://doi.org/10.34024/rnc.2020.v28.9561

2. Reich SG, Savitt JM. Parkinson's Disease. Med Clin North Am. 2019;103(2):337-350. https://doi.org/10.1016/j.mcna.2018.10.014

3. Armstrong MJ, Okun MS. Diagnosis and Treatment of Parkinson Disease: A Review. JAMA. 2020;323(6):548-560. https://doi.org/10.1001/jama.2019.22360

4. Requia WJ, Kondo EK, Adams MD, Gold DR, Struchiner CJ. Risk of the Brazilian health care system over 5572 municipalities to exceed health care capacity due to the 2019 novel coronavirus (COVID-19). Sci Total Environ. 2020;730:139144. https://doi.org/10.1016/j.scitotenv.2020.139144

5. Van der Kolk NM, de Vries NM, Kessels RPC, Joosten H, Zwinderman AH, Post B, et al. Effectiveness of home-based and remotely supervised aerobic exercise in Parkinson's disease: a double-blind, randomised controlled trial. Lancet Neurol. 2019;18(11):998-1008. https://doi.org/10.1016/S1474-4422(19)30285-6

6. COFFITO (Brasil). Resolução COFFITO nº 516/ 2020. Estabelece Teleconsulta, Telemonitoramento e Teleconsultoria. Brasília: Diário Oficial da União nº.56, Seção 1, de 23/03/2020; 2020. Disponível em: https://www.coffito.gov.br/nsite/?p=15825

7. Achey M, Aldred JL, Aljehani N, Bloem BR, Biglan KM, Chan P, et al. International Parkinson and Movement Disorder Society Telemedicine Task Force. The past, present, and future of telemedicine for Parkinson's disease. MovDisord. 2014;29(7):871-83. https://doi.org/10.1002/mds.25903

8. Cubo E, Hassan A, Bloem BR, Mari Z. MDS-Telemedicine Study Group. Implementation of Telemedicine for Urgent and Ongoing Healthcare for Patients with Parkinson's Disease During the COVID-19 Pandemic: New Expectations for the Future. J Parkinsons Dis. 2020;10(3):911-913. https://doi.org/10.3233/JPD-202108

9. Vellata C, Belli S, Balsamo F, Giordano A, Colombo R, Maggioni G. Effectiveness of Telerehabilitation on Motor Impairments, Non-motor Symptoms and Compliance in Patients With Parkinson's Disease: A Systematic Review. Front Neurol. 2021;12:627999. https://doi.org/10.3389/fneur.2021.627999

10. Truijen S, Abdullahi A, Bijsterbosch D, et al. Effect of home-based virtual reality training and telerehabilitation on balance in individuals with Parkinson disease, multiple sclerosis, and stroke: a systematic review and meta-analysis. Neurol Sci. 2022;43(5):2995-3006. https://doi.org/10.1007/s10072-021-05855-2

11. Kim A, Yun SJ, Sung KS, et al. Exercise Management Using a Mobile App in Patients With Parkinsonism: Prospective, Open-Label, Single-Arm Pilot Study. JMIR Mhealth Uhealth. 2021;9(8):e27662. https://doi.org/10.2196/27662

12. Goetz CG, Poewe W, Rascol O, Sampaio C, Stebbins GT, Counsell C, et al. Movement Disorder Society Task Force Report on the Hoehn and Yahr Staging Scale: Status and Recommendations. Mov Disord. 2004;19(9):1020–1028. https://doi.org/10.1002/mds.20213

13. Brucki SMD, Nitrini R, Caramelli P, Bertolucci PHF, Okamoto IH. Suggestions for utilization of the mini-mental state examination in Brazil. Arq. Neuro psiquiatr. 2003;61(3B). https://doi.org/10.1590/S0004-282X2003000500014

14. Benedetti TRB, Antunes PC, Rodrigues-añez CR, Mazo GZ, Petroski EL. Reproducibility and validity of the International Physical Activity Questionnaire (IPAQ) in elderly men. Rev Bras Med Esporte. 2007;13(1):11-16. https://doi.org/10.1590/S1517-86922007000100004

15. Duncan RP, Leddy AL, Earhart GM. Five times sit-to-stand test performance in Parkinson's disease. Arch Phys Med Rehabil. 2011;92(9):1431-6. https://doi.org/10.1016/j.apmr.2011.04.008

16. Blay SL, Ramos LR, Mari Jde J. Validity of a Brazilian version of the Older Americans Resources and Services (OARS) mental health screening questionnaire. J Am Geriatr Soc. 1988;36(8):687-92. https://doi.org/10.1111/j.1532-5415.1988.tb07169.x

17. Carod-Artal FJ, Martinez-Martin P, Vargas AP. Independent validation of SCOPA-psychosocial and metric properties of the PDQ-39 Brazilian version. Mov Disord. 2007;22(1):91-8. https://doi.org/10.1002/mds.21216

18. Domingos J, Keus SHJ, Dean J, de Vries NM, Ferreira JJ, Bloem BR. The European Physiotherapy Guideline for Parkinson's Disease: Implications for Neurologists. J Parkinsons Dis. 2018;8(4):499-502. https://doi.org/10.3233/JPD-181383

19. Zaman A, Ellingson L, Sunken A, Gibson E, Stegemöller EL. Determinants of exercise behaviour in persons with Parkinson's disease. Disabil Rehabil. 2021;43(5):696-702. https://doi.org/10.1080/09638288.2019.1638975

20. Moraes Filho AV, Chaves SN, Martins WR, Tolentino GP, Homem RCPP, Farias GL, et al. Progressive Resistance Training Improves Bradykinesia, Motor Symptoms and Functional Performance in Patients with Parkinson's Disease. Clin Interv Aging. 2020;15:87-95. https://doi.org/10.2147/CIA.S231359

21. Wu PL, Lee M, Huang TT. Effectiveness of physical activity on patients with depression and Parkinson's disease: A systematic review. PLoSOne. 2017;12(7):e0181515. https://doi.org/10.1371/journal.pone.0181515

22. Silva AKS, Missias AA, Rocha OS, Carmo AA, Mendes FAS. Efeitos de um programa de telerreabilitação sobre a qualidade de vida de pessoas com Doença de Parkinson, durante o isolamento social na pandemia da COVID-19. Thema. 2020;18(1):156-69. https://doi.org/10.15536/thema.V18.Especial.2020.156-169.1835

23. Li R, Zhang Y, Jiang Y, Wang M, Ang WHD, Lau Y. Rehabilitation training based on virtual reality for patients with Parkinson's disease in improving balance, quality of life, activities of daily living, and depressive symptoms: A systematic review and meta-regression analysis. Clin Rehabil. 2021;35(8):1089-1102. https://doi.org/10.1177/0269215521995179

24. Spear KL, Auinger P, Simone R, Dorsey ER, Francis J. Patient Views on Telemedicine for Parkinson Disease. J Parkinsons Dis. 2019;9(2):401-404. https://doi.org/10.3233/JPD-181557

25. Ypinga JHL, de Vries NM, Boonen LHHM, Koolman X, Munneke M, Zwinderman AH, et al. Effectiveness and costs of specialised physiotherapy given via Parkinson Net: a retrospective analysis of medical claims data. Lancet Neurol. 2018;17(2):153-61. https://doi.org/10.1016/S1474-4422(17)30406-4

Supplements

Supplement 1. Evaluation form

EVALUATION FORM

NAME INITIALS: _____ AGE: _____ GENDER: ( )Female ( )Male

ORIGIN: ( ) Capital ( ) Metropolitan ( ) Countryside Weight: _____ Height: _____

BIRTH DATE: ___/___/____ CONTACT: _____

CIVIL STATUS: ( ) Unmarried ( ) Married/Stable Union ( ) Divorced ( ) Widower

SCHOLARITY: ( ) Illiterate ( ) Elementary School ( ) High School ( ) Higher Education ( ) Complete ( ) Incomplete

OCCUPATION: _____

DIAGNOSTIC: _____

ANAMNESIS

MAIN COMPLAINT:

_____

_____

Physical activity currently? Which? Frequency?

_____

Medications/dosage:

_____

_____

_____

_____

_____

STAGES	SIGNALS
Stage 0	No signs of illness.
Stage 1	Unilateral disease.
Stage 1,5	Unilateral, more axial involvement.
Stage 2	Bilateral disease, without impairment of postural reflexes.
Stage 2,5	Mild bilateral disease, with recovery on postural reflex tests.
Stage 3	Mild to moderate bilateral disease. There is postural instability, regardless of daily activities.
Stage 4	High degree of disability, still able to walk or stand with assistance.
Stage 5	Confined to bed or wheelchair unless assisted.

PERSONAL BACKGROUND	FAMILY BACKGROUND
( ) Systemic arterial hypertension ( ) Controlled ( ) Not Controlled	( ) Systemic arterial hypertension
( ) Diabetes Mellitus ( ) Controlled ( ) Not Controlled	( ) Diabetes Mellitus
( ) Cardiopathies	( ) Cardiopathies
( ) Pneumopathies	( ) Pneumopathies
Others:	Others:
Smoker:	
Former smoker:	
Passive smoker:	
Alcoholism:	

PHYSICAL EVALUATION

COGNITION EVALUATION		
MMSE – in attachment		
EVALUATION OF THE LEVEL OF PHYSICAL ACTIVITY		
IPAQ – in attachment		
FUNCTIONAL PERFORMANCE EVALUATION OF LOWER LIMB		
Five times stand-to-sit test	Time: ___ second	Predicted:
PERFORMANCE EVALUATION IN DAILY LIVING ACTIVITIES		
BOMFAQ (in attachment)		
QUALITY OF LIFE EVALUATION		
PDQ-39 (in attachment)		

FREQUENCY:

1st session: **Date:**	**2nd session:** **Date:**	**3rd session:** **Date:**	**4th session:** **Date:**	**5th session:** **Date:**	**6th session:** **Date:**
7th session: **Date:**	**8th session:** **Date:**	**9th session:** **Date:**	**10th session:** **Date:**	**11th session:** **Date:**	**12th session:** **Date:**

EVALUATOR: _____

Supplement 2. Physical exercise program through telerehabilitation
12 Home sessions: 1 hour, 3 x week – duration: 4 weeks

1st STAGE: 1st-6th SESSION (1st and 2nd week)

	CONDUCT	TRUNK	UPPER LIMBS	LOWER LIMBS
WARM UP (15 minutes)	Stretching	Muscles: - Cervical - Pectoralis major - Trunk flexors - Trunk and lateral extensors (2x30 seconds)	- Anterior and posterior shoulder muscles - Posterior arm, lateral and upper trunk muscles - Forearm flexors (2x30 seconds)	- Anterior and posterior muscles of leg and thigh (2x30 seconds)
	Mobility	-Mobility of the trunk in flexion, extension, lateral inclinations (2x10)	Shoulder girdle dissociation (2x10)	Pelvic girdle dissociation (2x10)
TRAINING (30 minutes)	Gait and Muscle Strength Training	- Diagonal with flexion, abduction, external rotation and extension, adduction and internal rotation (2x10 repetitions) - Diagonal with flexion, adduction, external rotation and extension, abduction and internal rotation (2x10 repetitions) - Isotonic elbow flexion-extension exercise on the wall in standing position (2x10 repetitions).		- Isotonic transfer exercise from sitting to standing (2x10) - Isotonic exercise of alternating hip flexion/extension in bipedalism (2x10) - Isotonic exercise of plantar flexion and dorsiflexion in standing position (2x10) - Latero-lateral march (2x10 steps) - Gait training with waist dissociation (3 minutes)
COOLING DOWN (15 minutes)	Relaxation	Sitting down in a chair for 10 minutes associated with diaphragmatic awareness breathing exercises.		

Obs1: Between each series, rest for 1 to 2 minutes.
Obs2: The execution of the proposed exercises was directed from the verbal and visual command carried out by the researcher/applicator of the Program.

2nd STAGE: 7th-12th session (3rd and 4th week)

	CONDUCT	TRUNK	UPPER LIMBS	LOWER LIMBS
WARM UP (15 minutes)	Stretching	Muscles: - Cervical - Pectoralis major - Trunk flexors - Trunk and lateral extensors (2x30 seconds)	- Anterior and posterior shoulder muscles - Posterior arm, lateral and upper back muscles - Forearm flexors (2x30 seconds)	- Anterior and posterior muscles of leg and thigh (2x30 seconds)
	Mobility	-Mobility of the trunk in flexion, extension, lateral inclinations (10x)	Shoulder girdle dissociation (10x)	Pelvic girdle dissociation (10x)
TRAINING (30 minutes)	Gait and Muscle Strength Training	- Diagonal with flexion, abduction, external rotation and extension adduction and internal rotation (3x10) - Diagonal with flexion, adduction, external rotation and extension, abduction and internal rotation (3x10) - Isotonic exercise of elbow flexion-extension on the wall in standing position (3x10)		- Isotonic transfer exercise from sitting to standing (3x10) - Isotonic exercise of alternating hip flexion/extension in bipedalism (3x10) - Isotonic exercise of plantar flexion and dorsiflexion in standing position (3x10) - Latero-lateral march (3x10 steps) - Gait training with waist dissociation (5 minutes)
COOLING DOWN (15 minutes)	Relaxation	Sitting down in a chair for 10 minutes associated with diaphragmatic awareness breathing exercises.		

Obs1: Between each series, there will be a rest of 1 to 2 minutes.
Obs2: The execution of the proposed exercises will be directed from the verbal and visual command carried out by the researcher/applicator of the Program