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Tutorials

Physical exercise program via telemonitoring during the COVID-19 pandemic for individuals with Parkinson's disease: intervention development study

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ABBREVIATIONS

COVID-19	Coronavirus disease-19
HY	Hoehn and Yard
PD	Parkinson's disease
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2

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BACKGROUND: To mitigate the COVID-19 pandemic, social isolation was needed. Since individuals with Parkinson's disease (PD) have a high risk if catching the COVID-19, and physical exercise is one of the most effective treatments for this disease. In this scenario home-based exercise is a great solution to minimize losses by inactivity.
AIM: To report the process of development of a remote physical exercise program based on a face-to-face physical exercise program.
METHOD: We transform a one-hour-session-twice-a-week face-to-face program to a remote format keeping the objectives and structure. The sessions of the face-to-face program were structured by: warm-up, balance, aerobic capacity, resistance training, transference, and cool down.
RESULTS: An asynchronous remote program was chosen to ensure that the participants would be able to perform the physical exercises with a caregiver or family member at home as safely as possible. The sessions were delivered by a single video with all 5 parts with prescriptions (time, sets, and repetitions), instructions about safety, and alternatives exercises. We create two questionnaires to investigate attendance, barriers, safety, and overall experience.
CONCLUSION: This paper purposed an asynchronous program with a single video per session to initiate the remote program for individuals with PD, who already carried out a face-to-face program of physical exercise.

KEYWORDS: Parkinson's disease | Rehabilitation | Home-based | Telehealth | Remote-program | Exercise-therapy

INTRODUCTION

In December 2019, a novel coronavirus named Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) or (2019-nCoV) with unknown origin was found in Hubei, province of China [1]. The epidemic disease caused by SARS-CoV-2 was called the coronavirus disease-19 (COVID-19) [1]. The COVID-19 human-to-human transmission routes include direct inhalation of contaminated droplets spread by sneezing or coughing, and oral, nasal, and eye mucous contact transmission [2]. Infection control, such as early detection and social isolation, contact tracing, and the use of personal protective equipment can mitigate COVID-19 spread [2]. Governmental actions to deal with the pandemic have restrained population mobility and interrupted in-person out-patient rehabilitation appointments.

Parkinson's disease (PD) is a neurodegenerative disease [3, 4] with a high incidence in older people [5-7]. The risk factors such as neurological disease and aging related to the COVID-19 [8] have demanded to shift from face-to-face appointments to a remote rehabilitation model of care, a home-based exercise program. Individuals with PD have motor and non-motor symptoms [4]. Motor symptoms are resting tremor, bradykinesia, rigidity,

and postural instability [9]. For the non-motor symptoms, the cognitive symptoms play a key role, specifically in executive functions conditions, attentional and visuospatial changes [3-4, 10-11]; and the emotional conditions, like apathy [12]. Under the COVID-19 pandemic, these symptoms [12] and actual mobility restrictions constrain daily physical activity. On the other hand, the practice of physical exercises attenuates motor and non-motor symptoms [13-16]. Thus, alternatives to assist individuals with PD to keep exercising are needed. Telemonitoring a home-based exercise program can ensure individuals with PD to remain physically active and healthy [17], and can minimize the losses caused by a sedentary lifestyle [18]. This study aimed to report the process of developing a remote physical exercise program based on a face-to-face physical exercise existing program. We offer the context and a clinical rationale to switch from a face-to-face intervention to a remote physical exercise program for individuals with PD. This protocol study builds the rationale for a remote physical exercise program based on a face-to-face model. We presented information related to the purpose, strategies, and clinical rationale to develop an online physical exercise program tailored to individuals with PD.

MATERIALS AND METHODS

This study was conducted at the Motor Behavior Laboratory of the School of Physical Education and Sport of the University of Sao Paulo, Sao Paulo, Brazil. This study was approved by the Human Ethics Committee (Reg. No. 4.119.009; CAAE No. 32005420.4.0000.5391).

The GUIDED checklist was used to conduct the study [19].

Procedures

Due to the COVID-19 pandemic, there was a need to rapidly adapt the face-to-face program to a remote physical exercise program.

Interventions

Face-to-face program

The physical exercise program on its face-to-face format has been in progress since 2014 at the School of Physical Education and Sport at the University of Sao Paulo. This program aims to restore and provide the person with PD gains in physical and motor skills. Ultimately, we aim to enable the performance of functional activities and the improvement in social participation [20]. Two sessions per week were provided separately to individuals with mild PD symptoms [1.0 and 2.0 in the modified Hoehn and Yard [HY] modified scale [21]] and to individuals with moderate symptoms (2.5 to 3.0 HY modified scale). Such group division improves the safety strategies to overcome participant's difficulties.

The face-to-face program has the following general aims (Figure 1):

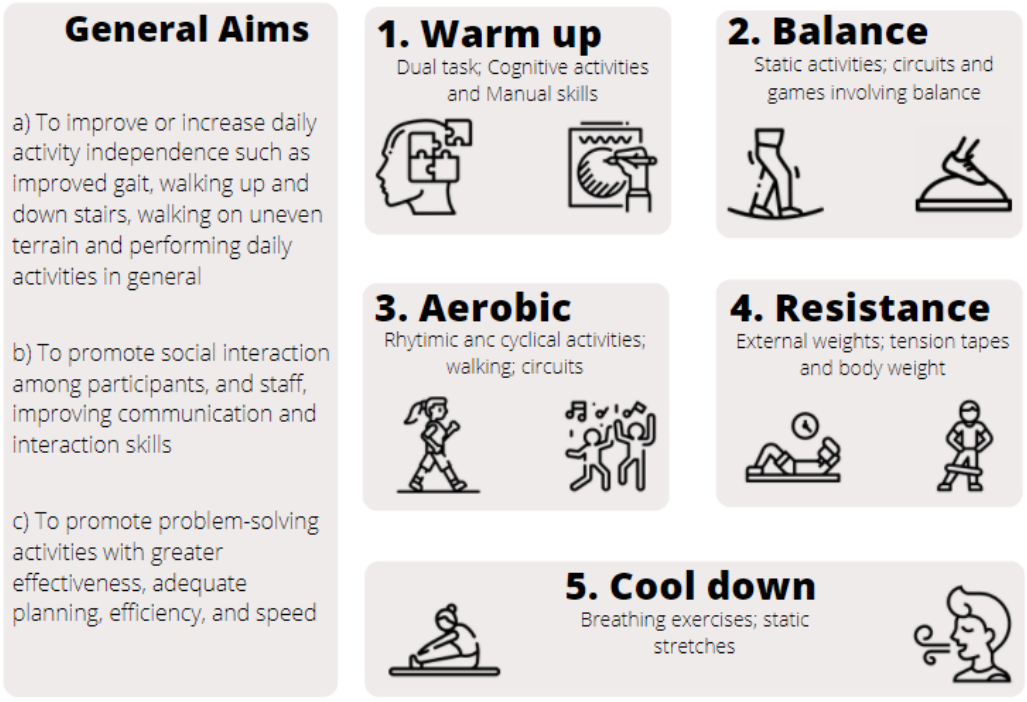

Figure 1. General aims of the face-to-face program based on Torriani-Pasin et al [20] and parts of the session.

This is an evidence-based [13,22], one-hour-session-twice-a-week program [20], tailored to the needs of individuals with PD [13,22]. The aims of this physical exercise program are: 1) to prevent a sedentary lifestyle [20]; 2) to prevent the fear of falls and falls [20]; 3) to keep or improve the functional capacity [20]; 4) to interact with people with similar characteristics/ and 5) to stimulate sharing of experiences and continue their process of acceptance, development, and adaptation towards the PD [20].

Face-to-face sessions were structured in six sections (warm-up, balance, aerobic capacity, resistance training, transference, and cool down).

The warm-up section (10 minutes long) was focused on preparing the body systems to exercise and to work on specific impairments that are most common in PD patients. The intervention strategies are dual-task, cognitive activities, and manual skills practice.

The balance section (15 minutes long) aims to improve the postural control (stability and orientation). The intervention strategies are static activities with a reduction in the base of support, with different support surfaces, with restricted visual field and with changes in the center of mass; circuits requiring dynamic and recovered balance, and games involving balance associated with other tasks.

The aerobic capacity section (15-20 minutes long) aims to improve cardiorespiratory fitness and endurance. The intervention strategies are rhythmic and cyclical activities, walking, straight walking and changing direction exercises.

The resistance training section (15-20 minutes long) aims to improve muscle strength, and the intervention strategies are exercises with various sources of resistance (e.g., external weights, tension tapes, bodyweight combined exercises, and circuits).

The transference section (5 minutes long) aims to practice the main postural transfers. The intervention strategies are to use explicit memory to favor the transfer. The last section is 5 minutes long and it is called cool down. The aim is to decrease heart rate and blood pressure, and the intervention strategies are breathing exercises, massage and self-massage, and static stretches (Table 1) [21].

Development of the telemonitoring program

As soon as the face-to-face program's activities were suspended due to the sanitary restrictions related to the COVID-19 pandemic, we have started our remote intervention via telemonitoring. In the first week, the participants received (by mobile text message) a written, theoretical-practical guide, to support their home-based physical exercises activities. This guide held the description of several activities to stimulate the cardiovascular, respiratory, muscular systems, and cognition, as well as information regarding their execution, prescription, and safety norms. This first action gave us time to prepare the remote strategies properly.

Over the first week, the researchers held three meetings to decide all aspects related to offering the remote program for an extended period, including safety, adherence, motivation, individual needs, human resources, and technological resources. Before switching to the remote mode, we have surveyed the potential participants about their internet connection. A team-based reflection on the motor and non-motor characteristics of individuals with PD and the importance of physical exercise [13-15] for this population, led us to the following statements:

- The remote program should be as similar as possible to our face-to-face program to assure the full mental and health development of the participants;
- The face-to-face and remote programs should have the same aims, content, and weekly attendance;
- Features such as bradykinesia, freezing, difficulties in transfers, and walking should be considered when choosing a synchronous or asynchronous program;
- The remote program should prioritize the safety and physical integrity of the participants.

Two weeks under social isolation, the remote physical exercise program started. For the first two weeks, we have provided the participants with only few parts of the session to familiarize them with the new intervention model. From the third week onwards, the activities were fully developed.

Table 1 depicts details of both face-to-face and remote physical exercise programs, their sections, the duration of the practice, the intervention strategies, and the aspects related to safety and increased complexity of the tasks.

Table 1. Description of the face-to-face and the remote physical exercise program

	Face-to-face	Remote
Warm-up		
Objective	Warm-up the body structures and work on specific impairments most common in PD patients.	
Description of task	Low-intensity activities, involving dual-task, cognition, and manual skills.	
Practice duration	10 minutes	Video: 1 to 3 minutes Practice: around 10 minutes
Intervention strategies	(i) Dual task: adapted games, activities in pairs or individual activities with emphasis: 1) in the combination of gait exercises and other motor or cognitive tasks; 2) in the combination of balance exercises and motor or cognitive tasks. (ii) Cognitive activities: Adapted games, activities in pairs or individual activities, focusing on attention, memory, reaction time (visual, auditory, and tactile stimuli), and problem-solving. (iii) Manual skills: fine and global, using several types of materials, such as balls, ropes, sticks, rackets, bladders.	Creative and easy-to-understand strategies, with various complexity options. (i) Dual task: individual activities with an emphasis on 1) combining gait exercises and other motor or cognitive tasks; 2) the combination of different manual tasks. (ii) Cognitive activities: guided and challenging individual activities, focusing on attention, memory, reaction time (visual and auditory stimuli), and reasoning. (iii) Hand skills: fine and global, using homemade materials.
Aspects related to security and task complexity	The professional: (i) conducts the activity and ensures the participant's physical integrity. (ii) increases the complexity of the task according to the possibilities of each participant and their restrictions. (iii) makes materials suitable to the needs of each participant (size for handling, complexity, and others).	The participant and the caregiver: (i) conduct the activity and follow the safety rules (presented by professionals) related to that activity. (ii) choose the complexity of the task (usually two or three levels of complexity are proposed). (iii) adapt or homemade materials.
Balance		
Objective	Improve postural control (stability and orientation).	
Description of task	Static, dynamic, and recovered balance exercises, with variations in the base of support, the support surface, the visual field, and the center of mass.	
Practice duration	15 minutes	Video: 1 to 3 minutes Practice: 10 minutes
Intervention strategies	(i) Static activities with a reduction in the base of support, with different support surfaces, with restricted visual field, and with changes in the center of mass. (ii) Circuits that request dynamic and recovered balance. (iii) games involving balance associated with other tasks.	(i) static activities or circuits, with a reduction in the base of support, with different support surfaces, with restriction of the visual field, and with changes in the center of mass, performed in safe environments.
Aspects related to security and task complexity	The professional: (i) conducts the activity and ensures the participant's physical integrity.	The participant and the caregiver:

	(ii) increases the complexity of the task according to the possibilities of each participant and their restrictions.	(i) conduct the activity and follow the safety rules (presented by professionals) related to that activity. (iii) choose the complexity of the task (2 or 3 levels of difficulty are proposed).
Aerobic capacity		
Objective	Improve cardiorespiratory fitness and endurance.	
Description of task	Continuous exercise, with mild to moderate intensity, involving large muscle groups, with the goal of increased heart rate.	
Practice duration	15-20 minutes	Video: 6 to 7 minutes Practice: 12 to 15 minutes (participants repeat the proposed sequence 2 times)
Intervention strategies	(i) rhythmic and cyclical activities (ii) walking (iii) straight walking and changing direction exercises (iv) circuits NOTE: exercise intensity was controlled by measuring HR in the face-to-face program, as well as by applying the BORG scale (in the remote program the scale is applied by the participant)	
Aspects related to security and task complexity	The professional: (i) conducts the activity and ensures the participant's physical integrity. (ii) proposes an increase in the intensity of the task, according to the participant's beliefs.	Activities that promote increased HR, safe and with minimal risk of falling. The participant and the caregiver: (i) conduct the activity and follow the safety rules (presented by professionals) related to that activity. (ii) perform the activity at moderate intensity (according to the professionals' guidance).
Resistance training		
Objective	Improve muscle strength.	
Description of task	Dynamic or isometric exercises for the trunk, upper and lower limbs. Prescription: 3 sets of 12-15 repetitions in the face-to-face program. 2 sets of 12-15 repetitions in the remote program.	
Practice duration	15-20 minutes	Video: 5 minutes Practice: 15 minutes
Intervention strategies	(i) exercises with different implements: external weights, tension tapes, body weight (ii) combined exercises	(i) exercises with adapted weights
Aspects related to security and task complexity	The professional: (i) conducts the activity and makes postural corrections. (ii) supervises the exercise intensity (load, number of sets, and repetitions)	The participant and the caregiver: (i) conduct the activity and follow the postural alignment guidelines contained in the video. (ii) choose the intensity of the exercise, guided by their feeling of effort.
Transference		
Objective	Train the main postural transfers.	
Description of task	Training of posture transfers most often used in daily life (such as climbing stairs, getting in the car, getting out of bed, and others), aiming at the use of explicit memory.	
Practice duration	5 minutes	Practice: 5 minutes – all the exercises will be taken from a book that all the participants had from the face-to-face program

Intervention strategies	The training includes 1) understanding of each phase of the movement, through guided reading; 2) demonstration of the movement (made by the professional); 3) skills training. One transfer per class is trained. NOTE: item 2 is not performed in the remote program	
Aspects related to security and task complexity	<u>The professional:</u> (i) conducts the activity and guides the sequence and completion of each transfer.	<u>The participant and the caregiver:</u> (i) conduct the activity and follow the sequence of the movement described in the handout made for this purpose.
Cooldown		
Objective	Decrease heart rate and blood pressure.	
Description of task	Breathing and stretching exercises.	
Practice duration	5 minutes	Video: 1 to 2 minutes Practice: 2 minutes
Intervention strategies	(i) breathing exercises (ii) massage and self-massage (iii) static stretches	(i) breathing exercises
Aspects related to security and task complexity	<u>The professional:</u> (i) conducts the activity and makes postural corrections. (ii) supervises the intensity of the exercise (range and time of execution)	<u>The participant and the caregiver:</u> (i) conduct the activity and follow the postural alignment guidelines contained in the video

HR: heart rate.

Figure 2 shows the timeline including the transition from face-to-face program to telemonitoring mode program.

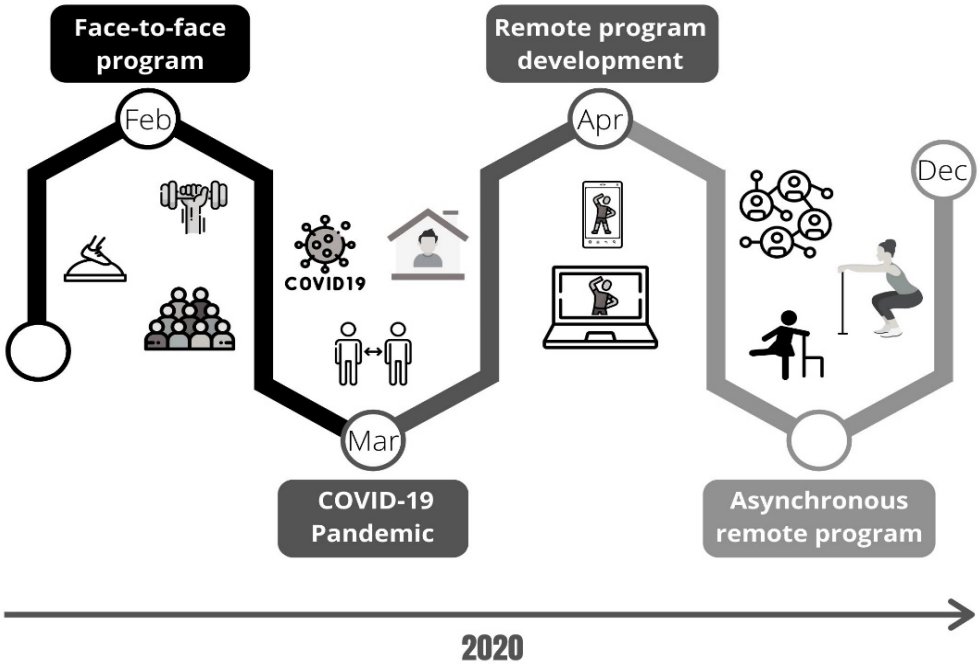

Figure 2. Timeline of transition of the programs. Image: Flaticon.com

RESULTS

An asynchronous remote program was chosen to ensure that the participants would be able to perform the physical exercises with a caregiver or family member at home as safely as possible. We have chosen the asynchronous model after assessing the positive and negative aspects of this model compared to the synchronous model (Table 2). For individuals with PD, this delivery model allows each participant to perform the activities at a comfortable speed (due to bradykinesia, freezing of gait, tremor on upper limbs, slower gait speed, and difficulties with transfers). They could also perform the activities at their "on" medication period, thus optimizing their experience when performing the exercises. The sessions were available by videos. The videos were uploaded at a private YouTube channel by a private link that was shared via text message and private social network group with the participants.

Table 2. Positive and negative aspects of synchronous and asynchronous format

Positive	Negative
Synchronous	
• Professional can observe the participant's performance and provide specific feedback or adaptation online; • Promote interaction among participants; • Maintenance of the earlier exercise routine.	• Requires stable internet connection at a specific time, for both the professional and the participant; • Caregivers need to adjust their routine to help the participant; • Requires more staff members online to help all the participants properly; • Requires proper device positioning (computer, tablet, or smartphone) and it is necessary to adjust it accordingly during each exercise.
Asynchronous	
• Caregiver and participants can do the session whenever and wherever they want; • The participants can decide whether they want to repeat the session throughout the week or distribute it in short bouts along the day; • Does not require an internet connection at a specific time; • Allows pause or turn back to listen again the instructions and visualize the performance of each exercise; • Professionals can save and store each exercise to use in other sessions in the future; • Professionals have fewer restrictions to explain the activity – which means more variability of the activities; • One professional can help many participants.	• Requires personal commitment; • Participant is free to take long breaks, which can compromise the prescribed intensity; • Take more time to record and edit the video; • Requires the participant to download and store the video.

The remote and face-to-face programs' goals were the same. Thus, reducing physical inactivity, increasing functional capacity (throughout the development of aerobic capacity and strength), and improving mobility, balance, gait, and cognition were the targets. The session´s contents and structure remained the same as well. Twice a week, 12-to-15

min long videos with instructions for every session's section were sent to the participants. These videos included oriented activities to ensure the participants' practice to last 60 minutes per session.

The intervention strategies (proposed exercises and aspects related to the complexity of the task) and safety rules were adapted to enhance the program's adherence. Exercises easy to understand were proposed. House facilities (broom handle, chair, plastic bags, paper, pillow, and bottles with water or sand) were included. Meanwhile, the need to attend complexity and difficulty diversity were also targeted. At the opening of each daily session, safety warnings were mentioned related to each specific section. Participants characterized as moderated by HY [21]; and/or less than 20 in the Mini Balance Evaluation Systems Test [23]; and/or less than 21 in the Montreal Cognitive Assessment [24], were guided to perform the entire session along with their caregiver or family member.

Table 1 describes the aim, content, duration of the practice, intervention strategies, and aspects related to safety and the increasing of complexity of the task for the face-to-face and remote programs. In the complementary material, there is a video for each part of the session.

The part of the session related to the training of transfers was carried out by using a booklet with photos of the participants themselves. This booklet and examples of the videos of the remote program are in the supplementary material. Additionally, Table 3 describes the information contained in each part of the video.

Table 3. Parts of the session and their description

Part of sessions	Video description
Warm-up	Practice time for each task. Presentation of levels of complexity. Intercurrences during the task (tremor, freezing of gait, memorization difficulties).
Balance	Safety rules: work close to the wall, on a suitable floor, with a caregiver or family member nearby (when necessary). Prescription (time and number of series). Presentation of levels of complexity.
Aerobic capacity	Safety rules: work close to a support, in a safe and adequate environment. Prescription: suggestion of moderate and continuous activity (Borg 12-15), activity time (12 to 15 minutes). Complications during the practice (freezing, imbalances, extreme tiredness), and precautions to take.
Resistance training	Prescription (overload, number of series, and repetitions). Guidelines for postural alignment and execution of the exercise. Exercise alternatives, in case of joint pain or discomfort.
Cooldown	Prescription (practice time). Guidelines for postural alignment and execution of the exercise. Exercise alternatives, in case of joint pain or discomfort.

Two questionnaires were created by the authors to investigate the frequency of sessions, attendance, the occurrence of falls, and the adverse effects. In addition, the

researchers looked at the participants' overall experience to participate in the program remotely. The participants should answer weekly and monthly questionnaires, throughout the entire process [25]. All information was obtained by telephone.

The weekly questionnaire targets the barriers, the frequency of sessions, and the safety when adverse sensations occurred during the session, such as pain, dizziness, and nausea as well as fear, or insecurity to perform some exercises, and adverse events as falls. The monthly questionnaire included a perception scale about their overall experience related to the remote program (its format, safety, adequacy of exercises, communication with the professionals, effectiveness, kindness of the professionals) and a self-perception of health, disposition, and relationship with family members, including a part directed to the caregiver [25].

DISCUSSION

The purpose of this study was to report the process to develop a remote physical exercise program based on an existing face-to-face physical exercise program. We intended to provide context and a clinical rationale for this process of transition from face-to-face to a remote physical exercise program for individuals with PD. Our remote program arose from a need for immediate support and guidance that the individuals with PD at home present since there is evidence that physical exercise is paramount to control symptoms and control the rate of progression of the disease [14].

We faced many challenges in implementing the remote program. The first challenge was to deal with the uncertainty of the effectiveness of a remote care model. In a short time, there was the need to choose between a synchronous or asynchronous model of intervention and define the format of sessions, accounting for their aims and content. Our decision was based on related factors and characteristics of the asynchronous model and individuals with PD. It seems that the asynchronous model was the most appropriate one, especially because the participants already had an exercise routine and some knowledge about the activities that would be proposed. In addition, the participant could select the best time of the day related to the on-period of the dopaminergic medication and the family schedule.

In addition, bradykinesia, one of the symptoms of PD, can make the participant to do activities slowly, and the asynchronous model makes it possible to perform activities without following the pace determined by a group synchronously [9].

The asynchronous model could be challenging due to the lack of security in carrying out the program without the presence of a professional to correct possible misalignments and compensations. However, all sessions follow a sequence of procedures and recommendations regarding the best way to carry out the proposed activity safely. In addition, the more impaired participants should perform the session in the presence of a caregiver/family member. This procedure also makes the individual responsible for their safety and health leading to increased self-efficacy and adherence to the program [26].

The development of the program required constant evaluation of the strategies adopted and the participant's feedback. At each planning of a new session, we will continue questioning the efficiency of our activities:

- Are the sessions accessible and easy to understand?
- Are the exercises pleasant and capable of motivating the participants?
- Do the exercises present various levels of complexity that encompass those that are less affected and those that are more affected by the disease?
- Are the exercises safe and preserve the participants' physical integrity?
- Do the sessions stimulate properly (intensity, volume, practice time, type of exercise) the various systems of the body?

We believe that the remote physical exercise program will be beneficial to individuals with PD, once it keeps them active and inserted in a physical exercise program-oriented that is specific to their main impairments. However, a future study is needed to investigate the effect, adherence, safety, and main barriers and facilitators of this intervention development study of remote physical exercise to individuals with PD. We hope to supply our results soon.

Finally, we believe that our physical exercise remote program is now ready to be tested in terms of safety, adherence, satisfaction, and effectiveness. Therefore, it will be possible to affirm whether or not the remote interventions can serve as a sustainable platform for exercise training programs for people with PD, as well as other neurodegenerative diseases. We anticipate that even with the allowance to return to the face-to-face activities, this modality could be incorporated as a strategy to increase the number of sessions performed per week and reduce sedentary behavior.

CONCLUSION

We conclude that the remote physical exercise program based on a face-to-face physical exercise existing program was created respecting the particularities and needs of individuals with PD. This paper purposed an asynchronous program to initiate the remote program for individuals with PD, who already carried out a face-to-face program of physical exercise. This decision was based on their particularities and needs, as well as the participants' independence to perform the session according to their routine. This format of program needs to be properly evaluated to guarantee safety to the participant's practice of the exercises. A future study is needed to investigate the effectiveness, adherence, safety, and main barriers and facilitators of this remote physical exercise protocol to individuals with PD.

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