DOI: 10.22456/133496

ARTIGO ORIGINAL

A QUASI-EXPERIMENTAL STUDY EVALUATING THE ACCEPTABILITY AND FEASIBILITY OF ASYNCHRONOUS AND SYNCHRONOUS HOME-BASED TELE-EXERCISE PROGRAMS AIMED TO MAINTAIN OLDER ADULTS PHYSICAL ACTIVITY DURING COVID-19 PANDEMIC

UM ESTUDO QUASE-EXPERIMENTAL AVALIANDO A ACEITABILIDADE E VIABILIDADE DE PROGRAMAS DE TELEEXERCÍCIOS DOMICILIARES ASSÍNCRONOS E SÍNCRONOS COM O OBJETIVO DE MANTER A ATIVIDADE FÍSICA DE ADULTOS MAIS VELHOS DURANTE A PANDEMIA DE COVID-19

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Resumo

A utilização de tecnologias fornece suporte à saúde física de idosos durante o isolamento decorrente da pandemia de COVID-19. O objetivo deste estudo é investigar a aceitabilidade e a viabilidade de programas de exercícios domiciliares tele-orientados, síncronos e assíncronos, de 12 semanas, projetados para manter os níveis de atividade física de idosos. A amostra foi recrutada e alocada em dois grupos experimentais (tele-exercício domiciliar assíncrono ou síncrono) e um grupo controle (educação em saúde). O programa de tele-exercício consistiu em 12 semanas de treinamento multicomponente domiciliar. Aceitabilidade, viabilidade e nível de atividade física (HEPA) foram medidos. A permanência, adesão e satisfação de ambos os programas de exercícios remotos foram altas. Nenhum evento adverso grave ocorreu durante as atividades dos grupos intervenção. A maioria dos participantes dos grupos de tele-exercício manteve ou melhorou a categoria HEPA ativa. Intervenções domiciliares e remotas são uma forma aceitável, adaptável, viável e segura de prescrição de exercícios físicos que manteve, com sucesso, os idosos ativos durante o período de isolamento.

PALAVRAS-CHAVE

Implementação de plano de saúde; Reabilitação remota; Telessaúde; Intervenção online.

Abstract

Web technologies could be harnessed to provide physical health support of older adults during gathering isolation due to COVID-19 pandemic. The aim of this study is investigate the acceptability and feasibility of both synchronous and asynchronous 12 weeks tele-oriented home-based exercise programs designed to maintain older adults' physical activity levels. Older adults were recruited and allocated into two experimental groups (asynchronous or synchronous home-based tele-exercise) and a control group (health education control group). Tele-exercise program consisted of 12 weeks of home-based multicomponent training. Acceptability, feasibility and health-enhancing physical activity (HEPA) active scores were measured. Permanence, adherence and satisfaction of both remote exercise programs were high. No severe adverse events occurred during any intervention group activities. Most of the participants of tele-exercise groups maintained or improved HEPA active category. Remotely-delivery home-based interventions are an acceptable, adaptable, feasible and safe form of physical exercise prescription that successfully maintain older adults active during self-isolation.

KEYWORDS
Health plan implementations; remote rehabilitation; telehealth; Internet-Based Intervention.

1 Introduction

The COVID-19 pandemic due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), began in December 2019 in China and has rapidly spread all over the world. Epidemiologic data suggest that droplets expelled during face-to-face exposure (i.e. talking, coughing, or sneezing) is the most common mode of transmission (Wiersinga *et al.*, 2020). For this reason, public health interventions such as home quarantine after infection, restricting mass gatherings, travel restrictions, and social distancing have been recommended to reduce rates of transmission and to align the medical care capacity to the number of cases (Jüni *et al.*, 2020). Nevertheless, these interventions cause unintended greater time at home and consequently a reduction in daily physical activity and an increase in sedentary time, which is harmful mainly for older adults (Buckinx *et al*., 2021).

Due to social distancing and controlled access to gyms and physiotherapy centers, home-based exercise programs constitute an important alternative to counteract physical inactivity and maintain/improve the health and fitness of healthy older adults (Garcia et al., 2021). In fact, recent studies highlighted positive effects of home-based exercises on muscle strength, muscle endurance, muscle power, balance and risk of falls of older adults (Chaabene *et al*., 2021; Machado *et al*., 2020).

Technological advances and accessibility of older adults to digital communication technologies have created enormous opportunities to support training from home during the COVID-19 pandemic. Although exercise prescription and communication between participants and rehabilitation or exercise specialists takes place through a variety of synchronous approaches (i.e video-calling, internet-based video conferencing), or asynchronous methods (i.e. video-based exercises and explanatory booklets) (Laver *et al*., 2013; Miyata *et al.,* 2021), the differences concerning the implementation between synchronous and asynchronous modalities are not well established. Thus, considering that remote exercise programs using tele-orientation are low-cost, safe and a viable therapeutic source of exercise during social distancing, the main aim of the study was to investigate the acceptability and feasibility of both synchronous and asynchronous 12 weeks home-based tele-exercise programs designed to maintain older adults' physical activity levels. We hypothesized that both synchronous and asynchronous tele-exercise programs would be feasible during Covid-19 lockdown. Also, synchronous modality would demonstrate high adherence and permanence rates compared to asynchronous one.

2 Methods

This feasibility quasi-experimental controlled trial was registered in the Brazilian Clinical Trials Registry (ReBEC; RBR-46hscsv). Ethical approval was obtained by the institutional ethics board (CAAE: 43592721.8.0000.5345) and all participants consented to participate voluntarily. The study was carried out between May and July 2021, during the Covid-19 pandemic in Brazil.

Participants

A total of fifty-one community-dwelling older adults were recruited to participate in this study. To be included in the study, participants had to be: (*a*) aged 60 years or older; (*b*) physically independent [according Katz Index (Katz, 1963)]; (*c*) scored ≥ 24 on Mini-Mental State Examination (MMSE) (in case of less than 4 years

of schooling, the cut-off point was set to 17) *(Santiago-Bravo et al.*, 2019); (*d*) able to access internet by computer, tablet device, or smartphone and have a valid email address; and (*e*) available to participate in the program on pre-established days and times. Participants were excluded if they had: (*a*) uncontrolled chronic conditions; (*b*) physical limitations that made it impossible to perform the proposed exercise programs; or (*c*) disabling pain.

Sample size determination

Sample size was estimated using the GPower 3.1 software. A moderate effect size (ES) was adopted for all studied outcomes (dz=0.55). Using a matched pairs model, Power (ß-1) = 0.95, α=0.05, a total of 54 participants was required.

Experimental procedure

An online invitation to participate in this study was performed by social network advertisements. Participants that demonstrated interest in participating in the study were informed about the objectives, protocols and procedures of the research. If willing to participate, they signed a consent form and an email containing a link for an online sociodemographic and health-related questionnaire (Google Forms online platform) was sent to participants. After completing the online screening, eligible participants were randomly allocated into one of the study groups by the main researcher with sealed envelopes (1:1:1): (*a*) asynchronous tele-exercise group, (*b*) synchronous tele-exercise group and (*c*) health education control group.

Home-based tele-exercise program and health education

Both exercise-based study arms consisted of a 12-week home-based tele-exercise program and were conducted twice a week for 45 minutes. Exercise protocol consisted of strengthening, balance, walking, and aerobic exercises, and were performed based on individual tolerance at participant's home environment. In the present study, exercise protocol was adapted to be conducted remotely in the following modalities: (a) synchronous or (b) asynchronous.

Synchronous tele-exercise training was delivered live by a supervisor, on pre-arranged days, using a free video-calling app (WhatsApp software) and conducted in groups of three to five participants. Asynchronous tele-exercise training was delivered by pre-recorded videos and explanatory booklets that were sent weekly, to be performed individually, using the same software. For both synchronous and asynchronous tele-exercises groups, control of training intensity was performed considering their perceived loads during training sessions and adjusted according to their responses.

The health education control group, received, once a week, during the 12 weeks, informative digital pamphlets by a free message app (WhatsApp software). The topics covered were: (*a*) importance of physical exercise for quality of life; (*b*) preventing the risk of falls; (*c*) tips for healthy eating; (*d*) importance of keeping the mind active; (*e*) cognitive stimulation; (*f*) urinary incontinence; (*g*) medication (organization and self-medication); (*h*) the importance of leisure in physical and mental health; (*i*) sexuality in old age; and (*j*) spirituality.

Outcome measures

Acceptability and feasibility of synchronous and asynchronous tele-exercise programs were measured following: (*a*) adherence and permanence rates; (*b*) self-satisfaction; (*c*) reasons for missing sessions, (*d*) motivators, facilitators and barriers; and (*e*) adverse events during exercise conduction. Facilitators and barriers to remote asynchronous and synchronous modalities from supervisors' point of view were also considered outcome measures of this study.

Also, all participants were monitored similarly and had a remote meeting delivered by video-calling at enrolment (ie, baseline) and after 12 weeks (ie, end of study) to assess their level of physical activity. The evaluators were blinded as to the allocation group of the participant.

Acceptability and feasibility of remote exercise program

Adherence and permanence rates were calculated for participants in all exercise-based study arms. Permanence on the intervention was defined as ≥75% of sessions completed; dropout as <75% of sessions completed. Permanence rate was the number of individuals who completed the intervention divided by total participants. For all participants who completed the intervention, adherence rate was calculated as the number of completed sessions divided by total possible sessions.

Picorelli's questionnaire (Picorelli *et al.,* 2014) was used to understand reasons for lack of attendance at sessions, motivating factors, and barriers to adherence and permanence within the different exercise programs. Each statement could be answered with "yes" or "no". Results of reasons for lack of adherence are presented in blocks of intrapersonal, interpersonal and environmental factors demonstrating the statements that at least one participant had answered in the affirmative. Also, participants were asked to answer a 5-point likert scale (from "*very dissatisfied"* to "*very satisfied"*) to assess their perceived level of satisfaction with the prescribed program.

In addition, supervisors were instructed to report any adverse events that occurred during exercise conduction. At the end of the study protocol, a qualitative structured interview was administered with supervisors conducting both tele-exercise programs in order to understand the facilitators and barriers to remote asynchronous and synchronous modalities. The following open-ended questions were asked: *"What did or did not facilitate implementing/conducting such remote exercise programs?"* and *"What did or did not facilitate supervising participants during such remote exercise programs?"*.

Physical activity level

The physical activity level was measured by the Short-form International Physical Activity Questionnaire (IPAQ). This form includes seven items and records the amount of time that subjects spent being physically active over the past seven days considering four intensity levels: (*1*) vigorous-intensity activity, (*2*) moderate-intensity activity, (*3*) walking, and (*4*) sitting (Lee *et al*., 2011). Data were translated into a health-enhancing physical activity (HEPA) categorical score (*"inactive"*, *"minimally active"*, and *"Health-Enhancing Physical Activity [HEPA] active"*) to describe subjects' physical activity level (Gay *et al*., 2019).

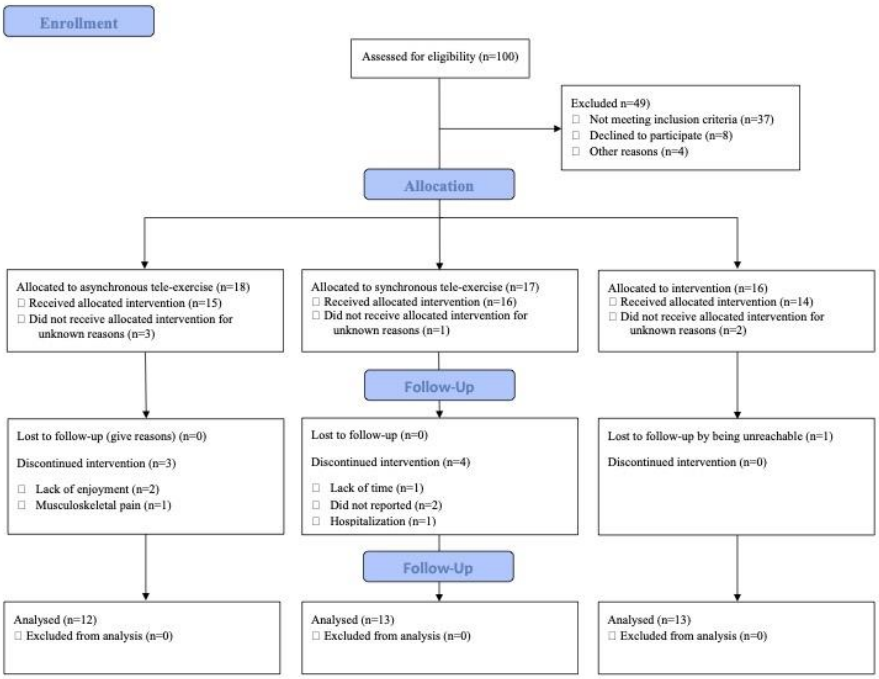
Statistical analyses

Descriptive statistics of mean and standard deviation were used for continuous variables, and frequency for categorical variables to present the sample profile. T Test was used to compare adherence between asynchronous and synchronous home-based tele-exercise groups. Anova was used to verify mean differences of the continuous variables at baseline between all experimental groups. Statistical significance was set at $\alpha \leq 0.05$, and analysis were performed using SPSS v.22.0 (SPSS Inc – Chicago, IL, United States).

3 Results

Participant enrollment is shown in Figure 1. As observed, a total of 100 older adults were screened for eligibility. Of those, 49 were excluded upon eligibility. The remaining 51 participants were allocated to one of the three intervention groups (participants that reported difficulty accessing the internet synchronously were relocated into one of the two remaining groups before starting the program). Six participants elected not to begin the program for unknown reasons, three of them from the asynchronous group, one from the synchronous group and two from the health education control group.

Figure 1. Flow diagram



Source: Research data

Table 1 provides the baseline demographic and health characteristics of the 45 participants, comparing subjects accordingly to group allocation. There were no group differences in demographic and health characteristics.

Table 1. *Sociodemographic Characteristics and Health Profile According to Groups*

	Asynchronous tele-exercise (n=12)	Synchronous tele-exercise (n=13)	Health education control (n=13)
Age, years	65.3±5.3	67.3±4.9	66.7±5.7
Sex, (Male/Female)	2/10	0/13	4/9
BMI (kg/m2)	28.9±4.9	28.8±4.2	26.9±6.6
Level of education			
Elementary School (n)	1	1	4
High School (n)	2	7	6
University Education (n)	9	5	3
Hours spent online (hours/week)	26.2±17.4	27.7±18.3	23.1±15.4
Sleep hours per night (hours)	7.0±1.1	7.4±1.4	7.9±0.6
MMSE Score	29.3±0.8	29±1.5	29±1.2
ABC Scale (% confidence), M±SD	91.6±7.3	90±8.8	88±15.3
SF-12 Physical component, M±SD	52.7±5.8	48.3±8.9	52.4±3.6
SF-12 Mental component, M±SD	52.1±9.9	50.1±11.3	54.5±7.7
Depression (Yes/No)	1/11	2/11	4/9
Medications (Yes/No)	7/5	12/1	10/3
Smoking (Yes/No)	1/11	1/12	1/12
Alcoholism (Yes/ No)	0/12	0/13	0/13
Hypertension (Yes/No)	3/9	8/5	4/9

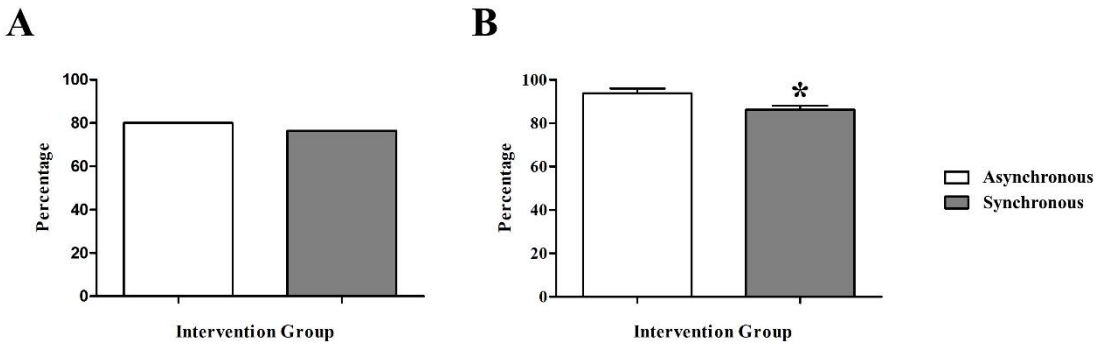
Diabetes (Yes/No)	2/10	4/9	3/10
Cardiac insufficiency (Yes/No)	0/12	0/13	0/13

ABC, Activities-specific Balance Confidence Scale; BMI, Body Mass Index; MMSE, Mini Mental Examination; SF-12, 12-Item Short Form Health Surve
Source: Research data

Permanence and adherence rates across intervention groups

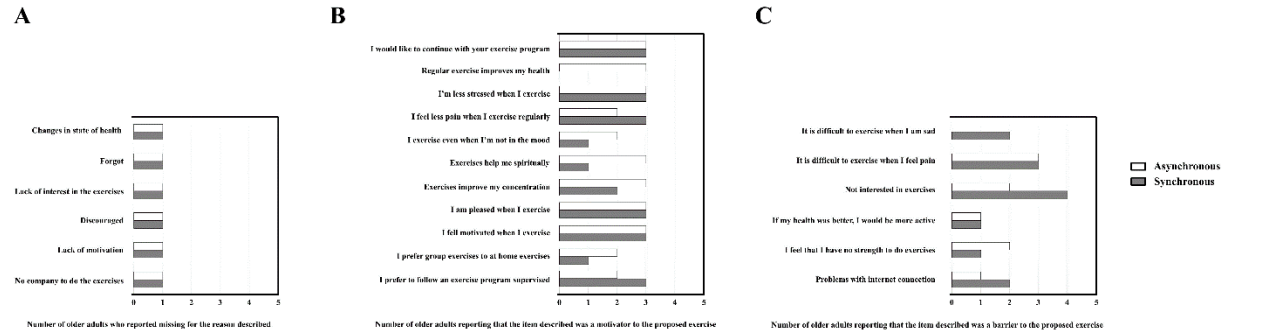
To determine attrition, the permanence rate for both asynchronous and synchronous intervention groups was calculated (Figure 2A). Three participants in the asynchronous training group (20.0%) and four participants in the synchronous training group (23.5%) dropped out. There was no difference in permanence rate comparing both groups. The expressed reasons why participants dropped out of the asynchronous exercise program were musculoskeletal pain (not related to study protocol; n=1) and lack of enjoyment (n=2). Participants of the synchronous training group reported lack of time (n=1) and hospitalization (n=1). Two participants of the synchronous group did not report any reason for dropping out. In addition, adherence rate was calculated for subjects who completed the intervention to investigate how consistently subjects from each group were able to follow the program (Figure 2B). Adherence rate was higher on the asynchronous group compared to the synchronous group (93.75% and 86.22% respectively; $p < 0.05$). Descriptive data of reasons for missed sessions are presented on Figure 3A. Reasons for missing exercise sessions were similar between groups. Participants of both groups expressed changes in state of health (e.g. adverse effect following immunization and common cold/influenza), forgetting exercise sessions, lack of interest or no company to exercise, discouraged and lack of motivation as reasons for missing session.

Figure 2. Permanence and Adherence Rates Across Intervention Groups



Source: Research data

Figure 3. Descriptive Analysis of Reasons for Missed Sessions, Motivators and Barriers to the Proposed Exercise Program



Source: Research data

Self-reported satisfaction, motivators and barriers of participants to remote exercise program

Participants' satisfaction with both remote exercise programs were high. Six participants (50%) in the asynchronous tele-exercise group expressed satisfaction with their exercise program, while six (50%) were very satisfied. In the synchronous tele-exercise group, the number of very satisfied participants was 13 (100%). Descriptive data of motivators and barriers of participants included in both synchronous and asynchronous proposed programs are presented on Figure 3B and 3C.

Supervisor's facilitators and barriers to asynchronous and/or synchronous training

Three supervisors were responsible to conduct synchronous tele-exercise sessions and supervise participants upon the following 12 weeks. From the supervisors' point of view, the facilitators to implement/conduct the synchronous tele-exercise and supervise participants during the proposed program were the commitment of participants and supervisor's team members, the user-friendly adopted technology/platform (WhatsApp software), the flexibility to conduct exercise programs from home and the possibility of maintaining active/exercising with older adults despite the COVID-19 lockdown. Supervisors' expressed barriers refers to internet connection, difficulty to provide tactile feedback or personal assistance to participants. The technology/platform was also indicated as a barrier (need for teaching technology to older adults, limited number of participants during the video-call and the positioning of the camera during exercise sessions).

One supervisor was responsible for developing exercise's instructions for the asynchronous tele-exercise program (maintaining the same objective as the synchronous group), sending video via mobile phone and encouraging participants to exercise. From this supervisor's point of view, the facilitators of the asynchronous protocol were the existence of pre-recorded videos with different levels of intensity and complexity so that all participants were able to perform the exercises and adapt them to their own level and the possibility of contacting supervisor in case of any doubts. The technology/platform and the lack of interaction and interpersonal relationship between participants and supervisor were indicated as barriers for asynchronous training.

Safety and adverse events

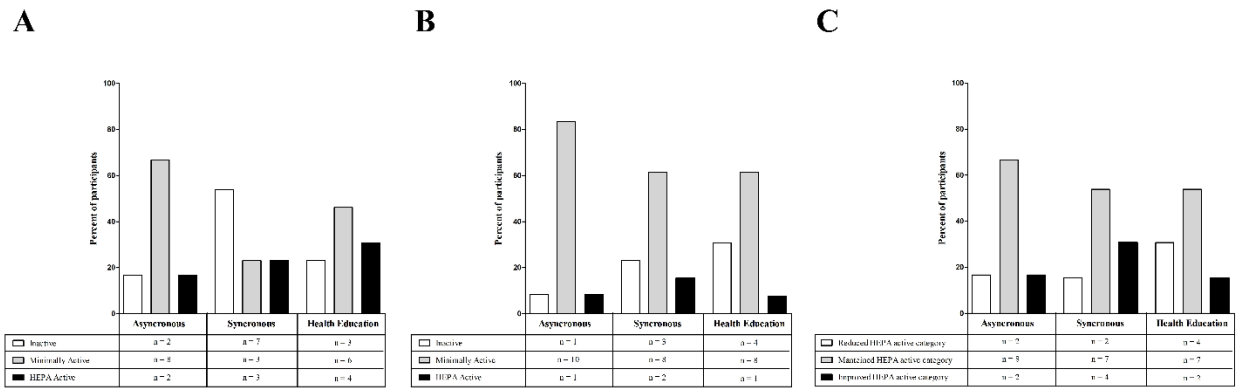
No severe adverse events occurred during any intervention group activities. Although two participants in the asynchronous group (16.6%) and one in the synchronous group (7.7%) reported pain during one exercise session, none of the participants indicated that exercises were uncomfortable. The fear of hurting themselves during exercise or falling was cited by only one participant of the synchronous group (7.7%). One participant from the synchronous group (7.7%) described difficulty to perform the *"Knee Bends – No Support"* exercise,

and one to perform the *"Walking and Turning Around''* exercise (7.7%). None of the participants reported the lack of face-to-face supervision as a safety issue.

Physical activity levels across intervention groups

HEPA active categorical scores at enrolment (ie, baseline), after 12 weeks (ie, end of study protocol) as well the changes of category after the end of the study are presented in Figure 4. As observed at Figure 4C, the distributions of different values across baseline and the end of the study are equally likely at both training groups. Most of the participants at those groups maintained or improved HEPA active category (83.3% and 84.6% for asynchronous and synchronous groups respectively). Meanwhile, only 69.2% of the participants at the health education control group maintained or improved HEPA active category.

Figure 4. HEPA Active Categorical Scores at Enrolment, Follow-up and Changes of Category



Source: Research data

4 Discussion

As new COVID-19 cases increased worldwide, many healthy older adults were requested to stay at home in self-quarantine. In Brazil, as in many countries, public places, fitness and activity centers and other locations where individuals are usually active stayed closed during several months between 2020 and 2021 (Pitanga; Beck; Pitanga, 2020; Vancini *et al.*, 2021). This scenario triggered consequences in older adults' health, and as such, represented the focus of intervention in this trial. In this study, we investigated the acceptability and feasibility of two structured home-based tele-exercise interventions aiming to maintain older adults undergoing self-quarantine active and thus, results must be interpreted in the context of home confinement due to the COVID-19 outbreak. As main findings, this study provide evidence of acceptability and feasibility of both asynchronous and synchronous home-based tele-exercise programs. Also, independent of the modality, both protocols were able to maintain or increase participants' HEPA active category.

The results of this study demonstrated that participants across both synchronous and asynchronous tele-exercise training programs had high permanence and adherence rates despite the demanding time commitment and stringent criterion for being considered as someone who completed the program. More than 76% of participants finished the program and completers had between 93.7% and 86.2% adherence rates (asynchronous and synchronous groups respectively).

It has been previously proposed that the relationships among participants and/or supervisors during synchronous and/or face-to-face classes influences adherence (Collado-Mateo *et al.*, 2021; Lima *et al.*, 2019; Torriani-Pasin *et al.*, 2021). Therefore, we had hypothesized that adherence would be higher in the synchronous group. Although comparisons across studies are hampered due to discrepancies in reporting, higher adherence rates observed in the asynchronous group could be result of either by an over-estimation of adherence rates due the use of self-reported exercise registries and/or obsequious responses from participants (Jansons; Haines; O'brien, 2017) or the protocol and technology used in the present study. Asynchronous methods have been used in studies of tele-rehabilitation and tele-exercise. Those studies demonstrated positive aspects such as not requiring online activities and allowing participants to exercise when they prefer to (Tenforde *et al.*, 2020; Torriani-Pasin *et al.*, 2022) thus, leading to an increased compliance of participants to the program. Additionally, it is possible that interaction between participants using a video-calling app was restricted during synchronous classes by the limited cell phone screen dimensions, the number of participants during the video call and the positioning of the camera during exercise sessions and thus, impacted socialization and adherence. Considering the study protocol, four participants from synchronous group indicated lack of interest in the exercises. In clinical research, individually tailored interventions are highlighted as key factors to overcome barriers to exercise and achieve high levels of adherence (Collado-Mateo *et al.*, 2021). Although the asynchronous group presented more promising adherence rates, overall, adherence rates in both interventions groups were high. This suggests that participants performed the programs with consistency (Gates; Ealing, 2019).

With regards to satisfaction with the proposed intervention, overall, most participants in the present study described themselves as *"satisfied"* and/or "*very satisfied"*. Satisfaction and positive experiences have been suggested as a critical enabling factor to engage older adults to exercise (Devereux-Fitzgerald *et al.*, 2016), which in the case of the present study, seemed to contribute to the adherence rates observed. In addition, both asynchronous and synchronous exercise protocols were based on a multicomponent program consisted of strengthening, balance, walking, and aerobic exercises with a frequency of twice per week a 12-weeks duration. The use of different exercise types with supported evidence of effectiveness, a frequency higher than once per week, and a moderate duration of the program also been reported as key factors to promote exercise adherence (Collado-Mateo *et al.*, 2021).

Also, our results showed that problems associated with the access to the tele-exercise classes and technical setup of software were minimal. Problems with internet connection were only indicated by three participants. This result was not surprising as the proportion of older adults who access internet has increased substantially in the past years. Additionally, most of older adults uses internet predominantly via mobile phone and specifically through social networks such as Facebook or WhatsApp (Diniz *et al.*, 2020). Moreover, most of participants had at least concluded the secondary level of education, with mean age of 65.5 years that is a group considered to be technology savvy (Diniz *et al.*, 2020; Takemoto *et al.*, 2018).

Finally, the present study demonstrated that barriers to maintain active during self-isolation may potentially be overcome using a simple digital communication technology. Quarantine and restrictions to prevent the spread of COVID-19 significantly impact older adults' lifestyle leading to increased use of electronic devices (Mon-López *et al.*, 2020), increased sitting time, decreased number of daily steps, reduced time spent in moderate and vigorous physical activities and decreased energy expenditure (Schuch *et al.*, 2022; Vancini *et al.*, 2021). Such sedentary behavior is known to be associated with an increase in morbidity and prevalence of noncommunicable diseases (Vancini *et al.*, 2021). In this context, exercise is an essential key to preserve physical function in general, maintaining participants´ autonomy and delaying the onset of negative consequences of sedentary behavior and inactivity (De Maio *et al.*, 2022; Yi; Yim, 2021). At the present study, performing synchronous or asynchronous exercise tele-exercise classes demonstrated similar results for

maintaining HEPA active scores during self-quarantine, but a greater number of participants of the synchronous group improved HEPA active scores compared with the other two groups. Those results corroborate with previous findings indicating greater results on supervised exercise classes (Lacroix *et al.*, 2017). Also, synchronous classes were handled in groups between three to five participants which could create a more motivating and joyful atmosphere, making participants share each other's progress and spurring then to work harder (Claesson; Stahle; Johansson, 2020).

Study limitations

This study has some limitations and must be considered when interpreting the findings. First, given all participants were required to be physically independent and have access to internet to be included in the study, this may limit the generalization of the findings to the broader population. Also, participants were relatively healthy and physically active which may have positively influenced the feasibility and/or acceptability of participants undertaking the home-based tele-exercise intervention and the magnitude of HEPA active scores changes from baseline. Second, our study included a relatively small sample size. Six participants elected not to begin the program for unknown reasons and seven could not complete the study protocol, preventing the study from reaching the planned sample. Additionally, randomization was not performed. Despite these limitations, the positive findings of both tele-exercise intervention suggest that a simple digital communication technology may be a promising approach for engaging older adults maintain active during self-isolation periods.

5 Conclusion

Based on the results from this study, it is possible to conclude that remotely-delivery home-based interventions are an acceptable, adaptable and feasible form of physical exercise prescription that successfully engaged older adults to maintain active during COVID-19 lockdown. All participants performed protocol sessions without adverse events and high dropping out, evidencing the safety and sustainability of both synchronous and asynchronous exercise prescription. Altogether, those results support that such modalities can be carried out at home as an alternative exercise management strategy for older adults who are experiencing difficulties in accessing fitness and activity centers during quarantine periods, such as those induced by the COVID-19 pandemic and serve as a foundation for future research on this important topic. This study was performed between May and July 2021, during the Covid-19 pandemic in Brazil that conditioned many active and independent older adults to stay restricted at home's environment. Thus, results must be interpreted in the context of home confinement due to the COVID-19 outbreak and additional research is necessary to determine if the results of the present study would be observed in interventions involving different contexts, longer periods and a more diverse population.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship and/or publication of this article.

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Submissão: 24/06/2024
Aceite: 20/02/2025

Como citar o artigo:

STIGGER, Felipe de Souza et al. A Quasi-Experimental Study Evaluating the Acceptability and Feasibility of Asynchronous and Synchronous Home-Based Tele-Exercise Programs Aimed to Maintain Older Adults Physical Activity During COVID-19 Pandemic. **Estudos interdisciplinares sobre o Envelhecimento**, Porto Alegre, v. 30, e133496, 2025. DOI: 10.22456/2316-2171.133496