



# Acceptability of a home-based multicomponent exercise program (Vivifrail®) for the oldest-old via videoconferencing during the Covid-19 pandemic

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## Abstract

**Objective:** To investigate the acceptability and adequacy of a multicomponent exercise program via videoconferencing for the oldest-old in Porto Alegre, a city in southern Brazil. **Method:** This is a quasi-experimental study. Fourteen participants were enrolled in the multicomponent exercise program Vivifrail® for 12 weeks, 5 days a week, with weekly video calls for assessment of acceptability and adequacy. The acceptability and adequacy questionnaire was based on 6 barriers that older adults face when engaging in physical exercise. Responses were measured using a 5-point Likert scale ranging from 0 to 4 points, with a maximum score of 24 points (maximum acceptability). **Results:** Fourteen participants (89.07±6.30 years) concluded the protocol, with an acceptability rate of 70%. Internal consistency was moderate, with a Cronbach's coefficient alpha of 0.7. Participants showed an overall increase in acceptability and adequacy (from 17.8±3.51 points in the first week to 22.0±2.94 in the 12th week). Four participants (28.6%) required some modification to the exercise protocol. **Conclusion:** The Vivifrail® protocol, together with weekly follow-up via videoconferencing, was well accepted and adequate. It could be an important tool for promoting quality of life, especially in the oldest-old with difficulty leaving home. The acceptability questionnaire was able to detect exercise barriers and suggest possible modifications to the training program and could be presented as a suggestion for the evaluation of intervention protocols in the oldest-old population. Therefore, the Vivifrail® protocol, with weekly follow-up via videoconferencing, could be a new field of intervention for health professionals.

**Keywords:** Public Health. Aged, 80 and over. Exercise. Longevity. Covid-19.

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## INTRODUCTION

Aging is a natural, slow, and gradual process that induces biological changes throughout the body, manifested by a progressive reduction in functional capacity, which is particularly evident in the oldest-old<sup>1,2</sup>. Physical inactivity, combined with chronic conditions prevalent in this age group, can lead to a higher risk of adverse health outcomes. Studies show that inactive older adults have an increased risk of falls (39%), mortality (31%), loss of independence (50%), frailty (48%), hospitalization (15%), and institutionalization (21%) compared with physically active counterparts<sup>3-5</sup>. Annually, physical inactivity is estimated to incur \$53 million in public health expenses globally<sup>6</sup>.

Physical exercise is crucial for the promotion of a healthy phenotype in older adults, and its main benefits include the improvement of functional capacity and the preservation of autonomy and independence for longer<sup>7</sup>. Benefits have been reported for different exercise modalities, such as resistance training, aerobic training, pilates, among others<sup>8-10</sup>. However, choosing the right type of exercise is extremely important.

According to the World Health Organization (WHO)<sup>11</sup>, for older individuals to obtain significant gains, they should adhere to exercise programs that promote the development of physical fitness components such as aerobic capacity, muscular endurance, balance, and flexibility, that is, multicomponent training. However, physical exercise interventions in the oldest-old have not been reported as frequently as in the youngest-old<sup>12</sup>. Likewise, little is known about the acceptability and adequacy of a multicomponent physical exercise program for the oldest-old. Biehl-Printes et al.<sup>13</sup> reported that lack of interest was the main reason for the oldest-old not participating in physical exercise programs. Krug Lopes & Mazo<sup>12</sup> also mentioned reasons such as physical limitations, poor disposition, excessive care from family members, and inadequate exercises (insufficient or very intense).

Promoting healthy practices and behaviors among older individuals is crucial, especially during periods such as the Covid-19 pandemic, in which containment

strategies such as the lockdown negatively impacted the health of the population<sup>14</sup>. On the other hand, the lockdown made older adults more familiar with technologies such as videoconferencing<sup>15</sup>. Therefore, home-based exercise programs via videoconferencing can be an alternative to improve or maintain functional capacity in this population<sup>14</sup>, and may also be well received in periods other than the pandemic, as home exercises had already been proven to benefit older adults long before Covid-19<sup>16,17</sup>.

In this context, Vivifrail® was developed as a multicomponent home exercise program to improve the functional capacity of older adults<sup>18</sup>. The program proposes different exercise protocols based on the participant's functional capacity, ranging from frail to robust states. However, to date, no study has investigated the acceptability and adequacy of this type of intervention in the oldest-old. Therefore, this study aims to investigate the acceptability and adequacy of a home-based multicomponent exercise program via videoconferencing among the oldest-old in Porto Alegre, a city in southern Brazil.

## METHODS

This is a quasi-experimental study with a repeated measures design, involving weekly monitoring of exercise acceptability. Participants were recruited from follow-up studies of nonagenarians previously enrolled in home-based research and healthy volunteers who signed up for projects at the Pontifícia Universidade Católica do Rio Grande do Sul (PUCRS). Participants were selected by convenience sampling through telephone calls in which the researcher explained the study to the participant, who agreed to participate or not.

The study was approved by the institutional Research Ethics Committee (number 21628419.9.0000.5336) and was conducted in accordance with the Declaration of Helsinki<sup>19</sup>.

The inclusion criteria were patients aged  $\geq 80$  years previously enrolled in PUCRS projects. The exclusion criteria were not having a smartphone for videoconferencing, not having a companion available during the evaluation and practice of the proposed exercises, and inability to respond to verbal

commands, in addition to the exclusion criteria defined by the Vivifrail® protocol<sup>18</sup>.

Initially, the study was presented to potential participants or their caregivers by phone, and a video call was scheduled for the initial evaluation. The lead researcher emphasized the importance of a caregiver or family member being present during the assessment and explained about the Informed Consent Form (ICF), which was sent by mail for signature.

After the participant signed the ICF, the trained researcher conducted the physical assessment and administered the comprehensive questionnaire on sociodemographic and clinical conditions at the initial, intermediate (6 weeks), and final (12 weeks) assessments via videoconferencing. The instrument on sociodemographic and clinical conditions collected information on the presence of symptoms and illnesses related to exclusion criteria or that could interfere with the acceptance of exercise practices (joint pains, depression, or dizziness). It also inquired about physical exercise routines, falls, ease or difficulty in performing functional activities, cognition, and memory (Geriatric Depression Scale and Mini-Mental State Examination). Physical evaluation was conducted according to Vivifrail® recommendations to determine the best exercise passport based on the participant's functional capacity and risk of falls<sup>18</sup>. Functional capacity was assessed using the Short Physical Performance Battery (SPPB) and the risk of falls was assessed using a 4-step protocol. The assessment was described in full by Izquierdo et al.<sup>18</sup>

Chart 1 shows the best exercise passport according to the functional assessment score (SPPB).

The exercise program took place from October to December 2020, 5 times a week, totaling 60 sessions

over 12 weeks. Each participant received an exercise passport (protocol manual) by mail and performed the exercises at home with the presence of an adult caregiver. The researcher contacted the participants weekly via videoconferencing to monitor the exercises, clarify any potential questions or issues, and evaluate acceptability of exercises, as described below.

Each passport contains movement illustrations with descriptions of initial position, performance, final position, risks, and contraindications. All passports should be executed in a daily routine lasting 30 to 45 minutes, from Monday to Friday, over 12 weeks. In addition, each passport includes an activity diary for participants to track their progress. During "circuit" sessions, participants should perform all circuit exercises, and during "walking" sessions, participants should only walk. Patients considered at risk of falls received a passport marked with a plus (+) sign (B+ and C+). The exercise passports were published by Izquierdo et al.<sup>20</sup> and are available at: <https://vivifrail.com>.

The main outcomes measured were the acceptability and adequacy of the exercise program over 12 weeks. As there were no instruments available that could adequately assess patient progress in the setting of our study, we constructed a questionnaire to understand the difficulties and acceptability of the exercises by the participants. The questionnaire was not validated. Questions were based on the 6 barriers that older adults face when trying to engage in physical activity described by González et al.<sup>21</sup> The questionnaire was administered weekly by the researcher via videoconferencing over the 12 weeks of the exercise protocol, and responses were measured using a 5-point Likert scale.

**Chart 1.** Classification of the Vivifrail® passport according to the functional assessment score, Porto Alegre/RS, 2021.

SPPB score	Classification
0-3	A: Disabled
4-6	B: Frail
7-9	C: Prefrail
10-12	D: Robust

Source: Izquierdo et al.<sup>18</sup>.

Participants were asked about (1) the importance they attributed to engaging in physical exercise (none/very little [0 points] to extremely important [4 points]), (2) their acceptability and satisfaction of the exercises (none/very little [0 points] to very high [4 points]), (3) the discomfort they felt during the exercises (none/very little [4]; mild [3]; indifferent/moderate [2]; very bad [1]; severe [0]), (4) how challenging it was to perform the exercises (none/very little [4]; little [3]; indifferent/moderate [2]; very challenging [1]; extremely challenging [0]), (5) exercise duration (very little/none [0]; little [2]; indifferent/sufficient [4]; a lot/extremely high [2]; too much [0]), and (6) whether the exercises could assist in activities of daily living (very little/insignificant [0 points] to extremely important [4 points]). Participants had to justify all their answers, allowing the researcher to understand the difficulties and discomforts they experienced and, when necessary, adapt some exercises according to individual needs and limitations.

The score ranges from 0 to 24 points, with higher scores indicating greater acceptability. Internal consistency assessment was performed using Cronbach's alpha, which estimates the reliability of a questionnaire constructed for research projects<sup>22</sup>. Freitas and Rodrigues<sup>23</sup> suggest using the following ranges to rate reliability according to Cronbach's alpha: (A) a  $\alpha$  0.30 – Very low; (B)  $0.30 < \alpha \leq 0.60$  – Low; (C)  $0.60 < \alpha \leq 0.75$  – Moderate; (D)  $0.75 < \alpha \leq 0.90$  – High; and (E)  $\alpha > 0.90$  – Very high.

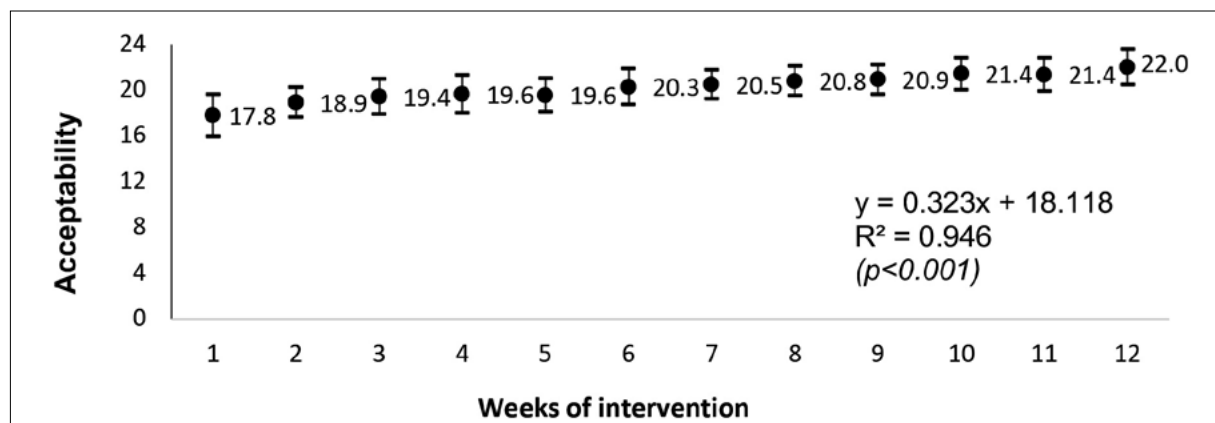
At the end of each session, an acceptability score was calculated for each participant. Pearson's linear correlation was used to assess the correlation between the degree of acceptability in each assessment and the follow-up time. A  $p$ -value  $< 0.05$  was considered statistically significant.

## DATA AVAILABILITY

The dataset supporting the results of this study is available upon request to the corresponding author Ana Paula Tiecker (ana.tiecker96@edu.pucrs.br).

## RESULTS

Of 20 participants initially evaluated, 14 (70%), with a mean age of  $89.07 \pm 6.30$  years completed the study. Reasons for dropping out included osteoarticular disease in 2 (33%) and a lack of will to continue in 4 (67%). Five (83%) of those who dropped out were women and 1 (17%) was a man, with a mean age of  $93.8 \pm 3.96$  years. Figure 1 shows a progressive increase in exercise acceptability over the 12-week period. Pearson's linear correlation showed, with a 95% correlation, a 0.323-point increase in acceptability per week. At the end of the 12-week period, participants had an increase of 4.2 points (from  $17.8 \pm 3.51$  to  $22.0 \pm 2.94$ ), with a statically significant correlation ( $p < 0.001$  and a sample power  $> 0.99$ ). Statistical power was calculated using the G\*Power software, assuming an alpha of 0.001, a sample size of 14, and an effect size of 50 (the maximum allowed by the program).



Source: The authors, 2022. Notes:  $R^2$  = correlation coefficient.

**Figure 1.** Exercise acceptability over the 12-week intervention period, Porto Alegre/RS, 2021.

Acceptability was not improved in only 2 participants due to pain or lack of commitment. Four (28.6%) required some exercise modifications, including a participant suffering from pain and discomfort due to osteoarticular disease that required an almost complete passport change. Another participant required temporary modifications because of knee inflammation, with interruption of 2 exercises: sitting and standing, and climbing and descending stairs. Two participants needed to increase rest intervals during walking because of extreme fatigue.

Internal consistency analysis of the acceptability questionnaire yielded a consistency of 66% when including all questions. After removal of question 4, as all participants responded that exercise duration was adequate over the 12-week period, internal consistency increased to 70%. Both consistency levels are considered moderate.

Acceptability of the exercises proposed by Vivifrail® was improved in most participants, as shown in Figure 1. In the subjective assessment, participants were asked about the reasons behind their responses. The most representative responses are shown in Table 2.

Regarding the importance of performing the proposed exercises, 12 (85%) participants found it important or extremely important because exercise makes them more energetic, helps reduce pain, can help in the performance of daily activities, and because the body needs to stay healthy. Their perception did not change over the 12-week intervention period. The other 2 (15%) changed their perception from not important to little important and from not important to very important.

When asked about satisfaction with the proposed exercises, 13 (93%) participants were satisfied from the first week. Only 1 (7%) participant responded “indifferent” because they had difficulty performing the exercises. As the weeks passed, the satisfaction of the 13 participants further improved, while the other participant remained dissatisfied during the follow-up weeks because they only liked to walk and were more involved in a hobby (fixing furniture). After some adjustments, the participant became

more motivated but remained dissatisfied. At the end of the 12-week period, participants, in general, were very satisfied with the exercises.

Regarding discomfort, 10 (71%) participants felt some discomfort in the first week, including fatigue and pain during or after exercise. At the beginning of the program, 2 participants felt pain during a specific upper limb stretch, and another developed knee pain. After some adjustments (interruption or reduction of exercises that could aggravate symptoms), pain reduced and acceptability increased in these patients. After 6 weeks, 6 (42%) participants still experienced fatigue, and pain was reduced in those who reported it at the beginning of the study. Only 1 participant started experiencing pain during the follow-up weeks as a result of osteoarticular disease, which was aggravated by the exercises. The rest of the participants no longer experienced any discomfort. At the end of the 12-week program, 2 (14%) participants continued to experience some discomfort: one due to fatigue from walking, which had significantly decreased since the beginning of the program, and the other due to pain from osteoarticular disease.

Seven (50%) participants found it very or extremely difficult to perform the proposed exercises in the first week, mainly due to the time they had been without exercising. The exercise that participants found most challenging was walking within the time proposed by the passport, and some experienced difficulty even after implementation of rest intervals. Upper limb stretching was also challenging for 2 participants. The difficulty decreased with exercise adjustments, longer rest intervals, and replacement of the stretching exercise. With each passing week, participants experienced less difficulty and improved physical condition. Ten (71%) participants reported feeling very little or little difficulty at the end of the 12 weeks.

Regarding duration, all participants found it adequate since the first week. Ten (71%) participants reported that exercise could help in daily activities. As the weeks passed, not only participants but also caregivers and family members reported physical improvements and greater ease for participants in performing their daily activities.

**Chart 2.** Subjective assessment of responses to the acceptability questionnaire in the follow-up weeks, Porto Alegre-(RS), 2022.

	End of 1st week	End of 6th week	End of 12th week
Importance of performing the proposed exercises	Most participants found it important: "Because exercise makes you feel more energetic"; "It helps reduce pain, it can help with my daily activities"; "Because the body needs to stay healthy."	The vast majority continued to report the same level of importance, while others began to see it as more important.	The vast majority reported that the proposed exercises were very important: "My physical condition improved after exercising, my movements are better. I think it's extremely important"; "I can walk more easily and steadily."
Satisfaction in performing the exercises	The vast majority of participants were satisfied from the first week. Reasons included the following: "Because I feel better"; "Because I can do them all"; "Because it's helping with my pain." Only 1 participant responded "indifferent", as he was having difficulty performing the exercises, which were adjusted over the weeks.	Most participants were satisfied with the exercises. Only 1 participant was not satisfied and did not adhere to the exercise program because, according to him, he did not like exercising, he just liked walking. We made some adjustments to the exercise program and encouraged him to do as many times a week as possible (up to 5 times).	Participants were very satisfied with the exercises: "I'm satisfied because my physical condition has improved a lot. I am walking more easily and that makes me happy"; "Because in those 12 weeks I enjoyed it. I hoped to improve a little and I did." The participant who was not satisfied and did not adhere to the exercise program did not change his perception, as he did not like exercising.
Discomfort when performing the exercises	The vast majority felt some type of discomfort, including fatigue and pain during or after exercise. Pain during exercise was observed in 2 participants and, for both, it was related to upper limb stretching; we made some modifications to the exercise to improve acceptability. Another participant had pain due to knee inflammation. To improve acceptability, we made some adjustments to the exercises that could aggravate symptoms.	Some participants continued to experience fatigue, while pain decreased for most who reported it. One participant began to experience pain during the follow-up weeks due to osteoarticular disease; according to the participant, some exercises aggravated the pain. Some changes were made to allow participants to continue in the exercise program.	At the end of the 12 weeks, only 2 participants continued to feel discomfort during exercise. One was due to fatigue from walking and the other was due to pain from osteoarticular disease.
Difficulty performing the exercises	Half of participants found it a little difficult or extremely difficult to perform the proposed exercises in the first week. Some of the reasons included: "I haven't exercised for a long time"; "I don't do anything anymore. I don't even leave the house anymore." Walking was considered the most challenging exercise. Two participants needed to increase their rest interval during the walk.	Each week, participants who reported difficulty said it got easier and that they felt better and more energetic. Only 2 participants reported some difficulty during the follow-up period: one because he still felt very tired while walking and the other because of pain due to osteoarticular disease.	Only 2 participants continued to experience difficulty: one due to fatigue from walking, but which was related to a very reduced functional capacity, and the other because of pain due to osteoarticular disease. Both said it got better over the 12-week period.

to be continued

Continuation of Chart 2

	End of 1st week	End of 6th week	End of 12th week
Duration of exercises	All participants found exercise duration adequate.	It remained adequate for everyone.	It remained adequate for everyone.
Can physical activity help with activities of daily living?	Participants described the following expectations: "I think exercise will help me walk better"; "It will give me more strength to do the tasks here at home"; "I feel like it will help me a lot, I feel stronger now"; "When the pandemic is over, I want to be well so I can do the same activities as before, and exercise can help me with that."	With each passing week, the reports changed. The vast majority reported improvement in physical capacity, such as walking better and carrying out activities of daily living with more ease.	At the end of the 12 weeks, participants as well as caregivers and family members reported improvements in the physical condition of participants: "I have been able to feed myself every day, I feel more capable"; "I feel like I have more energy, I can do more activities throughout the day than before"; "Caregiver: She can get out of bed without much help and get dressed too"; "Participant's daughter: I no longer need to help him get up from the chair, he takes the walker and gets up on his own"; "I'm walking without a walker, now I just use a cane, I'm stronger"; "It has improved my mobility and ability to do things with my arms and hands."; "After I started exercising, I no longer felt any pain in my legs."

## DISCUSSION

The main study findings demonstrate that a 12-week home-based multicomponent exercise program, supported by weekly follow-up via videoconferencing, was well-received by participants. Acceptability progressively increased over the 12-week period, with subjective reports of improvement by the participants. Weekly follow-up with application of the acceptability questionnaire via videoconferencing revealed a good acceptability rate of the exercises proposed by Vivifrail®. Moreover, the program proved to be adequate for this population of older individuals, especially during the Covid-19 pandemic, as it offered support during this challenging time.

Acceptability is crucial for treatment adherence and outcomes<sup>24</sup>, particularly among the oldest-old, who are less inclined to engage in physical activity<sup>13,25</sup>. Lopes et al.<sup>25</sup> showed that the place where physical activity is performed has a significant impact on acceptability by the oldest-old. Appropriate places

facilitate engagement for both active and inactive older individuals, especially if closer to home, as they (especially women) find it more difficult to leave their homes<sup>25,26</sup>. Additionally, participants were in lockdown due to the Covid-19 pandemic, consequently leading to a reduction in physical exercise despite health authorities' encouragement<sup>14,27</sup>. Thus, home-based activities might be better suited for these individuals.

Other factors affecting acceptability are the belief that an intervention will be effective (ie, outcome expectation) and adherence to the intervention (ie, efficacy expectation)<sup>25,28</sup>. By conducting weekly follow-up via videoconferencing, we allowed participants to self-evaluate and report difficulties and improvements, which in turn allowed us to better adapt the exercises when necessary, contributing to a better acceptability rate. The literature has also shown that, before initiating an exercise program, it is important that participants receive a detailed verbal and written description of the program that informs

the frequency, intensity, duration, modality, load, and progression of the exercise<sup>29</sup>. A clear description of the program promotes motivation and adherence among participants, as was observed in this study. To the best of our knowledge, data on acceptability of exercise protocols among the oldest-old are scarce, making this the first study to evaluate such outcomes in this population.

Participants' acceptability of the exercise program is crucial for achieving successful outcomes. Recent studies have suggested strategies to minimize the effects of social isolation in older people, considering the significant repercussions of physical inactivity in this population<sup>15,30</sup>. Chaabene et al.<sup>16</sup> conducted a meta-analysis to evaluate the effects of online home-based exercise programs on the physical fitness of healthy older people. They showed that home exercises can improve physical fitness and functional health aspects such as strength, muscular endurance, and balance. In Brazil, one of the few studies using an online intervention during the pandemic reported the experience of only one participant, an older adult. The online experience was positive both in terms of organization and execution, and the patient positively adhered to the program<sup>31</sup>. Therefore, physical exercise programs via videoconferencing, when well accepted by the participants, are an important alternative to reduce the effects of a sedentary lifestyle.

Given the paucity of studies investigating the acceptability of home-based physical exercise protocols, we sought to support our findings with different studies evaluating acceptability. Bower et al.<sup>32</sup> evaluated, among other outcomes, the acceptability of an exercise program based on interactive gaming technology. As in this study, the authors observed a good acceptability rate among most participants (92.5%), as well as increasing acceptability as modifications were made to the interactive games. This suggests that acceptability involves various aspects of human behavior and is directly linked to adherence and continued engagement in physical exercise programs. Bacha et al.<sup>33</sup> evaluated postural control in older patients using Kinect Adventures versus conventional physical therapy in a controlled randomized study, assessing treatment acceptability and adherence. In terms of acceptability, both groups

were satisfied with the interventions, with a 91% adherence rate. This highlights that acceptability improves engagement in proposed activities.

In our study, multicomponent exercises were successfully administered via videoconferencing without in-person monitoring. The recent literature shows that exercises performed at home with minimal supervision produce significant health benefits for older patients<sup>32</sup>. A recent meta-analysis by Kis et al.<sup>34</sup> showed that minimally supervised home-based physical training is a safe, effective, and cost-efficient option to increase lower body muscle strength in older individuals with different health conditions.

This study has some limitations. The small sample size, lack of randomization, absence of a control group, and mandatory smartphone use might limit the generalization of results with higher evidence levels. However, mandatory smartphone use was not a major restriction on participation in this study. Another limitation is the lack of a validated acceptability questionnaire, and the fact that the proposed questionnaire had a moderate internal consistency. In addition, the results may have been influenced by the fact that the researcher who applied the acceptability questionnaire was the same person who guided the proposed intervention. The research setting, in which participants had a prior and trusting relationship with the researcher, and the fact that they were contacted and monitored during a period of psychological vulnerability, may have favored the positive results.

Nevertheless, a trust-based relationship should exist between patients and all health care professionals, and we believe a similar environment could be reproduced in other health care settings. It is important to note that, to the best of our knowledge, this is the first Brazilian study to assess the acceptability of the multimodal exercise protocol Vivifrail® during lockdown via videoconferencing. Although the lack of in-person meetings with participants presented many challenges, we were able to overcome them. From a practical perspective, our findings suggest good acceptability and adequacy of a low-cost, easy-to-follow, and monitorable exercise intervention aiming to improve functional capacity in the oldest-old, particularly during lockdown.



Home-based programs like Vivifrail® seem to be a useful strategy to promote physical activity among older individuals, particularly the oldest-old, reducing adverse effects associated with sedentary behavior in this population.

## CONCLUSION

In this study, a multicomponent and individualized home training program, with weekly monitoring via videoconferencing for 12 weeks, was well accepted and adequate for a population of oldest-old individuals during lockdown in Porto Alegre, Brazil. The acceptability questionnaire was effective in detecting barriers to exercises and suggesting possible modifications to the training program; less than a third of participants required adjustments to the initially proposed program. The questionnaire constructed for this study can be used to evaluate the acceptability of exercise programs by oldest-old individuals. However, it still requires validation in future studies.

This study was able to overcome challenges not presented in other studies, transforming an unusual situation (lockdown due to Covid-19) into a potential new field of intervention for health professionals. In fact, some study researchers, after observing the acceptability of the program, started to apply Vivifrail® to their patients during online care. Considering

that the multicomponent exercise program can be performed efficiently via videoconferencing, future intervention projects with an adequate sample size and control group, using the same methodology, may provide the benefits suggested in this study.

## AUTHORSHIP

- Ana Paula Tiecker was responsible for all aspects of the study, ensuring the accuracy and integrity of the study.
- Eduardo Lusa Cadore participated in the study design, interpretation of data, critical review, and approval of the final version.
- Mikel Izquierdo participated in the study design, interpretation of data, critical review, and approval of the final version.
- Gabriela Guimarães Oliveira Zmuda participated in critical review and approval of the final version.
- Francielle Bonett Aguirre participated in critical review and approval of the final version.
- Ângelo José Gonçalves Bós was responsible for all aspects of the study, ensuring the accuracy and integrity of the study.

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