Usability of Videoconferencing for Physical Exercise Interventions in Older Adults: A Scoping Review

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Abstract

Background: Videoconference combines the convenience of home physical exercise (PE) with group interaction and supervision of exercise in the community and could be useful for facilitating PE practice among older adults

Objective: This scoping review aims to access evidence on the usability of videoconferencing technologies as a medium for PE interventions delivered synchronously to healthy older adults.

Methods: Electronic searches on databases (Pubmed/Ovid Medline, Science Direct, Scopus, CINHAL) until December 2023 for identifying articles on measures of usability (i.e.: effectiveness, efficiency, and satisfaction of technology).

Results: Thirteen studies out of 1846 unique records were included. Retrieved results showed that videoconferencing strategies can be used to deliver synchronous exercise interventions. However, their effectiveness, efficiency, and satisfaction are variable depending on the technological medium used. Despite widespread use among older individuals, few studies evaluate usability, highlighting a gap in evaluation methods for PE remote intervention.

Conclusions: The review suggests that while older adults can use technology to deliver synchronous interventions, further research with standardized tools is crucial to ensure their active engagement in physical exercise. Evaluating the usability of the technologies used for these programs can help tailor them to the needs and characteristics of older adults. Our findings also underscore the importance of continuing research to assess the effectiveness and acceptability of videoconferencing technologies within the context of exercise interventions. Ongoing research is essential to guide the development of customized solutions and optimize the efficacy of interventions for this population.

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Original Manuscript

Scoping review

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Running head: Usability of videoconferencing for older exercices.

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Keywords: Usability; videoconferencing; tele-exercise; older adult.

Introduction

The practice of physical exercise (PE), defined as planned, structured, and repeated physical activity performed to improve or maintain regular physical fitness [1], limits some of the detrimental effects

of aging and preserves the quality of life and independence of older adults [2]. In particular, multimodal exercises (e.g., Pilates [3], or Otago Exercise Program [4], or Vivifrail Program [5]) have become popular for targeting balance impairments in older adults [6]. However, older adults' commitment to physical exercise is low [7]. It may be influenced by individual factors, such as physical limitations [8,9], motivation, and personal beliefs [7,10], or environmental factors [11], such as the difficulty of accessing the infrastructure where these programs are delivered [12].

Recently, the challenges posed by the COVID-19 pandemic have notably reinforced social isolation and reduced activities among older individuals [13]. Telehealth, defined as an activity, service, or system, related to health or social services, carried out remotely, using Information and Communication Technologies (ICT), for educational, diagnostic or treatment, research, clinical management, or training purposes, emerges as a fitting service model for clinicians [14]. This situation has allowed clinicians to use ICT by proposing synchronous physical activities based on videoconferencing [14].

The interventions delivered through ICT include physical exercise programs [15,16] fall prevention programs [17,18], as well as exercises for hands and arms [19]. Among the possibilities enabled by digital technology, videoconferencing allows a group of older adults and a clinician to "meet" from their homes and perform an exercise training program together live and interactively [20–22]. These systems offer the potential for new strategies such as feedback, social support, coaching, and appear to be particularly useful for increasing PE engagement [20]. To be used effectively, it appears essential that the technology matches the user's needs (clients and clinicians) [23]. This consideration refers to the concept of usability. The International Organization for Standardization (ISO) described usability as "the degree to which a product can be used, by identified users, to achieve defined goals with effectiveness, efficiency, and satisfaction, within a specified context of use" [24]. According to this definition, the effectiveness of a tool corresponds to its ability to achieve an objective, while efficiency corresponds to the ability to produce a task with the minimum effort. Finally, satisfaction corresponds to the comfort felt by the user when using a tool[24]. As scientific literature previously reported age-related barriers that can hinder eHealth use [25], usability studies are crucial for understanding the reasons behind older adults' acceptance or rejection of technologies, considering factors such as complexity, lack of experience, and fear of reducing human interaction. Therefore, in part due to an increased use of telehealth strategies during the last decade, it seems necessary to appraise evidence on the usability of videoconferencing solution for providing PE intervention. The evaluation of the usability of technologies is a research area that is still underexplored, involving various types of studies and different methodologies [26] (usability tests such as the System Usability Scale, gathering feedback, conducting post-use interviews, and administering questionnaires) with heterogeneous knowledge. Investigating this research topic through a scoping rewiew approach could help to map the depth and breadth of this specific topic [27]. Our scoping review aimed to assess the evidence on the usability of videoconferencing technologies as a support for synchronous physical education interventions delivered to healthy older adults, and to identify the types of evidence and gaps in this field.

Methods

Search strategy

This scoping review was structured according to the PRISMA-ScR guidelines [28]. The review was conducted by 2 independent reviewers (LR and BB) using the following four leading databases: Pubmed/Ovid Medline, Embase, Scopus, and CINHAL. The following keywords were identified and combined to address the research questions: 1) The target population was healthy older adults. The population studied in the articles did not have to present any specific health characteristic (osteoarthritis, post-fall, motor or cognitive disorders...); 2) videoconference should have been used

as support of intervention; 3) program of PE as a type of intervention and 4) usability as the main purpose. Synonyms were used to maximize inclusion. Keywords and related subject headings were searched using Boolean operators. Publications were included until December 2023. The MeSH terms and combinations used are listed in Table 1.

Table 1: Research terms

	MeSh Terms
Population	(Aged people) OR (Aged adult*) OR (Aging) OR (older adult*) OR ("Older people") OR (Elder*) OR (Seniors)
	AND
Method of intervention	(eHealth) OR (web-based) OR (e-Health) OR (MHealth) OR (teleconferenc*) OR (Videoconferenc*) OR (Telehealth) OR (Telerehabilitation) OR (Tele-rehabilitation) OR (Teleexercise) OR (Tele-exercise)
	AND
Type of intervention	((Physical exercise*) OR (Physical activit*) OR (Fitness exercise*) OR (Physical fitness) OR (physical exercises program)
	AND
Outcomes	(Usability) OR (Acceptability) OR (feasibility)

Eligibility Criteria

The selection of studies was conducted based on pre-specified PICOS criteria [29]:

- *Participants:* Older adults (≥65 years old) living in the community.
- *Intervention*: Physical exercises delivered via videoconferencing technologies. The tele-exercise should have been delivered at home or in the context of the local community.
- *Comparison:* A control group was not necessary for this research.
- *Outcomes:* Information on usability as defined by ISO criteria (even if it was not the main outcome) - Different criteria such as i) efficiency (ease of use, reliability, cost), ii) effectiveness (retention rate, rate of sessions completed, adherence rate) of videoconferencing technologies; or iii) satisfaction or acceptance of the older adults - testified to the usability of the technology as a mean of remote intervention.
- *Study design:* we included Randomized Controlled Trials (RCT), non-randomized controlled trials (NRCT), non-controlled trials (NCT), crossover, and pilot studies without control group (qualitative or quantitative design).

Non-peer reviewed conference and journal publications, review articles, and publications that took place in hospitals, rehabilitation centers, or care settings were excluded.

Data collection and analysis

Selection of studies. Using Covidence software (Covidence systematic review software, Veritas Health Innovation, Melbourne, Australia), two authors (LR, BB) reviewed and pre-screened all titles and abstracts of studies identified by the search strategy for possible inclusion according to the PICOS eligibility criteria. The full text of the pre-selected articles was checked for eligibility.
Data extraction. When articles met the eligibility criteria, we extracted, from the full text, authors' names, year of study, country, objectives, study design, population (i.e. sample size, age, and place of residence), intervention modalities (e.g. technological support, group or individual sessions) and, when available, comparator (e.g. face-to-face intervention or simply counseling), results and conclusions on usability (effectiveness, efficiency, and satisfaction) of the proposed technologies.
A narrative synthesis of the data was produced [30].

Results

The search strategy yielded 2325 records, from which 1846 abstracts were selected after eliminating duplicates. After title and abstract selection, 146 articles were retained for full-text screening. After reading each publication, 1 article was found and added, and 134 publications were excluded. Reasons for article exclusion are provided in Figure 1. Finally, 13 full-text publications were included (Figure 1).

*** Figure 1 near here ***

Included studies

The main characteristics of the studies are summarised in Table 2. The studies were published in English and came from various countries: England [21], the United States [22,31–36], Brazil [37], Canada [38], Singapore [39], Japan [40], and Israel [41].

*** Table 2 near here ***

Publication year and study participants.

Most of the identified articles were relatively recent as none of the included articles were published before 2006; one study was published in 2006 [31] and twelve between 2016 and 2023 [21,22,31–41]. Sample sizes varied across the studies, ranging from 7 up to 302 participants. Participants were on average 73.1 years old, with an average age ranges from 69.6 to 81 years, according to the sources reviewed. Intervention.
The interventions consisted of the adaptation of a PE program inspired by pre-existing home-based activity programs, e.g., Gerofit [22], Otago [21,36], or yoga and tai chi techniques [31] or designed by physiotherapists [41]. Except for one study [21], which lasted only 3 weeks, PE interventions duration ranged between 8 and 24 weeks. The interventions were all supervised by health professionals or certified trainers. Two studies compared the group receiving a live remote intervention with a group receiving a recorded intervention [38] or a control group receiving a traditional intervention [36]. The participant-to-professional ratio varied across studies, ranging from 1 to 25 participants, and could also fluctuate within the same study depending on the number of available participants.

Videoconferencing systems.

Authors used different terms to describe the intervention: Teleconferencing [21], videoconferencing [31,41], tele-exercise [32,34,39], telehealth [22,36], web-based intervention [38,40] and virtual-group exercise [35]. Similarly, various technological supports were used: computer [35,36], tablet

[40] smartphone [21], TV screen [31], allowing access to various videoconferencing software such as Zoom® [22,32,34,37–41], Skype® [21], Whats'app® [41] or others undetermined applications [31,35,36]. Despite the different terms and configurations used, all these studies proposed a synchronous intervention, with direct interaction.

Usability of technological support:

Effectiveness of technological support for videoconferencing:

All studies indicate that it is possible to deliver PE interventions synchronously via videoconferencing technology. Mean adherence rate of intervention were 87.8% [from 78 to 97%] [31–38,40,41]. Reasons given for continuing or not continuing exercise during studies were independent of the technology used. There were individual characteristics, like lack of interest in the intervention or health problems [38]. The instructions and progression of the exercise were the same as face-to-face [35]. All the technological supports have been effective in delivering video conferencing intervention programs.

Efficiency of technological support for videoconferencing:

Eleven studies evaluated the efficiency of the interventions offered by videoconferencing [21,22,31–34,37–41]. These studies report the correct efficiency of the technologies used, but certain points of concern concerning technological anxiety, ease of use and learning, technological reliability, safety, and cost are highlighted.

Technological anxiety: Gell et al., (2022) reported that participants were not anxious about using the technology (score = 3.5 (±4) /10) [34]. According to Hawley-Hague et al., (2021), the initial concerns of the older adults were about installing the equipment and using it (sometimes large screens in small spaces) [21]. Nevertheless, most of the participants managed to use the technology without major difficulties. Where difficulties arose, the use of the technology was facilitated by the existence of associated services [21,31].

Ease of use and learn: Hyodo et al., (2023) reported that 73% of participants had some problems using technology at the beginning [40]. VanRavenstein et al., (2020) highlighted that 2 participants had difficulty using the touch screen [36]. In the study led by Granet et al., (2022), 69% of participants found the technology easy to use [38]. Ho & Merchant, (2022) highlighted that, while 79% of respondents reported knowing to use the system, 57% (n=24) were apprehensive about using the technology. Forty-one percent (n=17) disagreed or were neutral that the technology is easy to use. However, a majority (60%, n=25) of respondents agreed with the affirmation "technology is easy to learn". Eighty-six percent (n=36) agreed that they could accomplish the task if someone showed them or through an instruction manual [39]. Similarly, Patel et al., (2022) and Schwartz et al., (2021) reported that participants rated ease of use at 6/7 and 7/7 respectively [33,41] . For some participants, the proper use of the tool required a learning period from the intervention sessions in 2 studies [21,31]. These sessions were either two face-to-face sessions to learn about the technology and software [21] or a short 2.5 hours of training session [31]. In addition, to deal with problems arising during the course (staying on the meeting), telephone assistance was also necessary [32].

Reliability of the technology: In case of technology-related issues, the authors report that support services can assist with various aspects, including connectivity and audio adjustments (such as modifying microphone volume). They also help with troubleshooting hardware issues (e.g., malfunctioning camera, microphone, or audio circuit in the videoconferencing device) that could compromise the interaction between the clinician and the participant, as well as the execution of the intervention [21,31–34,37,41]. The technology support chosen to be more or less effective was depending on the group. Jennings et al., (2020) indicated that the group size was influenced by the platform used, the Veteran affairs platform had limitations on the number of people observed simultaneously, while the Zoom platform did not [22].

Safety: No adverse events were reported by different authors [34,37,38]. Hawley- Hague et al., (2021) reported that for health professionals, a display issue emerged: difficulty in seeing contrasts when the older person was dressed in black or if the room light was low Hague et al., (2021). This was exacerbated in group sessions as the individual image was smaller. While these difficulties were not a concern for the patients who felt safe performing the exercises, it raised up increased safety concerns according to the professionals [21]. Jennings et al., (2020) also reported that 95% of participants had reported feeling safe during exercise sessions [22].
Cost: the economic situation of older adults was considered in two studies. For 35% of the participants in the study of Ho & Merchant., (2022), this aspect limited technology use [39]. Similarly, participants (n=7) were resistant to broadband installation because of the cost that would have to be borne once the study was completed [21].

Satisfaction of technological support for videoconferencing:

Some people were afraid to have the technology installed in their homes, finding it too intrusive [21]. However, as reported in many other studies, people were satisfied with the overall intervention, the proposed program and the technology [21,22,31,33,35,36,38–41]. They were willing to continue the interventions by videoconference if possible [33,35,41].
Various advantages of videoconferencing technologies were noted. These technologies made it possible to limit external risks such as frozen roads [31], and was more interesting than telephone follow-up, particularly during the follow-up phase [21]. The group sessions enabled by the technology provided considerable added value through the possible interaction between participants and the instructor. Schwartz et al., (2021) reported that for one person, the group activity allowed by videoconferencing helped alleviate feelings of loneliness and created a positive atmosphere. The instructor's remote presence via videoconferencing and professionalism were appreciated and reassuring [35,41]. Two studies reported that the technology delivered an intervention in which participants perceived benefits on physical and mental well-being [39,41].

Discussion

The use of videoconferencing allows professionals to offer PE interventions to older adults. Nevertheless, it seemed important to evaluate the usability of the technological supports used to propose these interventions while encouraging the adherence of the older adults. To our knowledge, this is the first scoping review to evaluate the usability of various technological supports for delivering PE programs to older adults via videoconferencing. Our results indicate that intervention strategies via videoconferencing are usable, but their usability is variable depending on the technological support used.

Usability of videoconferencing technologies:

All All the studies included in this review demonstrated the effectiveness of technological videoconferencing media in the implementation of live and remote PE interventions, with variable adherence rates (ranging from 57% to 100%), sometimes higher than adherence rates for exercise programs offered without video conferencing [42]. The high adherence of participants in the studies testifies to the effectiveness of the technologies used. It appears possible for participants to join the interventions conducted remotely. . While videoconferencing is effective in providing a live remote PE intervention, our results indicate various points of caution. Firstly, variations in participants' adherence to the program could be influenced by user characteristics. It may be more difficult to use technology for adults inexperienced with technology [38]. The results showed that older adults may require external assistance to use the technology [21,31,34,39]. These observations are consistent with the literature. Kim et al., (2022) reported that cardiovascular rehabilitation can be adapted remotely for older adults who are disabled, isolated, or socioeconomically disadvantaged [43]. Some

factors hold back the use of technology by older adult users, namely the cost of the technology, followed by the complexity to use it [44,45]. This may justify the importance for obtaining environmental supports, i.e. financial support and training opportunities, as it appears essential to help older users to overcome technological barriers [46]. Secondly, variations in technology effectiveness could be influenced by device characteristics and user satisfaction with the technology. According to our results, clinicians and older adults may encounter reliability issues with the technology that compromised the intervention and thus hindered users' satisfaction and safety of older adults [31,36]. Some platforms appear to be less usable than others for large group interventions [21,22]. For videoconferencing systems, the required bandwidth, the security of the transmitted images and the reliability of technolgoy are important factors to consider [47]. In the event of difficulties with technology, some solutions exist, as for example, Granet et al., (2022) who suggested that recorded sessions may be appropriate for participants who are temporarily unable to attend live, online group sessions [38].

Assessment of usability

Through this synthesis, we have identified different methods to assess the usability of videoconferencing technology to deliver PE programs to older adults. Qualitative interviews, auto-questionnaires and observations were preferred to assess the efficiency of the technological support and the satisfaction of the users with the system and the proposed intervention. These self-reported collection methods provide relevant information about users' perceptions: if they report positive feelings or reactions to technology, then they are likely to use or reuse it [48]. Some studies have also based their measures on theories like constructivist grounded theory [36] or the Technology Acceptance Model [21]. However, no study used existing usability scales such as the System Usability Scale [49] or the Quebec User Evaluation of Satisfaction with Assistive Technology [50]. While qualitative methods are essential for providing specific details that quantitative measures sometimes cannot capture, both qualitative and quantitative approaches should be applied to the design or improvement of technologies. Albert and Tullis (2022) emphasized the importance of using standardized tools to ensure measurement quality because these tools are valid, reliable, and available for comparison purposes [48].

We also noted that no study had assessed all the usability attributes defined by the ISO [24] or Nielsen, (1993)[51]. Most studies assessed elements covering only part of the theoretical concept, with satisfaction and effectiveness being the most common attributes, while other important aspects such as ease of use or safety are left out. This observation is also shared by Sousa & Dunn Lopez, (2017). The results of their review indicated that the questionnaires constructed and used to assess usability in studies only assessed part of the usability construct [52]. However, it is possible that some effectiveness studies did not include the assessment of efficiency and satisfaction, as these data could be assessed earlier in the intervention design process.

Limitations

The use of technology has become very popular in recent years, attracting much research interest. Yet, despite this popularity, quality studies evaluating the usability of technologies are rare. This raises questions about the reliability of the information disseminated and the importance of conducting rigorous scientific research.

The level of evidence and the small number of included studies (n=13) are the main limitations of our search. This small number may be in part due to the choice of our population. We chose to include only studies on a healthy population. Indeed, people with specific medical conditions may have different needs and constraints when using the technology (e.g. cognitive limitations; reduced motor skills such as tremors or muscle rigidity; sensory conditions such as hearing or visual impairment) which could influence the results and make the generalization of conclusions more

difficult. However, as revealed by our review, the limited number of included studies can be explained by the fact that usability testing is rarely mentioned in research with older adults. This observation is consistent with [53], who reported that usability issues of intervention technologies for people with dementia are very poorly studied. Usability testing of remote intervention technologies appears to be an emerging field whose potential is accentuated during major events, such as the COVID-19 pandemic [26]. For this reason, we included pilot studies because videoconferencing interventions have not yet been widely evaluated in healthy older adults. Pilot studies often act as a preliminary step for larger research projects [54]. These preliminary studies provide a lot of information about the feasibility of a targeted method. Indeed, pilot studies may allow evaluating i) the methods of recruitment of the population; ii) the reliability of the technological equipment, and iii) adverse events (related to the technology and the intervention or inherent to the safety of the users) [55,56]. Such studies thus provide evidence that can be used to assess the usability of interventions delivered via videoconferencing. The democratization of remote interventions following the pandemic could lead to an increase in studies and publications on this topic. Future research could make usability assessment more comprehensive, for example through mixed methods promoting mixed models, using standardized tools to assess the usability of technologies used with older adults. This review may be updated in the next few years.

Perspectives

The recent and increasing use of videoconferencing technologies and the adaptation of remote physical exercise programs have led to a reassessment and reflection on care delivery models, promoting improved accessibility and adaptability of technologies across the healthcare continuum. Although in-person interventions are still available, the option to offer these programs remotely remains crucial for individuals facing difficulties accessing face-to-face care, particularly in rural areas or for those dealing with age-related mobility issues. The current challenge is to harmonize practices for remote physical exercise programs in rehabilitation.

Conclusion

The results of this exploratory study highlight the ease of use of videoconferencing support technologies to deliver remote exercise programs, highlighting positive aspects such as usability, user satisfaction, efficiency and effectiveness. However, our findings also highlight the importance of environmental supports, such as financial assistance and training opportunities, which are essential in helping older people to use information and communication technologies. In the future, it is imperative to conduct research, using standardized tools, to enhance the usability of technologies tailored to the specific needs and characteristics of older adults, thereby ensuring the clinical effectiveness of these interventions.

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Tables

Table 2: Main characteristics of included studies.

Authors (year)	Study design and objectives	Population	Intervention	Supervision, duration and frequency of intervention	Technology and equipment	Outcomes
Granet et al., (2021) [38]	RCT To examine and compare the acceptability, feasibility, and potential benefits of 2 modalities of web-based PA interventions in older adults.	Non-physically active community-dwelling older adults (>60 years) from the CRIUGM's volunteer database. EG: 70.7 years (±5.2), n=38 (81% of women) CG (recorded group): 69.6 years (±5.1), n=45 (83% of women).	Exercise protocol: Muscle function, flexibility, and cardiovascular exercises.	Three 55-minute sessions per week for 12 weeks. Program delivered by 2 certified instructors (kinesiologists). Participant-to-professional ratio = 10-14:1.	Online via Zoom videoconferencing interfaces.	Initial Ability to Use Technology In both groups: >78% used technologies for more than 1 year, >82% considered themselves "tech savvy", and > 59% used touchpad. Feasibility - Adherence rate: 85%; EG: 89%, CG: 81% - Retention Rate EG: 16% drop out vs CG: 46% -> lack of interest Acceptability of intervention (4-Likert scale): - Satisfaction: EG: 77% vs CG: 64% - Enjoyment: 100% - Perceived difficulty (easy): EG: 69% vs CG:82% - Perceived exertion (a little easy - a little difficult): EG: 42%-42% vs CG: 48%-37%. Satisfaction Precautions: ie, phone close by, remove objects or carpets from path, levels of progression. no adverse events. No model or analysis grid reported.
Gell et al.,	RCT	Cancer survivors	EnhanceFitness	1 h, 3 days/week for	Online via Zoom	Feasibility:

(2022) [34]	To determine the feasibility of remotely delivered exercise (tele-exercise) for older, rural cancer survivors	(>60 years), 2/3 are classified as obese. EG: 70.1 years (± 5.3), n = 20 (80% of women) CG (waiting list): 70,6 years (± 6.2), n = 19 (78% of women).	(tele-EF) exercise program, inclusive of aerobic, strength, and balance training.	16 weeks American Council on Exercise certified instructors. Participant-to-professional ratio: 10-12:1.	videoconferencing interfaces.	- Enrollment: 64% consented to participate, higher than 50% expected. - Adherence rate: 86.9% (interquartile range: 79–94%) - Attrition: 95% completing the study. Material: One participant was provided with a tablet and one participant was provided with an external camera. Safety: - Precaution: assistant joined each class to monitor for safety - No serious adverse events. No model or analysis grid reported.
Gell et al., (2021) [32]	Exploratory mixed methods study(1) examine the needs of older adults previously enrolled in community-based exercise for transition to tele-exercise, (2) identify barriers to and facilitators of tele-exercise uptake and continued participation, and (3) describe technology support	Community-dwelling older adult with symptomatic knee osteoarthritis (>65 years). EG: 74 years (± 6.3), n = 44 (86% of women).	EnhanceFitness (tele-EF) exercise program, inclusive of aerobic, strength, and balance training.	1 h, 3 days/week. Participant-to-professional ratio: No reported, session available for all participants.	Online via Zoom videoconferencing interfaces.	Material: 91% owned a smartphone and had broadband access, but 1/3 did not own a tablet and 1/3 did not own a computer with a webcam. Acceptability (Senior Technology Acceptance Model): - Attitudinal beliefs: 8.7 (±3) / 10 - Control beliefs: 8.9 (±2.5) /10 - Gerontechnology anxiety: 3.5 (±4) /10 - Challenge during setup phase: no device camera or microphone (n=1). - Challenge during classes: internet connectivity issues (n=5); zoom audio (n=11), joining or staying on the meeting

	challenges and successes encountered by older adults starting tele-exercise.					(n=15). - Facilitating conditions: 48 % required a single call to address the technology challenges. Adherence: 93 % (IQR 88 %-98 %). No model or analysis grid reported.
Hawley-Hague and al., (2021) [21]	Feasibility study Usability, acceptability and feasibility of smartphone-based teleconferencing for health professionals and older adults.	Community-dwelling older adults. EG: 77 (range 64-92), n=7. Health professionals: n=11.	Virtual intervention: OTAGO program + balance exercises from the FaME program (evidence-based falls management exercise).	2wks: classic intervention before usability test. Program delivered by a health professional, 1x/ week during 2 weeks in individual and 1x in a single group session. Researchers present with participants and help to use technology if difficult. Participant-to-professional ratio: 1:1 for the individual session and 2-3:1 for the group sessions.	Samsung Galaxy S4 with 4G network connected to TV or screen provided by HDMI cable or Chrome Cast. (Connection to video by placing phone on the dock connected to TV). Broadband (if not available) has been set up and paid for by the research team (as a smartphone) Wireless headset. Software: Skype	*Issue-log or field notes:* Acceptability and Usability: - Setting up and connecting the technology and accessing Skype requirement for internet or 4G- Poor connectivity --> limited reliability of teleconferencing. - Positioning of the technology for delivery exercise. -Anxiety and Safety Concerns: the patients were not as concerned as the health professionals. - Cost: Broadband installation met with resistance, even when it was proposed to provide it, due to the cost that would be incurred once the study was completed. - Experiences of using the technology: issues with the positioning of technology and with view and contrast. Feasibility: Ideal size of group Types of exercise that could be delivered through the smartphone.

						FARSEEING: FAll Repository for the design of Smart and sElf-adaptive Environments prolonging Independent livinGTAM: technology acceptance model.
Ho and Merchant., (2022) [39]	Cross-sectional Study To study the acceptability of technology and perceived self-reported benefit of tele-exercise in our community-dwelling older adults.	Older adult (>60y) in community-dwelling. EG: 69.1 years (± 4.7), n=42 (93% of women)?	Healthy Ageing Promotion Program for You (HAPPY): multicomponent exercise focusing on cognition and physical function.	Minimal length of 8 sessions. 3 sessions of theoretical training and cocreation of dual-task exercise and 8 hours of on-site training as assistant instructor and assessment. Program was conducted by health coaches and peer leaders who were trained to perform dual-task exercises by physiotherapists. Participant-to-professional ratio: No reported, session available for all participants.	Online via Zoom videoconferencing interfaces.	*Online questionnaire regarding technology* Acceptability of digital technology: - Utility: 91% agreed that technology is a good idea and 79% agreed that technology would allow them to be independent for longer. - Ease of use: 79% thought they had the necessary knowledge and 86% thought they could use the technology if someone showed them or provided an instruction manual. 41% disagreed or were neutral that technology is easy to use and that technology is easy to learn. - Facilitating condition (knowledge, external assistance): Someone was available for technological assistance for 91% of participants. - Technology apprehension: 7% (n=24) were apprehensive about using technology. No model or analysis grid reported.
Hyodo et al., (2023) [40]	Pilot studyTo examine the feasibility, safety, and enjoyment of a web-based aerobic dance exercise program and the usability of a web-	Older adult (>65y) in community-dwelling. EG:77.6 years (± 4.5), n=16 (75% of women).	Slow Aerobic Dance Exercise (SADE).	20 min, every weekday for 8-weeks. Participant-to-professional ratio: 16:1.	Online via Zoom videoconferencing tablet interfaces	Feasibility - Retention rate = 93,8% - Adherence rate = 97.40% - Security: No adverse event. - Enjoyment, 11-point Likert scale: improvement throughout sessions. Usability (interview)

	based exercise delivery system using a videoconferencing platform for older adults.					Ease of use: - 27% had no problem - 73% had some challenges at the beginning. No model or analysis grid reported.
Jennings et al., (2020) [22]	Pilot study To describe the preliminary results and lessons learned from the rapid implementation of a telehealth-supported group exercise intervention.	Veterans (> 65 years), with authorization of Durham Veterans Affairs (VA) Medical Center. (offered at 17 medical centers in the USA) EG: 74.0 years (±6.7), n=308	"Gerofit program": (cardiovascular exercises, strengthening on individual machines + classes such as Tai chi, yoga, chair or floor.	Program delivered by 2 instructors. 3x/wks. For at least 8 weeks for some centers. Participant-to-professional ratio: variable group sizes.	Online via Zoom videoconferencing Tablet, smartphone or computer interfaces, or Veteran Affairs (VA) supported platforms (The VA supports telehealth using VA Video Connect (VVC) within the VA Virtual Care Manager (VCM) platform).	Feasibility - Adherence rate: 6.4% attended fewer than 25% of the total available number of GTH classes, and the majority, (93.6%), attended classes regularly, with 53% attending more than 75% of the time. - Satisfaction and safety: 94% are likely to recommend GTH to another veteran, and 95% said they felt safe exercising at home. No model or analysis grid reported.
Patel et al., (2022) [33]	Pilot study To evaluate the feasibility and acceptability of remotely delivered EF (tele-EF).	Older adults (> 65 years) residents of Lewis County, with symptomatic knee osteoarthritis. EG: 71,8 years (±5,8), n=15 (93,3 % of women).	EnhanceFitness (EF): Strength training involved progressive resistance exercises using adjustable 1- to 10-pound ankle and wrist weights.	EF-certified instructor 60min, 3 days/week for 12 weeks. Participant-to-professional ratio: 10-12:1.	Online via Zoom videoconferencing interfaces.	Feasibility - Retention rate: 55.6% enrolled - Adherence rate: 86.7 - Acceptability of program (satisfaction): 91.4% (interquartile range: 84.5%-94.3%; n = 15) - Material: 5 participants were loaned a cellular-enabled tablet Technology acceptance (TAM scale) - Ease of use: 6.4/7 - Usefulness: 6.6/7

						- Financial cost: 2.8/7 - Intention to use: 6.3/7 No model or analysis grid reported.
Pinto et al., (2023) [37]	Feasibility studyCompare the barriers and facilitators of telerehabilitation between groups of people with and without Parkinson's disease.	Older adults with and without Parkinson disease (PD) EG: 69.00 (64.68; 73.32), n=14CG with PD: 69,00 (65,17 ; 72,83), n=12	Dance for PD®.	60min, 2 days/weeks for 8 weeks Professional dancer and physiotherapist sequence of movements. The participant-to-professional ratio was not reported.	Online via Zoom videoconferencing Tablet, smartphone, or computer interfaces.	Feasibility - Retention rate: 100% - Adherence rate: 91.7% to 87.5% with PD and without PD, respectively. Usability - Connection: 5.8 reported poor connection. - Sound problem: <2.4% in both groups. - Difficulty accessing of managing between 9.6 and 10.4%. Security: - Precaution: Check of environment (enough and clear space to move). - No adverse event. No model or analysis grid reported.
Schwartz et al., (2021) [41]	Pilot study To explore the feasibility of an 8-week intervention in a group of older adults.	Older adults (> 60 years old) living in the community. EG: 71.5 (± 4), n=31 (67% of women).	Exercise protocol: https://www.youtube.com/watch?v=5pqh9dXUn3s Resistance and aerobic exercises; individualized program	45min, 2x/week for 8 weeks Search teams = 2 physiotherapists + 2 personal trainers. 2 instructors 1 technical assistant The participant-to-professional ratio: 15:1.	Online via Zoom videoconferencing interfaces WhatsApp group chat/reminders.	*Online Questionnaire:* Satisfaction levels with the technological aspects (final survey) - Ease of use: 7 (5-7) out of 7 - Quality of video and audio: 7 (5-7) and 7 (5-6) out of 7 - Future intentions: 97% would like to continue - Enjoy training: 7 (5-7) out of 7

			according to perceived exertion (Borg scale).			- Perceived exertion: 6 (3–7) out of 10 No model or analysis grid reported.
Tomita et al (2016) [35]	RCT To explore attrition rate and effectiveness to the intervention on falls, balance, and depression.	Older adults (60-90) living in the community. N=51; EG: 72.3 years (±7.7), n= 25 (92% of women). CG: 74 years (±7.8), n=26 (87% of women).	EG=Virtual-Group Exercise at Home (V-GEAH). The exercise program inspired by Tai-Chi and the OTAGO program. CG= encouraged to walk.	25 to 40 min, 3x/week for 24 weeks Certified fitness trainer. Participant-to-professional ratio: 25:1.	Intervention is possible on a desktop or laptop computer. Video communication software called ooVoo; a free program called ManyCam.	Feasibility: Adherence rate: 84,4%. Satisfaction: 5% of participants thought the 6-month duration was very long while 77% said they would miss the V-GEAH session Security: Participants felt safe No model or analysis grid reported.
VanRavenstein et al., (2020) [36]	Controlled study To examine the feasibility of tele-intervention to a small group of low-income older adults living independently in the community.	Older adults (> 55 years), relatively autonomous (able to stand for 15 minutes, able to move 150 feet, follow instructions, charge, wear and use a fitbit tracker). EG: 74 (60-84), n=6 (100% of women) CG: 69 (57-74), n=6 (83% of	Modified Otago exercise program: strength and balance exercises. EG = distance session TG = face-to-face session.	2x/week, 12 weeks Program physical therapist (PT), and PT student. Participant-to-professional ratio: 6:1.	Instructor: desktop computer with a 32-inch screen, speakers and the Vidyo telehealth platform. Participants could view the instructor using a second computer. Fitbit (recorded walking activity).	*Qualitative Interviews:* Feeling on the participation in an exercise program over the technology. - Ease of use: difficult to the touch screen (n=2). - Satisfaction: Participants appreciated the telehealth sessions. Constructivist grounded theory.

		women).				
Wu et al., (2006) [31]	Pilot studyTo assess the feasibility of a group intervention designed for balance impaired older adults to improve their balance and reduce their fear of falling.	Older adults (>65 years) community-dwellingEG: 81 (IQR =72; 93), n=17 (76% of women).	Yang style Tai Chi Quan movements emphasizing flexibility, strength, and balance coordination.	1hn 3x/week for 15 weeks with a Certified tai-chi teacher. Participant-to-professional ratio: 6-11:1.	Video camera and ordinary TVs, displaying all participants for the instructor, and displaying either the instructor alone or with other participants.	Feasibility - Adherence rate: 78% ±15% (ranging from 51% to 98%) - Drop out: n=3 *Interview questionnaire and logbook* Level of acceptance and satisfaction: - All subjects reported favorably about the program via videoconference. Ease of use: - Most subjects (n=15) reported no concerns. - 2 requiring assistance until the third week. Efficiency: - Participants were satisfactory image and voice quality. - Technical support mainly concerned connection problems, audio problems (microphone volume) or hardware problems (camera, microphone or audio circuit failure). Most problems were solved by telephone. Hardware problems required one-hour home visits. No model or analysis grid reported.

Note: RCT = randomized controlled study; n= number of participants or observation; EG = experimental group; CG = control group.

Supplementary Files

Figures

Untitled.