



Tele-rehabilitation interventions for individuals living with dementia during the COVID-19 pandemic: Mixed-method systematic review

Review

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ABSTRACT

Background: Considering COVID-19, individuals living with dementia are more vulnerable, and tele-rehabilitation can be incorporated into dementia care. **Objective:** To analyse the evidence of the availability and effectiveness of tele-rehabilitation interventions for individuals living with dementia in the community during the COVID-19 pandemic. **Methods:** A mixed-method systematic review was conducted. Cochrane, ProQuest, PubMed and Google Scholar databases were searched using keywords that include dementia, tele-rehabilitation, and COVID-19. Article quality was assessed using the Mixed Methods Appraisal tool. **Results:** Thirteen articles were included. Findings suggest, most tele-interventions were being implemented in European and high-income countries. These interventions included: videoconferences, telephone-based interventions, television-based assistive technology, and human-robot. **Conclusion:** Despite the lack of rigorous studies, tele-rehabilitation is effective in improving cognition, behavioural and psychological symptoms, quality of life, and social connectedness. Rigorous methodologies, i.e., randomised control trials, are recommended.

KEYWORDS

COVID-19; Dementia; Telehealth; Telerehabilitation

INTRODUCTION

COVID-19 is an infectious disease caused by a virus, known as SARS-CoV-2 (López et al., 2021; World Health Organisation [WHO], 2022). This virus is spread by droplets and aerosols produced by infected people (WHO, 2022). Social distancing to reduce COVID-19 transmission leads to social isolation and loneliness (Gorenko et al., 2021) that negatively impact on the physical and psychological status of individuals living with dementia (Barros et al., 2020). These negative impacts included a decline in communication and mood, changes in cognition, worsening behavioural and psychological symptoms and functional ability (Suarez-Gonzalez et al., 2021; Tsapanou et al., 2021). Dementia is a progressive syndrome characterised by the deterioration of mental capacity that limits daily functioning (Gale et al., 2018; Iadecola et al., 2019) and has been identified as a worldwide health priority (Iadecola et al., 2019). With significant negative consequences of COVID-19 on dementia (Barros et al., 2020), rehabilitation is a

priority for individuals living with dementia (Mantovani et al., 2020), which enables better living by slowing the progression and relieving behavioural and psychological symptoms of dementia (BPSD) (Maki et al., 2018).

Social distance increases the need for remote healthcare delivery for the community-dwelling people (Temesgen et al., 2020), and tele-health has an essential role in supporting individuals living with dementia living in the community (Mantovani et al., 2020). Tele-health facilitates health services from a distance through information and communication technologies, including computers, cell phones and the internet (WHO, 2010), and consists of texting, phone calls, web-based applications, multimedia interventions, virtual reality, electronic health records, mobile games, robots, and drones (Choi & Paik, 2018; Laver et al., 2020; Peretti et al., 2017; WHO, 2010). Tele-rehabilitation refers to “the



delivery of rehabilitation and habilitation services via information and communication technologies” (Richmond et al., 2017) and includes evaluation, assessment, monitoring, prevention, intervention, supervision, education, consultation and coaching via those technologies (Richmond et al., 2017). But, limited evidence is available concerning tele-rehabilitation interventions delivered for individuals living with dementia affected by the COVID-19 pandemic (Di Lorito et al., 2021; Mantovani et al., 2020; Panerai et al., 2021). Therefore, further investigation is needed to determine and assess the available rehabilitation interventions for individuals living with dementia during the COVID-19 pandemic. This systematic review aimed to identify the available tele-rehabilitation interventions and assess their effectiveness in the context of individuals living with dementia living in the community during the COVID-19 crisis.

RESEARCH QUESTIONS

The review questions were:

- (1) What are the available tele-rehabilitation interventions for individuals living with dementia living in the community during the COVID-19 pandemic?
- (2) What is the effectiveness of tele-rehabilitation interventions on individuals living with dementia living in the community during the COVID-19 pandemic?

METHODS

Study Design

This study was a mixed-method systematic review combining quantitative and qualitative findings in a single review (Joanna Briggs Institute, 2014). The “Preferred Reporting for Systematic Review and Meta-Analysis 2020” (PRISMA-2020) guideline (Page et al., 2021) was used. The review protocol was registered on PROSPERO: International prospective register of systematic reviews site (registration ID: CRD42021254565).

Search Strategies

Cochrane Library, ProQuest, PubMed, and Google Scholar databases were searched from 12.05.2021 to 20.05.2021. The literature search was updated between 02.07.2022 and 08.07.2022. Hand searches in the reference lists of the included studies

and review articles yielded additional studies. Literature indicates that Google Scholar covers 97.2% of search results (Bramer et al., 2016) and Medline with reference list checking covers 93.7% (Goossen et al., 2020), including articles from academic journals covering medicine, nursing, pharmacy, dentistry, veterinary medicine, and health care. PubMed is a broad database that provides articles from several databases, including articles before or during Medline indexing and non-indexed articles under “supplied by publisher” (Theander, 2006). ProQuest allows searching multiple databases simultaneously, including public health, allied health, and nursing studies. Cochrane Library includes randomised control trials and systematic reviews that help to identify related studies. Three concept categories were reviewed: “dementia”, “tele-rehabilitation”, and “COVID-19”.

Eligibility Criteria

The current review was based on the peer-reviewed articles published in English from 2019 to date. COVID-19 was first reported in 2019. The included interventional studies were quantitative studies, qualitative studies, mixed-method studies, feasibility studies, and pilot studies.

The inclusion criteria for the concepts of the current review were chosen according to the “Problem/ Patient/ Population, Intervention, Comparison, and Outcome” (PICO) framework for quantitative studies and “Population, Phenomena of interest and Context” (PICO) framework for qualitative studies (Theander, 2006). Studies were included if 1) the population was individuals living with dementia, 2) the intervention was tele-rehabilitation intervention, 3) studies were conducted during the COVID-19 pandemic, and 4) the context was community-dwelling individuals living with dementia. The interventions that focused only on caregivers were excluded.

The primary outcomes in this review were 1) reporting the available tele-rehabilitation interventions and 2) their effectiveness. The availability of intervention was reported based on the type of interventions, type of technology and the purpose of the rehabilitation. Type of interventions concerned were pharmacological and non-pharmacological interventions (Chang et al., 2018; D’Onofrio et al., 2016). Their effectiveness was measured based on the changes in variables between pre-intervention and post-interventions or between interventional groups and control groups, or as a



comparison among two technologies for the same intervention.

The variables determining the effectiveness included cognition, behaviours, neuropsychiatric symptoms, activity level, communication, well-being, and Quality of Life (QoL). The additional outcomes of the current review were user acceptance and satisfaction with tele-rehabilitation.

Data Screening, Extraction, and Quality Assessment

The first reviewer retrieved the studies and removed duplicates using EndNote X7.1 reference management software. Two reviewers reviewed 10% of titles and abstracts, and the first reviewer continued the screening. Two reviewers then independently screened full-text studies. The relevancy was judged using a 5-point Likert scale ranging from 1 (not at all relevant) to 5 (extremely relevant) (Hong et al., 2019). “Extremely relevant” and “very relevant” articles were grouped as “relevant”, and Cohen’s Kappa inter-rater agreement was calculated (McHugh, 2012). Disagreements were resolved at a consensus meeting. Reasons for excluding the articles were recorded.

Two reviewers independently appraised the quality of the included studies using the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018). Differences were resolved by consensus agreement. Studies with low MMAT scores were not excluded because of their high information value and contributed to an in-depth understanding of the tele-rehabilitation interventions during the COVID-19 crisis.

The two reviewers developed an abstraction template and a data dictionary, including study identification data, aims of the study, population characteristics, intervention characteristics, quality assessment, outcomes, results, and limitations. The first reviewer extracted the data, and the second reviewer checked for accuracy.

Data Synthesis and Analysis

Data were synthesised narratively concerning designs and study outcomes. Quantitative outcomes and qualitative outcomes were synthesised separately and then merged to interpret (Joanna Briggs Institute, 2014). A meta-analysis was not possible due to the heterogeneity of the studies included.

RESULTS

Study Selection

The flow of study selection was illustrated in [Figure 1](#), along with the reasons for study exclusion. The database searches yielded 638 articles. Duplicates were removed (n=67). Title/abstract screening resulted in 98 sources for full-text screening. Of the selected 98 sources, one article was unobtainable. A moderate inter-rater agreement (Kappa, 0.69) was exhibited in full-text screening by independent reviewers (McHugh, 2012). Finally, 13 primary studies were selected for the current review. Screening of hand searches and snowballing yielded 20 full texts, and none were chosen for the current review as they were not meeting the inclusion criteria.

Study Characteristics

Studies were conducted in the COVID-19 era and published in 2020 and 2022. Geographically, nine were conducted in European countries: Italy (n=4) (Arighi et al., 2021; Capozzo et al., 2020; Gareri et al., 2022; Panerai et al., 2021), Spain (n=3) (Benaque et al., 2020; Dura-Perez et al., 2022; Goodman-Casanova et al., 2020), Canada (n=1) (Vellani et al., 2022), and the United Kingdom (n=1) (Di Lorito et al., 2021). Three were found in Asian countries: Hong Kong (Lai et al., 2020), India (Lima et al., 2021) and Taiwan (Lai et al., 2022). The study conducted in India was an extension of the work conducted in the United Kingdom (Lima et al., 2021). One was intervened in Brazil (Brandão et al., 2021).

There were different interventional study designs, including randomised control trial (Goodman-Casanova et al., 2020), pretest-posttest interventional design (Lai et al., 2020; Lai et al., 2022), non-randomised interventional comparison design (Panerai et al., 2021), interventional qualitative study (Di Lorito et al., 2021), cohort study (Dura-Perez et al., 2022), feasibility study (Brandão et al., 2021), pilot study (Vellani et al., 2022) and other pre-experimental designs (Arighi et al., 2021; Benaque et al., 2020; Capozzo et al., 2020; Gareri et al., 2022). Five were mixed-method studies (Brandão et al., 2021; Capozzo et al., 2020; Dura-Perez et al., 2022; Goodman-Casanova et al., 2020; Vellani et al., 2022). Lima et al. (2021) focused on an intervention development study (i.e., a human-robotic) consisting of three phases: developing, designing and pilot testing.

Concerning the sample characteristics, seven studies were conducted on individuals living with dementia or mild cognitive impairments (Arighi et al.,



2021; Benaque et al., 2020; Dura-Perez et al., 2022; Gareri et al., 2022; Goodman-Casanova et al., 2020; Lai et al., 2022; Vellani et al., 2022). Caregivers had participated in five studies (Capozzo et al., 2020; Di Lorito et al., 2021; Lai et al., 2020; Lai et al., 2022; Panerai et al., 2021). Caregivers with their trusted individuals (family or friends) participated in one study (Vellani et al., 2022). One study recruited individuals living with dementia and healthy older adults in the designing phase, while one person with dementia participated in the testing phase (Lima et al., 2021). Brandão et al. (2021) recruited older adults, including individuals living with aphasia and dementia. Only one study included people with a specific type of dementia, i.e., frontotemporal dementia (FTD), and most of the interviews were carried out with caregivers (n=28), while four were carried out with patients and caregivers together (Capozzo et al., 2020). The sample size of individuals living with dementia ranged from one to 350. The average age of participants ranged from 65 to 83 years. The detailed study characteristics can be found in [Table 2](#).

Quality Appraisal

Only three studies showed a score of 4 (Brandão et al., 2021; Panerai et al., 2021) or 5 (Di Lorito et al., 2021) out of five in the MMAT, and others received 1 or 2 or 3 scores ([Table 2](#)). Moreover, only a few studies in the current review reported aim(s)/research problem(s), and none reported a theoretical background.

Tele-rehabilitation Interventions

This review did not find any tele-rehabilitation based pharmacological interventions during the COVID-19 period for individuals living with dementia. Reported non-pharmacological interventions were cognitive interventions (Brandão et al., 2021; Goodman-Casanova et al., 2020; Panerai et al., 2021), sensory stimulation interventions (Brandão et al., 2021; Di Lorito et al., 2021; Goodman-Casanova et al., 2020), social interventions (Brandão et al., 2021), educational interventions (Lai et al., 2022; Vellani et al., 2022) and assistive technology interventions (Lima et al., 2021). Cognitive interventions included reality orientation therapy (ROT) and memory games (Arighi et al., 2021; Goodman-Casanova et al., 2020). For sensory stimulation, activity therapies had been used (Brandão et al., 2021; Di Lorito et al., 2021; Goodman-Casanova et al., 2020); for example, in the study by Brandão et al. (2021), these interventions focused on communication, memory, and imagination.

Six tele-communication interventional studies, including tele-visits, tele-conference and tele-assessment in patient assessment or follow-up care were identified (Arighi et al., 2021; Benaque et al., 2020; Capozzo et al., 2020; Dura-Perez et al., 2022; Gareri et al., 2022; Lai et al., 2020). Two studies conducted supportive teaching classes about health promotion activities (Lai et al., 2022) and advance care planning (Vellani et al., 2022) ([Table 1](#)).

Technologies in Tele-rehabilitation

Different types of technologies were used to deliver tele-rehabilitation for individuals living with dementia during the COVID-19 crisis, including video-conferences (Arighi et al., 2021; Benaque et al., 2020; Di Lorito et al., 2021; Gareri et al., 2022; Lai et al., 2020; Vellani et al., 2022), WhatsApp and Zoom based video calls and group interactions (Brandão et al., 2021), telephone-based interventions (Arighi et al., 2021; Benaque et al., 2020; Capozzo et al., 2020; Dura-Perez et al., 2022; Goodman-Casanova et al., 2020; Lai et al., 2020; Lai et al., 2022; Panerai et al., 2021), television-based assistive technology (Goodman-Casanova et al., 2020), and human-robot ([Table 2](#)). Video tele-consultation was used in three studies, and participants had an option of telephone consultation if video communication was not possible (Arighi et al., 2021; Benaque et al., 2020; Capozzo et al., 2020).

One study compared the effectiveness of videoconferences with telephone-only interviews (Lai et al., 2020), and one study only used video-conference technology for tele-rehabilitation (Vellani et al., 2022). One study conducted group-based learning sessions for art-related activities: clowning, dancing, storytelling, and cooking (Brandão et al., 2021). Complex technologies were used in two studies, including television-based assistive services (TV-AssistDem) (Goodman-Casanova et al., 2020) and a hybrid face-robotic system (human-robot) (Lima et al., 2021). Moreover, emails, WhatsApp, Skype, Teams, and Facetime have been used in several studies. One study did not report the digital technology used with the experimental group (Lai et al., 2022).

Purpose of tele-rehabilitation

The current review identified three main purposes of rehabilitation in dementia care: monitoring and providing dementia-specific care, controlling COVID-19 infection, and providing supportive care for individuals living with dementia ([Table 2](#)).



Monitoring and providing dementia-specific care. Dementia-specific care included several types of care, for example, follow-up care patient assessments, prescribing or modifying therapy, evaluating interventions that focused on dementia-specific care, ROT, and memory games. Five studies reported follow-up care such as history taking (Arighi et al., 2021), neurological and neuropsychological assessments (Arighi et al., 2021; Benaque et al., 2020; Gareri et al., 2022) and participants' social background assessment (Benaque et al., 2020; Dura-Perez et al., 2022; Gareri et al., 2022). One study focused on providing treatment, for example, prescriptions or modifications of the treatment via video-consultations (Arighi et al., 2021). Five studies conducted dementia-specific evaluations following the interventions, such as cognition (Capozzo et al., 2020; Dura-Perez et al., 2022; Gareri et al., 2022; Lai et al., 2020; Panerai et al., 2021), depression (Dura-Perez et al., 2022; Gareri et al., 2022; Panerai et al., 2021), behavioural changes (Capozzo et al., 2020; Gareri et al., 2022; Lai et al., 2020; Panerai et al., 2021), physical changes (Capozzo et al., 2020), and functional abilities (Capozzo et al., 2020; Gareri et al., 2022). One study reported the use of the telephone-based ROT to improve cognition, mood, and neuropsychiatric symptoms (Panerai et al., 2021). In one study, the TV-AssistDem facilitated memory games, leading to cognitive enhancement (Goodman-Casanova et al., 2020).

Control of COVID-19 infection. Tele-rehabilitation has been used in knowledge assessment, information provision and monitoring of the participants concerning the COVID-19 outbreak. The TV-AssistDem study evaluated the participants' knowledge of the COVID-19 situation, health services and social services and explored the impact of quarantine on the health-related well-being among older adults with mild cognitive impairments and mild dementia (Goodman-Casanova et al., 2020). Two studies provided videos including information to protect from COVID-19, for example, hand washing (Goodman-Casanova et al., 2020), providing links to official online sites such as the World Health Organisation or the Spanish Ministry of Health (Goodman-Casanova et al., 2020), and providing online health education materials (not specified) (Benaque et al., 2020). One study reported tele-medicine consultations to ensure the safety of participants from COVID-19 infection by monitoring health status weekly and maintaining a register regarding the COVID-19 positive or suspected participants (Benaque et al., 2020). Dura-Perez et al. (2022) assessed changes in living places with reference to lockdown, presence of COVID-19

symptoms, and frequency of access to COVID-19 information. One study evaluated the use of personal protective equipment, the need to quarantine, and the effects of social distancing (Gareri et al., 2022).

Providing supportive care for individuals living with dementia. Tele-rehabilitation was used to improve physical activities, social connectedness, and psychological well-being during the COVID-19 pandemic. In two studies, physical activities were promoted by video interactions (Di Lorito et al., 2021; Goodman-Casanova et al., 2020). Two studies provided participants with information through video sessions or telephone consultations that included information on QoL and physical and psychological well-being (Goodman-Casanova et al., 2020; Lai et al., 2020).

In the study of TV-AssistDem, individuals living with dementia were facilitated to maintain social connectedness with loved ones and health professionals using video calls (Di Lorito et al., 2021). In another study, a few groups were created to conduct live-stream sessions called the Playful Living program to promote well-being and social connectedness (Brandão et al., 2021). Both individuals with dementia and health professionals were allocated to each group, and the program provided several opportunities for individuals living with dementia, including learning, pleasurable communication activities, social interactions, and feelings of belonging and empowerment (Brandão et al., 2021). It was observed that family members and pets also participated in these group sessions (Brandão et al., 2021). Moreover, individuals with dementia had social sensory experiences through utilising home utensils for activities of daily living and a virtually offered hot tea drink during the sessions (Brandão et al., 2021). One study provided advice on managing psychological distresses through video-consultation (Goodman-Casanova et al., 2020). In another study, the human-robot psychosocial interaction aimed to promote interactions and reduce anxiety and loneliness of individuals living with dementia (Lima et al., 2021). The study by Lai et al. (2022) digitally delivered a health promotion program to the participants. In another study, participants learned what to expect with the progression of dementia and how to prepare for advance care plans (Vellani et al., 2022). Furthermore, they had a chance to clarify their thoughts about future care when they were terminally ill or in a vegetative state and unable to speak for themselves (Vellani et al., 2022).



Effectiveness of Tele-rehabilitation Interventions

Quantitative outcomes of tele-rehabilitation interventions. In the selected studies, the primary outcomes focused on cognitive functions, behavioural changes, neuropsychological symptoms, physical well-being, functional and speech abilities, and QoL. In process evaluation (secondary outcome), satisfaction or user acceptance has been considered ([Table 2](#)).

One study reported a significant improvement in *cognitive functions* following the ROT in the experimental group compared to the control group whilst in the post-test experiment group compared to the pre-test experiment group (Panerai et al., 2021). Another study reported that video-conference consultation was associated with a higher and more stable cognitive functioning than telephone-only consultation (Lai et al., 2020). This study further found deterioration of neurocognitive status in some participants in the control group, but not in the intervention group (Lai et al., 2020). Similarly, another study reported a deterioration in cognition in patients with FTD during the tele-consultation assessment period (Capozzo et al., 2020).

Telephone-based ROT study reported a significant decrease in *behavioral and psychological changes, as well as depression* in the experimental group compared to the control group and the post-test experiment group compared to the pre-test experiment group (Panerai et al., 2021). One study reported a decreased intensity of BPSD scores among individuals living with dementia in the experimental group and either an upward or an invariable pattern in the control group (Lai, et al., 2022). In contrast, another study reported no difference in mental health and sleeping problems in the experimental or control group following the TV-AssistDem interventions (Lai et al., 2020). Moreover, one study reported a deterioration in behaviours such as apathy, irascibility, verbal aggression, anger and sleeping pattern changes among FTD patients during the tele-consultation period (Capozzo et al., 2020).

One study reported that participants did not show any *nutritional or respiratory* status deteriorations or improvements during the tele-conference assessment period (Capozzo et al., 2020).

Capozzo et al. (2020) reported that FTD patients showed a mild deterioration of bradykinesia, limb rigidity and swallowing during the telephone-based assessment intervention (Capozzo et al., 2020). This study further reported that *language abilities*

deteriorated during the telephone-based interventions (Capozzo et al., 2020). The TV-AssistDem study reported no improvements in *functional abilities* among the intervention group participants, and Gordon's Functional Health Patterns variables did not significantly differ between the intervention and control groups (Goodman-Casanova et al., 2020).

One study reported that the tele-conferencing consultation increased the *Quality of Life* (QoL) of individuals living with dementia in the intervention group during the COVID-19 pandemic (Lai et al., 2020). In this study, a falling trend of QoL was observed in the control group, and the QoL was significantly higher in the intervention group compared to the control group (Lai et al., 2020).

Five studies reported *process evaluation* as satisfaction or acceptance of tele-rehabilitation interventions. One study reported that most of the tele-visits (68.5%) were successful (Arighi et al., 2021). Notably, the higher success rate was reported in engaging tele-visits with the presence of a young caregiver than in engaging tele-visit without a young caregiver (Arighi et al., 2021). One study reported that 75% of tele-visits were equal to or better than face-to-face consultations (Benaque et al., 2020). Another study reported that the participant showed "happy face" in pre and post human-robotic interactions, and the engagement time with the human-robotic interaction was increased with several interactions (Lima et al., 2021). Another study reported that FTD patients were satisfied with the telephone-based assessments (88%) and expressed their willingness to continue the tele-medicine program (90%) (Capozzo et al., 2020). In the study by Vellani et al. (2022), the participants reported that the video-conference educational program was acceptable on the Treatment Evaluation Inventory questionnaire (54.7 ± 8.9). These participants rated the high video quality and sound quality, and they experienced minimum lag in video (Vellani et al., 2022).

Qualitative outcomes of tele-rehabilitation interventions. The effectiveness of tele-rehabilitation was qualitatively explored in two studies, which delivered physical exercises by a video-consultation platform (the PrAISED study) (Di Lorito et al., 2021) and group-based remote learning sessions for art-related activities (Brandão et al., 2021). The participants of the study by Di Lorito et al. (2021) expressed positive perceptions towards the program, including enhancing rapport and connectedness with the therapists and allowing to



identify non-verbal cues; recognising the therapist as a model due to the therapist also do exercise with clients during video sessions; and allowing the therapist to assess the improvement and facilitating progression.

Moreover, participants in this study found that video-calling was not familiar or not easy to learn for older people compared to the younger group; however, the presence of a caregiver is a key to face potential risks of exercising (Di Lorito et al., 2021). In the study by Brandão et al. (2021), participants had opportunities to enjoy, learn, imagine, and improve creativity, and they experienced a feeling of belonging and connectedness.

Four studies reported qualitative findings in relation to process evaluation. One study reported that the online program was supportive regarding the experience of engaging with the program (Brandão et al., 2021). One study reported that the video-delivered exercise sessions were less attractive than the face-to-face sessions due to a lack of meaningful human interactions in video-delivered sessions (Di Lorito et al., 2021). The human-robotic study revealed that the participant had no difficulty talking to the robot or was never disruptive during any sessions (Lima et al., 2021). Participants' opinions on videoconferencing were mainly positive due to saving time and cost during COVID-19 (Vellani et al., 2022).

Barriers and challenges of using new technologies by individuals living with dementia

The included studies have identified barriers or challenges of delivering tele-interventions for individuals living with dementia concerning resources, internet connection, and participants' abilities. These barriers and challenges included non-availability of devices and the internet (Arighi et al., 2021; Benaque et al., 2020; Di Lorito et al., 2021), lack of information technology knowledge (Brandão et al., 2021; Di Lorito et al., 2021), connection errors (Arighi et al., 2021; Lima et al., 2021; Vellani et al., 2022), challenges of using the devices, such as the inability of positioning the devices (Brandão et al., 2021), memory issues, such as forgetfulness to participate (Brandão et al., 2021), environmental barriers such as unexpected visitors and smoke alarms (Vellani et al., 2022), the inability of rehabilitation professionals to support caregivers concerning technological issues due to travel restrictions (Capozzo et al., 2020), reluctances of engaging in tele-rehabilitation interventions (Benaque et al., 2020; Capozzo et al., 2020), and hearing issues (Brandão et al., 2021).

One study reported that participants refused video-consultations due to unavailability and non-familiarity with the devices (Capozzo et al., 2020). A difficulty in language assessments through tele-consultation was also reported (Capozzo et al., 2020). Another study found that individuals with dementia gathered limited information during tele-consultation due to information overload or lengthy interviews that diminished information gathering during the consultation (Goodman-Casanova et al., 2020).

DISCUSSION

The current review systematically explored the recent evidence on tele-rehabilitation interventions, including their effectiveness concerning individuals living with dementia during the COVID-19 pandemic. This review revealed that tele-rehabilitation interventions were mainly limited to European and high-income countries, and this trend was also reported before the COVID-19 pandemic (Saito & Izawa, 2021). However, approximately 60% of the dementia population live in low-and-middle-income countries (WHO, 2020), and the adverse effects of dementia on the older population are well-known throughout the world (Azarpazhooh et al., 2020). Furthermore, a significant correlation was reported globally between the burden of dementia, COVID-19 cases, and death (Azarpazhooh et al., 2020). Given the challenges of dementia care amidst the COVID-19 pandemic, individuals living with dementia worldwide need urgent support, and tele-medicine and digital technology devices are one of effective ways to provide this support (Cuffaro et al., 2020). Therefore, tele-rehabilitation interventions can be expanded to reduce the dual burden of dementia and COVID-19 globally.

The current review identified that methodically robust studies are sparse, particularly randomised control trials to identify the effectiveness. Moreover, most of the included studies recruited participants from their own projects or units, leading to a higher risk of bias. Given COVID-19 guidelines and safety measures, conducting randomised control trials that require physical examinations and laboratory tests was a challenge (Wijesooriya et al., 2020). However, Wijesooriya et al. (2020) emphasised how to perform randomised control trials using tele-health. For example, screening the subject, obtaining informed consent, and follow-up activities can be effectively fulfilled without labs or physical examinations, which may be required by randomised control trials (Wijesooriya et al., 2020).



Type of Dementia Interventions

Although a number of pharmacological and non-pharmacological interventions are available for individuals living with dementia, this review reports limited availability of such interventions incorporating tele-rehabilitation during the COVID-19 pandemic. Therefore, expanding such interventions is beneficial to improve well-being and QoL among individuals living with dementia during the COVID-19 pandemic. These interventions include optimising medication through tele-dementia clinics (Chang et al., 2018), reminiscence therapy (Ge et al., 2018), music therapy (Clements-Cortés & Silva, 2021), occupational therapy (Ge et al., 2018), group-based virtual cognitive stimulation therapy (Cheung & Peri, 2021) and 2D exercise sessions (Bernini et al., 2020).

Use of technologies in Tele-rehabilitation

The current review found that a wide range of technologies, from simple telephone calls to complex television-based assistive technology or robotic technology, was used to rehabilitate individuals living with dementia. Videoconference was the most used technology during the COVID-19 outbreak, particularly for monitoring and teaching. Similarly, videoconferencing was a widely used technology in dementia before the pandemic (Burton et al., 2016; Lindauer et al., 2017). Therefore, videoconferencing might be used by clinicians in managing individuals living with dementia living in the community. It will allow individuals living with dementia to reduce their risk of having COVID-19. Robotic technology is one of the advanced tele-medicine options used in tele-rehabilitation. Previous literature supports accepting robotic interventions by individuals living with dementia (Gongora Alonso et al., 2019), and robots interventions improved social connectedness (Moyle et al., 2017). Conversely, poor technological knowledge of participants was reported as a barrier to using robotic technology (Moyle et al., 2017). More studies are essential before expanding robotic interventions in tele-rehabilitation for individuals living with dementia.

Despite several technologies used during the COVID-19 pandemic, the current review identified a lack of computer-based tele-rehabilitation and the unavailability of mHealth interventions. However, previous literature reported the availability of computer-based cognitive training interventions, including online neuropsychological testing, interactive video games and integrated simulating programs (Garcia-Casal et al., 2017; Paddock et al.,

2019; Rhodius-Meester et al., 2020). mHealth applications were developed to facilitate individuals living with dementia, for example, memory enhancement, communication, safety monitoring applications, and calendar-based reminders or audio reminders (Elfaki & Alotaibi, 2018). These interventions may be appropriate for individuals living with dementia living in low-and-middle-income countries during this COVID-19 pandemic (Ghani et al., 2020) due to their cost-effectiveness (Ghani et al., 2020) and high accessibility (Yousaf et al., 2019).

Purpose of Tele-rehabilitation in Dementia Care

The current review identified three main purposes of using tele-rehabilitation for individuals living with dementia during the COVID-19 pandemic: monitoring and providing dementia-specific care, controlling COVID-19 infection, and providing supportive care for individuals living with dementia. In line with the present study, Mok et al. (2020) have identified similar themes in a framework of home-based care strategies for dementia amidst the COVID-19 pandemic. These themes included control of infection, care for basic needs, calm down challenging behaviours, comprehensive cognitive enhancement, clinical management of cognitive disorders, and concerns for and credits to caregivers. In dementia-specific care, tele-rehabilitation interventions of the current review have addressed several aspects of rehabilitation of individuals living with dementia. For example, tele-rehabilitation has been used to assess the health status of individuals living with dementia and evaluate the effectiveness of the intervention on them. Geddes et al. (2020) argued that dementia neurological assessment tests were remotely reliable with limited validity.

The current review identified an emerging purpose of dementia tele-rehabilitation: “protecting individuals living with dementia from the COVID-19 outbreak”. These new technologies can be used to protect individuals living with dementia during the COVID-19 outbreak. Information provision is one of the primary functions of tele-rehabilitation that can be incorporated into educating people regarding the COVID-19 infection (Monaghesh & Hajizadeh, 2020). This review shows that COVID-19-related information has been delivered through tele-rehabilitation interventions, for example, information on COVID-19 disease, basic safety measures, managing psychological distresses and health guidelines. Moreover, this review found that tele-rehabilitation interventions help to monitor signs and symptoms of COVID-19 and assess the impact of



confinement due to COVID-19; therefore, these activities can be expanded during the COVID-19 pandemic.

Tele-rehabilitation provides supporting services for individuals living with dementia; for example, exercise programs were reportedly proven to provide greater acceptance in dementia care even before the COVID-19 pandemic (Bello-Haas et al., 2014). In addition, individuals living with dementia were supported to communicate with health professionals and loved ones by tele-rehabilitation, particularly using video-technologies.

It has been shown that a limited number of tele-rehabilitation interventions were developed to manage dementia and improve mental and physical well-being during the COVID-19 pandemic. However, individuals living with dementia present with cognitive impairments, BPSD and functional disabilities (Borges-Machado et al., 2020). Recent literature supports that new technologies can be used effectively in managing these needs. For example, tele-rehabilitation supports individuals living with dementia with cognitive development, remote monitoring, fall prevention, dealing with wandering, providing a communication channel between loved ones, early notification of risks and guidance for risk modification, audio reminding for daily activities and information provision (Elfaki & Alotaibi, 2018). Therefore, expanding tele-rehabilitation is essential into those aspects, i.e., providing dementia-specific care and providing supportive services.

Effectiveness of Tele-rehabilitation Interventions

Only a few studies have measured the effectiveness of interventions on individuals living with dementia during the COVID-19 pandemic. The current review reported that tele-rehabilitation interventions were effectively incorporated into individuals living with dementia in improving cognition, BPSD and QoL.

Furthermore, individuals living with dementia were satisfied and accepted tele-rehabilitation interventions, and a previous systematic review also reported that tele-rehabilitation interventions had improved outcome measures, for example, cognitive assessment of individuals living with dementia (Yi et al., 2021). Conversely, another systematic review revealed that the effectiveness of cognitive tele-rehabilitation was limited on individuals living with dementia (Cotelli et al., 2019).

Moreover, the lack of high-quality randomised control trials prevents the full understanding of the

effectiveness. Consequently, the prevailing restrictions with the COVID-19 pandemic have increased the necessity of empirical evidence in this context.

Another gap identified that further studies are needed to determine cultural differences in effectiveness, satisfaction, and acceptance of tele-rehabilitation used by individuals living with dementia because most studies belong to European and high-income countries.

Barriers and Challenges

The current review identified some barriers or challenges of using technology by older populations living with dementia, especially when maintaining social distance. Firstly, the non-availability of devices restricts the use of tele-rehabilitation interventions. The previous literature reported that researchers had handed over tele-intervention devices to individuals living with dementia during their interventions (Gately et al., 2019). Secondly, the current review identified that participants' poor technological knowledge was a limitation to implement tele-rehabilitation. However, literature support that tele-rehabilitation effectiveness could be enhanced by in-home software installation and providing training for the participants (Gately et al., 2019). The current review further reported that social restrictions with the COVID-19 prevented the research team from supporting the participants to overcome technological problems. Thirdly, in this mixed-method systematic review, both quantitative and qualitative findings identified that individuals living with dementia, who were mainly older, successfully participated in tele-rehabilitation interventions in the presence of a caregiver.

A previous study also found that the presence of caregivers facilitated the engagement with tele-rehabilitation interventions (Bello-Haas et al., 2014). This review did not find advantages of having caregivers along with individuals living with dementia during tele-interventions. It might be attributed to age-related changes in this population with dementia because a previous systematic review found that participants of tele-health were affected by hearing or visual impairments related to ageing (Yi et al., 2021). Therefore, participation of both individuals living with dementia and their caregivers are warranted in tele-rehabilitation studies during the COVID-19 pandemic.

LIMITATIONS



The limitations of the review were considering only English language studies from limited databases and including only peer-review journal articles.

CONCLUSION

During the COVID-19 pandemic, there were no tele-rehabilitation based pharmacological interventions, and only a limited number of nonpharmacological interventions are available for patients with dementia. Many available interventions are based on developed countries, especially from European countries. Several methods such as video consultation, telephoning, television assisted program and human-robotic interventions have been used in tele-rehabilitation and are accepted by individuals living with dementia. The main purposes of tele-rehabilitation include monitoring and providing dementia-specific care, control of COVID-19 infection, and providing supportive care for individuals living with dementia. As an effective mode of remote monitoring and treating, health professionals can use tele-rehabilitative interventions in dementia care. However, the effectiveness cannot be generalised due to the lack of methodical rigour of interventions. Moreover, tele-rehabilitation interventions did not increase the functional abilities of individuals living with dementia, and health professionals need to pay attention to rehabilitate FTD patients during the COVID-19 pandemic. The identified tele-rehabilitation usability barriers for individuals living with dementia were lack of devices and digital knowledge, reluctance to use tele-interventions, and connection issues. The engagement with interventions can be enhanced by engaging both individuals living with dementia and their caregivers. This review suggests the need for expanding high-quality studies, particularly trials to support the individuals living with dementia living with the challenges of the COVID-19 crisis.

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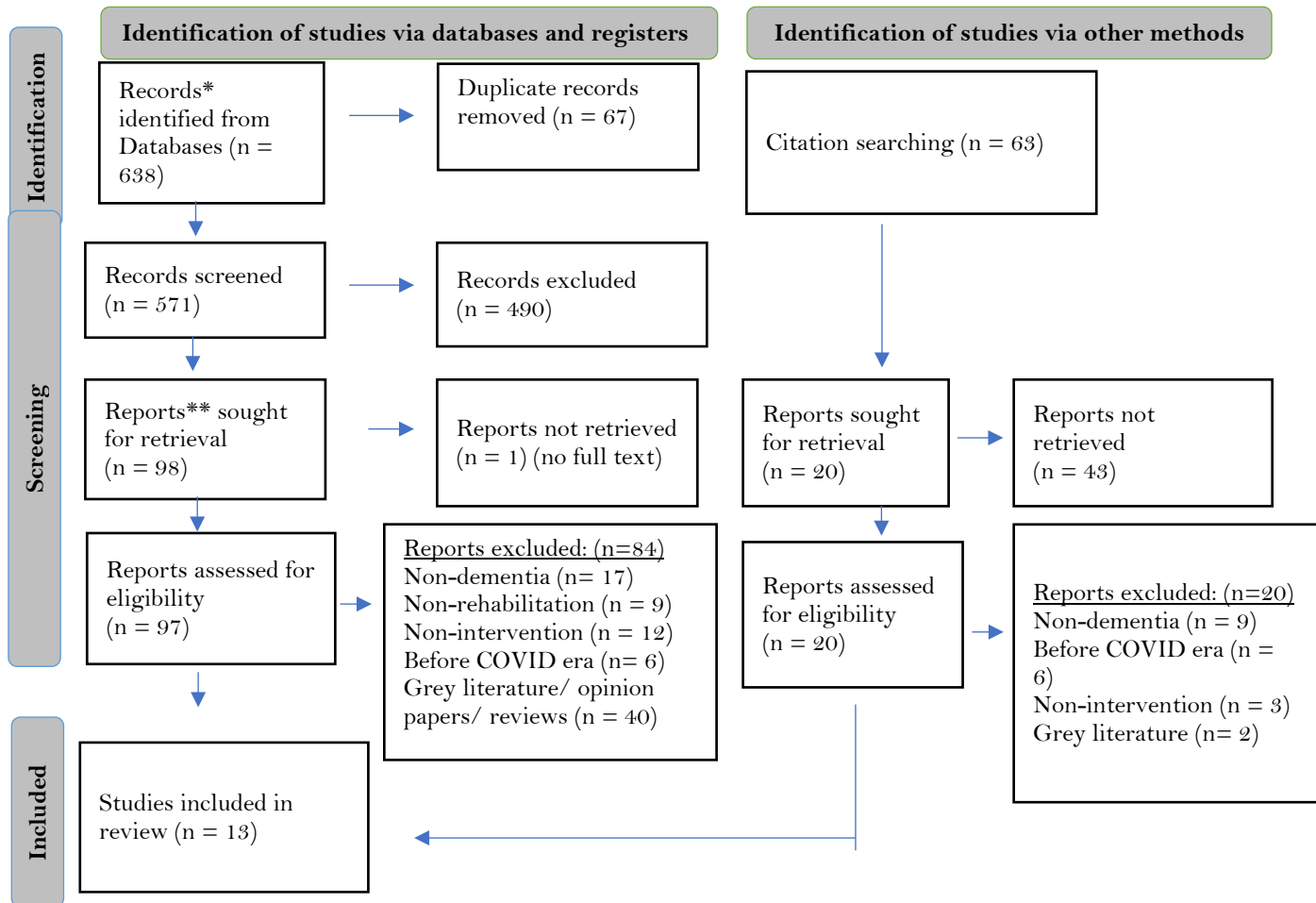


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Figure 1: The PRISMA-2020 flow diagram for study selection (Page et al., 2021)



* Record-The title or abstract (or both) of a report indexed in a database or website

** Report-A document supplying information about a particular study

Table 1. Study Characteristics

Author, Year, Country	Aim of the Study	Design	Population, Groups, Sampling	Type of Intervention and Tele-rehabilitation Involved and Duration/ Intensity	Study Variables (Study Tool)	Barriers and Challenges of Using Interventions
Arighi (2021), Italy	To describe the digital divide of a population of patients with dementia contacted by tele-medicine during the lockdown due to the COVID-19 pandemic and to understand which factors can influence tele-medicine successfulness (i.e., demographic and cognitive data of the subjects, presence, and generation of caregivers)	Interventional study	<p>Sample: people with dementia (n= 108) from an Alzheimer's Centre</p> <p>Groups: video tele-visits (n=78) and telephone tele-visits (n=34)</p> <p>Sampling: convenience sampling</p>	<p>Non-pharmacological intervention (tele-visit)</p> <p>Telemedicine visits using Microsoft Teams for follow-up care to patients with dementia.</p> <p>Duration/ intense: not given</p>	<p>Quantitative measurements: Medical history</p> <p>Cognition (MMSE)</p>	<p>Lack of devices with Internet: 23.5% (n=8), Connection issues: 76.4% (n=26)</p> <p>The results can be affected by the time and frequency of contacts</p>
Benaque (2020), Spain	To assess the major challenges with the unexpected disruption of the normality of the	Interventional study	Sample: people with dementia; or cognitive impairment or without signs of cognitive impairment (n=350)	<p>Non-pharmacological intervention (tele-conference)</p> <p>Telemedicine videoconference.</p>	<p>Quantitative measurements:</p> <p>Health status (using a checklist)</p>	Some patients and families were reluctant to tele-medicine. Some others did not have devices.



	health system, caused by the COVID-19 outbreak and its consequences. To assess the rapid evolving from face-to-face-consultation to telemedicine consultation, and the outcomes of this transition.		from a memory unit and on follow-up Sampling: convenience sampling	If videoconference was not possible, telephone conversation) Duration/ intense: weekly visits / for 16 weeks	Estimated the average number of visits Causes for not doing virtual consultations	
Brandão (2021), Brazil	To examine the feasibility of an intergenerational remote intervention program designed to promote the well-being and social connection of vulnerable older adults, mainly people with aphasia and dementia during the COVID-19 pandemic in the south of Brazil.	A mixed-method design of the study assessing the feasibility and acceptability of the interventional program	Sample: older adults with stroke-induced cognitive impairments, dementia, and individuals without any neurological conditions (n=34) Dementia reported mild to moderate 5 (20.8%).	Non-pharmacological intervention (Online inter-disciplinary program) Zoom sessions under 3 themes for 3 months: communication, memory and imagination. Artistic activities included dancing, clowning, storytelling, and cooking. Interactions were made through video calls using WhatsApp and Zoom Duration: 3 months	Quantitative measurements: Depression (GDS), Anxiety (Geriatric Anxiety Inventory) Qualitative measurements Participative observations of group sessions Participants' perceptions of the program	Hearing difficulties, Position the tablet correctly to capture face and gestures. Technological problems (e.g., activating the microphone and camera, "troubleshoot", experiencing abrupt disconnection) Cognitive challenges (memory and executive difficulties, such as forgetting meetings and not checking messages)



<p>Capozzo (2020), Italy</p>	<p>To evaluate whether the assessment of people with FTD using telemedicine is feasible and acceptable during the COVID-19 pandemic.</p>	<p>Interventional study</p>	<p>Sample: People with FTD (n=32) and their caregivers. (Participants were enrolled within the “SLAP-Dem Study”, a population-based study)</p> <p>Sampling: convenience sampling</p>	<p>Non-pharmacological intervention (Tele-medicine assessment)</p> <p>Multidisciplinary tele-medicine assessment (using tele/cell phone)</p> <p>Duration/ intensity: 1 week consultation; 60-90 minutes tele-visits</p>	<p>Quantitative measurements: Demographic data Clinical assessment data Frontotemporal Dementia ratings (CDR-FTD) Signs/symptoms of COVID-19 infection Qualitative measurements: Participants’ opinions of the telemedicine interview</p>	<p>Inability of tele-medicine physician to perform both a physical and neurological examination, the difficulties in the evaluating some items (e.g., language assessment), unavailability of devices, and the inability to provide any support due to the outbreak restrictions.</p>
<p>Di Lorito (2021), England</p>	<p>To identify participants in early dementia that video delivery program worked, which was designed for promoting activity, independence, and stability To highlight this program’s benefits and its challenges.</p>	<p>Follow up qualitative study.</p>	<p>Sample: people with dementia (n=5) and their caregivers (n=5) from a previously established exercise and functional activities of daily living program</p> <p>Sampling: purposive sample</p>	<p>Non-pharmacological intervention (Activity therapy)</p> <p>Sensory stimulation intervention</p> <p>The PrAISED through a video consultation platform called as Q health.</p> <p>PrAISED is a tailored program of physical, dual-task exercises, and functional activities of daily living delivered.</p>	<p>Qualitative measurements: Experience about the PrAISED</p>	<p>Users’ poor IT skills and resources.</p>



				Duration/ intensity: four months		
Dura-Perez (2022), Spain	To explore the impact of the COVID-19 outbreak on cognition, quality of life, perceived health status, and depression in older people with mild cognitive impairment or dementia	Cohort study	<p>Sample: participants with mild cognitive impairment or mild Dementia (n=151)</p> <p>Sampling: sample from previously established two randomised control trials</p>	<p>Non-pharmacological intervention (Tele-medicine assessment)</p> <p>Assessment of cognition, quality of life, perceived health status, and depression using telephones</p> <p>Duration/ intensity: six months</p>	<p>Quantitative measurements:</p> <p>Demographic data Cognition (MMSE), Quality of life (QoL-AD), Depression (GDS), Stress (PSS).</p> <p>Health perception-management (ie, change in living arrangements due to lockdown, presence of COVID-19 symptoms, frequency of access to COVID-19 information);</p> <p>Coping-stress tolerance (ie, self-perceived mental health and well-being and mood);</p> <p>Self-perceived alterations in usual sleep patterns.</p> <p>Technology enthusiasm and technology anxiety (TechPH).</p>	None



					<p>The use of information technology (smartphone, tablet, television, laptop) and their uses (Informative, cognitive, entertainment, and socialization).</p> <p>Qualitative measurements: coping-stress tolerance, activity-exercise, and role-relationships</p>	
<p>Gareri, 2022</p> <p>Italy</p>	<p>To evaluate whether outpatient and home care services with remote monitoring and consultation could mitigate the impact of the COVID-19 pandemic on the mental and affective status, perceived well-being, and personal capabilities of outpatient and home care patients with</p>	<p>Interventional study</p>	<p>Sample: ambulatory outpatients (n=52) and home care patients (38) receiving care from the Centre for Cognitive Disorders and Dementia</p> <p>Sampling: convenience sampling</p>	<p>Non-pharmacological intervention (Tele-consultation) Routine visits via video call</p> <p>Duration/ intensity: three months</p>	<p>Quantitative measurements:</p> <p>Cognition (MMSE), functional capabilities (ADL, IADL), comorbidities and their impact on patients' health (CIRS), Mood (GDS), perceived quality (EuroQoL-5D) Possible behavioural disorders (e.g., aggression and irritability), changes in sleep, dietary and bowel habits Living arrangement, presence of carer, food purchasing</p>	<p>None</p>



	cognitive disorders				The use of personal protective equipment, the need for workers or patients to quarantine in the event of suspected/ overt SARS-CoV-2 infection, effects of social distancing, psychological reactions to isolation	
Goodman-Casanova (2021), Spain	To explore the impact of confinement on the physical and mental health and well-being of community-dwelling older people with mild cognitive impairment or mild dementia, to provide television-based and telephone-based health and social support, and to study the effects of a television-based assistive integrated technology (TV-AssistDem).	Randomized clinical trial	<p>Sample: community-dwelling older adults with mild cognitive impairment or mild dementia (n=93) from TV-AssistDem study</p> <p>Groups: intervention group (n=47, 51%) and control group (n=46, 49%)</p> <p>Sampling: sample from previously establish randomized experimental sample and control group</p>	<p>Non-pharmacological intervention (Activity therapy)</p> <p>Cognitive intervention/ Sensory stimulation intervention</p> <p>TV-AssistDem to support health and social status, improve the QoL and provide relief to caregiver (e.g., memory games, videos of physical activity, enables the communication with loved ones, information provision)</p> <p>The researchers interviewed the participants using the telephone-based survey. During each interview, when necessary, health information, updates in TV-AssistDem and counselling was provided by the health professionals regarding COVID-19.</p>	<p>Quantitative measurements: Functional Health patterns (Gordon's Functional Health Patterns)</p> <p>Knowledge of the COVID-19 situation and health and social services</p> <p>Qualitative measurements: Experiences of coping-stress tolerance, exercise, and role-relationship patterns</p>	Potential limitations include gathering limited information from a single call, overloading with excessive information or long-time interviews



				Duration/ intention: follow-up visits at 6 and 12 months/ mean duration of the telephone calls: 12 minutes and 4 seconds		
Lai (2020), Hong Kong	To evaluate whether supplementary tele-health via video-conferencing platforms could bring additional benefits to care-recipient with neurocognitive disorder and their spousal caregivers at home.	Pretest - posttest interventional study	Sample: of people with neurocognitive disorder and their caregiver (n= 60 dyads) from an activity daycare centre for older adults Sampling: Convenience sampling	Non-pharmacological intervention (Tele-communication intervention) Carers in the intervention and control groups received a weekly care service via telephone (relevant to older adults' well-being of community living, focusing on healthy ageing, psychosocial needs, and physical well-being) - Care recipients and caregiver in the intervention group received (both) weekly health services delivered through video communication Duration/ intensity: Weekly telephone (30 minutes per session).	Quantitative measurements: a) Cognition (Chinese versions of MoCA) Memory and Behavior Problem (RMBPC) Quality of life (QoL-AD)	None
Lai (2022), Taiwan	To evaluate the effects of the Tele-Health intervention program on home-dwelling persons with dementia or mild	Non-randomized two groups, pretest-posttest	Sample: Participants with mild cognitive impairment (n=1) or mild dementia (n=17) and their informal carers (10 and 8 in experimental and	Non-pharmacological intervention (Tele-Health intervention) Health promotional activities for the experimental group Duration/ intensity: 8 weeks	Quantitative measurements: Neuropsychiatric symptoms (NPI-Q)	None



	cognitive impairment and on their primary carers during the COVID-19 pandemic	interventional study	control groups, respectively) Sampling: Convenience sampling			
Lima (2021), India	To design, develop, and pilot testing of a multimodal robotic framework fusing verbal (contextual speech) and nonverbal (facial expressions) social cues, aimed to improve engagement in human-robot interaction and ultimately facilitate mental health telemedicine during and beyond the COVID-19 pandemic.	Intervention development study	Sample: <u>Designing phase- user centre design for:</u> a) an expression recognition task with healthy participants (n=15) in the United Kingdom, b) qualitative interviews for optimizing the design acceptability and cultural appropriateness to South India with people with dementia and their caregiver, professionals, and robotics researchers (n=?), c) emotion recognition tasks with people with dementia (n=14) and healthy older adults (n=26) <u>Testing of tele-rehabilitation intervention:</u> people with dementia in South India (n=1)	Non-pharmacological intervention (Assistive technology) Development, designing and feasibility testing of using a Robotic tele-medicine system to support the mental health of people with dementia in South India. <u>Testing with individuals living with dementia:</u> Interactions between the robot and participant included presenting the robot, discussing newspaper articles, and listening to music. Duration/ Intensity: 3 robot-assisted cognitive engagement Sessions (in testing with one person with dementia)	Designing phase- user experience: Emotion Recognition User Experience (UEQ) Testing with people with dementia: User observation (Face scale- modified and OME-modified)	Network connection leads o lags and distortion of voice during remote human-robot sessions, dependency on the same network for clinicians and people with dementia, problems in streaming music, lack of a synthetically generated robot's voice instead of a recognisable human one (may interfere with the acceptability of the robot)



			Sampling: convenience sampling			
Panerai (2021), Italy	To assess the efficacy of telephone support for patients who had benefited from previous rehabilitation interventions in an institute and who were required to stay at home because of the public health restrictions adopted during the COVID-19 outbreak. To assess changes in stress in their primary carers.	Non randomized interventional comparison study	<p>Sample: patients with neurodegenerative disorders Groups: experimental group (n=14) and control group (n=13) Their caregiver were divided into group one and group two. (The included participants were previously diagnosed as Alzheimer’s disease, vascular dementia, FTD, mixed dementia or other types of dementia).</p> <p>Sampling: Participants were divided into the groups based on their preference to participate in the intervention study</p>	<p>Nonpharmacological intervention (Cognitive intervention)</p> <p>Telephone-based reality orientation therapy [ROT]</p> <p>Duration/ Intensity: 10 sessions over four weeks</p>	<p><u>Quantitative measurements:</u> Baseline data</p> <p>Cumulative Illness Rating (CIRS)</p> <p>Activities of daily living (Katz Index of Independence in Activities of Daily Living) and Lawton Instrumental Activities of Daily Living Scale)</p> <p>Mood (HAM-D, CSDD)</p> <p>Neuropsychiatric symptoms (NPI-Q)</p> <p>Cognition (Telephone-MMSE)</p>	None



<p>Vellani, (2022) Canada</p>	<p>To determine the feasibility, preliminary efficacy, and acceptability of the Voice Your Values, a tailored advance care planning intervention.</p>	<p>Pilot study</p>	<p>Sample: Community-dwelling older people with mild dementia and more than 65 years or older Enrolled as a caregiver - trusted individual (friend or family) dyad (n=21 dyads) Sampling: none reported</p>	<p>Non-pharmacological intervention (Videoconferencing intervention) Sharing participants' perspectives on living with dementia Provision of tailored education, and coaching to think about, and share participants' values and wishes for future care related to being in a terminal and/or vegetative state Duration/ Intensity: two sessions</p>	<p>Feasibility did not report in this article <u>Quantitative measurements</u> Acceptability: TEI Experience with videoconferencing: VEP-Q, VEP-R <u>Qualitative measurements</u> Diary log: Acceptability and experience with videoconferencing</p>	<p>Network issues due to living in rural areas and winter storms Environmental factors such as unexpected visitors (e.g., mail delivery) or smoke alarms</p>
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Notes: ADL, Activities of Daily Living; CIRS, Cumulative Illness Rating Scale; CDR-FTD, Clinical Dementia Rating Scale–FrontoTemporal Dementia; CSDD, Cornell Scale for Depression in Dementia; EuroQoL-5D, Euro Quality of Life; FTD, FrontoTemporal lobar Dementia; GDS, Geriatric Depression Scale; HAM-D, Hamilton Rating Scale for Depression; IADL, Instrumental Activities on Daily Living; MMSE, Mini Mental State Examination; MoCA, Montreal Cognitive Assessment; OME, Observational Measure of Engagement; PrAISED, Promoting Activity, Independence and Stability in Early Dementia; PSS, Percived Stress Scale; OME, Observational Measure of Engagement; RMBPC, Revised Memory and Behavior Problem Checklist; ROT, Reality Orientation Therapy; TechPH, the Instrument for Measuring Older People’s Attitudes Toward Technology; TEI, Treatment Evaluation Inventory, TV-AssistDem, Television-based ASSistive Integrated Service; VEQ-P, Virtual Experience Questionnaire-Participants; VEQ-R, Virtual Experience Questionnaire-Researcher, UEQ, User Experience Questionnaire

Table 2. Technologies and Purpose of Tele-rehabilitation

Study	Technology of Tele-rehabilitation	Other Technologies Involved	Purposes of Tele-rehabilitation	Results of Tele-rehabilitation Intervention	Quality appraisal score*
Arighi et al. (2021)	Video call using Microsoft team If failed, phone call	Sending Microsoft Teams and contacting participants via mail and phone calls	To monitor and provide dementia-specific care	This study reported that the successful tele-visits rate was 68.5%, and failed tele-visits rate was 31.5%. Successful tele-visits for patients with young carers was 80%, and for patients with the same generation and young carers was 95%. Among patients with young carers, tele-visit without the presence of young carer successful tele-visit was 49%, with the presence of young carer successful tele-visit was 86%. The presence of a carer of young carer significantly influenced tele-visit success ($p < 0.001$, OR 5.14, confidence interval 1.98–13.38).	2
Benaque et al. (2020)	Video-conference platforms (WhatsApp, Skype, Teams, Facetime) If impossible, over the phones	None.	To monitor and provide dementia-specific care	Among scheduled visits, 71% were video-conferencing, and 29% were telephone calls. Videoconferences were conducted using WhatsApp (86%), Skype (12%) and Facetime (2%). 75% of tele-visits were equal to or better than face-to-face consultations (perception of health professionals). After week 16, 78% of the planned tele-visits were conducted.	1
Brandão (2021), Brazil	Zoom sessions	WhatsApp groups for sending reminders WhatsApp video for conducting sessions in the first month and calling the participants regularly	To provide supportive care for people with dementia	Family members supported the participants during sessions. Pets also participated, which was a fun activity. Home utensils were also used and it engaged the participants in meaningful social sensory experiences. A virtual mate circle was included in the sessions and it offered a virtual hot tea drink for the participants. Sensory challenges for digital inclusion included hearing difficulties, positioning the tablet correctly,	4



				<p>and difficulties in learning to activate the microphone and camera to troubleshoot technological problems.</p> <p>Cognitive challenges for digital inclusion were related to memory and executive difficulties (forgot meetings and did not check messages).</p> <p>Participants perceived the program as supportive. Feelings of belonging, feelings of connectedness and perceived learning were achieved.</p> <p>Playful Living program was feasible in terms of recruitment, retention, attrition, and acceptability for Brazilian older adults with and without stroke and dementia induced cognitive impairments.</p>	
Capozzo et al. (2020)	Patients refused video. Therefore, telephone-based assessment was conducted	The evaluation survey via email or WhatsApp	To monitor and provide dementia-specific care	<p>88% of respondents were satisfied with the clinical interview made by the neurologist. 90% of them expressed their willingness to continue tele-consultation. 88% were reported about saving money by avoiding travelling.</p> <p>Significant worsening was reported in behaviour (56% of respondents), language (47%), cognitive functions (53%), sleep disturbances (25%), and swallowing problems (9%) than the previous visit. A mild worsening of bradykinesia and limb rigidity was reported by 32% of participants than the previous visit.</p> <p>Among the participants, no significant worsening since was reported for nutritional or respiratory changes than the previous evaluation</p>	1
Di Lorito et al. (2021)	A video-calling platform using computers, tablets or smartphones	Inviting the participants to the intervention; and evaluating the intervention outcome via phone call, email, video calling	To provide supportive care for people with dementia	<p>During the tele-interviews, the informants of the study revealed their perceptions and experiences over the exercise program as follows.</p> <p>The presence of a caregiver in a home is a key to face potential risks of exercises. Video sessions enhance rapport and connectedness and allow to identify non-verbal cues. During the video session,</p>	5



				the therapist did exercises with the client, therefore, the therapist became a modal. Video sessions allow the therapist to facilitate progress and assess the improvement. It became a motivation for the care receiver. Video sessions are not valuable as face-to-face sessions due to not having a meaningful human connection. Video sessions are not familiar or not easy to learn for older people than the younger generation.	
Dura-Perez et al. (2022)	Telephone	None	To monitor and provide dementia-specific care To control COVID-19 infection To provide supportive care for people with dementia	The pandemic did not significantly impact cognition, quality of life, or mood. The impact of perceived stress was in a moderate level.	3



<p>Gareri et al. (2022)</p>	<p>Telephone-based video call (WhatsApp or Face-Time or, Skype)</p>	<p>Use of iPad or laptop</p>	<p>To monitor and provide dementia-specific care To control COVID-19 infection</p>	<p>Slightly worsening in activities in daily living, cognition, and the quality of life. Behavioural changes (24.4%), with new-onset or worsening of anxiety and insomnia (17.7%) Alzheimer's dementia presented a greater worsening of the quality of life Vascular dementia demonstrated a significant loss in instrumental activities in daily life</p>	<p>3</p>
<p>Goodman-Casanova et al. (2020)</p>	<p>Television-based assistive integrated technology (memory game, video visualization/ video calls)</p>	<p>Telephone base evaluations</p>	<p>To monitor and provide dementia-specific care To control COVID-19 infection To provide supportive care for people with dementia</p>	<p>Intervention respondents performed more memory exercises than control respondents [52% (n=24) vs 17.4% (n=8); P<.001]. Intervention group respondents kept pets and plants lower than control group [4% (n=2) vs 22% (n=10); p=0.01]. There were no significant differences between the intervention and control groups in variables associated with COVID-19 (knowledge of COVID-19 situation, health services and social services). There were no differences in health management, mental health, well-being, or sleeping problems between the intervention group and the control group.</p>	<p>2</p>
<p>Lai et al. (2020)</p>	<p>Experimental group: telephone and video communication apps (Zoom, WhatsApp, or Facetime via mobile device)</p>	<p>None</p>	<p>To monitor and provide dementia-specific care</p>	<p>Intervention group (video-conferencing) reported higher and largely stable cognitive functioning (in MoCA) than the control group (telephone only). MoCA scores was significantly higher in the intervention group at study's end [MoCA: F(1,58) = 17.97, p <0.001, $\eta^2 = 0.24$].</p>	<p>2</p>



	Both experiment and control group: telephone		To provide supportive care	<p>Memory and Behavior Problem changes were not reported following the intervention.</p> <p>The intervention group did not show a falling trend in QoL, which was observed in the control group. The intervention group enjoyed a higher QoL than the control group. QoL-AD scores were significantly higher in the intervention group at study's end [QoL-AD: $F(1,58) = 5.54, p < 0.05, \eta^2 = 0.09$]. However, controlling baseline difference had rendered the post-test group difference in QoL-AD no longer significant [$F(1,57) = 2.44, p = 0.12, \eta^2 = 0.04$].</p> <p>A high proportion (16 of 17) of care recipients with "pre-NCD" MoCA scores in the control group had attained the MoCA criterion for mild NCD in the study period. This trend was not seen in the intervention group.</p> <p>Concerning the interaction between care recipient and carer, an association of moderate effect size was detected in the intervention group (measured based on study outcomes), but not in the control group.</p>	
Lai et al. (2022)	Digitally delivered, synchronous distance teaching class: experimental group Telephone-based teaching: control group	Online survey (mode not reported)	To provide supportive care	<p>The tele-health intervention program significantly increased the well-being of the participants. The participants in the experimental group had a significantly higher NPI intensity score than those in the control group.</p> <p>The mean scores of the NPI intensity decreased in the experimental group either an upward or an invariable trend in the control group.</p>	2
Lima et al. (2021)	Hybrid-face robotic system	None	To provide supportive care	<p>Regarding the pilot testing with 1 person of dementia, in all three sessions, the participant (n=1) rated mood as "very happy" on the pre and post measures of the face scale before and after each</p>	2



				session. The duration of engagement with the robot from session 1 (9 min 35 s) to session 3 (18 min 1 s) was longer. The participant had no difficulty talking to the robot. The participant was never disruptive during any of the sessions.	
Panerai et al. (2021)	Telephone	None	To monitor and provide dementia-specific care	Comparison of differences in pretest-posttest scores for the experiment group compared with control groups revealed that there was a significant decrease of NPI-Q (medium effect size for frequency and large effect size for severity) and both depression scales (CSDD and HAM-D) (a large effect sizes). Furthermore, there was a significant increase of MMSE (a large effect size) in the experimental group than in the control group. Within group pretest–posttest comparisons, there was a significant improvement in the experimental group with a large effect size for depression (HAM-D, $z = 2.98$, $p = .0028$, $r = .80$), neuropsychiatric symptoms (NPI-Q Frequency, $z = 2.52$, $p = .011$, $r = .67$; NPI-Q Severity, $z = 2.80$, $p = .005$, $r = .75$), and cognition (MMSE, $z = 3.23$, $p = .0012$, $r = .86$). No significant differences were found in the control group for any of the measures.	4
Vellani et al (2022)	Microsoft Teams	None	To monitor and provide dementia-specific care	All participants reported the program as acceptable (TEI, 54.7 ± 8.9) They rated the video and sound quality as high and experienced minimum lags in the video Older adults who lived with their trusted individuals were more likely to find the intervention acceptable compared to those who did not live with their trusted individuals ($t = 3.559$, $p = 0.001$, $\beta = 0.323$) This study was the first opportunity to participate in advance care planning. They learnt what to expect with the progression of dementia and how to prepare for it.	3



				<p>They had a chance to clarify their own thoughts about future care when the person with dementia is terminally ill or in a vegetative state and unable to speak for themselves</p> <p>Participants' opinions on videoconferencing were predominantly positive: it saved their time and cost during the COVID-19</p>	
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Notes: * using MMAT, Mixed Methods Appraisal Tool (total scores: 5)