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Social assistive robots and intelligent environments in psychological well-being in the elderly: a systematic review

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Título: Robots de asistencia social y entornos inteligentes en el bienestar psicológico de las personas mayores: una revisión sistemática.

Resumen: Los avances de los últimos años han llevado al desarrollo de robots sociales asistenciales y entornos inteligentes en viviendas asistidas centrados en la prevención y promoción de la salud de las personas mayores, aunque es necesario explorar su evidencia. Por ello, proponemos una revisión sistemática -método PRISMA-, examinando 802 estudios realizados desde enero de 2019 a septiembre de 2024 con el objetivo de analizar la eficacia en distintas variables psicológicas en personas mayores, con o sin diagnóstico de trastorno mental, que residan en una vivienda independiente o residencia comunitaria, tanto solas como acompañadas, de la intervención con robots sociales asistenciales y entornos de asistencia para la vida diaria. Tras aplicar los criterios de inclusión y exclusión, se seleccionaron 12 estudios. El uso de los dispositivos tecnológicos se contextualizó en diferentes ámbitos de intervención (social, promoción de la autonomía, hábitos saludables, emocional, tratamiento médico-psicológico o seguimiento del estado de salud, adherencia a la medicación y área cognitiva). Se encontró una reducción de los síntomas depresivos y ansiosos, así como una mejora en la calidad de vida, área social, adherencia al tratamiento, sueño y autonomía. La mayoría de investigaciones eran europeas y estadounidenses consistentes en estudios experimentales y cuasiexperimentales. El uso de robots de sociales asistenciales y entornos inteligentes son herramientas prometedoras para promover el bienestar psicológico y la calidad de vida de las personas mayores, aunque la evidencia hallada es limitada y variada.

Palabras clave: Robots sociales asistenciales. Autonomía. Personas mayores. Entornos inteligentes. Bienestar psicológico. Calidad de vida.

Abstract: Recent advances have led to the development of assistive social robots and intelligent environments in assisted living facilities focused on prevention and promotion of health in the elderly and it is essential to explore the supporting evidence for these innovations. Consequently, we carried out a systematic review -PRISMA method-, examining 802 studies published between January 2019 and September 2024. We aimed to analyze the effectiveness of intervention with assistive social robots and assistive environments for daily living on various psychological variables in older people regardless of diagnosis of a mental disorder or were residing in an independent home or community residence, either alone or accompanied. After applying the inclusion and exclusion criteria, 12 studies were selected. The use of the technological devices was contextualized in different areas of intervention (social, promotion of autonomy, healthy habits, emotional, medical/psychological treatment or monitoring of health status, adherence to medication and cognitive area). A reduction in depressive and anxious symptoms was found, as well as an improvement in quality of life, social area, adherence to treatment, sleep, and autonomy. Most research proceeded from European countries and the US and consisted of experimental and quasi-experimental designs. The use of social care robots and smart environments are promising tools to promote psychological well-being and quality of life in the elderly.

Keywords: Assistive social robots. Autonomy. Elderly people. Intelligent environments. Psychological well-being. Quality of life.

Introduction

Population aging is a worldwide occurrence. It is expected that by 2050 the number of people over the age of 65 will be more than 1.5 billion, over double the estimated older population in 2020 (Office C, 2023). In Europe, in 2020 the percentage of people over 65 years of age was 34.8%, and it is envisaged that in 2050 it will represent 50.7% of the population (European Union, 2021). according to the INE projection (2023-2040), in Spain, Pérez Díaz et al. (2023) reported that in 2040 there will be more than 14.2 million elderly people, representing 27.4% of the total population. This increase will continue both in average age and proportion, especially from 2030 onwards; then the greatest increases will be registered, when the aging of cohorts corresponding to the baby boom phenomenon will take place. In fact, the population of octogenarians currently represents 6% of the Spanish population. Furthermore, according to statistical data from the Continuous Register (INE), in 2022 the elderly represented 19.97% of the Spanish population and the average age of the population was 44.08 years (42.76 years for men and 45.35 for women) when in 1970 it was 32.7, increasing unabated throughout the 20th century (Pérez Díaz et al., 2023).

The trend towards an aging population therefore poses political, health, economic and social challenges in terms of individuals with a higher risk of dependence and use of health, social and care resources (Ribeiro et al., 2022). This is because the rise in life expectancy implies a higher risk of chronic diseases and, therefore, associated disabilities such as mobility problems, cognitive diseases such as dementia or Alzheimer's, injuries caused by falls, vision loss, hearing difficulties, etc. For instance, according to the Global Dementia Observatory (WHO, 2021), it is projected that by the year 2030, the number of individuals affected by dementia will reach 78 million, and by 2050, this figure may increase to 139 million. This would therefore mean a cost of 2.8 trillion by 2030, which together with the severity of dementia may result in the need to significantly increase social, economic and health resources to respond to the care of the elderly.

Advances in recent years in areas such as artificial intelligence and technology have led to the emergence of a wide range of applications and technological devices that can facil-

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itate multiple tasks for people, thus improving their quality of life and ability to interact with their environment. (Gursoy & Cai, 2025; Jiang et al., 2022; Vishwakarma et al., 2025). Specifically, González-González et al. (2021) indicated that the scientific community has increasingly focused on the application of these technologies in healthcare, recognizing their potential to enhance the quality of care and improve intervention procedures. One particular population group that has received significant research attention is the elderly, aiming to enhance their quality of life and foster their independence. In this context, one area of research that has been developed involves Ambient Assisted Living (AAL). According to Cruces et al. (2024), these devices consist of a network of sensors installed within an individual's home, which are integrated with various technologies to facilitate the monitoring of the user's health status and location. This integration enables the detection of critical events, such as falls or emergencies. Such devices play a vital role in enhancing the safety and independence of elderly individuals while simultaneously alleviating the demands placed on caregivers and healthcare professionals. Furthermore, they support the implementation of therapeutic strategies designed to enhance cognitive function, promote social interaction, and encourage healthy lifestyle practices.

Similarly, assistive social robots have been developed to represent a social entity and therefore possess the ability to establish social interactions (Kachouie et al., 2014) thus the Social Assistive Robot (SAR) can be considered an AAL interface which enables interaction and development of activities with the user to support independent living, as well as implementation of intervention strategies aimed at cognitive stimulation, social interaction, treatment adherence, emotional management and healthy habits. In this context, Lee et al. (2024) emphasize that SAR can provide emotional support and companionship, decrease loneliness and depression, as well as reduce stress and anxiety in elderly people who are isolated or live alone in their homes.

The boom in technological development has been reflected through the increasing number of systematic reviews that address the characteristics of these platforms, their functionalities and impact on users (Mohan et al., 2024). Addressing such a complex topic, which evolves rapidly due to technological and societal changes, requires a well-structured and systematic organization of the knowledge base produced by the scientific community. In this regard, reviewing recent literature serves as a valuable method to assess the current state of research and to delineate the future direction of inquiry (Choi et al., 2025; Huq et al., 2024). Nevertheless, Nichol et al. (2024) discovered through a meta-analysis that there is a limited number of empirical studies examining the effectiveness of assistive social robots, along with generally weak evidence regarding their influence on behavioral aspects. Furthermore, they emphasize the need for enhanced accuracy in reporting of these studies, which hinders evaluation of the impact of social care robots.

The therapeutic effectiveness of assistive robots remains a topic of debate among researchers. Gonzalez-Gonzalez et al. (2021) and Khosravi & Ghapanchi (2016) found that social robots can improve independent living, alleviate depression and social isolation in elderly people. However, Nichol et al. (2024) claim that despite promising evidence suggesting that the robot can promote social interaction, improve mood, positive affect and may have a positive impact on feelings of loneliness and stress, their meta-analysis yields low evidence regarding impact on depression, anxiety, apathy, sleep, medication use, activity level, neuropsychiatric symptoms and quality of life in older adults with and without dementia. Similarly, Macdonald et al. (2024) concluded that the use of social assistive technologies such as videoconferencing in nursing home residents, can enhance the perception of well-being, but there is insufficient empirical support claims regarding their effectiveness in addressing depression and loneliness.

It is essential to explore the evidence on the effectiveness of social robots in assisted living environments for prevention and promotion of health among the elderly. This exploration aims to establish recommendations for future research and practical applications that can improve the quality of life and psychological well-being of older adults (Nichol et al, 2024).

Given the existing scientific literature on social care robots and assisted living environments, this review seeks to analyze their efficacy on various psychological variables in elderly people, regardless of whether they have a mental disorder diagnosis, live in an independent home or community residence, either alone or accompanied, while taking into account the methodological quality of the studies reviewed .

1. Specifically, this review addresses analysis of the following aspects: To examine the main descriptive characteristics of the selected studies (country origin, design, financing and sample), as well as of intervention (duration, location, evaluation instruments and results).
2. To analyze therapeutic strategies employed through technological devices to promote various areas of intervention (treatment adherence, autonomy, cognitive and social functioning, and psychological well-being).
3. To study evidence on the efficacy of intervention in various areas (treatment adherence, autonomy, cognitive and social functioning, psychological well-being, and overall quality of life.

The hypotheses related to the above specific objectives are as follows:

H1: The main characteristics of the selected studies, such as country of origin, design, funding, and sample composition, as well as key aspects of interventions, such as their design, location, evaluation tools, and outcomes, will vary considerably between investigations. These variations may affect the applicability and comparability of findings regarding the use of technology to improve the health of older adults.

H2: Therapeutic strategies based on technological devices will be designed to improve key areas such as treatment adherence, autonomy, cognitive and social functioning, and psychological well-being, consequently their effectiveness may depend on factors such as accessibility of technology use, level of user engagement, and therapeutic approach.

H3: Technological interventions are expected to prove effective in improving treatment adherence, autonomy, cognitive and social functioning, psychological well-being and quality of life among older adults. However, their impact may vary according to methodological quality, type of intervention and individual characteristics of participants

Methods

Analysis of the impact of Socially Assistive Robots (SAR) and/or Ambient Assistive Living (AAL) on the psychological well-being of older people was conducted by means of a systematic review following the PRISMA criteria (Page et al., 2021).

Search procedures

The search for studies was conducted in September 2024 across five databases: Cochrane Library Plus, Web of Science, Scopus, ProQuest Central, and EBSCOhost (includes AgeLine, APA PsycArticles, APA PsycInfo, Eric, Medline, Psychology and Behavioral Sciences Collection). The keywords used in the above databases were (elderly) AND ("ambient assisted living" OR "socially assistive robots") AND ("psychological well-being" OR "mental health" OR "cognitive impairment" OR "health prevention" OR "independent living" OR "quality of life" OR efficacy OR effectiveness OR "empirical study") NOT (review OR meta-analysis OR "systematic review").

In addition, further search criteria were applied in all databases to obtain more comprehensive results according to the objectives of the study. Specifically, the publication date between January 2019 and September 2024, the academic or scientific nature of publications, available in full text and written in English. The criterion of participants over 65 years of age was also introduced.

Variable coding

Inclusion criteria to ensure selection of studies related to the objectives of the review were as follows:

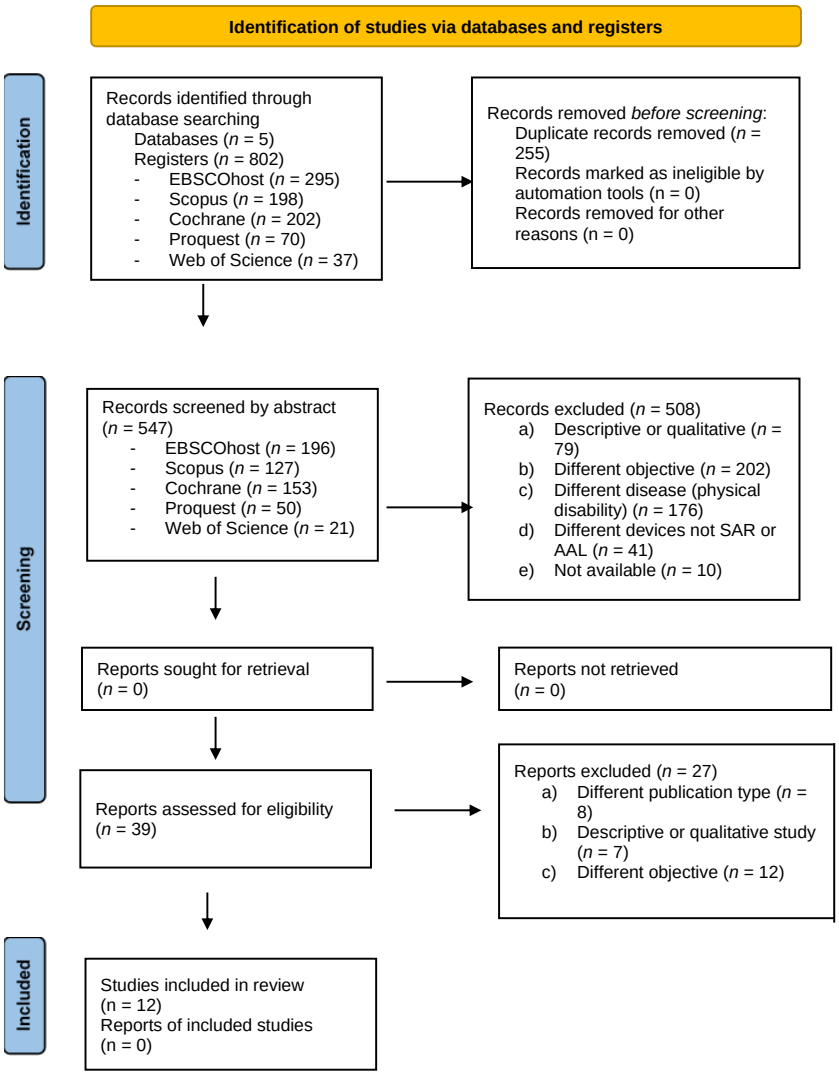
(1) Publication date from January 2019 to September 2024.
(2) Written in English.
(3) Age of participants over 65 years old.
(4) Academic publications or scientific articles.
(5) Use of SAR and/or AAL.
(6) Quantitative measurement of psychological variables (psychological well-being, depression, anxiety, loneliness, social interaction, quality of life, cognitive skills).
(7) Intervention site where SAR and/or AAL is employed in housing or re-housing.
(8) Participants live alone or accompanied by immediate family members or others.
(9) Participants are elderly, informal caregivers or health professionals.
(10) Intervention targets participants both without cognitive impairment or mental disorder, and with cognitive impairment and mental disorder.

Similarly, the exclusion criteria were as follows:

(11) Systematic reviews or meta-analysis.
(12) Descriptive, theoretical or qualitative studies.
(13) Book chapters, letters to the editor, and conference publications.
(14) Articles not available in full text.
(15) Publications in a language other than English.
(16) Use of technological devices or intervention programs not integrated into SAR and/or AAL, such as mobile applications, telecare, fitness coaching.
(17) Evaluation of psychological measures other than those described (participant satisfaction or interaction with SAR and/or AAL).
(18) Use of technological devices in other types of diseases or physical disabilities.

The process of study selection, data extraction, and data synthesis is described below (Figure 1).

Figure 1
PRISMA flow chart



Study selection criteria

In the initial database search, a total of 802 studies were identified, with 255 removed due to duplication. The selection process for the remaining studies (*n*=547) commenced with an evaluation of titles and abstracts based on predetermined criteria. Subsequently, a thorough examination of the full texts was conducted (*n*=39), leading to exclusion of studies that focused on variables unrelated to the primary research objective, such as device usability or non-scientific publications like theoretical contributions or project descriptions. 12 articles were finally selected for inclusion.

Data extraction was conducted in accordance with the Cochrane guidelines (Pollock et al., 2020) and adapted to meet the specific objectives of the review. In particular, data was collected on the following elements: research design, sample characteristics and size, features of the technological devices, psychological intervention areas, therapeutic intervention strategies, duration and location of intervention, along with evaluation instruments and statistical results obtained.

To analyze the methodological quality of the selected studies, we used the PEDro scale (Verhagen et al., 1998) using the following items: (1) inclusion of selection criteria, (2) random assignment, (3) concealed assignment, (4) group homogeneity s, (5) blinded subjects, (6) blinded therapists, (7) blinded evaluators, (8) initial sample, (9) results of complete sample, (10) analysis of comparison between groups, (11) point and variability measures. Table 1 shows compliance with items for each study. Thus, it is observed that

three studies (Balasubramanian et al., 2021; Gosetto et al., 2024; Lee et al., 2024) had a low methodological quality (score between 0-4), likewise five studies were found (Assander et al., 2022; Boatman et al., 2020; Parker et al, 2021; Pino et al., 2020; Tseng and Hsu 2019) that possessed moderate methodological quality (score between 5-6) and four studies (Bradwell et al., 2022; Papadopoulos et al., 2022; Pollak et al., 2022; Taramasco et al., 2023) that possessed good quality (score between 7-8).

Table 1
Results obtained in the PEDro Scale.

Article	Selection criteria	Random assignment	Hidden assignment	Homogeneity of groups	Subjects blinded	Blinded therapists	Blinded evaluators	Measurements over 85% sample	Results of all participants	Statistical comparison between groups	Point and variability measures	Over all score
Tseng & Hsu (2019)	1	0	0	1	0	0	0	1	1	1	1	5
Boatman et al. (2020)	1	0	0	1	0	0	0	1	1	1	1	5
Pino et al. (2020)	1	0	0	1	0	0	0	1	1	1	1	5
Balasubramanian et al. (2021)	1	0	0	0	0	0	0	0	1	1	0	2
Assander et al. (2022)	1	0	0	1	0	0	0	1	1	1	1	5
Bradwell et al. (2022)	1	1	1	1	0	0	0	1	1	1	1	7
Papadopoulos et al. (2022)	1	1	1	0	1	0	0	1	1	1	1	7
Parker et al. (2022)	1	0	0	1	0	0	0	1	1	1	1	5
Pollak et al. (2022)	1	1	1	1	0	0	0	1	1	1	1	7
Taramasco et al. (2023)	1	1	1	0	0	0	1	1	1	1	1	7
Gosetto et al. (2024)	0	0	0	0	0	0	0	1	1	0	0	2
Lee et al. (2024)	1	0	0	0	0	0	0	1	1	1	1	4

All studies except Gosetto et al. (2024) described the selection criteria of the research participants, while four performed random and concealed assignment to each research group (Bradwell et al., 2022; Papadopoulos et al., 2022; Pollak et al., 2022; Taramasco et al., 2023). In addition, seven studies reported that groups were homogeneous as regards sociodemographic characteristics and the main study variables (Assander et al., 2022; Boatman et al., 2020; Bradwell et al., 2022; Parker et al., 2021; Pino et al., 2020; Pollak et al., 2022; Tseng and Hsu, 2019). We found that only Papadopoulos et al. (2022) included blinded raters who were unaware of participant assignment and only Taramasco et al. (2023) conducted the intervention with blinded participants. No study included blinded therapists. As for results analysis, all studies, apart from Gosetto et al. (2024), reported point and variability measures of the studied variables, along with statistical analyses between groups. In addition, all studies collected results obtained from the entire sample and included data from more than 85% of initial participants.

Results

In response to objective 1, Appendix 1 presents the main data collected from the studies included in this review. Thus, we can appreciate that publication dates of articles were between January 2019 and September 2024, proceeded from North America (n = 4), Europe (n = 5), South America (n = 1), and Asia (n = 2).

As for financing of studies, it five received public financing, four were funded through public-private financing and two were supported by private financing. The study conducted by Pino et al. (2020) did not disclose this information. In no instance was there mention of potential conflicts of interest concerning research, authorship, or publication of the study.

Among the 12 studies analyzed, one presented a longitudinal non-experimental methodology (Boatman et al., 2020), seven studies were classified as purely experimental, as participants were randomly assigned to the experimental conditions (Bradwell et al., 2022; Gosetto et al., 2024; Papadopoulos et al., 2022; Parker et al., 2021; Pino et al., 2020; Pollak et al., 2022; Taramasco et al., 2023), while the remainder were

quasi-experimental studies since the design included one or two groups without random participant assignment to the different experimental conditions, or by having several experimental conditions (or groups where participant assignment was not randomized (Assander et al., 2022; Balasubramanian et al., 2021; Lee et al., 2024; Tseng & Hsu, 2019).

All studies included participants over 65 years of age, three included family caregivers while two included health professionals. In total, the sample consisted of 560 participants, of whom 20 were family caregivers and 21 health professionals. The mean age of the elderly participants was 78.31 years ranging from 65 years to 98 years, of which 73.64% were women. Marital status data was collected in only three studies, with 162 being single, separated or widowed.

In terms of the location of the intervention, eight studies were conducted in the participants' homes, (n = 395). Among these, five studies indicated that participants lived alone (n = 173), representing 43.8% of the eight studies. While three studies were conducted in residential settings (n = 103) of which 32.03% (n = 33) utilized the facilities in their own rooms for individual purposes. The study by Pino et al. (2020) was unique in that it employed the device in a neuropsychological rehabilitation center, in a group format under the supervision of a neuropsychologist

As regards the social area, two studies reported on the social interaction of the participants stating that 20 engaged in weekly communication with family members, while 47 individuals received home care services.

The clinical conditions of participants were detailed in nine studies, revealing diagnoses that included depression (n = 12), chronic illness (n = 106), mild-moderate cognitive impairment (n=99), and no clinically significant impairment (n = 17).

With regard to the characteristics of the technological devices, Appendix 2 illustrates that two studies used a humanoid-shaped robot, three simulated companion animals such as dogs or cats and even in the form of a doll, two studies used a tablet, and five integrated various types of technology such as sensors and interaction devices. The duration of the intervention ranged from a minimum of 1 week to a maximum of 26 months, although three studies were conducted over 1 and 4 weeks, eight between 2 and 4 months, and one study for 26 months.

The evaluation instruments employed in studies include various assessment tools, particularly validated scales that measure life quality, life satisfaction, loneliness, depression, anxiety, and overall health status. Additionally, semi-structured interviews were carried out with elderly participants. Notably, only four studies incorporated surveys to assess usability or level of competence with the device (Gosetto et al., 2024; Papadopoulos et al., 2022; Pino et al., 2020; Pollak et al., 2022). Certain studies utilized scales designed for family members or caregivers, as seen in the works of Bradwell et al. (2022) and Parker et al. (2022).

In relation to objective 2, Table 2 illustrates that the application of technological devices identified in the studies reviewed was contextualized in different intervention areas: social area (six studies), promotion of autonomy (six studies), healthy habits (four studies), emotional domain (four studies), medical/psychological treatment or health status monitoring (three studies), medication adherence (two studies), and cognitive area (two studies).

Table 2
Therapeutic strategies employed in each intervention area

Areas of intervention	Therapeutic strategies	Devices
Medication adherence	Medication schedule reminders	Hyodol (Lee et al., 2024)
	Personalized recommendations from health professionals	H2HCare (Gosetto et al., 2024)
Treatment or monitoring of health status	Medical appointment reminders	SCIS (Tseng & Hsu, 2019)
	Monitoring of health parameters (weight, blood pressure, heart rate, rest time)	Quida Platform (Taramasco et al., 2023)
		H2H Care (Gosetto et al., 2024)
	Notice for abnormal parameters or fall detection	
	Visualization of data from informal caregivers and healthcare professionals	
Emotional area	Pleasurable activities (listening to the radio or music, watching videos, jokes, riddles, games) guided meditation and relaxation	Hyodol (Lee et al., 2024)
		ASSIST 1.0 Program (Assander et al., 2022)
		Robot CARESSES (Papadopoulos et al., 2022)
		Alexa Echo 8 (Balasubramanian et al., 2021)
Social area	Contact with family and friends through messages, calls, or video calls	Hyodol (Lee et al., 2024)
		SCIS (Tseng & Hsu, 2019)
	Informal caregivers receive information about activity and health parameters	Robot CARESSES (Papadopoulos et al., 2022)
		JfA (Bradwell et al., 2022)
	Companionship or emotional bond with a robot (for example, the robot responds to caresses, hugs, and movement)	Ageless Innovation (Pollak et al., 2022),
		Alexa Echo 8 (Balasubramanian et al., 2021)
	Talking to a robot	

Areas of intervention	Therapeutic strategies	Devices
Autonomy	Reminders for daily life activities Monitoring activities of daily living (information for professional or caregiver) Visual maps	Hyodol (Lee et al., 2024) Visual maps Software Program ASSIST 1.O (Assander et al., 2022) Quida Platform (Taramasco et al., 2023) MapHabit (Parker et al., 2022) Alexa Echo 8 (Balasubramanian et al., 2021)
Cognitive	Cognitive stimulation Memory training program	Hyodol (Lee et al., 2024) NAO (Pino et al., 2020)
Healthy habits	Feeding and sleep reminders Exercise, healthy recipes, detection of sedentary lifestyle Facilitate sleep through music or sound, monitor sleep pattern and activity during the night	Hyodol (Lee et al., 2024) Quida Platform (Taramasco et al., 2023) H2HCare (Gosetto et al., 2024) Alexa Echo 8 (Balasubramanian et al., 2021)

As regards objective 3, Table 3 presents an analysis of the effect of technological devices on the psychological well-being and quality of life of older adults based on the areas of assessment and evidence obtained. A statistically significant reduction in depressive symptoms was found in two of the four studies ($p < .05$), as well as a reduction in anxious symptoms in one of the four studies ($p < .001$). Loneliness decreased non-significantly in one of the three studies. As for quality of life, three of five studies analyzed showed a statistically significant improvement ($p < .03$). In the social domain, a statistically significant improvement was found in two of four studies, specifically regarding increased interaction between parents and children and emotional support related to the use of SCIS (Tseng & Hsu, 2019) ($p < .001$) as well as a notable rise in in positive expressions associated with the use of NAO (Pino et al., 2020) ($p < .05$). Likewise, improvements in emotional well-being and health perception were noted in one of two studies ($p = .019$ and $p < .03$, respectively). In the cognitive domain, one of three studies found a significant improvement ($p < .006$), and caregiver burden was significantly reduced in one study ($p < .05$). Treatment adherence was evaluated in a study that reported significant improvements ($p < .001$). No statistically significant changes were observed regarding sleep and autonomy.

Table 3
Main findings of the investigations based on the evaluation areas and the evidence obtained

Evaluation areas	Studies	Evidence
Depression	Hyodol (Lee et al., 2024), visual maps (Boatman et al., 2020), JfA (Bradwell et al., 2022), Ageless Innovation (Pollak et al., 2022)	Hyodol and JfA decrease significatively ($p < .05$)
Anxiety	Visual maps (Boatman et al., 2020), ASSIST 1.0 (Assander et al., 2022), NAO (Pino et al., 2020), JfA (Bradwell et al., 2022)	JfA decreases significatively ($p < .001$)
Solitude	Hyodol (Lee et al., 2024), CARESSES (Papadopoulos et al., 2022), JfA (Bradwell et al., 2022)	CARESSES slight and no significant reduction
Adherence to treatment	Hyodol (Lee et al., 2024)	Significant improvement ($p < .001$)
Autonomy	Hyodol (Lee et al., 2024), ASSIST 1.0 (Assander et al., 2022), H2HCare (Gosetto et al.,2024)	No significant improvements
Quality of life	Visual maps (Boatman et al., 2020), ASSIST 1.0 (Assander et al., 2022), Quida Platform (Taramasco et al., 2023), H2HCare (Gosetto et al., 2024), MapHabit (Parker et al., 2022)	Visual maps, Quida Platform, MapHabit with significant improvements ($p < .03$)
Cognitive	Visual maps (Boatman et al., 2020), NAO (Pino et al., 2020), Ageless Innovation (Pollak et al., 2022)	NAO significat improvement in memory, attention, and verbal fluency ($p < .006$)
Social	SCIS (Tseng & Hsu, 2019), NAO (Pino et al., 2020), JfA (Bradwell et al., 2022), Ageless Innovation (Pollak et al., 2022)	SCIS shows significant improvement ($p < .001$) in parent-child interaction and emotional support. NAO achieves significantly higher frequency ($p < .05$) of positive expressions with robot than with therapist
Dream	Visual maps (Boatman et al., 2020)	No significant changes
Personal satisfaction or emotional well-being, self-efficacy	ASSIST 1.0 (Assander et al., 2022), CARESSES (Papadopoulos et al., 2022)	CARESSES: significant improvement in emotional well-being ($p = .019$)
Health perception	ASSIST 1.0 (Assander et al., 2022), H2HCare (Gosetto et al., 2024)	ASSIST 1.0: Significant ($p < .03$). H2HCare: No significant
Caregiver burden	MapHabit (Parker et al., 2022)	Significant improvement ($p < .05$)

Discussion

The main goal was to evaluate the efficacy of interventions based on technological devices on several psychological variables in elderly people, regardless of whether they had a diagnosis of mental disorder, lived independently or in a community setting, alone or accompanied, while considering the quality of the studies. Considering the scientific literature on assistive social robots and daily living assistance environments, this review aimed to analyze their effectiveness on various psychological variables in older adults, both with or without a mental disorder diagnosis, residing in an independent home or community facilities, either alone or accompanied, considering their methodological quality. From an initial pool of 802 studies, after applying inclusion and exclusion criteria, 12 studies published between January 2019 and September 2024 were the subject of this review.

As regards hypothesis 1, studies mainly proceeded from Europe and North America, with fewer from South America and Asia. Most studies received public funding, public-private, or from private sources, with the exception of research conducted by Pino et al. (2020), which did not disclose this information

In terms of the methodological design employed, it is noteworthy that all studies adopted experimental methodology (Bradwell et al., 2022; Gosetto et al., 2024; Papadopoulos et al., 2022; Parker et al., 2022; Pino et al., 2020; Pollak et al., 2022; Taramasco et al., 2023), or quasi-experimental (Assander et al., 2022; Balasubramanian et al., 2021; Lee et al., 2024; Tseng and Hsu, 2019), except for one which was non-experimental of a longitudinal type (Boatman et al., 2020), including participants over 65 years old. The total sample comprised 560 participants, of which 20 were family caregivers and 21 healthcare professionals. The predominant medical conditions among participants were chronic diseases, cognitive impairment, or depression. Most interventions were conducted in the participants' homes, with 43.8% living alone while the remainder were in community health centers such as residences or rehabilitation centers. Although the duration of the intervention ranged from one week to 26 months, most studies were conducted over a period of between 2 and 4 months.

Most studies used assessment instruments such as validated scales on quality of life, life satisfaction, loneliness, depression, anxiety, general health status, or the use of semi-structured interviews with the elderly to evaluate the effect of the intervention or with family members or caregivers. While only four of 12 studies measured the use of surveys on usability or the level of competence with the device (Gosetto et al., 2024; Papadopoulos et al., 2022; Pino et al., 2020; Pollak et al., 2022).

As for characteristics of the technological devices used, there is considerable variability particularly concerning their physical appearance, size, functions, and type of interaction. Most devices are equipped with sensors that detect various behaviors exhibited by the user, along with manual or voice interaction capabilities intended for both the elderly individual and their caregiver or professional. Additionally, some devices featured interaction functions in response to certain situations or behaviors of the participants; for example, JfA (Bradwell et al., 2022) reacted to caresses or hugs, while NAO (Pino et al., 2020) could identify the person it interacted with and remember their name. Similarly, physical characteristics exhibited great variability, ranging from humanoid-type devices, companion animals, screens or tablets, to technological instruments integrated into the furniture and installations of the home.

Concerning hypothesis 2, it is important to highlight that this review addresses intervention areas mainly related to the promotion of autonomy, social interaction, emotional management strategies, and the establishment or monitoring of healthy habits. The therapeutic strategies employed to promote autonomy included the use of reminders for daily life activities, as well as their monitoring, thereby offering an activity pattern observable by both caregiver and professional. Also, the social aspect was addressed from different perspectives; some studies focused on promoting the frequency of social contact through phone or video calls with family and friends (Papadopoulos et al., 2022; Tseng & Hsu, 2019), others on creating an emotional bond through interaction with the robot itself, as in the case of JfA (Bradwell et al., 2022), Ageless (Pollak et al., 2022), and in the case of Hyodol (Lee et al., 2024), which responded to caresses or hugs, and other studies incorporated oral interaction as a therapeutic strategy, such as in Alexa Echo 8 (Balasubramanian et al., 2021).

In the emotional area, primary interventions involved encouraging or reminding individuals to engage in pleasurable activities, relaxation, or guided meditation (Assander et al., 2022; Balasubramanian et al., 2021; Lee et al., 2024; Papadopoulos et al., 2022). Healthy lifestyle practices, mainly related to diet, physical exercise, and sleep, were incorporated through reminders and, in certain instances, with the support of the assistive robot which provided healthy recipes or instructional videos to guide physical exercise (Balasubramanian et al., 2021; Gosetto et al., 2024; Lee et al., 2024; Taramasco et al., 2023). The areas related to medication adherence, medical/psychological treatment, or health status monitoring and cognitive area were incorporated to a lesser extent and primarily employed strategies such as cognitive stimulation, as in the case of NAO (Pino et al., 2020) or in the case of Hyodol (Lee et al., 2024). Medication reminders, health status monitoring accessible by the caregiver or professional, and alerts for potential health risks were also implemented (Gosetto et al., 2024; Lee et al., 2024; Taramasco et al., 2023; Tseng & Hsu, 2019). Consequently, there was a wide range of intervention areas wherein the use of assistive social robots and smart environments offered different lines of intervention with various therapeutic strategies, reflecting a high functional and technical variability among devices used.

As regards hypothesis 3, it is noteworthy that changes in the psychological assessment areas reported following inter-

vention showed that in 50% of the studies (Bradwell et al., 2022; Lee et al., 2024) where depressive symptomatology was measured, a significant improvement was observed, while in those studies assessing anxious symptoms, a significant reduction occurred in 25% of cases (Bradwell et al., 2022). As for loneliness, an improvement was found in 33% of studies (Papadopoulos et al., 2022), though this was not statistically significant. Concerning quality of life, a significant improvement was found in 60% of studies (Boatman et al., 2020; Parker et al., 2022; Taramasco et al., 2023) that analyzed this variable, while 50% of studies found improvements in emotional well-being Papadopoulos et al., 2022), social well-being (Pino et al., 2020; Tseng & Hsu, 2019), and health perception (Assander et al., 2023), while in the cognitive domain, a significant improvement was observed in 33% of studies (Pino et al., 2020). The burden and functions of caregivers were only analyzed in one study, which found a significant reduction (Parker et al., 2022), as well as treatment adherence, which improved significantly in one study (Lee et al., 2024). However, autonomy and sleep quality showed no significant changes in studies which evaluated these variables (Assander et al., 2022; Boatman et al., 2020; Gosetto et al., 2024; Lee et al., 2024).

The observed results appeared to indicate limited empirical evidence that presented some heterogeneity. The improvement in quality of life, emotional and social well-being, health perception, as well as the reduction of depressive symptoms indicated favorable empirical evidence, as found by González-González et al. (2021) and Khosravi & Ghapanchi (2016), while favorable but limited evidence was identified regarding caregiver burden and treatment adherence. However, no consistent data were obtained to support the efficacy of assistive social robots and smart environments on the improvement of autonomy, anxious symptoms, cognitive area, and sleep quality. Conversely, González-González et al. (2021) and Khosravi & Ghapanchi (2016) found that social robots contributed positively to an improvement in autonomy.

There are various factors that may affect results observed in the studies included in this review. First, there is wide variability in the contextual, social, and clinical characteristics of participants, whose medical conditions ranged across a broad spectrum, from chronic diseases like hypertension to neurodegenerative disorders like Parkinson's or in terms of their social context, as only 41.3% of the sample used the device alone. Moreover, the objectives and devices employed in the studies exhibited high heterogeneity. Alexa Echo 8 (Balasubramanian et al., 2021) was capable of executing tasks upon request from the elderly, while Hydol spontaneously and personalized suggested activities and interactions (Lee et al., 2024).

As highlighted by Nichol et al. (2024) regarding the need to improve the accuracy of reports to study the effect of social assistive robots, this review indicates that it would be beneficial for studies to provide a broader description of the intervention in psychological areas, thus facilitating analysis of the effect of variables such as: frequency and duration of device use, frequency and duration of engaging in pleasurable activities or cognitive stimulation. Moreover, it is recommended to control for external variables such as sociodemographic, social, clinical, and psychological characteristics to obtain more precise results on the effectiveness of the assistive technology intervention., In this review, only two studies reported on frequency and type of social interaction maintained during the intervention (Assander et al., 2022; Lee et al., 2024).

Analysis of the methodological quality of the studies in this review revealed significant variability, as some studies achieved moderate or high quality according to the PEDro scale (Bradwell et al., 2022; Papadopoulos et al., 2022; Taramasco et al., 2023; Pollak et al., 2022), while others showed less rigorous designs (Assander et al., 2022; Balasubramanian et al., 2021; Boatman et al., 2020; Gosetto et al., 2024; Lee et al., 2024; Parker et al., 2022; Pino et al., 2020; Tseng & Hsu, 2019), characterized by issues such as lack of blinding of participants, assessors, or therapists, non-randomized allocation of participants, and absence of homogeneity among groups regarding relevant variables for the study. , Few studies included longitudinal measures, which limited understanding of the long-term effects of these interventions. The final number of studies analyzed has been reduced, due to the established inclusion and exclusion criteria, despite finding a substantial body of literature on the subject. This reduction is attributed to the identification of several studies with inadequate methodological quality. Consequently, a limitation of this systematic review is the limited number of studies included, which hampers the ability to generalize results to the broader population. as well as the broad areas of knowledge involved and variability of characteristics (medical conditions, family dynamics, etc.) that determine a small sample size for the study of each treatment.

The usefulness of this research lies in its contribution to systematized knowledge on the effectiveness of assistive social robots and intelligent environments on the psychological health of older adults. Through the synthesis and critical assessment of existing studies, this review enables identification of trends, strengths, and limitations in the available evidence, thereby facilitating data-driven decision making for researchers, technology developers, and healthcare professionals. The design of more effective interventions, improvement of public policies on aging, and optimization of technological development to more effectively address the needs of older adults are three essential characteristics that underscore the usefulness of this research.

Considering these limitations, we suggest that future research should investigate additional variables not addressed in this study. This could include broadening the range of search years, incorporating other databases, analyzing other sociodemographic characteristics such as participants' place of origin or birth, analyzing other psychological traits such as personality. It may also be beneficial to analyze the field or area of expertise of the study authors, etc. In addition, as

highlighted by Nichol et al. (2024), a more in-depth examination of the role of caregivers is essential, given their significant, as role in the intervention with elderly people. Caregivers contribute to daily life activities, provide emotional support, assist in decision-making, and maintain ongoing communication with healthcare resources.

It is essential to reach a consensus on the technological features that assistive social robots and smart environments must possess to improve interventions aimed at enhancing the autonomy and quality of life of older adults. Likewise, it is necessary to delineate the types of therapeutic strategies and intervention characteristics that can provide greater empirical support concerning their effectiveness, based on the personal, emotional, psychological, and social traits of the user. Furthermore, the need to promote interdisciplinary collaboration between technology developers, healthcare professionals, and end users is highlighted to ensure these technological strategies are effective and tailored to the needs and characteristics of older adults. Similarly, research with more rigorous designs and larger samples can yield more precise results on the effectiveness of social assistive robots and smart environments.

Conclusions

In summary, the results of the systematic review suggest that the use of assistive social robots and smart environments hold potential as effective tools to promote psychological well-being and quality of life in older adults, although evidence found is limited and varied. The methodological limitations, diversity in research designs, and small number of empirical studies do not allow for a definitive scientific endorsement, as highlighted by Nichol (2024). Nonetheless these findings lay the groundwork for developing interdisciplinary intervention proposals focused on improving the autonomy and quality of life for older adults.

Complementary information

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Appendix 1.
Main descriptive characteristics of the selected studies by country, design, financing, and sample

Authors	Country	Funding	Conflict of interest	Research design	Participants		Place	Sample characteristics		Clinical characteristics of the sample
					Age	Sample size		Sociodemographic	Social area	
Tseng & Hsu (2019)	Taiwan	Public	No	Cua-si-experimental (pretest and post-test measurements) Older group: SCIC in classroom Children group: SCIC App	Elderly group *M* = 73.33 *SD* = 6.8 Range 68-81 Children group *M* = 45.67 *SD* = 9.5 Range 36-55	*N* = 6 Elderly group (*n* = 3) Children group (*n* = 3)	Home	Elderly group Females *n* = 2 Children group Females *n* = 1 Elderly group (over 65 years old, retired, medium/good socioeconomic level). Children group (Employees)	Live alone (*n* = 1)	Chronic diseases
Boatman et al. (2020)	United States of America	Public/private	No	Non-experimental (non-randomized longitudinal, single-arm, repeated measures)	*M* = 81 *SD* = 8.56 Range 68-92	*N* = 7	Residence	Females (*n* = 5)	N/A	Mild cognitive impairment (*n* = 1) Alzheimer's disease (*n* = 3) Alzheimer's related to dementia (*n* = 3)
Pino et al. (2020)	Italy	N/A	No	Experimental (pretest and posttest measures). G1: common program, voice interaction. G2: two cameras and no automatic switching, voice interaction G3: one more camera, humanized voice, Qi-Chat, patient and name recognition, physical contact interaction	*M* = 73.45 *SD* = 7.71	*N* = 21 3 groups with psychologist	Intervention Center for cognitive disorders and dementia	Females (*n* = 10)	N/A	Mild or moderate cognitive impairment
Balasubramanian et al. (2021)	England	Public	No	Quasi-experimental (two seal groups)	Range 50-90	Patients *n* = 44 Informal caregivers *n* = 7	Home	N/A	N/A	Comorbidity: diabetes (type 1 and 2), dementia, Parkinson's disease, asthma, Behcet's disease, Cushing's syndrome, phenylketonuria, depression, anxiety, dyslexia, cognitive impairment, severe visual impairment, chronic pain with mobility impairment
Assander et al. (2022)	Switzerland	Public/ Private	No	Quasi-experimental (no random, method mixed with preset and postest	IG *M* = 87 years Range 78-94	*N* = 17 IG = 7 CG = 10	Home	IG Females 70% (*n* = 5) CG = 10	Live alone IG 85% (*n* = 5), CG 70% (*n* = 7)	Cognitive impairment not clinically significant

Authors	Country	Funding	Conflict of interest	Research design	Participants		Place	Sample characteristics		Clinical characteristics of the sample
					Age	Sample size		Sociodemographic	Social area	
				measurements) Experimental group (IG) receives ASSIST 1.0 Control group (CG) receives regular home care service	CG *M* = 86 Range 70-92	Females		Females 70% (*n* = 7)	Frequency of home care 1-3 times/day IG 28% (*n* = 2), CG 70% (*n* = 7) Home care 4-6 times/day GI 56% (*n* = 4); CG 30% (*n* = 3) Family and friends support IG 100% (*n* = 7), CG 80% (*n* = 8)	
Bradwell et al. (2022)	England	Public/Private	No	Experimental (randomized controlled trial, stratified, cluster). Experimental group (IG): 2 devices JfA Control group (CG): usual intervention	*M* = 87.21 *SD* = 7.42	*N* = 63 8 residences Formal caregivers (*N* = 16)	Residences	Elderly Females (*N* = 49)	N/A	Dementia score *M* = 32.11 *SD* = 10.52
Papadopoulos et al. (2022)	England and Japan	Public	No	Experimental (randomized controlled, single-blind, parallel-group trial). -Control Group 1 (CG1) Control robot without cultural competence -Control group 2 (CG2) Usual intervention, without robot - Experimental group (EG) -Experimental group (EG) Robot with cultural competence	*M* = 81.9 *DT* = 9.82 Range 65-98	*N*= 33 England 8 residences Japan 1 residence	Residence	Females 66.7% (*n* = 22) Widows 69.7% (*n* = 23)	Live in a single room in a residence	N/A
Parker et al. (2022)	United States of America	Private	No	Experimental	*M* = 78 *SD* = 10.3 Caregivers *M* = 65 *SD* = 9.2	Elderly *N* = 8 Family caregivers (*n* = 8)	Home	Elderly Females (n = 3) Caregivers Females (*n* = 6) African-American outpatient clinic patients presenting with cognitive impairment	N/A	Impairment cognitive RBANS: Repeatable Battery for the Assessment of Neuropsychological Status. *M* = 58.00 *SD* =15.57 (Impairment and significant impairment cognitive)
Pollak et	United	Private	No	Experimental (ran-	IG	*N* = 220	Home	IG	Live alone	N/A

Authors	Country	Funding	Conflict of interest	Research design	Participants		Place	Sample characteristics		Clinical characteristics of the sample
					Age	Sample size		Sociodemographic	Social area	
al. (2022)	States of America			domized controlled trial). Control group (CG) no intervention Experimental group (IG) robot, dog or cat	*M* = 76.5 *SD* = 7.66 CG *M* = 75.7 *SD* = 7.85 Range 65-93	IG (*n* = 107) CG (*n* = 113)		Females 84.1% (*n* = 90) CG Females 70.8% (*n* = 80)	IG 35.5% (*n* = 38) CG 28.3% (*n* = 32) Married IG 41.1% (*n* = 44) CG 54.9% (*n* = 62) Caucasians IG 80.4% (*n* = 86) CG 18.9% (*n* = 18) No pet IG 23.4% (*n* = 25) CG 26.5% (*n* = 30)	
Taramasco et al. (2023)	Chile	Public	No	Experimental (randomized clinical trial with control group) Experimental group (EG): Quida platform Control group (CG): usual care	*M* = 69.4 *SD* = 7.6	*N* = 69 CG (n = 32) EG (*n* = 37)	Home	Females 79.7% (*n* = 55) High socioeconomic risk	Live alone	Depression 10.1% (*n* = 7) Arterial hypertension 72.5% (*n* = 50) Diabetes mellitus 34.8% (*n* = 24)
Gosetto et al. (2024)	Switzerland	Public	No	Experimental (pretest y postest measurements)	*M* = 72 *SD* = 6.58	*N* = 4 Caregivers (*n* = 2) Professionals (*n* = 5)	Home	Female 0%	N/A	Heart attack (*n* = 2) Heart transplant (*n* = 1) Heart failure (*n* = 1)
Lee et al. (2024)	United States of America	Public/Private	No	Quasi-experimental (pretest and posttest without a control group)	*M* = 82.6 *SD* = 6.35 Range 71-95	*N* = 30	Home	Females 73.3% (*n* = 22) Country of origin Korea Low income 70.3% Marital status Married 16.7% (n = 21) Widowed 53.5% (n = 16) Separated 30% (n = 9)	Live alone 70% (*n* = 21) Hours alone each day *M* = 15.17; *SD* = 8.29 Home care service per week *M* = 1.52; *SD* = 8.29 Visit to community center *M* = 1.20; *SD* = 1.66 Frequency of contact with children 1 time/day 10% (*n* = 3) 1 time/3 days 0 1 time/1 week 6.7% (*n* = 2) 1 time/month 10% (*n* = 3)	Depression 16.7% (*n* = 5) Chronic diseases *M* = 2.87; SD = 1.28 Daily medication *M* = 3.30; *SD* = 1.64

Authors	Country	Funding	Conflict of interest	Research design	Participants		Place	Sample characteristics		Clinical characteristics of the sample
					Age	Sample size		Sociodemo-graphic	Social area	
									1 time / 3 months 30% (*n* = 9) 1 time/6 months 16.7% (*n* = 5) 1 time/year or more 26.7% (*n* = 8)	

Note. *M*: Media; *SD*: Standard Deviation; N/A: Not Applicable or Not Available.

Appendix 2

Main characteristics of technological devices, intervention, and study results

Authors	Devices			Duration	Intervention characteristics		Intervention Areas	Assessment tools	Results
	Characteristics	Functions	Therapeutic strategies		Robot	Professional Presence			
Tseng & Hsu (2019)	Parents: SCIS (Smart care interactive system) interactive smart chair with sensors Children: mobile app	SCIS: identifies rest, heart rate, blood pressure, weight App: Information about status and notification of abnormal situations parent	Objective: To improve family relationships between elderly people and their children through knowledge of the elderly person's condition and activities	1 week	N/A	N/A	Social interaction between the elderly and family members	Intergenerational Relations Scale, IRS (adapted by Wang, 2012)	Global score Significant improvement (t = 11.54, p < .001) Emotional support Significat improvement (t = 13.68, p < .001) Children-parents interaction Significat improvement (t = 5.14, p < .001)
Boatman et al. (2020)	Tablet with visual programm maps Individualized images	Visual maps with words and images about sequences of daily activities	Objective: To Help people with memory disease to organize daily activities	3 months Daily sessions	Supports the intervention	Entrenamiento cuidador Evaluación Intervención	Activities of daily living	Pre test Generalized Anxiety Disorder, GAD7 (Spitzer et al., 2006) Personal Health Questionnaire, PHQ8 (Kroenke et al.,2009) Quality of sleep/pain, QSQ5 (Lacasse et al.,2004) Wisconsin University Quality of Life Questionnaire, GQL8 (Diaz et al., 1999) Repeatable Battery for Assesment of Neuropsychological Status (RBANS, form A) (Randolph et al., 1998) POST Repeatable Battery for Assesment of Neuropsychological Status (RBANS, form B) (Randolph et al., 1998) Quality of Life Questionnaire (QoL18) (Boyer et al., 2010)	Anxiety (GAD7) No significant differences (p > .05) $M1$ = 4, $M2$ = 1.6 Depression No significant differences (p > .05) $M1$ = 3.7 $M2$ = 1.7 Dream quality (QSQ5) No significant differences (p > .05) $M1$ = 4.1 $M2$ = 1.4 Dream quality (QLQ8) Significant differences $M1$ = 2.9 $M2$ = 6.7 (t = 2.81, p < .01) Neuropsychology (RBANS) No significat differences (p > .05) $M1$ = 46.14 $M2$ = 56.42
Balasubramanian et al. (2021)	Alexa Echo 8 tablet with screen and voice control Digital assistance and a wide range of applications	Meditation, facilitating sleep (music, sounds) Calls and video calls Reminders (appointments, AVL) Healthy recipes Watch videos and do exercises Converse with the device Obtain information	Self-efficacy, autonomy, healthy habits, social and mental well-being	2 months	N/A	N/A	Self-efficacy, autonomy, healthy habits, social, and mental well-being	Telephone survey (follow-up)	-91% daily use. Overall, perception of positive impact on health and well-being -Organization routine (remembering appointments, medication, cooking, eating, drinking, taking out the trash). -Habits (diet, exer-

Authors	Devices			Duration	Intervention characteristics		Interven-tion Areas	Assessment tools	Results
	Characteristics	Functions	Therapeutic strategies		Robot	Professional Presence			
		on weather, news, general knowledge, doctors... Listen to radio, music, shopping, jokes, and riddles							cise, recipes adapted to medical conditions, exercise videos) -Improvement of health (knowledge, adherence, healthy habits) -Improvement of emotional well-being and mental health (meditation, talking to Alexa reduces loneliness, practicing hobbies) -Increase in social activities -Safety (turn off the burners) -Caregivers: reduction of burden and perception of increased autonomy of the elderly
Pino et al. (2020)	NAO Scheduled computer Height 58cm. Weight 4.3 kg Two cameras Two hands with three fingers Touch sensors in hands and feet Light in eyes and body Four microphones Movement of head, shoulders, elbow, wrist, waist, legs, and ankles	Voice interaction or physical interaction through touch sensors between robot and participant G1: common program, voice interaction G2: two cameras and no automatic switch, voice interaction G3: one more camera, humanized voice, Qi-Chat, user and name recognition, interaction through physical contact	Memory training program: (1) reading stories, (2) question about the story, (3) associated/not associated words, (4) recall of associated/not associated words, and (5) match song/artist	8 weeks, 1 group session per week lasting 1 hour and 30 minutes.	N/A	Presence of a neuropsychologist in sessions	Memory training program Adherence to treatment Participant-Robot Report	Anna Pesenti test (episodic memory and verbal MLP) (Novelli et al., 1986) Digit Span (MCP) (Orsini et al., 1987) Attentional matrices (atención visual) (Spinnler, 1987) Memory Assesment Clinics Questionnaire, MAC-Q (Crook et al., 1992) Verbal fluency, PFL (Novelli et al., 1986) Hospital Anxiety and Depression Scale, HADS (Montazeri et al., 2003) State-Trait Anxiety Inventory, STAI-X (Spielberger, 1983) Video analysis: frequency and duration of visual attention, frequency and duration of positive expressions Psychosocial Impact of Assistive Devices Scales PIADS (Jutai & Dei, 2002) System Usability	Anxiety, depression, and MCP no significant differences Prosodic memory Mixed model ANOVA significant improvement ($F(1,18) = 9.128$, $p < .007$ Verbal fluency Significant improvement ($F(1.18) = 9.650$, $p < .006$) Attention (varies depending on the group and measurement period) ($F(2, 18) = 6.08$ $p < .009$) Frequency of positive expression higher in NAO than psychologist in a significant way recognition and name ($p < .05$), associated words ($p < .05$), recall of associated words ($p < .05$). Frequency and duration of visual attention greater in

Authors	Devices			Duration	Intervention characteristics		Intervention Areas	Assessment tools	Results
	Characteristics	Functions	Therapeutic strategies		Robot	Professional Presence			
								Scale, SUS (Brooke, 1996)	NAO significant recognition and name ($p < .05$), associated words ($p < .05$), and matching song/artist ($p < .05$)
Assander et al. (2022)	ASSIST 1.0 Program Smart application (Information and Communication Technology, ICT) Personalization		Establish goals between healthcare personnel and participant regarding ADLs according to COPM Tasks on objectives Task reminders Information about the tasks performed	10 weeks	N/A	Weekly meetings for healthcare staff	Activities of daily living (self-care, productivity, pleasure) Support for healthcare professionals	Barthel/Katz Extended Activities of Daily Living, ADL (Mahoney & Barthel, 1965) Canadian Occupational Performance Measure, COPM (Carswell et al., 2016) Frenchay Activity Index, FAI (Turnbull et al., 2000) Self-Efficacy Scale, SES (Bandura, 2006) Reintegration to Normal Living, RNL (Wood-Dauphinee et al., 1988) Hospital Anxiety and Depression Scale, HADS (Snaith, 2003) Life Satisfaction Questionnaire, LiSat-11 (Fugl-Meyer et al., 1991) Quality of Life, EQ-5D-3L (EuroQol Research Foundation, 2018) EQ-Visual Analogue Scale, EQ-VAS (EuroQol Research Foundation, 2018) Sense of Coherence, SOC-13 (von Humboldt y Leal, 2015) WHO Disability Assesment Schedule 2.0, WHODAS 2.0 (Ustun et al.,2010) The Darthmouth Functional Health Assesment Chart/WONKA, COOP/WONKA (Lennon et al., 2011) Semi-estructured interviews	EQ-VAS (health perception). Significant improvement in IG compared to CG ($p < .03$)

Authors	Devices			Duration	Intervention characteristics		Intervention Areas	Assessment tools	Results
	Characteristics	Functions	Therapeutic strategies		Robot	Professional Presence			
Bradwell et al. (2022)	Device JfA Appearance of cat and dog		When the participant experiences loneliness, anxiety, depression, or agitation .	4 months IG and CG 4 months all IG, only qualitative data Record of 109 days, 516.3 hours (M= 3.9h; range 0.25-24h)	Personal decides group or individual use, (specific time and place) loneliness, anxiety, depression, or agitation	Yes, two per center	Psychiatric symptoms Disruptive behavior Communication Solitude	Neuropsychiatric Inventory, NPI (Wood et at., 2000). Occupational disruptiveness subscale Challenging Behavior Scale (Moniz-Cook et al.,2001) Holden Communication Scale (Strom et al., 2016) Questionnaire (measuring your impact on loneliness in later life) (Campaign to end Loneliness, n.d.) Semi-structured interview with caregivers	Neuropsychiatric symptoms IG significant decrease Delirium (p = .03) Depression (p = .01) Anxiety (p = .001) Elation (p = .02) Apathy (p = .009) Significant difference IG (M= 9.58, SD = 14.06) CG (M = 2.76, SD = 9.43). Test de Mann-Whitney p < .001 Challenging behavior Scale Communicat Scale: No significant differences
Papadopoulos et al. (2022)	Humanoid robot CARESSES (Pepper by Soft-Bank Robotics) Weight: 63 kg Height 1.20m Robot experimental (EG) Personalizes cultural aspects, preferences, and values Control de robot CARESSES (GC1) Personalize interaction, not cultural	Conversation Suggest activities (listening to music, watching videos, playing games, sending messages or making video calls to contacts)	Promote social interaction Improve mood	2 weeks 6 sessions of 3 hours each	Use according to preference	N/A	Solitude Emotional well-being	Short Form Health Survey version, SF-36 (Ware & Sherbourne, 1992) Short Form UCLA Loneliness Scale, ULS-8 (Hays & DiMatteo, 1987) Cultural Competence Assesment Tool-Robotics, CCATool-Robotics (adapted by Papadopoulos et al., 2004)	SF-36 (mental health) CG2: significant reduction (M1 = 76.22, SD = 16.51; M2 = 63.30, SD = 25.3, p < .05) CG1: No decrease EG: slight increase (M1= 77.59, SD =16.4; M2=78.39, SD = 12.15) No significant changes in the physical health subscale ANCOVA CG2 and EG in emotional well-being, significant improvement in EG compared to CG2 (F = 6.614, p = .019). Significant improvement in EG and CG2 compared to CG1 ANCOVA (F = 5.128, p = .031) Soledad (ULS-8) Slight non-significant decrease

Authors	Devices			Duration	Intervention characteristics		Intervention Areas	Assessment tools	Results
	Characteristics	Functions	Therapeutic strategies		Robot	Professional Presence			
									in GC1 and EG Slight non-significant increase in GC2
Parker et al. (2022)	MapHabit Visual maps program on tablet	Drawings and keywords in daily life activities	Objective: improve autonomy in activities of daily living	3 months	N/A	N/A	Activities of daily living Quality of life Caregiver burden	Quality of life Exit Questionnaire (Boatman et al., 2020) The Zarit Caregiver Burden Interview (Herbert et al., 2000)	Quality of life Elderly Significant improvement ($M1$=3.2, $M2$=4.3, $p < .01$) Caregivers Significant improvement ($M1$= 2.5, $M2$= 4.5, p = .03) Caregiver burden Significant improvement ($M1$=2.1, $M2$=1.5, $p < .05$) Negative feelings show significant improvement ($p <$ .05) Significant improvement in loss of control ($p <$ .001) Self-care does not significantly improve ($p > .10$)
Pollak et al. (2022)	Cat or dog device (Agless Innovation, n.d.)	Simulate interactive qualities of a dog or cat. Respond with sounds like barks, meows, caresses, hugs, and movement	Objective: to promote companionship and comfort	1 month	Custom use, no previous parameters	Previous instructions	Social and physical fragility Depression Cognitive functioning	Questionnaire to Define Social Frailty Status, QDSFS, (Makizako, 2015) Frial Questionnaire (Van Kan et al., 2008) Short Portable Mental Status Questionnaire, SPMSQ (Pfeiffer, 1975) Geriatric Depression Scale-Short Form, GDS-SF (Yesavage et al., 1982-1983) Usability, PEQ (Heerink et al., 2008)	No significant differences
Taramasco et al. (2023)	Plataforma Quida (AAL) Non-invasive sensors (temperature, light, and motion) Actimetry, body in motion or rest	Monitor basic and instrumental daily living activities. -Sleep pattern -Activity during the night -Sedentary lifestyle -Detection of events with physical risk. -Abnormal levels of carbon monoxide		26 months	N/A	N/A	Quality of life	EuroQOL-5D questionnaire, EQ-5D (Zarate et al., 2011)	Quality of Life (EQ-5D) Significant increase in EG compared to CG ($p < .03$)

Authors	Devices			Duration	Intervention characteristics		Intervention Areas	Assessment tools	Results
	Characteristics	Functions	Therapeutic strategies		Robot	Professional Presence			
		-Humidity -Temperature -Fall detection -Nighttime awakenings -Alert notifications to family or referral center							
Gosetto et al. (2024)	H2HCare (AAL) KOMP asistente digital Fitbit tracker Dialogue Non-touchscreen App	Monitoring of activities, blood pressure, and weight that can be viewed by a healthcare professional Medication reminders Messages and calls from formal and informal caregivers Personalized recommendations Alert for data requiring rehospitalization -Data visualization by caregivers -Data visualization and risk alert after evaluation by a healthcare professional (KCCQ-23)	Objective: Support adherence to treatment and changes in daily habits to reduce the risk of rehospitalization	3 months	N/A	Yes	Quality of life and care Risk of rehospitalization Communication (support for healthcare professionals and caregivers)	QoL Health Survey update, SF-36 (Ware, 2000) Physical functioning Social functioning Limitations Mental health Energy Pain General health perception Cardiomyopathy questionnaire KCCQ-23 (Sherrod et al.,2024) System Usability Scale, SUS (Brooke, 1996) Semi-structured interview	No statistical analysis, just percentage No changes in quality of life Improvement in SF-36
Lee et al. (2024)	Hyodol Integrated sensors and AI functions Doll shape Lightweight Soft touch Adjust interests, preferences, and routines	Play audio of melodies, narrate stories, health information	Objective: to assist with daily activities, health habits, and cognitive stimulation Activities: music, exercise, guided meditation, readings Routine reminders: meals, sleep, medication schedule Hyodol's accompaniment	4 months	"Free" use (acceptable and useful)	- Presentation, installation - Initial, follow-up, and final evaluation (community center professionals)	- Medication adherence - Depression - Solitude - Disability	Medication adherence Rating Scale, MARS (Chan et al., 2020) The Patient Health Questionnaire-9, PHQ-9 (Han et al., 2008). Los Angeles Loneliness Scale, UCLA-LS (Russel et al., 1980). World Health Organization Disability Assessment Schedule, WHODAS-12 (Saltychev et al., 2021) Qualitative Interview Guide at Follow-up (Cridland et al., 2016)	Medication adherence shows significant improvement (t = - 4.51 df=29, p < .001). Large size effect (Cohen's d = .82) Depressive symptoms. Significant decrease (t = 3.41, df = 29, p < .001) Average size effect (Cohen's d = .62) Disability. No significant changes (t = 0.14 df = 29 p = .885). Cohen's d = .02 Solitude. No significant changes (t = 1.48, df = 29, p = .149). Cohen's d = .21

Note. M: Media; *SD*: Standard Deviation; N/A: Not Applicable or Not Available; n.d.: no data.