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Gerontechnologies to Support Family Caregivers of Elderly Individuals with Alzheimer's Disease: a strategic action research study

Gerontecnologias para auxiliar familiares cuidadores de pessoas idosas com doença de Alzheimer: pesquisa-ação estratégica

Gerontecnologías para ayudar a los cuidadores familiares de personas mayores con enfermedad de Alzheimer: investigación acción estratégica

Silomar Ilha[I]; Francine Casarin[II]; Betânia Huppes[III]; Daiane Porto Gautério-Abreu[IV]; Francisco Fernandes[II]; Oclaris Lopes Munhoz[IV]

[I]Universidade Federal de Santa Maria. Palmeira das Missões, RS, Brazil; [II]Universidade Federal de Santa Maria. Santa Maria, RS, Brazil; [III]Universidade Regional do Noroeste do Estado do Rio Grande do Sul. Ijuí, RS, Brazil; [IV]Universidade Federal do Rio Grande. Rio Grande, RS, Brazil

ABSTRACT

Objective: to describe gerontechnologies suggested by undergraduate health students to assist family caregivers with the main challenges experienced in caring for elderly individuals with Alzheimer's disease. **Method:** a strategic action research study conducted with seven family caregivers of elderly people with Alzheimer's disease and 12 undergraduate students from a university in Rio Grande do Sul. Data were collected from the caregivers through semi-structured interviews. Meanwhile, two focus groups were held with the students. Data analysis was carried out using the technique of discursive textual analysis. **Results:** ten challenges emerged, corresponding to cognitive aspects, Activities of Daily Living, and issues related to family/caregiver/society. It was possible to describe ten categories of gerontechnologies for care in the form of products and/or processes/knowledge/strategies. **Final Considerations:** the identified gerontechnologies have the potential to assist families and caregivers in the care of elderly people with Alzheimer's disease.
Descriptors: Geriatrics; Aged; Alzheimer Disease; Caregivers; Technology.

RESUMO

Objetivo: descrever gerontecnologias sugeridas por estudantes de graduação da área da saúde para auxiliar familiares cuidadores nas principais dificuldades vivenciadas no cuidado de pessoas idosas com doença de Alzheimer. **Método:** estudo do tipo pesquisa-ação estratégica, realizada com sete familiares cuidadores de idosos com a doença de Alzheimer e 12 estudantes de graduação de uma universidade do Rio Grande do Sul. Os dados foram coletados com os familiares por meio de entrevista semiestruturada. Com os estudantes, realizaram-se dois grupos focais. O tratamento dos dados ocorreu pela técnica de análise textual discursiva. **Resultados:** emergiram dez dificuldades que correspondem aos aspectos cognitivos, às Atividades de Vida Diária e às questões ligadas à família/cuidador/sociedade. Foi possível descrever dez categorias de gerontecnologias de cuidado na forma de produto e/ou de processo/conhecimento/estratégia. **Considerações finais:** as gerontecnologias identificadas possuem potencial de auxiliar famílias e cuidadores no cuidado à pessoa idosa com doença de Alzheimer.
Descritores: Geriatria; Idoso; Doença de Alzheimer; Cuidadores; Tecnologia.

RESUMEN

Objetivo: describir gerontecnologías sugeridas por estudiantes de carreras de grado en el área de la salud para ayudar a los cuidadores familiares con las principales dificultades que atraviesan para cuidar a personas mayores con enfermedad de Alzheimer. **Método:** investigación acción estratégica, realizada con siete cuidadores familiares de adultos mayores con enfermedad de Alzheimer y 12 estudiantes de carreras de grado de una universidad de Rio Grande do Sul. Los datos fueron obtenidos de los familiares a través de entrevistas semiestructuradas. Se realizaron dos grupos focales con los estudiantes. Los datos fueron procesados mediante la técnica de análisis textual discursivo. **Resultados:** surgieron diez dificultades que corresponden a aspectos cognitivos, actividades de la vida diaria y cuestiones vinculadas a la familia/cuidador/sociedad. Fue posible describir diez categorías de gerontecnologías del cuidado en forma de producto y/o proceso/conocimiento/estrategia. **Consideraciones finales:** las gerontecnologías identificadas pueden ayudar a las familias y los cuidadores a cuidar a personas mayores con enfermedad de Alzheimer.
Descriptores: Geriatría; Anciano; Enfermedad de Alzheimer; Cuidadores; Tecnología.

INTRODUCTION

Brazil is undergoing various changes, and in demographic terms, there is a noticeable increase in aging population. Projections indicate that by 2060, Brazil will have more people over the age of 65 (58.2 million) than under 14 (33.6 million)[1]. Although not a rule, as people age, they become more susceptible to the emergence of non-communicable chronic diseases (NCDs), among which neurodegenerative diseases such as dementia stand out, with Alzheimer's disease (AD) being one of them[2].

Corresponding author: Silomar Ilha. E-mail: silo_sm@hotmail.com
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Globally, the number of people with AD exceeds 15 million, and international statistics suggest that by 2050, this number will reach 139 million. In 2019, dementia was considered the seventh leading cause of death worldwide[3]. In Brazil, statistical precision is lacking, but it is estimated that around 1.2 million people are affected by AD, while others show symptoms but remain undiagnosed[4].

AD is a degenerative, progressive, and irreversible condition that affects cognition and functionality, impairing the performance of basic activities (ADLs), instrumental (IADLs), and advanced (AADLs) activities of daily living. It is characterized by three stages or phases: early, intermediate, and terminal. The initial phase lasts, on average, two to four years, during which there is difficulty in memorizing recent events, gradually evolving into difficulties in IADLs. The intermediate phase lasts between two and ten years, with worsening memory loss, mobility difficulties, impaired verbal communication, reasoning, and loss of autonomy and independence for IADLs and AADLs. In the terminal phase, muscle rigidity worsens, compromising the ability to perform ADLs, leading to a state of frailty and total loss of autonomy, eventually progressing to a fetal position[5].

As AD progresses, the elderly person requires constant care, which, in the Brazilian context, is often provided by a family caregiver in the home environment. Family caregivers face numerous challenges in daily care for older adults with AD. These difficulties can be mitigated through the use of technologies, which, in the broadest sense, can be classified as light (relationship-based), light-hard (structured knowledge such as theories), and hard (material resources and equipment)[6]. When technology is directed at the care of the aging people and their families, it is referred to as gerontechnology, which can be presented as a product, characterized by equipment and devices along with the manifestation of care strategies (such as support bars, non-slip rugs), or as a process/knowledge/strategy, which includes non-materialized tools used in elderly care, such as support groups [7].

Research conducted in different countries shows that technology has much to offer in supporting, facilitating, and creating new possibilities in the care of aging people with dementia[8-10]. However, a study conducted by Swiss researchers describes that interventions in the context of older adults with dementia are complex and must be centered on their uniqueness[11]. Therefore, when selecting and using one or more gerontechnologies during the care process, it is essential to assess the unique needs of each aging person, as well as their family caregivers. Thus, it is crucial to understand the challenges faced in the daily lives of elderly people with AD in order to develop and describe gerontechnological care possibilities that can be used by family caregivers in different contexts, especially in the home environment.

In this regard, some research has been produced in Brazil with the proposal to use gerontechnologies for specific needs, such as fall prevention[12]; cognitive stimulation[13]; and hemodialysis treatment[14]. However, there is a scarcity of studies addressing the multiplicity of demands involved in caring for people with AD, which justifies the necessity and relevance of this research. The primary aim was to identify the main challenges and, subsequently, to propose strategies. Moreover, this study advances beyond other publications, particularly because the gerontechnologies were planned by undergraduate students from various health-related courses, with experience in aging and AD. This contributes to the assessment of the caregivers' needs in the care process from different disciplines, promoting an interprofessional approach. It is also important to note that research involving the aging population, as well as NCDs (in which AD is included), is necessary and has been highlighted as a research priority in Brazil[15].

In view of the above, the following is questioned: What gerontechnologies can be developed based on the challenges experienced by family caregivers in the daily care of elderly individuals with AD? Thus, the objective was to describe gerontechnologies suggested by undergraduate health students to assist family caregivers in addressing the main challenges in caring for elderly people with Alzheimer's disease.

METHOD

This is a strategic action research study, aimed at providing strategies for transformative actions and facilitating the search for solutions to problems. In its strategic nature, the transformation is pre-planned by the researcher, who is responsible for monitoring the effects of the intervention and evaluating its results[16]. To aid in the clarity and writing of this research report, the Consolidated criteria for reporting qualitative research (COREQ) were used as a guideline[17].

The study was conducted with two groups: the first consisting of family caregivers of elderly people with AD, and the second comprising undergraduate students from health-related courses. Both groups are participants in a support group for families and caregivers of people with AD, which is an extension project linked to a university in Rio Grande do Sul, Brazil. The group was created in 2006, and from then on, it has worked on various topics related

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to home care for older adults with AD, with prior experience in the use, planning, and development of gerontechnologies. Group activities occur weekly, with one week focused on professors and students from health-related undergraduate courses to study and plan activities, and the following week including family caregivers of people with AD.

The data collection settings included the homes of family caregivers of elderly people with AD and the support group for family caregivers. The selection criteria for family caregivers were: being or having been a family caregiver of an aging person with AD, being registered in the group, and participating regularly in meetings. For students, the criteria were: being an undergraduate student in a health-related course and having participated in the group for at least six months, a sufficient period to have experienced situations presented by family caregivers. The eligible population during the study period consisted of seven family caregivers and 40 students. All seven caregivers met the selection criteria and agreed to participate in the research. Among the students, 12 participated, as 20 had been in the group for less than six months and eight were unable to attend the focus group meetings. Thus, the research involved a non-predetermined total of 19 participants.

Data were collected in two stages: first, in August 2020, family caregivers were individually invited to participate via phone contact. After acceptance, home visits were conducted in September 2020, where the first phase of data collection occurred through semi-structured interviews, specifically developed for the research, conducted in a single session with each participant. The interview guide consisted of two parts: the first with participant descriptions, and the second with the open question: "What were/are the main difficulties that you and/or your family experienced or are experiencing in the daily care/living with the older adult with AD?" The interviews were conducted by a single researcher, a nurse experienced in qualitative research and the topic of gerontechnologies, who was also part of the extension project and had an established relationship with both the family caregivers and the undergraduate students involved in this study. The interviews were recorded using an MP3 device and then fully transcribed into Word documents. Subsequently, the transcribed interviews were returned individually to each family caregiver by the researcher for validation of the information.

After this initial stage, the researchers, through phone contact provided by the project coordination, invited the undergraduate students from the support group to participate in the study, with the aim of interprofessionally planning gerontechnologies to assist family caregivers in addressing the main challenges encountered in the daily care of elderly individuals with AD. These difficulties had been identified during the interviews with family caregivers in the previous stage of the study.

Data collection with the students (stage 2) took place from September to November 2020, using the Focus Group (FG) technique. The FG was led by a moderator (the same researcher who conducted the interviews with family caregivers) and included an observer (a research assistant) responsible for assisting with data collection, recording, note-taking, and other tasks during the sessions. There were three focus group sessions, each lasting approximately 120 minutes, of which two are described in this research. It is important to note that all COVID-19 protection and prevention recommendations were followed during the interviews and focus groups, as data collection occurred during the SARS-CoV-2 pandemic.

The first FG aimed to understand the undergraduate students' perceptions of gerontechnologies in the care of aging person and their families. Initially, participants were given an A4 sheet of paper and asked to write down what they understood by the term gerontechnology. Afterward, each participant presented their notes to the group, which sparked a collective discussion about the similarities and differences in their responses. Next, some concepts, illustrations, and images of gerontechnologies were presented to the participants, which could be used by different health care professionals. Subsequently, another A4 sheet was given to each participant, asking them to write down their understanding again after the previous activity.

In the second FG, the moderator presented a summary of the main difficulties experienced by family caregivers of aging people with AD, identified during the interviews (Figure 1), and asked the undergraduate students to think of strategies for each challenge presented. The participants had approximately ten minutes to think about possible gerontechnologies for care. Afterward, they were invited to present their suggestions to the larger group, which enabled discussion and further development of their ideas.

The data generated from the interviews with family caregivers and the FGs with students were recorded on an MP3 device, transcribed, and then analyzed using the discursive textual analysis technique, organized into three components: unitization, establishing relationships, and communication[18].

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Regarding the data from the interviews with family caregivers, the researchers began by thoroughly examining the texts, forming the central category related to the challenges experienced by family caregivers in the daily care of elderly people with AD, which was unitized into three meaning units. Next, in the second stage, each report from the meaning units was carefully read and separated into different units, giving rise to the categories of difficulties (Figure 1). For the final stage of analysis, the researchers carried out the communication process between the different challenges, through the description of metatexts as a result of interpreting the investigated phenomenon. Detailed descriptions of the reports that generated the difficulty categories are published in another manuscript[19]. The same analysis steps were followed for the data from the focus groups with undergraduate students, as shown in Figure 2.

The ethical principles involving research with human subjects were observed according to Resolution 466/2012 of the National Health Council. The project was approved by the Research Ethics Committee in March 2020. The research participants signed the Informed Consent Form (ICF) and were assured anonymity and confidentiality of the information, being identified in this study by the letters F (family) and A (academic) followed by a number (F1, F2... F7; A1, A2... A12).

RESULTS

Of the seven family caregivers of elderly people with AD, six were female, aged between 33 and 68 years. In terms of their relationship to the elderly person, three were children, three were caregivers, and one was a spouse, with caregiving experience ranging from two to 17 years. Of these, four lived with the older adults, and three lived in separate homes. Six family caregivers shared caregiving responsibilities with another person, while one provided care alone. The time they had participated in the support group varied between ten months and six years. Among the students from the health-related courses, all (n=12) were female, aged between 19 and 43 years old. One was studying nursing, two speech therapy, two physiotherapy, one nutrition, three dentistry, and three occupational therapy. Their participation in the support group ranged from six months to two and a half years.

The data from the interviews conducted with family caregivers resulted in a central category: the challenges experienced by family caregivers in the daily care of aging people with AD. Moreover, ten specific challenges were identified in the care of elderly individuals with AD, which were grouped into three major meaning units, as shown in Figure 1.

Challenges experienced by family caregivers in the care of older adults with Alzheimer's disease.		
Sense Units	**Categories of Challenges**	**Participant**
Cognition: Memory, Emotions, and Mood	- Aging person forgets about activities already completed or that need to be done.	F1; F2; F5
	- They lose sense of value with money.	F2; F4
	- They experience mood swings.	F1; F2
Activities of Daily Living	- Aging person refuses to take a bath.	F2; F5
	- Health risks associated with bathing them.	F1; F3; F5; F6
	- Difficulty with the their eating habits.	F1; F3; F6
	- Difficulty with their medication.	F2; F6; F7
Family/Caregiver/Society:	- Caregiver/family member feels overwhelmed.	F3; F4
	- Lack of acceptance and understanding of the disease.	F2; F5
	- Family disunity and lack of support in caregiving.	F2; F4

Figure 1: Challenges experienced by family caregivers of elderly individuals with Alzheimer's disease. Santa Maria, RS, Brazil, 2020.

The data from the focus groups (FGs) ith undergraduate health students were analyzed and resulted in a central category: Caring and Educational Gerontechnologies. This category was unitized into three sense units and ten subcategories, as shown in Figure 2.

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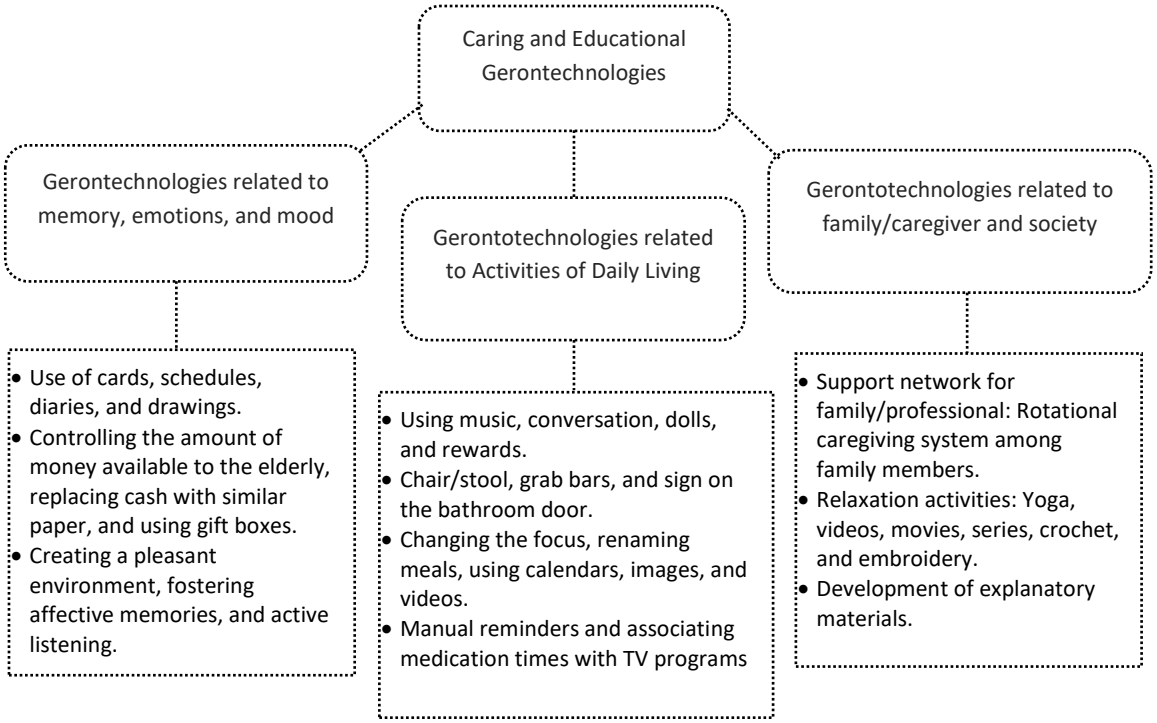

Figure 2: Representative diagram of the central category, sense units, and categories generated in the Focus Groups with undergraduate health students. Santa Maria, RS, Brazil, 2020.

Use of *cards, schedules,* diaries, and drawings

In response to the challenges reported by family caregivers regarding the older adult's forgetfulness about activities already completed or that needed to be done, health students suggested gerontechnologies in the form of products, such as creating and/or using cards (with content and actions to be performed by the aging person with AD), schedules, diaries, and drawings.

> *You could write on the cards, for example: at this time you do this, at this time you take a bath, for example, make it like a schedule, organize a routine. (A1)*

> *[...] You could make little cards, posted in a visible place, or near the bed, so when she gets up, close to the door if she is going out, or next to the bathroom, because then she will see it and remember what she can do. You could also use drawings, and the person could draw based on that moment, what the moment meant to them. (A4)*

> *Make a diary too, like today I talked about this, and she writes it down, then she looks at it later and remembers what she did a few hours ago. (A6)*

Controlling the amount of money available to the older adult, replacing real bills with similar paper and using a gift box

The difficulty experienced by elderly individuals with IADLs, specifically related to money, was also highlighted during the interviews with family caregivers, allowing the possibility of developing strategies for this context of care. Among the gerontechnologies in the form of products, undergraduate students suggested replacing real money with fictitious bills, as well as creating a box with low-cost gifts for situations in which they want to give someone a gift.

> *Fake money is a good idea because the aging person will not feel useless for having nothing, or for thinking that all their money was taken, and it also reduces the risk of them going around giving away the money they have. (A2).*

> *When the elderly person is in a phase of giving away valuable belongings to others, we can replace them with something of lesser value. A box of low-cost items can be prepared, and if they want to give something, either we or they can take it from the box and hand it out. Because if you tell them they cannot, they will feel useless [...] (A3)*

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Gerontechnologies in the form of processes/knowledge/strategies were also suggested for situations where the older adult still recognizes money. To maintain their autonomy and avoid irritation, one student described the possibility of keeping a smaller, controlled amount of money in the possession of the aging person and gradually giving it to them as needed.

> *If they are not in an advanced stage, I would need to leave some money because they will want to spend it, but not too much, because they will spend it all. If you take everything at once, like the debit card, it will change their mood. So, you can withdraw the money from the account and leave them with only a symbolic amount to maintain their autonomy, and gradually make more available as needed [...]. A symbolic value card can be given to the aging person, so they will feel useful going places and will not spend a lot of money. It will not completely take away their autonomy, which, like it or not, is important for their care. Then, from time to time, you transfer a certain amount of money to the debit card as needed. (A4)*

Pleasant environment, affective memories, and active listening

The elderly individual's mood swings due to Alzheimer's disease (AD) was another challenge mentioned by family caregivers. To assist in this context, students suggested gerontechnologies in the form of processes/knowledge/strategies aimed at stimulating the older adult's cognition. This could involve recalling memories through conversation, using photos and music, as well as maintaining a calm environment.

> *Try to create a calmer environment, play music, watch the birds, enjoy nature, and focus on things that are not the source of stress at that moment. (A2)*

> *See something that evokes good memories, something from childhood, like photos, and talk about the past. Never react or raise your voice because it will make things worse [...] you need to control yourself to calm them down. Try doing something that evokes positive memories, or make their favorite cake, for example, which might help calm them. (A4)*

Additionally, active listening and the patience to hear the older adult's stories, even repeatedly if necessary, were identified as helpful gerontechnologies.

> *I think it is very important to listen to the same story again and show that you are interested, even if you have heard it many times before, because emotions also play a role; (A2)*

> *Listening to the story more than once, repeating parts, and asking them: 'How was it again?' It might make them feel useful and forget the irritability they were experiencing at that moment. (A12)*

Use of music, conversation, dolls, and rewards

Family caregivers mentioned difficulties related to personal hygiene, as some aging people with AD either do not accept it or claim they have already done it when they have not. In this regard, students suggested gerontechnologies involving the use of music, conversation, and some form of reward.

> *Even by listening to music, or having something going on around them that makes them experience joy, I think it is very important. You can also think about the concept of a reward, something that will come after taking a bath. So, sometimes the aging person may not want to, but they know that if they take a bath, something good will happen. That is how the reward system would work. It is important to make sure it is something the person would actually receive, not just a false promise [...] sometimes they are afraid of bathing [...] they do not feel comfortable, so knowing there is a reward for doing it might make the bath more pleasant. (A7)*

> *The senses of the patient could be used, playing music they like, something that brings back memories, evokes good feelings, and turns that moment into something enjoyable. You could also give them a massage beforehand or do something that stimulates their senses, helping them take a bath. And if they do not want to shower, at least alternate between a shower and a bed bath. (A10)*

As for product-based gerontechnologies to assist with personal hygiene, a student shared an experience of using a doll:

> *In her case, the dementia was very strong, so she became attached to a doll, saying it was her daughter. So, we would say: 'Let's give your daughter a bath.' While we bathed her, she bathed the doll. I think making these associations can also help. (A6)*

Chair/stool, grab bars, and sign on the bathroom door

Due to the symptoms of the disease, which lead to difficulties with ADLs, bathing can increase health risks for the older adult, as reported by family caregivers. In response, students recognized the importance of using

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product-based gerontechnologies, such as grab bars, as well as chairs or stools for the aging person to sit on, facilitating personal hygiene.

> *She could stand, but she was very afraid of slipping in the shower [...] she only started to accept bathing again when we realized she was scared. So, we started sitting her down to make her feel more secure, and she became more willing to bathe again [...] (A6)*

> *Installing grab bars in the bathroom or even a little chair, as my colleague just mentioned. I think it is great to give them a bit more independence, as long as it is comfortable and safe for them, I think that is it (A8)*

> *Try to do something she enjoys and that gives her a sense of security, like a small chair for the elderly person to sit in while in the shower, so she feels safe. (A9)*

Student A5 also emphasized the importance of not locking the bathroom door, so that the family caregiver can intervene and help the older adult with AD in case of any difficulty. To address this, they suggested using product-based gerontechnologies, such as signs to indicate that the bathroom is occupied while the older adult is bathing.

> *A little sign to hang on the door: 'Grandma is taking a bath,' so she puts it on the door when she is bathing and does not lock the door. Imagine if she locks it and then falls, or something happens! With the sign, it is more reassuring; it is a strategy too [...] (A5)*

Changing the focus, renaming meals, using a calendar, images, and videos

Issues related to the feeding of aging people with AD were also mentioned as challenges faced by family caregivers. They experience moments when the older adult refuses to eat at scheduled times or requests food even after having already eaten. When this difficulty was presented to the undergraduate students, they suggested gerontechnologies in the form of processes/knowledge/strategies, such as changing the subject to distract the elderly individual and associating meals with a time or concept they enjoy more.

> *If they do not want to have lunch, but they like coffee, we try to associate it as if it is coffee, saying: 'Shall we have some coffee?' Even though it is lunchtime and you are serving lunch, it might work because they think, 'Oh, I like having coffee.' You change the wording because maybe they do not have good memories of lunch, and just hearing the word 'lunch' makes them refuse, so you swap the word. You can also record the aging person having coffee on your phone. Then, when they say they did not have it, you show them: 'Look, here you are, having coffee at 8 a.m.' Seeing themselves might help them remember and stop insisting on having it again. (A4)*

> *Regarding overeating, when the older person wants to eat but has just finished breakfast and does not remember, insisting that they want to eat again, the caregiver should change the subject to distract them and make them forget about eating at that moment. (A11)*

Student A2 suggested a product-based gerontechnology: a calendar with images and the times of main meals, with space for the older adult to write down what they ate at each meal.

> *Make a calendar, put images like: at 8 a.m. is breakfast, then write down what they had for breakfast, and the elderly individual writes it. Then, when it is noon, if they tell you they have not had breakfast yet, you show them the calendar and say, 'Remember, at breakfast you had this and that?' That might help them remember. And if they still do not, you let them read what they wrote themselves. (A2).*

Manual reminders, associating medication times with television programs

Medication was also mentioned as a difficulty, as some older adult forget the times or think they have already taken their medication when they have not. Two gerontechnologies were suggested: using a digital alarm and a poster with the medication time, which should match the alarm, and associating medication times with television programming.

> *You can associate the medication with a television show, so the older adult will associate the time of the show with the medication and remember to take it (A4)*

> *You could implement a digital alarm and, next to it, leave the medication with a card displaying the time the medication should be taken. For example, if the aging person has medication to take at 5 p.m., when the alarm goes off and the digital clock shows 5 p.m., they will see it matches the time written on the card and remember to take the medication that is right beside them [...] (A12)*

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Support network for family/professional: Rotational schedule among family members

Some family caregivers mentioned that the daily demands of caring for an elderly individual with AD result in physical and mental exhaustion. In response, students suggested gerontechnologies in the form of processes/knowledge/strategies, such as rotating caregiving responsibilities among family members.

> *"Create a schedule: one person cares for them on certain days, and another on other days, so it is not too overwhelming for anyone [...] one person takes Monday, Wednesday, and Friday; another, Tuesday, Thursday, and Saturday. Try to organize it so it is not too much for anyone. Family communication is key. (A2)*

> *"For those with a large family, they can set up a rotation among the children [...] it is important to alternate caregiving to avoid overburdening one person, rotating responsibilities, having a routine on that calendar. That is my gerontechnology. (A5)*

Additionally, some students mentioned the importance of a professional support network to help these family caregivers reflect on their lives and needs as human beings.

> *It is important to have a professional support network that supports the family and allows them to have someone to talk to and share their feelings with, because, usually, it is just one person doing the caregiving, and the burden must be enormous. So, it is crucial that they have someone to talk to at least once a week or every 15 days. That would be very important. (A9)*

Support groups emerged in participants' reports as gerontechnologies in the form of processes/knowledge/strategies, as they facilitate knowledge sharing among participants, helping to resolve doubts and guide actions.

> *In the support group, caregivers hear the stories of others and they think, 'Wow! I am not the only one in the world going through this challenge/difficulty...' That is why the support groups are important [...]. (A3)*

> *The support group is crucial for people to understand that those who participate can clarify their doubts [...]. (A7)*

Relaxation activities: Yoga, videos, movies, series, crochet, and embroidery

Activities that provide relaxation and help family caregivers take a break from the continuous caregiving routine were suggested as gerontechnologies in the form of products, as well as processes/knowledge/strategies to relieve the physical and mental fatigue caused by caregiving overload.

> *People need to find strategies, something they enjoy, like yoga, watching a video or a movie they like while the patient sleeps, or doing crochet or embroidery. Something that brings tranquility, comfort, and designating a time of day when the caregiver can do this, even if it is during the patient's sleeping time. (A5)*

> *If it is just one person caring for them, they need to have a period to rest, to free their mind and not think about caregiving all the time, even if only for moments during the day. It really helps! (A7)*

Development of explanatory materials

Denial and lack of understanding of the disease were situations mentioned as challenges for family caregivers. As product-based gerontechnologies, students suggested creating easy-access explanatory materials.

> *Something very practical could be created, with information like: in Alzheimer's, this or that happens in the brain. Try to explain it in a more playful way, with illustrations. Sometimes, there are even YouTube videos that illustrate everything step by step to show, in a lighthearted way, what will happen with the disease's progression and the necessary changes in care. (A2)*

> *Create a guide. If a certain situation occurs, this is how you should proceed; ways to deal with it. At first, they may not want to accept it, but if they had a guide, I believe it would help them understand. It does not have to be theoretical, it could be illustrated, in a more playful way. (A4)*

DISCUSSION

The identification of challenges faced by family caregivers of older adults with AD made it possible for health science undergraduate students to suggest gerontechnologies to assist in elderly care practices. One of the difficulties experienced by family caregivers is related to the aging person's forgetfulness due to AD. In this regard, gerontechnologies in the form of products were suggested, such as creating and/or using *cards*, schedules, care diaries, and drawings.

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In this sense, it is important to highlight that the use of materials focused on care can assist in the daily lives of elderly individuals, as they contribute to the quality of care provided[20]. Low-cost tools, such as those identified in this research, are characterized as health-promoting and disease-preventing resources. The Care Diary allows the caregiver to review the care provided to the aging person, serving as a guide in case of doubts, which can help guide daily care practices [21]. The cards and drawings, in addition to guiding the older adult regarding different rooms in the house, can also aid in cognitive stimulation[22].

Another challenge experienced by the participant caregivers was when the elderly person no longer recognized money. Among the product-based gerontechnologies suggested to address this challenge were replacing real bills with fake ones, as well as creating a low-cost gift box for occasions when they wish to give someone a present. Another difficulty identified is when the aging person still recognizes money but no longer understands its value. To address this situation, undergraduate students suggested, as a process/knowledge/strategy, keeping a smaller and controlled amount of money in the aging person's possession and giving them additional amounts gradually as needed.

These gerontechnologies help maintain their autonomy and prevent them from becoming irritated. It is important to clarify that the use of fake money as a therapeutic intervention is legal and should be agreed upon between family caregivers (the older person's legal guardians) and nearby commercial establishments where the fake money may be used to purchase products. In this way, the store owners can accept the fake money and later exchange it for real money with the family caregiver. Strategies related to difficulties in managing money were also highlighted in research conducted with family caregivers of people with AD. This research demonstrated that, in situations where the older adult no longer recognized the value of money, high-denomination bills were exchanged for the same amount in smaller denominations, which helped the aging person feel and remain autonomous[7].

Mood changes in elderly people with AD were also difficulties reported by family caregivers. In response, undergraduate students suggested gerontechnologies in the form of processes/knowledge/strategies, such as cognitive stimulation through dialogue about memories, photos, music, and maintaining a calm environment. Stimulating memory using tools such as music, for instance, has been studied as an important resource for health care professionals in caring for people with AD[23].

The ability to actively listen and the patience to hear the same stories told by the person with AD, as many times as necessary, was also mentioned as a process/knowledge/strategy-based gerontechnology. This finding aligns with research conducted in Bahia, which found that interpersonal relationships help in caregiving and serve as a motivational tool for continuing care, well-being, and improved quality of life. Thus, active listening is established as one of the key elements of care, as it creates a bond between those involved, providing a foundation for better care[24].

The difficulty in getting the older adult to accept personal hygiene was reported by family caregivers in this study. As a gerontechnology in the form of a process/knowledge/strategy, undergraduate students suggested using music, conversation, and some form of reward. In product-based gerontechnologies, an academic's experience highlighted the possibility of using a doll, where, while the older person bathes the doll, the family caregiver can assist them in their personal hygiene. This data is in line with investigations in which researchers identified that the use of music[25,26], as well as the use of dolls[27,28], as technology to assist in the care of the elderly, demonstrated potential.

Health risks associated with bathing for older adults were highlighted by four family caregivers. For greater safety during personal hygiene, participants suggested the use of grab bars and chairs or benches in the bathroom, allowing the older person to sit during bathing. Additionally, signs indicating that the bathroom is occupied were mentioned to prevent the door from being locked during bathing, ensuring safety. It is important to be aware of the available technological options and invest in tools that minimize or prevent risks during bathing. These tools foster innovation and contribute to an improved quality of health care, leading to better outcomes for both elderly individuals and their family caregivers[20]. Through the use of gerontechnologies, the aging people can perform their Activities of Daily Living (ADLs) more independently, reducing the risk of physical injuries due to functional impairments, such as falls[23].

Another challenge reported by caregivers was related to feeding difficulties, where the older adult might refuse meals or ask for food after already eating. To address these issues, students proposed cognitive stimulation

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techniques, such as changing the topic or distracting them, and associating meal times with a time of day that is more appealing to them. Research on older adults with AD also supports the idea that changing the focus or distracting attention with pleasant activities can help improve cooperation during care tasks[19]. For feeding assistance, the students suggested using a calendar with images and main meal times, where the elderly person could record what they ate during each meal. This aligns with recognized tools such as the 24-hour recall (R24h) and food diaries, which are widely used for assessing food intake[29].

The passage describes challenges related to managing medication for older people. To assist with medication management, gerontechnologies in the form of processes/knowledge/strategies were suggested, such as using a digital alarm clock and a chart displaying medication times, which should align with the alarm, as well as associating medication times with TV programming. A study conducted with family caregivers of older people identified the use of a similar device as a method of care to organize medications by days of the week and time of day/shift, to assist with the care and management of the elderly person's medication[7]. In that study, caregivers marked medication packs with a pen, noting the days of the month when the medications should be taken. This type of gerontechnology is a tool aimed at the uniqueness of the older person, as it is sensitive to the aging process, particularly in the case of AD, allowing for better assistance and care for the elderly individual[7].

The caregiver's burden, as well as family disintegration/disunity and the lack of support in caregiving, were also challenges reported by some family caregivers in this study. To address these, students suggested rotating caregiving duties among family members and seeking professional support networks for self-care, such as participating in support groups A study conducted in both Brazil and the United States revealed that caregiver overload increases as AD progresses, highlighting the importance of rotating caregivers[30].

Group dynamics and conversation circles are facilitating technologies in the teaching-learning process, as they occur in a shared manner, allowing individuals to socialize their feelings, thereby fostering support, the formation of bonds, and an understanding of self-care. A prospective, quantitative, quasi-experimental study identified group interventions as powerful tools for use with older people with cognitive impairments, as these interventions support independence in daily living activities (ADLs)[31]. Immaterial gerontechnologies in the form of processes/knowledge/strategies are thus crucial as socio-educational processes[32].

Additionally, in this study, undergraduate students suggested gerontechnologies in the form of products and processes/knowledge/strategies aimed at relieving the physical and mental fatigue of family caregivers, such as activities that promote relaxation and help them take a break from the continuous caregiving routine. Among the suggestions were yoga, watching videos, films, and series, as well as engaging in crafts like crochet and embroidery. Similar strategies for relaxation, such as reading, watching TV, listening to the radio, and engaging in recreational activities, were also highlighted in previous studies. Manual skills, including crafting and sewing, were particularly noted for their potential to help caregivers relax[33].

Another challenge faced by caregivers was the lack of acceptance and knowledge about AD. To address this, the creation of easily accessible educational materials was recommended, which can aid in understanding and accepting the disease. This type of educational gerontechnology was explored in other studies focused on creating and validating such materials[34,35]. These educational tools proved to be effective in helping caregivers manage day-to-day care, enhancing the quality of care for people with AD[34]. Thus, it has proven to be a powerful technological resource in supporting families and caregivers of aging people with AD.[35]. Based on the presented findings, it is possible to assert that when technology is well accepted, it can assist caregivers in their daily tasks with elderly individuals, helping to overcome various challenges, including physical and environmental issues[36].

This research offers contributions in terms of innovation and the practice of caring for older adults with AD. The gerontechnologies that emerged have the potential to support families and caregivers in their care efforts across different contexts and regions, both nationally and internationally. Thus, the results of this research could enhance developments in the field by fostering discussions about optimal care for the elderly, benefiting caregivers and society as a whole.

Study limitations

Despite the research contributions to innovation and caregiving practices, it is important to highlight that, since the study was conducted with family caregivers participating in a support group, the difficulties encountered

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may have been similar, as they were dealing with shared experiences discussed within the group. This could present as a limitation, implying that other challenges likely exist but were not covered in this study.

FINAL CONSIDERATIONS

This research allowed for the description of gerontechnologies aimed at assisting family caregivers in the daily care of aging people with AD. Two main types of gerontechnologies were highlighted: those presented as products and those in the form of processes/knowledge/strategies. It is suggested that the gerontechnologies presented in this study be utilized by family caregivers older adults with AD in their daily care, as well as by educators teaching gerontology-related subjects. It is understood that the topic is not fully exhausted by this research. Therefore, future studies are encouraged to focus on the application, evaluation, and, where possible, validation of these gerontechnologies.

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Author's contributions

Conceptualization, S.I. and F.C.; methodology, S.I.; F.C. and B.H.; formal analysis, S.I.; F.C.; B.H. and D.P.G.A.; investigation, S.I.; F.C.; B.H. and F.F.; data curation, S.I.; redação - manuscript writing, S.I.; F.C.; F.F., D.P.G.A. and O.L.M.; writing – review and editing, S.I.; F.C.; F.F., D.P.G.A. and O.L.M.; visualization, S.I.; F.C.; F.F., D.P.G.A. and O.L.M.; supervision, S.I.; administraproject administration, S.I. All authors read and agreed with the published version of the manuscript.