ACTA 30 YEARS 1988 - 2018

[Special article]

Call No. 01/2018 – Publication of scientific articles in the original article and systematic and integrative review categories under the topic "Advanced Nursing Practice: Specialized care and leadership in the building of excellence in nursing".

Systematic Review

Assistive technologies for demented elderly: a systematic review

Tecnologias assistivas para idosos com demência: revisão sistemática

Tecnologías de asistencia para ancianos con demencia: revisión sistemática

Juliana Cunha Maia[1]
Janaína Fonseca Victor Coutinho[1]
Caroline Ribeiro de Sousa[1]
Rachel Gabriel Bastos Barbosa[1]
Fernanda Rochelly do Nascimento Mota[2]
Marília Braga Marques[1]
Rávida da Rocha Lima Silva[1]
Rayanne Branco dos Santos Lima[1]

Keywords
Aged; Dementia; Self-help devices; Activities of daily living; Health of the elderly

Descritores
Idoso; Demência; Equipamentos de autoajuda; Atividades cotidianas; Saúde do idoso

Descriptores
Ancianos; Demencia; Dispositivos de autoayuda; Actividades cotidianas; Salud del anciano

Submitted
September 3rd 2018

Accepted
January 22nd 2019

Abstract
Objective: Analyze intervention studies using assistive technologies to help demented elderly with the execution of Basic and Instrumental Activities of Daily Living.
Methods: A survey was undertaken in the databases CINAHL, MEDLINE/PubMed, LILACS, SCOPUS, Scielo, *Cochrane* and *Web of Science*. The descriptors used were dementia/*demência*, aged/*idoso*, self-help devices/*equipamentos de autoajuda*. The methodological quality of the selected articles was analyzed by means of the *Physiotherapy Evidence Database* (PEDro) assessment tool.
Results: Four clinical trials were reviewed. The classification of the studies' methodological quality ranged from low to moderate. The effects of the nighttime monitoring system and voice command technologies on the Basic and Instrumental Activities of Daily Living were assessed better.
Conclusion: The application of these technological devices offers positive results to support elderly people and caregivers in performing their daily activities. The use of simple voice prompts is cheaper, easier to manage and more efficient for demented elderly to perform Instrumental Activities of Daily Living.

Resumo
Objetivo: Analisar estudos de intervenções com tecnologias assistivas, empregadas no auxílio de idosos com demência, na execução das Atividades Básicas e Instrumentais de Vida Diária.
Métodos: Realizou-se levantamento, através das bases de dados CINAHL, MEDLINE/PubMed, LILACS, SCOPUS, Scielo, *Cochrane* e *Web of Science*. Utilizaram-se os descritores *dementia*/demência, *aged*/idoso, *self-help devices*/equipamentos de autoajuda. Os artigos selecionados foram submetidos à análise de qualidade metodológica, na qual foi utilizada a escala de avaliação da *Physiotherapy Evidence Database* (PEDro).
Resultados: Quatro ensaios clínicos foram elencados para a revisão. Os estudos apresentaram classificação de baixa a moderada qualidade metodológica. As tecnologias de sistema de monitoramento noturno e as de comando de voz apresentaram melhor avaliação em relação aos efeitos nas Atividades Básicas e Instrumentais de Vida Diária.
Conclusão: A aplicação desse aparato tecnológico fornece resultados positivos no apoio a idosos e cuidadores na execução das atividades diárias. As utilizações de comandos verbais simples possuem menor custo, manuseio simples e maior eficiência para execução de Atividades Instrumentais de Vida Diária de idosos com demência.

Resumen
Objetivo: Analizar estudios de intervenciones con tecnologías de asistencia utilizadas para ayudar a ancianos con demencia, en la ejecución de las Actividades Básicas e Instrumentales de la Vida Diaria.
Métodos: Se realizó un relevamiento utilizando las bases CINAHL, MEDLINE/PubMed, LILACS, SCOPUS, Scielo, Cochrane y Web of Science. Se utilizaron los descriptores *dementia/demência, aged/idoso, self-help devices/equipamentos de autoajuda*. Artículos seleccionados sometidos a análisis de calidad metodológica, utilizando escala de evaluación de *Physiotherapy Evidence Database* (PEDro).
Resultados: Se incluyeron cuatro ensayos clínicos en la lista de revisión. Los estudios presentaron una clasificación de calidad metodológica de baja a moderada. Las tecnologías del sistema de monitoreo nocturno y de comando de voz presentaron mejor evaluación respecto de los efectos sobre las Actividades Básicas e Instrumentales de la Vida Diaria.
Conclusión: La aplicación de este aparato tecnológico proporciona resultados positivos en el apoyo al anciano y a los cuidadores pata ejecutar las actividades cotidianas. El uso de comandos verbales simples tiene menor costo, manejo simplificado y mayor eficiencia para realizar las Actividades Instrumentales de la Vida Diaria de los ancianos con demencia.

Corresponding author
Juliana Cunha Maia
http://orcid.org/0000-0002-1982-0186
Email: julianacmaia.cunha@gmail.com

DOI
http://dx.doi.org/10.1590/1982-0194201800089

How to cite:
Maia JC, Coutinho JF, Sousa CR, Barbosa RG, Mota FR, Marques MB, et al. Assistive technologies for demented elderly: a systematic review. Acta Paul Enferm. 2019;31(6):651-8.

[1]Universidade Federal do Ceará, Fortaleza, CE, Brazil.
[2]Universidade Estadual do Ceará, Fortaleza, CE, Brazil.

Conflicts of interest: none to declare.

Introduction

Dementia is a process of brain cell degeneration that affects cognitive abilities. Currently, about 46.8 million people are living with this degeneration, which will double every 20 years, reaching 74.7 million in 2030 and 131.5 million in 2050.[1] The global costs of dementia have increased 35% since 2010. The estimated spending amounted to US$ 818 billion in 2015 (more than one percent of the Gross Domestic Product) and about US$ 1 trillion by 2018.[2]

Most costs of dementia are focused on care for essential functions related to the maintenance of functional capacity, which requires models of care and support for the elderly and their caregivers.[3]

The symptoms of dementia can influence, compromise and impede the performance of activities of daily living (ADLs), considered essential in maintaining functional capacity and quality of life. ADLs include Basic Activities of Daily Living (BADLs), Instrumental Activities of Daily Living (IADLs) and Advanced Activities of Daily Living (AADLs).[4,5]

BADLs are related to self-care (feeding, bathing, grooming, mobilizing, walking and maintaining control over one's physiological needs); IADLs indicate the capacity to be independent (using means of transportation, manipulating medicines, using the telephone, preparing meals and taking care of finances); while AADLs are activities that are carried out independently but cannot be generalized because they involve individual social and economic conditions.[4,5]

In this context, the importance of using actions, strategies, and technologies that can assist caregivers and the elderly in performing BADLs and IADLs is highlighted.[5,6]

Among the technologies, Assistive Technology (AT) is used to maintain or improve the functional ability of disabled persons and includes the use of devices, equipment, and processes.[7,8] In addition, it has the potential to improve the quality of life, managing risks and customizing support.[9]

Studies on assistive technologies from the perspective of knowledge production are useful and necessary to promote the quality of life of elderly demented people. Thus, the objective was to analyze interventions studies that use assistive technologies to help demented elderly in the execution of BADLs and IADLs.

Methods

Systematic Literature Review (RSL), carried out in accordance with the recommendations of the Cochrane Systematic Review of Interventions manual, which establishes: formulation of the question and selection of inclusion criteria, search for studies, selection of studies and data collection, bias risk assessment of included studies, data analysis, presentation of results, interpretation of results and conclusions.[10]

Formulation of the question and choice of criteria

The formulation of the question was defined through the PICO strategy (Population, Intervention, Comparison, Outcomes (results).[11] Thus, the study population corresponds to demented elderly (P), the intervention studied is the use of assistive technologies (I). In this study, there was no comparison between standard intervention and other interventions (C) and the expected results are the effects of the AT to support the performance of BADLs and IADLs (O). Thus, the guiding question of the study was: for demented elderly (P), which effective assistive technologies (I) were used to help in the performance of the Basic and Instrumental Activities of Daily Living (O)? The inclusion criteria were articles reporting on experimental studies, without any time or language restriction. The exclusion criteria were observational, quasi-experimental, and review studies.

Search, identification of articles, selection, and collection of data

Two researchers paired up to execute the search, evaluation, selection, characterization, and analysis of the articles. They met for consensus in case of disagreement. The information survey followed the recommendations of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA).[12] The data were collected from

January to March 2018. A comprehensive survey was carried out through the following databases: Cumulative Index to Nursing and Allied Health Literature (CINAHL); National Library of Medicine (MEDLINE / PubMed); Latin American and Caribbean Center for Information and Health Sciences (LILACS), SCOPUS, Scientific Electronic Library Online (Scielo), Cochrane, and Web of Science. We used the controlled and fixed descriptors present in both classifications: Health Sciences Descriptors (DeCS) and Medical Subject Headings of US (MeSH), respectively: dementia/*demência*, aged/*idoso*, self-help devices/*equipamentos de autoajuda*. We also used the uncontrolled descriptor "assistive technology" and the Boolean operator "AND" for the combination of terms. The search strategies performed in the CINAHL, MEDLINE / PubMed, SCOPUS, Cochrane and Web of Science databases were: Dementia AND Aged AND "Self-help devices"; Dementia AND Aged AND "Assistive technology". In LILACS and Scielo, the combinations were: Dementia AND Elderly AND "Self-help equipment"; Dementia AND Elderly AND "Assistive Technology".

Bias risk assessment of included studies

The selected articles were submitted to methodological quality analysis using the Physiotherapy Evidence Database (PEDro) tool for the evaluation of clinical trials.[13] The PEDro scale consists of assisting and identifying 11 evaluation criteria (1. eligibility and origin of study participants 2. random distribution of study participants 3. secret allocation 4. similarity to starting point of the study 5. blinding of subjects 6. blinding of therapists; and 7. blinding of evaluators; 8. monitoring more than 85% of participants; 9. analysis by intention to treat; 10. intergroup statistical analysis; and 11. precision and variability measures.), the internal validity (criteria 2-9) of the randomized controlled trials and the presence of sufficient statistical information to interpret the results(criteria 10-11). The score ranges from 0 to 10 points, according to the items classified as satisfactory between criteria 2 to 11. Criterion 1 is not included as the scale does not evaluate the external validity of the clinical study.[13]

Presentation, analysis, and interpretation of results

The following data were extracted from the final sample: authors, year of publication, sample characteristics, types of AT used and outcomes relevant to the use of the BADLs and IADLs for the demented elderly. The results are presented in tables, with descriptive analysis and focus on the technologies used, characteristics and effectiveness.

Results

In figure 1, the trajectory is displayed that was followed in the search, selection, eligibility and inclusion of the evidence related to the use of AT to support the execution of BADLs and IADLs.

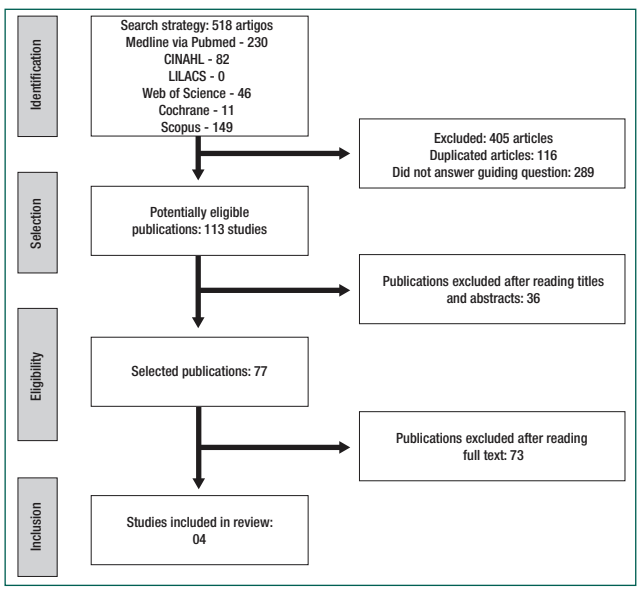

Figure 1. Identification and selection flow chart of articles for systematic review.

The search in MEDLINE, via the PubMed portal, resulted in 230 articles, 197 of which were excluded, 121 did not respond to the study object, 12 were articles whose abstract was not available, 63 were duplicates and one was a book, resulting in the selection of 33 articles. After reading the full versions, 12 were withdrawn because they did not correspond to the research problem, and 20 because they were not experimental studies, resulting in a single article included in the sample.

In LILACS and SciELO, searches resulted in no articles. The searches in CINAHL resulted in 82 articles, 65 of which were excluded (49 did not respond to the study object, 3 had no available abstract, 13 were repeated) and 17 were selected. After reading the full versions, all 17 articles were excluded. In Scopus, 149 articles were found, 98 of which were not suitable for the purpose of the study, four publications had no available abstract, 32 were repeated and 15 were selected for full reading. Only one was included in the sample. In the Cochrane Library, of the 11 articles found, four were excluded because they were duplicated and five because they were not related to the study theme. Two were selected for full reading, but none of the selected articles was included in the sample. In the Web Of Science database, of the 46 papers found, 10 were selected, four were repeated and four were excluded because they were not randomized experimental studies, resulting in two studies included in the sample. After completing the eligibility process, four articles were included to summarize the data, as displayed in chart 1.

The articles presented heterogeneity in the sample, in the methodological rigor and in the assessment of the intervention effects of the, preventing clustering. As regards the verification of methodological rigor by the PEDro scale, the articles scored as follows: A1 - 6 points, A2 - 5 points, A3 - 6 points and A4 - 6 points, being classified as low to moderate methodological quality and compromised internal validity. Regarding the sample characteristics of the articles, A1 was performed with pairs of demented elderly people and informal caregivers; in EG, the mean age was 78.45 years for the elderly and 61.35 years for the caregivers. In CG, the age of the elderly and caregivers was, respectively, 80.75 and 63.37 years. In EG, 42% of the elderly and 73% of the caregivers were female whereas, in the CG, 52% of the elderly and 85% of the caregivers were women. In relation to cognition, the elderly had moderate levels of dementia, with a mean MMSE score of 13.83 points (Chart 2). In A2, the mean age in the CG was 73.95 years, the majority was female (78.58%) and the mean MMSE score was 27.75. At the same time, the mean age in the EG was 75.09 years, the majority was female (57.78%) and the mean MMSE score was 26.10. It is emphasized that the study initially included healthy elderly individuals to assess the influence of the AT on the disease evolution, ending after ten years with 225 participants with moderate cognitive impairment.[14,15] In A3, a study performed with pairs of elderly peo-

Chart 1. Studies included in SLR, distributed by sample and sample and intervention characteristics

Articles	References	Countries	Samples	Inclusion criteria	Assistive technologies	Activities of daily living	Usage periods
A1.[14]	Rowe MA, Kelly A, Horne C, Lane S, Campbell J, Lehman B, et al. [Reducing Dangerous Nighttime Events in Persons with Dementia Using a Nighttime Monitoring System]. Alzheimers Dement. 2009; 5(5):419-26.	United States.	EG= 26 elderly and caregivers. GC= 27 elderly and caregivers.	Being primary caregiver as from 21 years of age; no physical impairment; not being under treatment for sleep disorders; speaking and reading in English and no cognitive impairment. For the elderly: dementia diagnosis, MMSE score < 23 and history of nocturnal awakenings.	Nighttime monitoring system.	Mobilization.	12 months.
A2.[15]	Thomas KR, Marsiske M. [Verbal Prompting to Improve Everyday Cognition in MCI and Unimpaired Older Adults]. Neuropsychology. 2014; 28(1):123-34.	United States.	EG= 909 elderly. CG= 1890 elderly.	Patients with MMSE score ≥ 23; No prior diagnosis of dementia or ADL limitations.	Stimuli through verbal prompts.	Medication administration; finance control.	10 years.
A3.[16]	Hattink BJ, Meiland FJ, Overmars-Marx T, Boer M, Ebben PW, Blanken M, et al. [The electronic, personalizable Rosetta system for dementia care: exploring the user-friendliness, usefulness and impact.]. Disabil Rehabil Assist Technol. 2016;11(1):61-71.	Holland, Belgium and Germany.	EG= 20 elderly and caregivers. CG= 22 elderly and caregivers.	Present mild cognitive impairment or moderate dementia, have at least one caregiver, live at home.	Activity and location monitoring system.	Mobilization; meal preparation and grooming.	1 to 8 months (average ≅4 months).
A4.[17]	Werner C, Moustris GP, Tzafestas CS, Hauer K. [User-Oriented Evaluation of a Robotic Rollator That Provides Navigation Assistance in Frail Older Adults with and without Cognitive Impairment]. Gerontology. 2018; 64:278–90.	Germany.	EG= 22 elderly. CG= 20 elderly.	Institutionalized elderly people using a rollator, with motor impairments, with and without cognitive impairments. Age ≥ 65 years, capable of performing the activity and understanding the instructions, without severe health problems.	Robotic navigation assistance for elderly people.	Mobilization.	Route 1 ≅ 84.1 seconds. Route 2 ≅ 104.9 seconds.

EG –Experimental Group; CG – Control Group; MEEM – Mini Mental State Examination

Chart 2. Description of interventions concerning assistive technologies, variables measured and outcomes

Articles	Assistive technologies	Variables measured	Outcomes
A1.[14]	Home monitoring system with domestic safety system platform, bed occupation sensors and alerts.	Caregiver satisfaction; Reliability.	System assessed as extremely reliable. No errors or false alarms. No adverse events caused by system failures. Subjects were classified as "highly satisfied" with the use of the technology. Nine nighttime events took place, three of which in EG, two falls and one nighttime leave. The nighttime events happened due to improper handling and the caregiver who did not awake when the alarms went off.
A2.[15]	Verbal prompts in the form of reminders or motivation to help in the performance of financial control and medication management activities, activated when the elderly behaves unable to proceed with the activity.	Usage efficacy.	The group with cognitive impairment achieve improvements in the performance of medication management and financial control activities. The performances of the subjects who used the technologies were superior to the subjects in the control group. The technology demonstrated improvements and maintenance in the performance of daily tasks.
A3.[16]	Multifunctional system Rosetta, resulting from the integration of three systems: "*Elderly Day Navigator (EDN)*", including a daily organizer, telephone agenda with pictures, simplified telephone call system and Global Positioning System (GPS); *"Early Detection System (EDS)"*, registering the elderly's behavioral pattern through the analysis of sensor signals, such as sleep-wake rhythm, mobility and meal preparation; "*Unattended Autonomous Surveillance – Advanced Awareness and Prevention System (UAS-AAPS)*", detecting situations through cameras and triggering alarms in case of a period of inactivity, such as a fall.	System utility; Easy use.	Rosetta assessed as "highly useful" and potentially resulting in feeling of greater safety in care provision. Informal caregivers indicated signs of decreased work burden. Three informal caregivers described feelings of trust and safety. Formal caregivers considered the system complex and hard to work with. EDN: considered useful by the caregivers and demented subjects. Classified as hard to manage. Different technical problems of the system were reported and informal caregivers mentioned dissatisfaction with the layout of the access portal. Caregivers were unable to use the GPS function due to technical errors. EDS: caregivers considered it useful to monitor the demented subjects' ADLs. The technology was considered hostile and hard to manage. Different errors occurred when accessing the portal. UAS-AAPS: participants indicated that the system was very useful and granted a feeling of safety. Presented false alarms that were considered bothersome and three fall events when the system failed and the alarm did not go off.
A4.[17]	Robotic navigation assistance innovation called MOBOT, offering integrated navigation system with audio-guided suggestions.	Performance on two routes; Success rate; Conclusion time; Number of stops; Gait speed; Distance walked.	Route 1: no significant associations were found between success rate and use of the device. For the conclusion and stop times, significant interaction was found between navigation assistance and cognitive condition. The participants using the device presented shorter conclusion and stop times. No significant effect was found on the number of stops, gait speed and distance walked. Route 2: no significant associations were found between success rate and use of the device. For the conclusion time and the number of stops, significant interaction effects were observed. The participants using the technology presented shorter conclusion time, fewer stops and shorter distance walked. No significant effect was found on the gait speed and stop time.

EG –Experimental Group

ple and informal caregivers, the mean age of the demented participants and caregivers in CG was 76.38 and 58.33 years, respectively. In EG, the age of the elderly and caregivers was 81 and 59.22 years. Most caregivers were female (78%) in both groups, as were the elderly. The mean MMSE of the elderly in CG was 21.77, against 21.36 in EG, with mild to moderate dementia.[16] The elderly in study A4 were institutionalized, with a mean age of 84.1 years in EG, the majority female (81.2%), the MMSE score 25.9. In CG, the mean age was 80.7 years, half of the participants were female (50%) and the mean MMSE score was 25.9, with and without moderate cognitive impairment.[17]

Discussion

The ATs have promising potential for demented elderly care, permitting advances in the care and reduction of the caregiver's burden.[18,19]

The sample profile of the studies corresponds to the sociodemographic profile of the elderly from a global perspective. It is relevant to point out that two Randomized Clinical Trials (RCTs) included the elderly - caregiver dyad in the sample. In this sense, research indicates the importance of the caregiver's preparation and inclusion in the evaluation and training process on the use of the AT. The inclusion of the caregiver in research involving elderly people with dementias provides benefits to the patient, caregiver, and researcher, as it grants additional value to the interventions.[20]

It is emphasized that ATs should be proposed in the prodromal stage of dementia, as it may help to promote independence and maximize the quality of life, being adaptable to the dementia phases.[21]

The home environment was used in most of the studies and the importance of applying the technologies at home is underlined. There is a growing body of evidence suggesting the potential of technologies to support the care of elderly people with

dementia at home and thereby improve the caregivers' quality of life, besides reducing care and early institutional care costs.[22]

The nighttime monitoring system is a potential solution as it permits reducing the risk of falls, allows a greater rest time for the caregiver, decreases the burden and reduces the probability of institutionalization.[23] Nevertheless, studies with greater methodological rigor are suggested, as well as the enhanced measuring of nighttime events, such as injuries due to falls and nocturnal leaves.[14]

Regarding the use of interventions with verbal prompts, a study emphasizes that the intervention with the greatest potential to improve the performance of daily activities in demented people is task-oriented training.[24] The research came with limitations though, due to the fact that the interventions with this technology are not promoted in the home environment. Also, the technology provided the verbal prompts in case the participant did not know the answer or took time to answer, but not in case of incorrect answers, characterizing a technological restriction that needs improvement.[15]

Monitoring technologies alleviate concerns about the safety of patients in periods of caregiver absence, with the objectives of ADL monitoring, surveillance in the event of falls and the detection of changes in health conditions.[25] Hence, the study that evaluated the effects of the monitoring system demonstrated a significant reduction in the caregiver burden after the use of the AT.[26] In the study that used monitoring technologies, however, the main limitation presented was system instability and poor functioning, with several technical failures. Also, the fact was highlighted that the samples are reduced, justified by the high cost of installing the technologies and the scarce budget.[16]

Regarding the localization systems, it is verified that the use of GPS increases the ability of the elderly to move independently, promoting a reduction of the dyad's stress.[27] Despite the caregivers' preparation to manage the technologies, many indicate difficulty to implement them on a daily basis, mainly due to the flaws they present, which reinforces the need for system improvements.[28]

Regarding the use of robotic navigation aids, the findings support the assertion that they effectively support the orientation and movement of demented people and are able to reduce the task performance time. Nevertheless, as the study included in the SLR associated the use of the robotic navigation aid with verbal direction prompts, the effectiveness of the contextual navigation prompts or not was questioned, as this was not evaluated separately in the research.[17]

The limitations of this study include the particularities of the method adopted, considering the limited number of experimental studies published in the databases consulted. It should be taken into account that none of the studies included describes the blinding process of the subjects, therapists, and evaluators.

Nevertheless, researchers underline the need for further research, looking for cost-effective solutions and for a more diverse audience.[29]

Conclusion

Assistive technologies can be applied to improve the quality of life of demented elderly. The application of this technological apparatus provides positive results, in the support to the elderly and their respective caregivers, in the execution of BADLs and IADLs. Given the clear aging process, the number of people with dementia, the costs involved in the care and the paramount role of nursing in the care process, in the near future, the assistive technologies will be present in the daily routine of the nursing team, concerning both their use and development. It is emphasized that nursing plays a fundamental role in the promotion, protection, and recovery of health by coordinating care plans, with an outstanding role in the implementation of AT. Evidence shows that monitoring presents satisfactory results but needs improvement. The use of verbal prompts constitutes a cheaper technology that is simple to handle and more efficient for the execution of IADLs of demented elderly. Robotic navigation devices are beneficial, but need further investment in research to assess their effectiveness.

Given the lack of experimental studies with AT and their importance for demented elderly and their caregivers, the development of new research on this theme is encouraged.

Acknowledgements

To the Graduate Nursing Program at *Universidade Federal do Ceará* (UFC) for support and to the Coordination for the Improvement of Higher Education Personnel (CAPES) for funding through Master's grants for Maia JC, Sousa CR, Silva RRL, Lima RBS.

References

1. Prince M, Wimo A, Guerchet M, Al GC, Wu YT, Prina M. World Alzheimer Report 2015: The Global Impact of Dementia [Internet]. Illinois: Alzheimer's Disease International; c2015; p. 1-87. [cited 2019 Jan 15]. Available from: https://www.alz.co.uk/research/world-report-2015
2. Wimo A, Guerchet M, Ali GC, Wu YT, Prina AM, Winblad B, et al. The worldwide costs of dementia 2015 and comparisons with 2010. Alzheimers Dement. 2017;13(1):1–7.
3. Price M, Comas-Herrera A, Knapp M, Guerchet M, Karagiannidou M. World Alzheimer Report 2016 Improving Healthcare for People Living with Dementia [Internet]. Illinois: Alzheimer's Disease International; c2016. p. 1-140. [cited 2019 Jan 15]. Available from: https://www.alz.co.uk/research/world-report-2016
4. Moraes EN. Atenção à saúde do idoso: aspectos conceituais. Brasília (DF): Organização Pan-Americana da Saúde; 2012. p. 1-102.
5. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Atenção Básica. Envelhecimento e saúde da pessoa idosa [Internet]. Brasília (DF): Ministério da Saúde; 2007 [citado 2017 Ago 12]:1- 192. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/abcad19.pdf.
6. Patomella A-H, Lovarini M, Lindqvist E, Kottorp A, Nygård L. Technology use to improve everyday occupations in older persons with mild dementia or mild cognitive impairment: A scoping review. Br J Occup Ther . 2018;81(10):555–65.
7. Galvão Filho T.A. A tecnologia assistiva: de que se trata? In: Machado GJ, Sobral MN, organizadores. Conexões: educação, comunicação, inclusão e interculturalidade. Porto Alegre: Redes Editora; 2009. p. 207-35.
8. Bersch R. Introdução à tecnologia assistiva. Porto Alegre: Assistiva Tecnologia e Educação; 2017. 20p.
9. Marciana P, De Oliveira P, Marlena L, Pagliuca F, Gomes Cezario K, César De Almeida P, et al. Amamentação: validação de tecnologia assistiva em áudio para pessoa com deficiência visual. Acta Paul Enferm. 2017;30(2):122–30.
10. Higgins JP, Green S, editors. Cochrane handbook for systematic reviews of interventions version 5.1.0. The Cochrane Collaboration [Internet]. 201. [cited 2017 Aug 13]. Available from: https://training.cochrane.org/handbook.
11. Botelho LL, Cunha CC, Macedo M. O método da revisão integrativa nos estudos organizacionais. Gestão Soc. 2011;5(11):121-36.
12. Moher D, Liberati A, Tetzlaff J, Altman DG. The PRISMA Group. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. Int J Surg. 2010;8(5):336-41.
13. Shiwa SR, Costa LO, Costa LC, Moseley A, Hespanhol Junior LC, Venâncio R, et al. Reproducibility of the Portuguese version of the PEDro Scale. Cad Saude Publica. 201;27(10):2063–8.
14. Rowe MA, Kelly A, Horne C, Lane S, Campbell J, Lehman B, et al. Reducing dangerous nighttime events in persons with dementia by using a nighttime monitoring system. Alzheimers Dement. 2009;5(5):419–26.
15. Thomas KR, Marsiske M. Verbal prompting to improve everyday cognition in MCI and unimpaired older adults. Neuropsychology. 2014 Jan;28(1):123–34.
16. Hattink BJ, Meiland FJ, Overmars-Marx T, Boer M, Ebben PW, Blanken M, et al. The electronic, personalizable Rosetta system for dementia care: exploring the user-friendliness, usefulness and impact. Disabil Rehabil Assist Technol. 2016;11(1):61–71.
17. Werner C, Moustris GP, Tzafestas CS, Hauer K. User-oriented evaluation of a robotic rollator that provides navigation assistance in frail older adults with and without cognitive impairment. Gerontology. 2018;64(3):278–90.
18. Ienca M, Jotterand F, Elger B, Caon M, Pappagallo AS, Kressig RW, et al. Intelligent assistive technology for alzheimer's disease and other dementias: a systematic review. J Alzheimers Dis. 2017;56(4):1301–40.
19. Kramer B. Dementia caregivers in germany and their acceptance of new technologies for care: the information gap. Public Policy Aging Rep. 2014;24(1):32–4.
20. Ciro CA. Maximizing ADL performance to facilitate aging in place for people with dementia. Nurs Clin North Am. 2014;49(2):157–69.
21. Teipel S, Babiloni C, Hoey J, Kaye J, Kirste T, Burmeister OK. Information and communication technology solutions for outdoor navigation in dementia. Alzheimers Dement. 2016;12(6):695–707.
22. D'Onofrio G, Sancarlo D, Ricciardi F, Panza F, Seripa D, Cavallo F, et al. Information and communication techonologies for the activities of daily living in older patients with dementia: A systematic review. J Alzheimers Dis. 2017;57(3):927–35.
23. Tchalla AE, Lachal F, Cardinaud N, Saulnier I, Rialle V, Preux PM, et al. Preventing and managing indoor falls with home-based technologies in mild and moderate Alzheimer's disease patients: pilot study in a community dwelling. Dement Geriatr Cogn Disord. 2013;36(3-4):251–61.
24. Braley R, Fritz R, Van Son CR, Schmitter-Edgecombe M. Prompting technology and

persons with dementia: the significance of context and communication. Gerontologist. 2019;59(1):101-11.

25. Peetoom KK, Lexis MA, Joore M, Dirksen CD, De Witte LP. Literature review on monitoring technologies and their outcomes in independently living elderly people. Disabil Rehabil Assist Technol. 2015;10(4):271-94.
26. Chi NC, Demiris G. A systematic review of telehealth tools and interventions to support family caregivers. J Telemed Telecare. 2015;21(1):37-44.
27. Liu L, Miguel Cruz A, Ruptash T, Barnard S, Juzwishin D. Acceptance of global positioning system (gps) technology among dementia clients and family caregivers. J Technol Hum Serv. 2017;35(2):99–119.

28. Megges H, Freiesleben SD, Jankowski N, Haas B, Peters O. Technology for home dementia care: A prototype locating system put to the test. Alzheimers Dement (N Y). 2017 May;3(3):332–8.

29. Lee G, Ohnuma T, Chong n, Lee SG. Walking intent-based movement control for JAIST active robotic walker. IEEE Trans Sys Man Cyber Sys. 2014[;44(5):665-72.