



An overview of technology-assisted nursing care in Elderly Care

A literature Review

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<p>Abstract:</p> <p>This thesis project aims to study the benefits and limitations of technology-assisted nursing care, mainly focused on robot-assisted nursing for older people. The objective of this thesis is to perform a literature review on robot-assisted nursing to find out the advantages and limitations of robot-assisted nursing in elderly health care. Dorothea Orem's self-care model theory is the theoretical framework to guide this thesis work. The method used in this thesis work is a qualitative literature review of ten articles. The data are collected from Academic search complete (EBSCO), Pub Med, Sage, ScienceDirect, and Google Scholar using inclusion and exclusion criteria.</p> <p>The finding identifies that assistive technologies benefit elderly people's health in improving their physical health, psychological health, social health, and overall well-being. It was found that these technologies improved the self-care ability of elderly people and improved their quality of living. It is evident that elderly people like the company of humanoid robots in different activities like entertainment and their assistance in daily activities. On the other hand, there are also certain drawbacks with all these benefits of assistive technologies. The drawback of using assistive technologies is that they can only perform simple tasks, they are expensive for elderly people, and their processing is slow. Also, robots are found to be very interesting at the beginning, but over a certain period of time, they are less interesting.</p>	
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FOREWORD

A very special thanks to my beloved husband for encouraging and supporting me during my studies, thesis writing process, and always. Without your love and support, I would not have made it this far.

I would also like to extend my gratitude to my supervisor Pauleen Mannevaara for your supervision and guidance while doing this thesis project.

I would like to thank my parents and siblings for being there for me emotionally and always encouraging me. Lastly, I want to thank my grandmother and grandfather for giving me this dream to become a nurse when I was very small. I hope you are very proud of me in heaven, my grandfather.

1 INTRODUCTION

Nurses are an essential part of health care service workers, and they are also the most significant workforce in the health care sector. The aging population worldwide is alarming, resulting in a massive effect on the health care system. According to Christoforou et al., (2020), it is estimated that the population of aged people above 65 years old by 2050 is going to be 149 million from the 2018 population of 101 million. The population equal to and above 85 growth rate is found to be 130.3%. However, people below 55 are going to decrease by 9.6% from 2018 by 2050. The old-age dependency is also increasing during this time period. This will impact old people in different aspects such as social, physical, mental, and cognitive aspects. That is why older people need help to perform their daily activities either from friends, family, and relatives. If the care need cannot be fulfilled by friends and family, then they need help from a different form of health care personnel. Older people need help from health care professionals, and the demand for health care professionals is very high. To fulfill this mismatch, new innovations and alternatives are needed. One of the alternatives to fulfill the mismatch would be the use of different robots and assistive technology, which can provide physical and social assistance for elderly people themselves or support nursing personnel in their care work (Christoforou et al., 2020).

This thesis project aims to study the benefits and limitations of technology-assisted nursing care, mainly focused on robot-assisted nursing for older people. The primary objective of this thesis is to perform a literature review on robot-assisted nursing to find out the advantages and limitations of robot-assisted nursing in elderly health care. At first, background study of robot and health care robots, their types, and the need for robot-assisted nursing for elderly people are described, and a theoretical framework was set using Orem's self-care model theory to guide this thesis project. Then, the method used is the literature review to collect and analyze data. Literature is searched from an electronic database accessed through Arcada's library Arcada Finna. The databases used were Academic search complete (EBSCO), Pub Med, Sage, ScienceDirect, and Google Scholar. While searching the information, inclusion and exclusion criteria have been used at the beginning of the search. Finally, ten relevant articles are chosen from the search, and the research question is answered based on the finding from these selected articles.

This thesis layout is divided into eight chapters, including the current introduction chapter. The remaining seven chapters are summarized below.

Chapter two provides the background of this thesis. In the background chapter, basic knowledge about robots is provided. The robots are then categorized according to their function. It is then narrowed down and focused specifically on robots used in the health care of elderly people. Lastly, the relation shows why the use of robots in the elderly can be beneficial to enhance elderly people's quality of life. Assistive technologies are used by elderly people themselves or by family members or health care workers.

Similarly, chapter three introduces a theoretical framework to guide this thesis. The theory that has been used to guide this thesis is Dorothea Orem's self-care model theory which is further categorized as the theory of self-care, the theory of self-care deficit, and the nursing theory. In chapter four, this thesis's aim and research question are formulated, and in chapter five, the methodology used in this thesis work is described. In chapter six, finding from the selected articles will be highlighted. Chapter seven discusses the finding of the research question, and chapter eight concludes this thesis project work.

2 BACKGROUND

In the background chapter, the author has introduced what robots and health care robots are. Also, the author has discussed the different types of health care robots used in the elderly nursing care sector and discussed why robots are needed to provide care to elderly people.

2.1 Robot and health care robot

The term robot was introduced by Karel Capek in 1921. It was derived from the word labor (Jordan, 2022). According to Merriam Webster (Webster, 2022), a robot is a machine that can perform a task or series of tasks itself based on its programming and its environment. The word robot is usually perceived as a human-like machine that is made of metal. But all the robot does not look like a human. There are different kinds of robots. They are classified and categorized according to their work performance, types, and how they look (Webster, 2022).

2.2 Types of a health care robot

Robots are used in many sectors, and they have diverse functions. Most of the robots have similar characteristics, such as they are powered by electricity, people program them to perform certain tasks, and they have the ability to respond to their environment (Revereschools, 2022).

Health care robots used for elderly people are found to be categorized differently in different sources of literature. According to the types of jobs they do, robots used in home-care and elderly homes are term as assistive robots. Assistive robots can be grouped on the basis of service or companion types of work (Zafrani and Nimrod, 2018). According to Zafrani and Nimrod (2018), service robots are further classified into communication and transportation robots, whereas companion types of robots look like human beings or animals and are primarily used for the well-being activities of elderly people. The following figure 1 gives the idea of types of assistive robots used for elderly people.

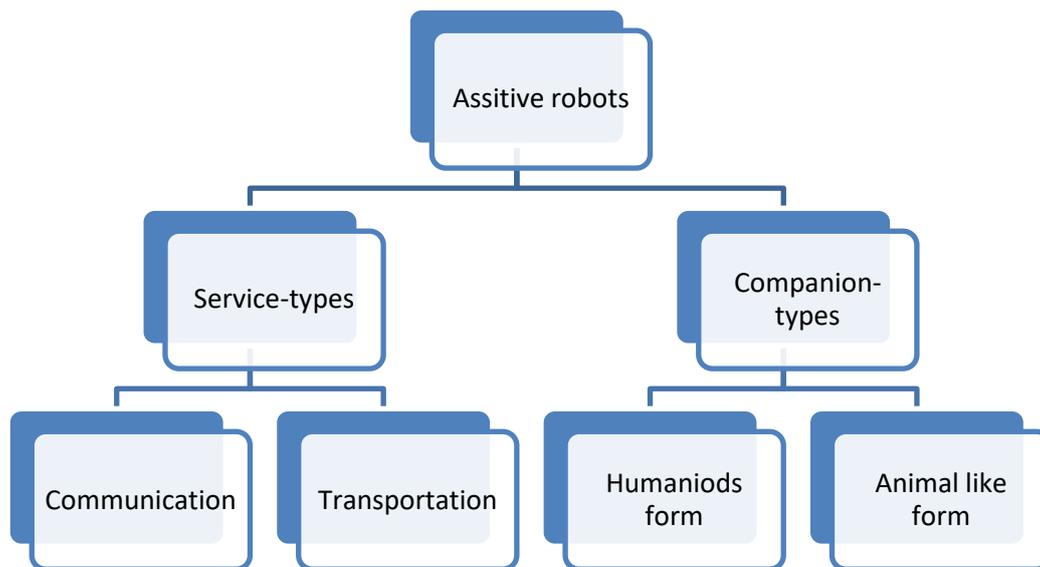


Figure 1. Types of assistive robots used for older people (Zafrani and Nimrod, 2018).

The robots used for communication and transportation are referred to as service-type robots. Communication and transportation robots are the robots that are used to perform everyday activities among elderly people. These robots are used to perform activities like showering, assisting in nutrition, and assisting hygiene, such as dressing. A communication robot is, for example, a mobile device used to see the activities of residents using video cameras. Transportation robots are the robots that facilitate carrying goods or persons from one point to another by the use of designed services (Zafrani and Nimrod, 2018).

The other types of assistive robot are companion robots. The companion-type robot is the type of robot that looks like a human being or animal. It performs tasks by copying human activities such as speaking, dancing, singing, and walking. Some robots may look exactly like human beings with having faces, eyes, ears, and expressions. They can do a series of features such as they are entertaining, they can help in other daily activities, and they can get data from the internet (Zafrani and Nimrod, 2018). Figure 2 illustrates an example of a companion robot where a humanoid robot is assisting an old lady, whereas a robot dog is entertaining a lady as a real dog.



Figure 2. A chart (reference) Example of robot-assisted nursing (Freepick, 2022).

2.3 Need of Robots in the care of elderly people

According to Valkama and Oulasvirta (2021), the number of elderly people is rapidly growing in Finland. In Europe, Finland is leading in terms of elderly growth. The growth of elderly people between the years 2000 to 2019 is from 14.8% to 21.8%. Whereas on the other hand, the childbirth rate is decreasing, which is really a matter of concern.

People are living longer nowadays due to the advancement of health technologies and science (Valkama and Oulasvirta, 2021). In official Statistics of Finland (2019), data have been found that in the year 2019, the life expectancy of females was 84.5 years and for males was 79.2 years.

In an article by Wang et al. (2022), the study finds that there is an increase in the life expectancy of the elderly population. Elderly people are growing, and people want to get older in their own homes rather than in any other geriatric home. They need care in their own homes as well as in the geriatric home. They are not able to perform daily household tasks and activities by themselves at home, and they need institutional help. Health care workers are providing care in the geriatric home, and they are also visiting home, but this is not being sufficient. With the increase in old people with physical and mental

disabilities and lack of workforce, it seems kind of impossible for human beings to fulfill all the needs of elderly people. New alternatives should be found in order to fulfill the lack of nursing personnel to meet the care needs of old people. Elderly people need assistance in daily chores such as personal hygiene, medications, etc. So, to promote self-care to elderly people, technology seems to be very beneficial. (Wang et al., 2022).

With the help of robots, we can provide care to elderly people. The idea of using a robot in the elderly home is not to replace nurses with the robot, but the idea is to enhance care, reduce the workload to health care workers, and deliver better care in the areas where the human being cannot be available all the time. For example, a robot can engage elderly people in different activities by focusing on their needs. The main goal is to maintain and improve the quality of life of elderly people by improving physical and mental health (Wang et al., 2022).

3 THEORETICAL FRAMEWORK

The theoretical framework is the fundamental structure of a research project. It connects and supports the existing studies and guides the formulated hypothesis by making theoretical assumptions in research. It explains and validates why this theory has been used to answer the formulated research aims and questions (Library.sacredheart.edu, 2022).

The Self-care model theory has been selected to guide this thesis project work. Orem's self-care model theory is very relevant in robot-assisted nursing practice in older adults. It focuses on enhancing self-care and building confidence by promoting independent living. It also covers limitations in robots assisted nursing care in the care home.

3.1 The Self-Care Model Theory

Dorothea Orem developed the self-care model theory. She was born in Baltimore in 1918. She finished her BS nursing in 1930 and MS in Nursing in 1945. Her concept of self-care theory was first published in 1959. Orem's self-care model contributes to nursing education and the nursing profession. Her self-care theory promotes recovery and healing. Orem's theories focus on abilities rather than limitations. The self-care model consists of three interrelated theories: the theory of self-care, the theory of self-care deficit, and the nursing system (Nursing Theory, (2022)). The overview of Orem's theory of self-care is illustrated in figure 2.

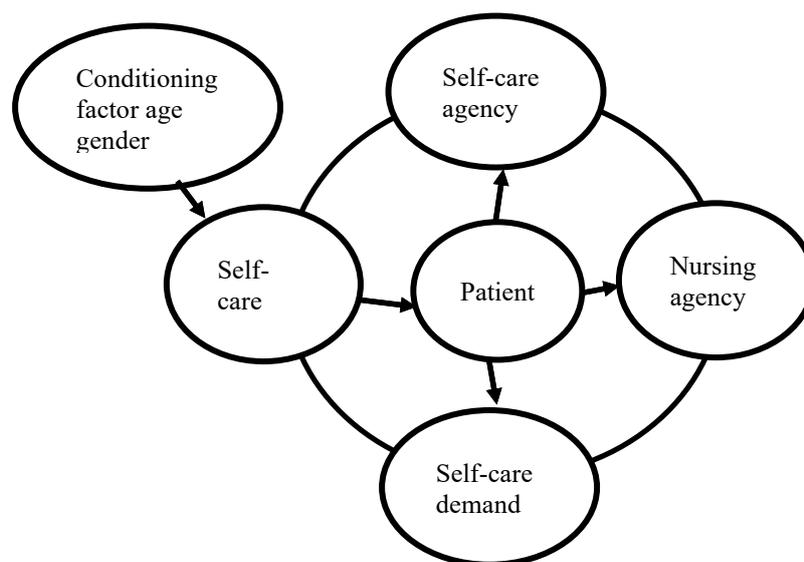


Figure 3. Orem's theory of self-care (Irshad Ali BH (2018))

3.1.1 The theory of self-care

The first component of Dorothea Orem's self-care model is the self-care theory. Self-care evaluation begins with a nursing assessment. To identify activities that the patient initiates and performs independently to maintain life, health, and well-being. The nurses assess the patient's ability to engage in self-care, considering their age, gender, abilities, environmental factors, and other factors into account.

Self-care requisites, also known as daily living activities, are assessed concerning universal, developmental, and health deviation requirements. Also, the need for therapeutic self-care is assessed. This evaluates total care activities needed to meet the individual's self-care needs at the moment or even over a while (Nursing Theory, 2022).

3.1.2 The theory of self-care deficit

The second component of Dorothea Orem's self-care model is the self-care deficit theory. During this phase, the nurses confirm the needs and other requirements of the patients. Once the needs are confirmed, the nurse begins to implement Orem's five methods of helping. The five methods of helping include: acting and doing for others, guiding, physical and psychological support, promote personal development, and teaching (Nursing Theory, 2022).

3.1.3 The theory of the nursing system

The final component of Dorothea Orem's self-care model is the theory of nursing systems. Orem's theory of the nursing system outlines how the patient's self-care needs will be met by the nurse, the patient, or both. Orem identifies three classifications of nursing systems to meet the patients' self-care requisites: The wholly compensatory system, partly compensatory system, and supportive educative system. Patients needing the wholly compensatory system have the most limitations and need complete care. Patients needing the partly compensatory system have some limitations but are able to perform some requisites independently. Patients requiring a supportive educative system are independent, except they need the education to promote self-care further (Nursing Theory, 2022).

3.2 Relevance of theory in this thesis

This thesis project work focuses on maintaining independence and maintenance of good health. Orem's three theories emphasized that individuals can provide care to themselves to maintain good health. When one cannot provide care to themselves and need assistance due to different factor (in this research, aging), this condition is called self-care deficit. In this situation, older people need help from the health care provider or family members. As described in Chapter two, due to a mismatch in population aging and high demand of nurse ratio, technological innovation is needed to maintain demand and supply of care. Assistive technologies have helped older people live independently, and it has helped promote quality of life.

4 AIM AND RESEARCH QUESTIONS

4.1 AIM

This thesis project aims to study the benefits and limitations of technology-assisted nursing care, mainly focused on robot-assisted nursing for older people. The primary objective of this thesis is to perform a literature review on robot-assisted nursing to find out the advantages and limitations of robot-assisted nursing in elderly health care.

4.2 Research questions

The research question that guides this thesis is:

1. What are the benefits and challenges of robot-assisted care in elderly care?

5 METHODOLOGY

The method used in this thesis work is the literature review. This chapter presents the method used to collect and analyze data. Literature is searched from an electronic database accessed through Arcada's library Arcada Finna. The databases used were Academic search complete (EBSCO), Pub Med, Sage, ScienceDirect, and Google Scholar. While searching the information, inclusion and exclusion criteria have been used at the beginning of the search. The main aim of this chapter is to find the information that can be used to answer this thesis project's research questions. In this chapter, the author describes the data collection process using inclusion and exclusion criteria, performs content analysis of articles, presents selected articles listed in chronological order, and discusses ethical considerations.

5.1 Data collection:

This thesis project database is accessed through Arcada library Arcada Finna. The databases used to collect relevant information were Academic search complete (EBSCO), Pub Med, Sage, ScienceDirect, and Google Scholar. The main three keywords used to search the information are nursing, robots, and aged people. In order to combine these keywords, a boolean moderator 'and' was used. The search keywords and combinations used is 'Nursing' and 'Robots' and 'aged people'. The time frame was set between 2012 –2022 to include only recent articles. Articles that are ten years old are only used to do this thesis project. The language was limited to English. Only articles that are free accessed were considered.

In the first phase, the titles that seemed to answer research questions were selected. Then, the article's hits were first reviewed by reading the title of the article. After reading titles, the articles that did not answer the research questions were not chosen to read the abstract. The articles that seemed relevant were chosen, and the abstracts were read. After reading the abstract, the articles that seem to answer the research questions were chosen and selected. The articles which are not relevant were not selected for abstract reading. The number of hits, the number of articles of which abstracts are read, and the selected articles are summarized in Table 1.

Table 1: Search keywords and results from different databases

Source	Search word	Number of hits	Relevant Articles	Selected
Academic search complete (EBSCO)	'Nursing' and 'Robots' and 'aged people'	6	6	2
Pub Med	'Nursing' and 'Robots' and 'aged people'	11	9	2
Sage	'Nursing' and 'Robots' and 'aged people'	183	13	4
ScienceDirect	'Nursing' and 'Robots' and 'aged people'	43	15	0
Google Scholar	'Nursing' and 'Robots' and 'aged people'	26	10	2

5.1.1 Inclusion and exclusion criteria

Before collecting data, the inclusion and exclusion criteria were set. The articles that are scientific and have been peer-reviewed are taken. The articles that have full text and have open access have been included. Only articles that are in the English language have been taken. Also, Boolean/phrase was applied in possible places. Articles that were published after 2012 have been used. Only free articles are used, and articles that need payment are excluded. The summary of inclusion and exclusion criteria is illustrated in Table 2.

Table 2: Inclusion and exclusion criteria

Inclusion criteria	Exclusion criteria
Articles from 2012-2022.	Articles before 2012
Articles in English language.	Articles in other .
Articles relevant to topic were included.	Unrelevant articles.
Free articles.	Paid articles.
Articles with full text.	Articles only with abstract.
Articles from academic database Academic search complete (EBSCO), PubMed, Sage, ScienceDirect, and Google Scholar.	Articles from non-academic database.

5.2 Presentation of the literature

Ten articles were chosen to study and conduct literature reviews from different databases with common search keywords defined in Table 1. The details of articles that have been chosen in this literature review are presented below. They are arranged in alphabetical order and then numbered accordingly from article number 1 to 10 based on alphabetical order as follows. The detailed information about this literature can be found in appendix 1.

- 1) Andtfolk, M., Nyholm, L., Eide, H. and Fagerström, L., 2021. Humanoid robots in the care of older persons: A scoping review. *Assistive Technology*, pp.1-9.
- 2) Birks, M., Bodak, M., Barlas, J., Harwood, J. and Pether, M., 2016. Robotic Seals as Therapeutic Tools in an Aged Care Facility: A Qualitative Study. *Journal of Aging Research*, 2016, pp.1-7.
- 3) Budak, K., Atefi, G., Hoel, V., Laporte Uribe, F., Meiland, F., Teupen, S., Felding, S. and Roes, M., 2021. Can technology impact loneliness in dementia? A scoping review on the role of assistive technologies in delivering psychosocial interventions in long-term care. *Disability and Rehabilitation: Assistive Technology*, pp.1-13.
- 4) Hersh, M., 2015. Overcoming Barriers and Increasing Independence – Service Robots for Elderly and Disabled People. *International Journal of Advanced Robotic Systems*, 12(8), pp.1-33.
- 5) Majumder, S., Aghayi, E., Nofaresti, M., Memarzadeh-Tehran, H., Mondal, T., Pang, Z. and Deen, M., 2022. Smart Homes for Elderly Healthcare—Recent Advances and Research Challenges.
- 6) Nwosu, A., Sturgeon, B., McGlinchey, T., Goodwin, C., Behera, A., Mason, S., Stanley, S. and Payne, T., 2019. Robotic technology for palliative and supportive care: Strengths, weaknesses, opportunities and threats. *Palliative Medicine*, 33(8), pp.1106-1113.

- 7) Obayashi, K., Kodate, N. and Masuyama, S., 2018. Enhancing older people's activity and participation with socially assistive robots: a multicentre quasi-experimental study using the ICF framework. *Advanced Robotics*, 32(22), pp.1207-1216.
- 8) T, M., 2018. scenarios. *International Journal of Advanced Research in Computer Science, Active and assisted living: A Comprehensive review of enabling technologies and* 9(1), pp.461-471.
- 9) Wu, Y., Wrobel, J., Cornuet, M., Kerhervé, H., Damnée, S. and Rigaud, A., 2014. Acceptance of an assistive robot in older adults: a mixed-method study of human–robot interaction over a 1-month period in the Living Lab setting. *Clinical Interventions in Aging*, pp.801-811.
- 10) Zhang, Q., Li, M. and Wu, Y., 2020. Smart home for elderly care: development and challenges in China. *BMC Geriatrics*, 20(1), pp.1-8.

5.3 Content Analysis

Content analysis is a very important part of qualitative research. It is a process where information is searched and extracted from raw data. Then the collected information is categorized according to the category, and the data is used with the goal of getting new useful information (Elo et al., 2014).

The author has chosen inductive qualitative content analysis (Elo and Kyngäs) to analyze the data. According to Elo and Kyngäs (2008), the most important thing about data analysis is that the data should be divided into a 'systematic manner' to describe the research. The author has identified, analyzed, and reported the data. This phase has been divided into three phases to explain the research, which are preparation, organizing, and reporting (Elo et al., 2014).

In the preparation phase, data related to robot-assisted care for aged people has been collected using the database from Arcada Finna. The databases used were Academic search complete (EBSCO), Pub Med, Sage, ScienceDirect, and Google Scholar. In the organizing phase, articles from data have been downloaded and kept in a different folder. A total of ten articles were chosen and printed as hard copies. Useful, relevant, and important information has been highlighted to make it easy to find by using a highlighter using different colors. The articles were read repeatedly. During this process, the author understands the contents of the selected articles, and then the data are grouped and categorized. In reporting phase author have answered research questions from the evidence that has been found from the article collected using the database (Elo et al., 2014). The following Table 2 illustrates the categorization of content from the selected articles.

Table 3: Categorization of Content

Articles	Theme	Subtheme
1,2,3,4, 5,7, and 8	Supports in daily living	Helps to enhance quality of life.
	Provides companionship and connection	
	Promotes psychological activity	
	Promotes physical activity	
2,4,5,6, 9, and 10	High operational cost and limited working capabilities	Limitations
	It cannot replace human interactions	
	Technical issues	
	Slow process	

5.4 Ethical considerations

To do this thesis project author accessed the article from Arcada's Library Arcada Finna. From Finna articles were retrieved using the databases, Academic search complete (EBSCO), Pub Med, Sage, ScienceDirect, and Google Scholar. The author has followed Arcada's thesis writing template guideline. In this thesis, project credit has been given to the original author to provide respect and acknowledgment of their work. To do so, in-text citation in the text and references at the bottom has been done. Harvard referencing is done according to Arcada's protocol. To make sure there is no plagiarism, this thesis project goes from the software name Urkand in Arcada.

Also, the most important research principle is guided by Finish National Board on research integrity (TENK). The principles that have been guided by TENK, such as minimizing the risk of harm, obtaining informed consent, protecting anonymity and confidentiality, avoiding deceptive practices, providing the right to withdraw, are some of the principles that are very important in every thesis (Kohonen, Luumi and Spoof, 2021).

6 FINDINGS

In this chapter, the findings of the thesis project are presented based on the information that has been collected from ten articles. The aim of this thesis project was set, and a research question was formulated based on the aim of this research. The research question is answered in this chapter. The goal is to find out the role or benefits, and challenges of robotics in elderly care. The author's main focus is on how technology can help to maintain self-care for elderly people. In this thesis project, ten articles have been used to do this research, and a qualitative method has been used.

6.1 Benefits of using robots to support self-care of aged people

In the article by Andtfolk, et.al., (2021), it was described that older people have many health-related problems. They have physical and psychological problems, which have hindered their self-esteem. This has caused in deterioration of the quality of life among older people. They need support and care in different forms. Some of them can do tasks by themselves with little assistance, whereas others need more support. The support is needed for them to maintain hygiene, to perform daily activities. In this research article, it has been found that robots and assistive technologies might be the alternative to solve this problem. Figure 4 summarizes the benefits of assistive technologies in self-care.



Figure 4. Benefits of assistive technologies in self-care.

6.1.1 Supports in daily living

Again, in the article by Andtfolk, et.al., (2021), it was found that humanoid robots are found to be helping older people by providing support in daily activities. They can remind the schedule by keeping up to date with the calendar; they remind medication timetable, helps in monitoring vital signs, and are capable of picking up and lifting different objects in their house. While receiving such service, older adults did not find any threat in performing self-care, and it has found to be safety and independence are not harmed.

In another article by Birks et al. (2016), research was done on an animal-like robot seal named Paro. This robot was found to be very helpful in assisting in everyday chores among residents, such as making ready for the bath and preparing meals.

T. M (2018) has found that technologies have a significant role in promoting the lives of aged people living actively and under assistance. Technology has helped the elderly be independent by being able to do the task by themselves; it has also boosted self-esteem and helped to move more quickly. The use of technologies has been found to enhance lifestyle and improve the quality of life among aged people. The use of technologies has been more effective and productive in older people.

6.1.2 Provides companionship and connection

In a research paper by Andtfolk, et. Al. (2021), it has been found that interactions, companionship, and connection between robots and aged people can be formed. Robots are also helpful in checking on surrounding information, measuring blood oxygen level, and making calls. At the same time, people with dementia can utilize technologies by listening to music and playing quiz games.

Again, Birks et al. (2016) found that Paro was therapeutic among aged people; they expressed feelings when they engaged with Paro relative to meeting other real animals. Paro helped to elevate mood among the elderly, and it was interestingly engaging. Older people also showed love and care to Paro. They were happy to touch Paro. It helped to decrease stress and avoid feeling lonely among residents and maintain good social relationship. It

did not only provide benefits to residents but also benefits workers and families by being the mediator of good communication among residents, staff, and family.

In another article by Budak et al.(2021) conducted in New Zealand, the use of animal-like robots was found to reduce unhappiness in residents with the help of good communication and companionship, and engagement with robots. Among all the residents with dementia is benefited more.

6.1.3 Promotes psychological activity

Assistive technologies have been beneficial to promote psychological activity among aged people. It was found that older people who can manage to live independently but need small assistance benefit from using assistive robots. The assistance is needed in reminding medication time, keeping track of diet, and playing the game that helps to maintain cognitive function. Aged people have found the use of assistive technologies to be fun. It has also been found that assistive technology is more useful among people with dementia because they tend to ask the same questions many times. Humanoid robots have improved the quality of life among aged people (Andtfolk, Nyholm, Eide and Fagerström, 2021).

In the article by (Obayashi, Kodate and Masuyama, 2018) quasi-experiment was done among residents with the robot named SAR. SAR was a socially active robot. He used to remind activities such as greetings, reminding of taking medications, asking about what activity resident is doing at a certain time, and was able to message if something critical happens. He was monitoring residents day and night. During day time, engagements and companionship for older people have a huge role. During the nighttime, monitoring done by robots made residents feel secure and monitored. Residents had psychological assurance. This helped to enhance the quality of life among residents psychologically.

6.1.4 Promotes physical activity

In an article by Andtfolk, et.al, (2021), humanoid robot is used to train older people to walk, and it was found that older people engaged in walking with a robot does not feel any threat. This promotes the physical activities of older people.

In another article by Hersh (2015), different types of assistive technology such as smart homes, smart wheelchairs, smart arms, and humanoid robots were studied. It was found that robots that help in physical assistance are helpful for the residents who need little care on an everyday basis. Two examples from articles, living in a smart home and using a smart wheelchair, were discussed in the articles. It was found that smart homes provide facilities like sensor lights, security facilities with cameras, automatic curtains, spacious area to perform daily chores. These areas are located on the ground floor and are centrally controlled and monitored. This promotes a feeling of safety and being monitored to residents. Also, a centrally controlled system can detect any kind of usual activities of residents. Hence, this promotes independent living and self-care for themselves. Also, it was found that the use of smart wheelchairs is very beneficial for residents to move more easily because of its small structure shape, lightweight, and user-friendly operational modes.

In another article by Majumder et al.(2022), similar studies were found, as discussed by Hersh(2015). Residents who are living in a similar smart home have many facilities. These facilities are remotely health monitoring and have a good connection between different smart phone and different sensor devices.

6.2 The limitations of robots in elderly care

In research done in France by Wu et al., (2014), A robot named Kompaï experimented in a lab among older people for one month. This robot has functions in aiding and maintaining independence to enhance the quality of life of older people. The experiment found that, older people were less interested in having a robot in everyday life. They also stated that the appearance of the robot was not interesting. Older people experience many uncomfortable in accepting robots. They feel difficult to use and have misperceptions toward the use of the robot such that the robot will affect their social, ethical, and moral value.

In another research by (Majumder et al., 2017), elderly people living in a smart home also have challenges in keeping their data safe. Since all the private data are transferred, which contain very personal information. Likewise, a lot of devices, hardware and software are used in smart homes, so it should be taken into consideration that most of the devices should be wireless and function remote. Also, a smart home is very expensive to build and needs lot of power supply to operate. So, while building this kind of homes protection of data, minimizing building costs and operating cost is a big concern. With that, the quality and performance should not be compromised. Figure 5 summarizes limitation of robots in elderly care.

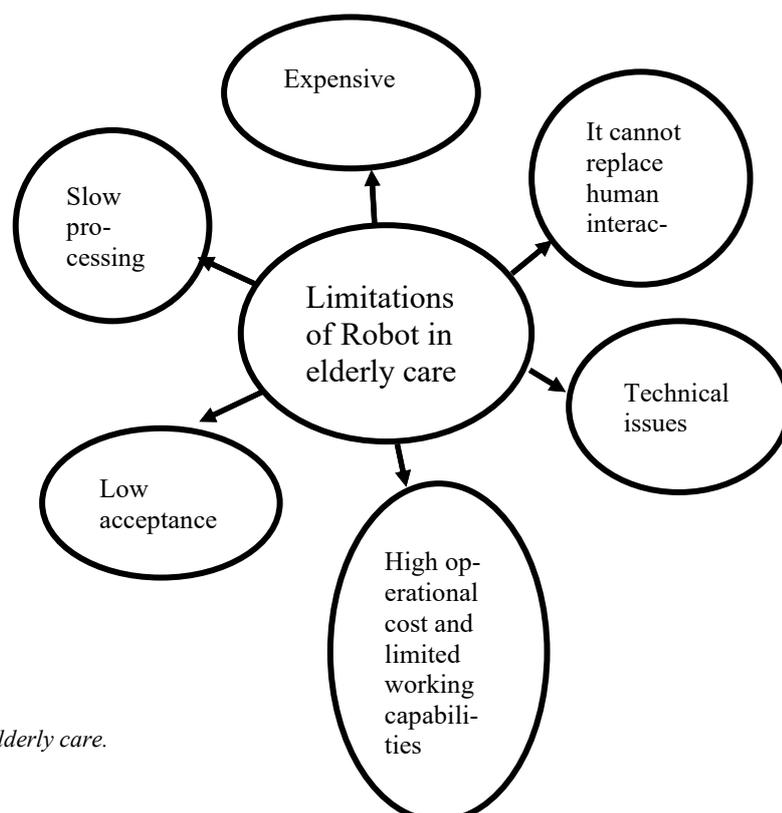


Figure 5. Limitation of robots in elderly care.

6.2.1 High operational cost and limited working capabilities

According to the article by Nwosu et al.,(2019) regarding the advantage and disadvantages of the use of the robot in the care home, it was found that there is some drawback of those robots. The disadvantages are that the operational cost of robots is expensive, they require highly trained manpower, need a good connection to the internet, and need to be programmed to perform each separate task. Its function is limited such as it can only perform the task that has been set. In case of emergency, a robot is not found to be helpful to solve the difficulties. Robots seem to have less use in performing small tasks by using hands and fingers. It is rather good for doing big tasks.

China being very progressive in technologies Zhang, Li and Wu (2020), they are having issues in setting up smart homes for elderly people. To help easy access to smart homes for elderly people in China, there should be made changes in policy reforms. The smart homes are quite expensive for the public to afford. So, there should be smart homes from both government and private. New technologies development should be promoted so that the prices of smart homes can be affordable to the common public.

6.2.2 It cannot replace human interactions

In the same article by Nwosu et al., (2019), robots cannot seem to replace human feeling because they are not capable of experiencing human emotions. This decreases the emotional bonding relationship between humans and robots.

Likewise, in another article by Hersh, (2015), older and younger people have said that robots are good for carrying the machine-like task and is good to have to get support from heavy workers rather than to communicate and to have companionship with. Robots are found to be less interesting to engage with verbally.

6.2.3 Technical problems

The article Birks et al., (2016), discusses the limitation of the PARO robot seal. Some of the limitations of PARO is that it is not easy to use, and the staff have expressed negativity regarding its use. So, before using PARO, good training should be provided to staff so that they can operate the system.

6.2.4 Slow processing

Again, Hersh(2015) found that young adults are less interested in interacting with robots because of their slow system due to having a lack of time in daily life. However, older adults are found to be a little more accepting of robots due to having more time in comparison.

7 DISCUSSION

The use of assistive technologies is a very important topic in elderly care these days. As the world's population is aging and the shortage of health care workers is increasing, the innovation of technology-assisted nursing is found to be beneficial in elderly care. In this thesis work, the focus is done on how assisted technologies can benefit elderly people in their self-care and achieve their quality of living. Limitations of the use of assistive technologies are also studied in this thesis project. The study is done by reviewing ten articles.

In a paper by (Andtfolk, Nyholm, Eide and Fagerström, 2021), older people need care in their own home as well as in institution. Health care workers are visiting homes and providing care in geriatric homes, but this is not being sufficient. This can cause in deterioration of physical and mental health of senior citizens. To fulfill the increase in older residents and lack of health care workers new alternatives should be found. This people are needing assistance in daily chores such as personal hygiene, medications, etc (Andtfolk, Nyholm, Eide and Fagerström, 2021).

In a research done by (Hersh, 2015) a survey is done on assistance robots. The robot is capable of providing assistance in everyday living such as to reach high places of home and take objects, can transfer objects, can do easy communications, remind about the schedules and calendars, health, vital signs and medications. It is also capable of detecting fall. This kind of robot is found to support physically in everyday living to assist older people to achieve quality of life.

Based on the evidence that has been collected robots and assistive technologies is found to very helpful in elderly people in relation to maintenance of self-care. Some of the elderly people are living independently with the assistance of assistive technologies. With help of technologies elderly people get their confidence boosted as they are being able to live on their own. This has added comfort and safety, and confidence to elderly people's life. At the same time, others are getting help from nurses or relatives for the use of technologies. This has resulted in the promotion of physical and mental activities. Technologies are also found to provide companionship and keep older adults engaged in activities.

According to (Birks et al., 2016) where a robot that looks like seal is found just like therapy tool among elderly people. It was found to be more helpful for people with cognitive problems such as dementia. They could not even differentiate it as the unreal seal. They were very happy to have interaction and communication with Paro named seal. They laughed better, and their face seemed happy. The Resident's relatives were also curious about Paro. Another participant was sharing her feeling with Paro and saying how she was doing. Paro is found to have the potential to provide companionship and interactions to elderly people. This helps elderly people to be less lonely, and it improves the mental health of elderly people.

Even though assistive technologies and robots have huge potential benefits for self care in elderly care, there are barriers to their use. Elderly and health care workers are unaware of its potential benefit. There is a lower rate of acceptance for the robot. In an article by (Wu et al., 2014) where a robot named Kompai was used for an experiment on older people. It has been found that robots were hard to be accepted. Participants found it to be less useful in everyday life. During this experiment everyone said that they were not interested in having a robot. Two of the participants said that if there is no option left for him then he chooses to accept the robot in compulsion otherwise he is not interested. He loved outer looks of robot but he does not feel the same way with robot as he feels with human being. He prefer human over robots. One said that he was old enough to learn new technology. He aged 80. Three of the member rejected the idea of having robot. Similarly, (Birks et al., 2016) also found that health care workers when asked in a interview about seal like structure robot named Paro, they expressed less interested in Paro and said that people are idiot as they are having interaction with paro. They also expressed that paro is useless to spend money on.

8 CONCLUSION

This thesis discusses the benefit and challenges of assistive technologies in elderly care. The focus is mainly done on robotic care for the elderly. A literature review has been done to collect data using the different academic databases, and ten articles were reviewed to answer the research question.

It was found that assistive technologies are helpful for elderly care to maintain their health and well-being, maintain their autonomy and independence by self-care, and maintain the quality of life of older people. They are also found to be beneficial not only to elderly people but also to elderly people's family members and health care providers. Elderly people can use assistive technologies for their self-care activities as long as they can take care of themselves. When elderly people become incapable of providing care to themselves, other family members and health care professionals can use assistive technologies to provide care to elderly people. Older adults living with families can use technologies in different forms. Family members can keep track of health and communicate using technologies.

The use of assistive technologies by elderly people for themselves, by elderly people's friends and family members, and by a health care provider is found to be very beneficial in the care of elderly people. Assistive technologies usage has helped older adults maintain health and promote physical, mental, and cognitive functioning. Older adults have found humanoid robots as a companion and can be used to do different entertaining activities such as playing memory games, communicating, and chatting. Likewise service type robot is found to be very beneficial in helping day to day activities.

With enormous benefits, using this technology also has a limitation, as it is costly to use. It needs expensive operational costs, and high skilled trained personnel are needed to program their tasks. Health care workers have found it very time-consuming to use. Even though robots can store many data, they cannot perform and think like humans. Even though to some level, robots seem to be exciting and good to engage with, it does not have feelings and emotions, and in the long term, it does not seem interesting at all. Hence, human interaction and connection cannot be replaced and felt with machines.

Finally, using technology-assisted nursing care using robots can be very beneficial in some nursing care work where the work needs to be done repeatedly; the work requires more physical strength. Furthermore, the technology can take good care regarding medication timetables and other works that can be automated. There are still some challenges and difficulties using these assisted robot nursing care types. However, the future might be different, and we might be using more of these types of technology to overcome nursing care personnel shortages.

8.1 Limitation

Some limitations were faced while writing this thesis report. Regarding this thesis, report only free data were collected due to which access to many good papers was not found, which added difficulty in finding data. Also, English-language articles were only searched because many good sources from Finland were not used in this thesis report.

While doing this research and writing this thesis report independently, the author has understood and developed independence in studying alone. However, the author has often been lost and confused due to a lack of brainstorming and discussions with peers.

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APPENDICES

Appendix 1: Details of reviewed articles.

S. N.	Articles		Year	Vol.	Pages	Database
1	Title	Humanoid robots in the care of older persons: A scoping review	2021		1-9	Pubmed
	Authors	Andtfolk Malin, Nyholm Linda, Eide Hilde, and Fagerström,				
	Publication	Taylor and Francis Online				
	DOI	10.1080/10400435.2021.1880493				
2	Title	Robotic Seals as Therapeutic Tools in an Aged Care Facility: A Qualitative Study. Journal of Aging Research	2016	2016	1-7	EBSCO
	Authors	Birks Melanie, Bodak Marie, Barlas Joanna, Harwood June and Pether Mary				
	Publication	Hindawi Publishing Corporation				
	DOI	10.1155/2016/8569602				
3	Title	Can technology impact loneliness in dementia? A scoping review on the role of assistive technologies in delivering psychosocial interventions in long-term care. Disability and Rehabilitation: Assistive Technology	2021		1-13	Google Scholar
	Authors	Budak Kubra Beliz, Atefi Golnaz, Hoel Viktoria, Laporte Uribe, Franziska, Meiland Franka, Teupen Sonja, Felding Simone Anna and Roes Martina				
	Publication	Taylor and Francis Online				
	DOI	10.1080/17483107.2021.1984594				
4	Title	Overcoming Barriers and Increasing Independence – Service Robots for Elderly and Disabled People. International Journal of Advanced Robotic Systems	2014	12	1-33	Sage
	Authors	Marion Hersh				
	Publication	International Journal of Advance Robotic System				
	DOI	10.5772/59230				
5	Title	Smart Homes for Elderly Healthcare—Recent Advances and Research Challenges	2017	17	1-32	Pubmed
	Authors	Sumit Majumder, Emad Aghayi, Moein Noferesti, Hamidreza Memarzadeh-Tehran, Tapas Mondal, Zhibo Pang and M. Jamal Deen				
	Publication	MPLI				
	DOI	10.3390/s17112496				
6	Title	Robotic technology for palliative and supportive care: Strengths, weaknesses, opportunities and threats	2019	33	1106-1113	Sage
	Authors	Amara Callistus Nwosu, Bethany Sturgeon, Tamsin McGlinchey, Christian DG Goodwin, Ardhendu Behera, Stephen Mason, Sarah Stanley and Terry R Payne				
	Publication	SagePub.com				
	DOI	10.1177/0269216319857628				
7	Title	Enhancing older people's activity and participation with socially assistive robots: a multicentre quasi-experimental study using the ICF framework	2018	32	1207-1216	EBSCO
	Authors	Kazuko Obayashi, Naonori Kodate and Shigeru Masuyama				
	Publication	Taylor and Francis Online				
	DOI	10.1080/01691864.2018.1528176				
8	Title	Active and assisted living: A Comprehensive review of enabling technologies	2018	9	461-471	Google Scholar
	Authors	Manoj T and Dr. Thyagaraju G S				
	Publication	International Journal of Advanced Research in Computer Science				
	DOI	10.26483/ijarcs.v9i1.528				
9	Title	Acceptance of an assistive robot in older adults: a mixed-method study of human-robot interaction over a 1-month period in the Living Lab setting. Clinical Interventions in Aging	2014	9	801-811	Pubmed
	Authors	Ya-Huei Wu, Jérémy Wrobel, Mélanie Cornuet, Hélène Kerhervé, Souad Damné and Anne-Sophie Rigaud				
	Publication	PMC pubmed Central				
	DOI	10.2147/CIA.S56435				
10	Title	Smart home for elderly care: development and challenges in China	2020		1-8	Pubmed
	Authors	Quan Zhang, Meiyu Li and Yijin Wu				
	Publication	BMC Geriatrics				
	DOI	10.1186/s12877-020-01737-y				