



# Companion robots for older adults: Rodgers' evolutionary concept analysis approach

Jeongeun Kim<sup>1</sup> · Sukwha Kim<sup>2</sup> · Seongheui Kim<sup>3</sup> · Euehun Lee<sup>4</sup> · Yoonjeong Heo<sup>5</sup> · Cheol-Yong Hwang<sup>6</sup> · Yun-Young Choi<sup>7</sup> · Hyoun-Joong Kong<sup>8</sup> · Hyeongju Ryu<sup>9</sup> · Hyeongsuk Lee<sup>10</sup> 

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## Abstract

This study aims to analyze the concept of companion robots for older adults from the perspective of nursing. This study employed a concept analysis. The literature from July 2011 to June 2021 was sought from databases using specific keywords. Any quantitative or qualitative study published in English or Korean focusing on companion robots for older adults was included in the study. Rodgers' evolutionary concept analysis was used to clarify the antecedents, attributes, and consequences. Seventy-five eligible articles were studied. The findings were categorized into antecedents, attributes, and consequences. Companion robot antecedents were classified into individual factors, attitude toward robots, and caregiver and social factors. The defining attributes included human–robot interaction, function, features, structure, cost, and management of the robot being a companion. Consequences were categorized into user, caregiver, and health related. Companion robots are designed to enhance well-being, quality of life, and independence by providing service and companionship and assisting daily life. This mainly includes cognitive and social support, mobility support, relaxation, health monitoring, and self-care support through human–robot interaction. The attributes, antecedents, and consequences of companion robots identified in this study can inform future decision making and interventions by caregivers for aging in place.

**Keywords** Companion robot · Older adults · Concept analysis · Nursing care · Aging in place

## 1 Introduction

Several countries worldwide are experiencing a rapidly aging population. However, the number of healthcare professionals to care for older adults is low [1]. Furthermore, social isolation—that is, loneliness because of limited social connections—may put older adults' psychological well-being at risk [2]. The COVID-19 crisis worsened this situation, increasing interest in robots that could help create, maintain, and strengthen social relationships [3]. In this context, various technology-driven interventions are being considered alternatives [4]. Information and communication technologies (ICT), assistive technologies (AT), and human–computer interaction (HCI) technologies are interdisciplinary topics being actively pursued in research and clinical practice. Among these, robotics and artificial intelligence (AI) are

expected to substitute mindless mimicry of human behavior for the real presence of conscious caring offered by humans.

Companion robots assist older adults, enabling them to remain autonomous in their residences for as long as possible [5]. Companion robots fall under the broader umbrella of socially assistive companion robots, whose use in the care of older adults has been widely reviewed, but mostly from a quantitative perspective [6, 7] and often across a broad base of care settings not specifically residential care. The literature focusing on robots for older adults has dealt with the concept of “robot” in a context wider than mere companion robots. For instance, the authors of [2] presented the definition of robots for older adults by classifying them into companion, telepresence, rehabilitation, health monitoring, and entertainment robots. Among them, companion robots are expected to be used in interventions for the social isolation of older adults and as a support system for aging in place.

However, considering that gerontechnology involves multiple scientific disciplines, such as geriatric medicine, psychology, social sciences, computer sciences, engineering and

✉ Hyeongsuk Lee  
leehyeongsuk@gachon.ac.kr

Extended author information available on the last page of the article

design, informatics, and economics, it is difficult to establish general, agreed methodological standards for evaluating technology in clinical practice [8]. Proper understanding and use of concepts are important for psychological and physical self-management by incorporating robots into nursing. Therefore, there is a need to reach a consensus about the definition of these technologies.

Furthermore, a paradigm shift has led to a greater variety of multidisciplinary approaches and programming methods in relatively simpler interventions, such as helping older people with their work, which are used in complex contexts for multiple purposes. Therefore, a new concept analysis is required considering the different situations in which the concept of a companion robot for older adults is used and the perceptions in various fields.

## 2 Methods

### 2.1 Concept analysis method

This study uses Rodgers' evolutionary concept analysis [9]. Although there are many ways to analyze concepts, Rodgers' approach is best suited for analyzing companion robots for older people. Over time, the purpose and context of using robots will differ, and new concepts will develop. Rodgers' model is based on Wilson's conceptual analysis method [10] and reflects the changing and dynamic nature of concepts. According to Rodgers [9], "significance" is a central aspect of the concepts chosen for analysis. "Significance" posits that a concept should serve a purposeful human goal in an actual case or praxis, contribute to solving problems, and provide an adequate characteristic of the phenomenon. Several concepts can express the same idea, which can initially confuse and affect the choice of concept analysis. When a concept is defined to a greater degree, it becomes possible to describe the phenomenon and its characteristic manner regarding the distinctive character of a discipline. Rodgers' model discerns interdisciplinary divergences regarding the concept and incorporates those presented in various fields [11]. This method is suitable for analyzing companion robots for older people in need of assistance across domains, such as nursing, medicine, and engineering.

Rodgers' evolutionary method identifies and categorizes data presented in each discipline related to the concept by emphasizing data collection. The process is carried out in six steps: (1) specifying a concept and its alternate terminologies; (2) determination and selection of the appropriate scope for data collection; (3) collection of data related to concept attributes and conceptual basis, including sociocultural, interdisciplinary, and temporal variables; (4) analysis based on concept attributes; (5) provision of examples that fit the

concept, if required; and (6) determination of hypotheses and applications for further evolution of the concept [9].

### 2.2 Sources of data

Fields of study related to companion robots for older adults include nursing, medicine, and robotics. Databases, such as CINAHL, MEDLINE, PubMed, and EMBASE, were searched for related articles using "AND" and "OR" operators in titles and abstractions. Search keywords were "aged," "elder\*," "older adult\*," "older people," "robot\*," "friend," "companion," "service," and "assist\*." We used "Not" operation, "surgery," or "rehabilita\*" as keywords to exclude articles related to robotic surgery or robot rehabilitation from the search results. If available, age (over 65 years old) and language (English and Korean) filters were used. The literature in only English and Korean was searched, and the search period was limited to 10 years, from July 2011 to June 2021, considering the speed of development in robotics. One hundred and fifty-nine documents were assessed for eligibility, and 75 articles were included in the analysis (Fig. 1).

### 2.3 Data analysis process

Articles selected for consideration were evaluated for their validity and quality. A literature review was conducted until the properties of the concepts extracted from 75 articles were saturated. Data collection and analyses were conducted simultaneously. Considering the general flow and the topics covered by the selected literature, nursing literature was analyzed first, followed by medical, computer sciences, engineering, and other academic literature. The analyses were subsequently incorporated to consider the definition of concepts. Consensus and disagreement over concepts between different disciplines were examined, and conceptual changes over time were identified. Subjects repeatedly appearing in the analysis process were categorized into "Attributes," "Antecedents," and "Consequences."

## 3 Results

This section presents and discusses the results in the form of attributes, antecedents, and consequences. Figure 2 depicts the relationship between antecedents, attributes, and consequences. Figure 3 presents the chronological trend of companion robots and similar concepts.

### 3.1 Antecedents of companion robots

Antecedents are events occurring before the occurrence of the intended concept [12]. The antecedents of companion

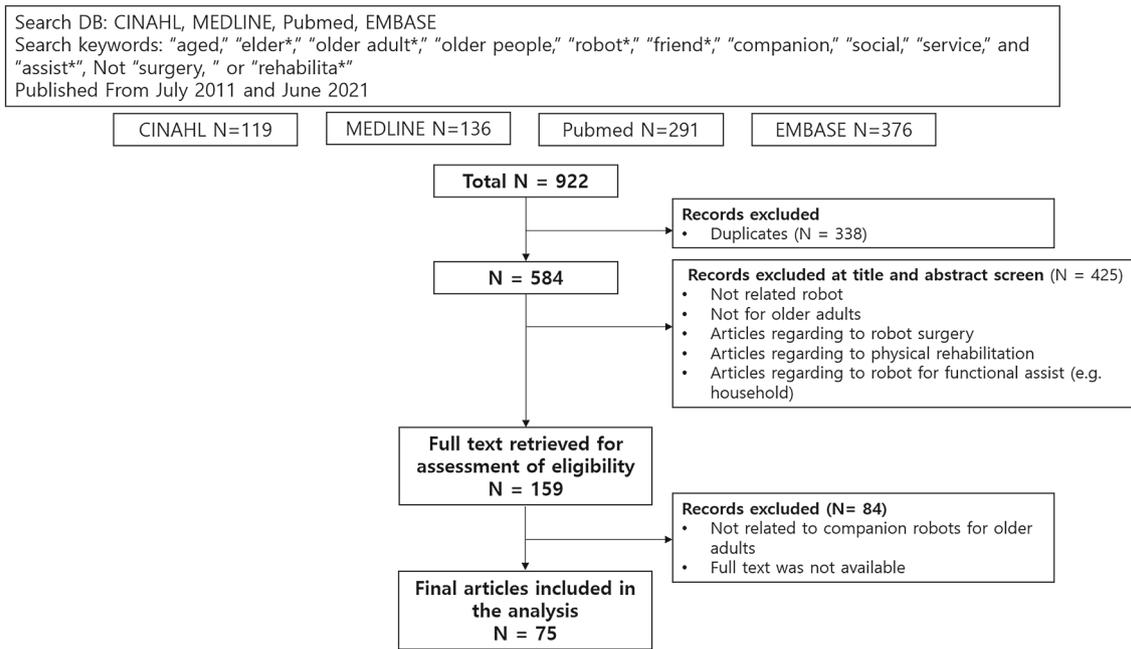
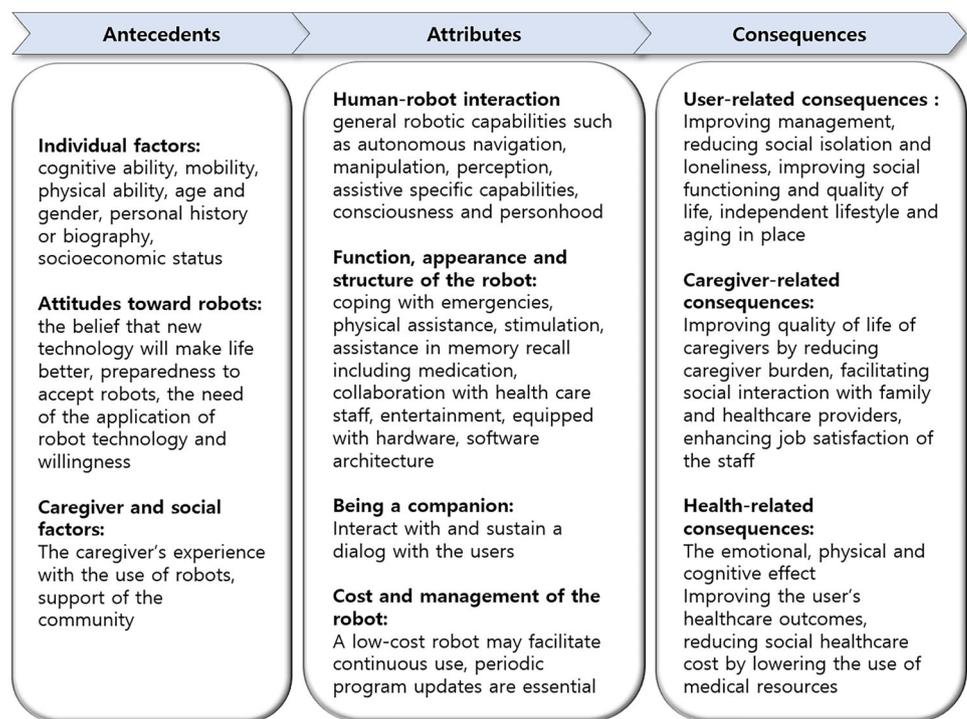


Fig. 1 Flowchart of the article selection process

Fig. 2 Proposed conceptual model of companion robots for older adults



robots relate to individual factors, attitude toward robots, and caregiver and social factors.

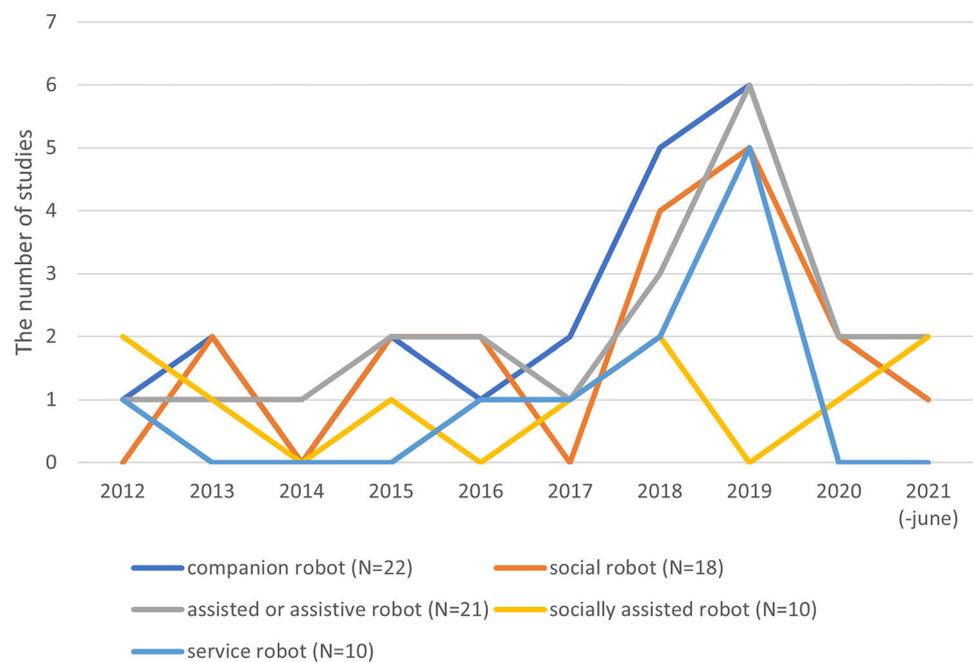
### 3.1.1 Antecedents related to individual factors

Individual factors, such as demographics, lifestyles, and personalities, are closely related to companion robots [12].

Health conditions, such as the user's cognitive ability, mobility, physical ability, including comorbidities, were mentioned as important antecedents [2, 6–8, 13–16].

Additionally, older people's personal history or biography can affect how they react and respond to their companion robots. Thus, experience with the robot or pet and the degree of knowledge related to the robot can be antecedents

**Fig. 3** Chronological trend of companion robots and similar concepts



for actual engagement with the robot [6, 7, 17–19]. Furthermore, socioeconomic status, including living environment, former occupation, retirement status, and education level, and informatics competency, including experience using computers or apps and eHealth literacy, were significantly associated with acceptance of robots [13, 15, 16, 20–23].

### 3.1.2 Antecedents related to attitude toward robots

Attitude toward robots, such as the belief that new technologies or devices will make life better, are antecedents of companion robots [13, 14, 24, 25]. Considering that older people may find it difficult to adapt to new and advanced technologies, the degree of preparedness to accept robots can affect actual robot acceptance [13]. It has also been emphasized that the need for robotic technology and willingness as an older person may affect acceptance of robots. However, some studies reported that although older adults experience difficulties managing some of their activities, they showed no signs of needing or wanting a robot [26–28]. Many older people are reluctant to change their lifestyle; therefore, new interventions in the form of robots need not change their habits or modify their environment [24, 29, 30].

### 3.1.3 Antecedents related to the caregiver and social factor

Studies reported that the caregiver’s experience with the use of robots and support of the community or caregiver in the context of their application were important priori-

ties. Caregivers identified numerous opportunities and were more open to robots [28]. However, they have difficulties imagining what robots exactly are because of it being something new and them lacking experience with robotics [31]. Studies found that training from experts skilled in robot use was essential before application [3, 13]. This suggests that even if older adults are trained in using a robot, they need to be explained the process repeatedly to help them adapt to it. Additionally, when using robots for older people in institutions, such as nursing homes, trained staff, other therapies, and a good staff-to-patient ratio should be considered [32].

## 3.2 Defining attributes of companion robots

Specifying the key attributes of a concept is an important part of its clarification, resulting in a deep understanding of the concept and differentiating it from similar or related concepts [12]. The attributes of a companion robot are “human–robot interaction,” “function, features, and structure of the robot,” “being a companion,” and “cost and management of the robot.”

### 3.2.1 Human–robot interaction (HRI)

Robots in health care are typically endowed not only with general robotic capabilities, such as autonomous navigation, manipulation, or perception, but also with assistive specific capabilities. Thus, HRI is crucial in this domain of application [33–36]. The authors of [36] mentioned that the use of robots involves concepts of consciousness

and personhood, and HRI has already become a field of research in which scholars are discovering psychological, philosophical, and even spiritual issues bearing significant implications for traditional nursing values. For example, in a practical application situation, positive behavioral responses were demonstrated through residents' touching, petting, stroking, holding, and hugging the companion robot [6].

To enjoy long-term and engaging multimodal interaction, the human–robot dialog is a key factor, which can be implemented through semantic analysis, understanding emotions from speech analysis, and the design of various robot behaviors [7, 13, 37, 38]. These dialogs need to be flexible enough to adapt to unforeseen circumstances during the conversation [38]. The authors of [20] found that older adults want to interact with robots at a moderate level; the robot need not constantly interact with its user but should be available when required. Further, for a successful HRI, the preparation for using a robot should be gradual initially, with considerable involvement of professional personnel to help the user get accustomed to the robot [13, 39].

### 3.2.2 Function, features, and structure of the robot

The functions of the robot as presented in previous studies included service-related and companion-related functions, such as coping with emergencies, physical assistance, stimulation, assistance in memory recall, including medication, nutritional support, help locate or bring objects, house-keeping, collaboration with healthcare staff, logging daily activities, and entertainment [2, 6, 8, 13, 19, 22, 24, 33, 34, 37, 40–45]. Early detection and timely reaction to emergencies, including falls, assisting and monitoring older adults using telepresence, and collaborating with healthcare staff, including exchanging data, were mentioned as important functions [19, 24, 33, 37, 46]. Additionally, assistance with mobility or rehabilitation and self-care support through cognitive or emotional stimulation are helpful functions in the life of older adults [8, 13, 15, 24, 33, 47]. They also enjoyed a companion robot with entertainment functions, including dancing, singing, storytelling, playing board games, or news reporting [15, 25]. According to studies, older adults were more receptive to the use of robots for simple and non-intimate physical assistance, such as reminders, domestic chores, and communication, while they were less receptive to the use of robots in activities, such as taking a bath, toileting, and managing finances [45, 48, 49]. Some studies on assisted robots reported that older adults value service-related functions more than companion-related functions [20], and robot functionality is more important than appearance [42].

To perform these functions, a robot needs to be equipped with hardware, such as arms, sensors, cameras, microphones,

tablets, monitors, or mobile manipulators [3, 17, 30, 50], and a software architecture capable of navigation, manipulation, and object recognition [5, 17, 37, 46]. In other words, robots can listen, respond to speech, talk in a few circumstances, recognize touch, and detect sound and light [5, 19, 38]. Social robots that could learn and adapt to people's preferences, perceptions, and the tasks at hand may fare better than a one-size-fits-all approach [12, 51, 52]. Appearance is also an important trait of companion robots; robots can be human-like, service-oriented, or animal-like. It has been reported that preference for appearance varies widely among older adults: Some prefer animal-like robots, while others want a humanoid robot [19, 20, 26, 39, 45, 53].

### 3.2.3 Being a companion

The companion robot can interact with and sustain a dialog with the users, thus reducing their loneliness and becoming friends [13, 15, 19, 24, 30, 32, 39, 41, 45, 54]. The terms “Social robot,” “Assistive or assisted robot,” or “Social assistive robot” were used interchangeably with “Companion robot” in the studies. In a study, a companion robot was defined as an assistant companion with an autonomous intelligence who should understand “user's commands” and how they feel, such as health disposition [54].

Several studies presented advantages of a companion robot, including pet robots, comparing them to pets. There is no need to feed, walk, and clean up the robot; thus, compared to a traditional pet, older adults do not need to take care of companion robots [32], and they are always available without any behavioral irregularities [55]. A companion robot can accompany older adults to the hospital or short-term care, and in case of damage, it can be repaired and replaced with a duplicate [53]. Further, robots yield similar results to complementary therapies with animals, as they generate positive emotions and promote multisensorial interactions through sight, hearing, and touch [56, 57]. The authors of [39] found that residents developed an emotional attachment to the robot in that they expressed affection for the robot and treated it as if they were a real pet. Robots helped combat loneliness by acting as a direct companion, a catalyst for social interaction, facilitating remote communication with others, and reminding users of upcoming social engagements [25, 58].

However, many participants worried about the thought of a robot as a companion. Robots that satisfy a companion-ship role were seen by some as a form of deception, given that such a relationship was thought of as counterfeit [45, 59].

### 3.2.4 Cost and management of robot

Until recently, companion robots, including robopets, have been prohibitively expensive [54]. The cost was a common reason for choosing not to purchase a device [60]. A new wave of cheaper robopets or low-cost telepresence robots may facilitate their continuous use [6, 8, 17, 18, 32, 43]. Additionally, periodic program updates and management are essential for long-term interaction [13].

### 3.3 Consequences of companion robots

Consequences are outcomes that occur due to the concept and can shed light on the social context in which the concept is used [12, 61]. There are user-, caregiver-, and health-related consequences for companion robots.

#### 3.3.1 User-related consequences

The findings suggest that the use of robots allows older adults to maintain their independence by improving health management and reducing social isolation and loneliness, thereby significantly contributing to improving their quality of life or well-being [3, 8, 15, 31, 32, 56, 62–67]. Companion robots have been widely used in addressing social isolation—a phenomenon older adults experience more than younger people because of the increased possibility of health problems and life-changing events [2, 62–64, 68, 69]. Companion robots can establish a direct relationship with the robot and enhance social contact between the users and the staff and family, thereby improving social functioning, mood, and participation [6, 18, 32, 50, 66].

Current healthcare and social policies encourage the concept of “aging in place,” where older people remain in their own residences and communities, as this is the best solution in terms of health, quality of life, and social connections of older people as well as in economic terms [8]. Companion robots may have value in supporting older adults in having an independent lifestyle and autonomy in terms of “aging in place” [19]. In other words, companion robots may enhance the ambient assisted living capabilities [33], thus prolonging independent living [17, 70]. For long-term usage, identifying features that enhance older adults’ acceptance of robots is essential [20, 25, 33, 60, 63].

#### 3.3.2 Caregiver-related consequences

Companion robots may improve caregivers’ quality of life by reducing their burdens. Specifically, the companion robot can contribute to reducing time, level of assistance, and the energy invested into caregiving, thus decreasing anxiety, fear, and task difficulty as well as increasing the safety of performing activities that require physical assistance [6, 8, 40].

The telepresence function of robots can assist healthcare providers in everyday activities [18], make access to medical care convenient for healthcare providers and patients [40], and facilitate social interaction with family and healthcare providers [37]. Moreover, companion robots can enhance the staff’s job satisfaction [18]. Abbott et al. (2019) found that the staff and family considered companion robots a therapeutic toolbox, convenient, and wonderful support [6]. In contrast, a family’s psychological burdens and time restrictions should be considered if family caregivers act as remote robot operators [71].

#### 3.3.3 Health-related consequences

Based on literature analysis, the emotional, physical, and cognitive effects of companion robots can be expected to ultimately improve the user’s healthcare outcomes and reduce social healthcare costs by lowering medical resource usage [5, 6, 18, 19, 32, 34, 43, 70, 72, 73]. Companion robots may be a useful tool in mitigating depression, agitation, anxiety, and loneliness while enhancing social connectedness, engagement, interaction, resilience, and overall quality of life for people with dementia [65, 72, 73]. For instance, companion robots significantly improve facial expressions (affect) and communication with staff (social interaction) [73]. One study reported on the esthetic appeal of the companion robot and how they engaged the residents’ visual, tactile, and auditory senses [6].

Studies have reported that behavioral and psychological symptoms of dementia can be reduced through cognitive interaction with the robot [18, 19, 34, 43]. As for the physical effects, Bates (2019) reported that the robot could increase the immune system response and reduce psychoactive and pain medications [32]. Furthermore, companion robots can improve healthcare outcomes and have economic effects. Economic effects, such as reduced hospitalization, healthcare costs, and individual and societal costs of caring, have already been reported [8, 40, 74, 75].

### 3.4 Barriers and ethical issues in the adoption of companion robots

Studies reported several concerns regarding robots in general. For instance, the complexity of using the robots and technical obstacles impede implementation in the real world [49, 69]. Older adults might fear the inability to handle the malfunctioning and rusting of the robot [20]. Further, robots may increase agitation or result in less social contact and more isolation [8, 18, 23, 31, 32]. Residents could also display excessive attachment to the robopets with detrimental effects for the individual and their relationships with other residents. Previous studies reported that residents refused to interact with the robot because of the failure to match

their expectations or desires [6, 19, 23]. In some cases, people soon lose interest in the non-living robot and its limited behavioral repertoire [53]. The benefits of robots for society and empowerment of older people must be contrasted against possible ethical concerns in the field around issues, such as deceit, infantilization, increased feeling of objectification or anxiety, loss of control and dignity, loss of privacy and personal freedom as well as reduced human contact and accountability [3, 14, 45, 49, 59, 60, 69, 75]. Concerns included the loss of jobs and personal care, while perceived benefits included allowing staff to spend quality time with residents and helping residents with self-care [3, 31, 41, 42].

## 4 Discussion

This study aimed at providing a clear definition of the concept of companion robots by specifying its diverse aspects. Rodgers' (1989) evolutionary concept analysis was used to conduct a literature review and analysis, describing the companion robot, to identify relevant precedents, attributes, and consequences based on users, place, purposes, and context [76]. The results showed that this concept is not limited to social robots used for entertainment or assistive robots used for simple tasks and that its proper implementation requires the consideration of many factors, including the needs of users and their family caregivers, the physical and functional abilities of older adults, the purpose of using robots, and the environment where the robot will be used. Although studies have shown that companion robots have been used for various purposes in different times and contexts, every study has emphasized specific aspects and outcomes. Furthermore, the literature review showed that although the development and use of companion robots are practically associated with many challenges, they are valuable, as shown by the above-mentioned consequences.

The findings indicated that companion robots are designed to enhance psychological and physical well-being, quality of life, and independence by providing companionship and assisting daily life. This mainly includes interaction, cognitive and social support, mobility support, stimulation, relaxation, reduce stress, health monitoring, and self-care support. Companion robots in the shape of a pet or a humanoid can listen, recognize speech and touch, and detect sound for smooth HRI; telepresence robots aid family caregivers as well as healthcare providers.

HRI was the first attribute considered in companion robots, with studies emphasizing that HRI is critical for long-term use [6, 7, 13, 46]. A study reported that there are differences in the preferences regarding HRI between older adults and roboticists [60]. Older adults responded positively toward life-simulation features, eye contact, robot

personalization, and obeying commands, and these are features undervalued by roboticists [60]. It proposed paying greater attention to users' preferences for robots' designs and features. Cultural, physical and social environment and application of longitudinal and simultaneous examination of uses, outcomes, and constraints should be considered in the robot design and development phase [35].

Despite the importance and high priority of interaction between users and companion robots [46], studies revealed challenges concerning facial or voice recognition, technical or usability issues (e.g., navigation failure, noise level, power consumption, and disconnecting), and the practicalities and modularity in real-life settings [3, 5, 23, 25, 31, 63, 64, 69]. Some studies showed that the robot was considered more like a toy than a supportive device for independent living because of a lack of technological robustness and slow performance [72]. Improvement of social skills and practicalities, including resolution of technical issues, were suggested to promote long-term use.

The second attribute considered the function, features, and structure of the robot. This is also closely related to the interaction between the users and the robot. Robots fulfill several functional and structural needs for healthcare support functions, such as timely reaction to emergencies and assisting and monitoring older adults through the telepresence of healthcare providers [3, 24, 50, 62]. The need for robots to perform functions closely related to health care is considered because older adults prefer aging in place to living in an institution or hospital.

Technology is not a device that helps to carry out specific tasks. However, it seems that technical ambitions still guide robots' development and not older adults' requirements [52]. Needs and capabilities vary across users [26, 29]. To be truly effective, the technologies need to be integrated into existing health and social contexts with the final aim to fit into a personalized and comprehensive older adults' everyday life [8, 19, 23, 24, 26, 45, 51, 68]. This emphasizes the complexity of service robot development for older adults and highlights the need for a personalized and flexible solution [25, 51]. Familiar product forms with augmented product functionalities would fit the system and maximize early product adoption [26].

Being a companion was the third attribute. "Being a friend and helper" was the most desired trait of a robot service [19], and the robot can live with the older adults and become a conversation partner, thus forming a friendship [18]. This can help combat loneliness, a major social issue, thus making it a good support system for aging in place.

However, there is another viewpoint according to which informal care will become increasingly important in future and will not be replaced by companion robots [31, 36, 77]. Caring has a subjective and sentient dimension and is not confined to performing tasks. A study that examined the

opinion of future healthcare professionals regarding the use of assistive robots reported that the robot should not be an older person's companion but only act as an assistant [41]. Older adults were not straightforwardly rejecting robotic assistance; they believed that robots could supplement human assistance in some ways [77]. This implies that robots should not aim to replace humans but should perform certain tasks. Robots could be introduced in the environment of nursing practice as assistants, supplements, and complements [36]. In this situation, healthcare providers should call for more specific definitions of their intended role of the robot. In a study, nurses responded negatively about using robots for nursing care; however, they were generally positive about their use for service, monitoring, and communication tasks [78]. For healthcare providers, including nurses, openness is required to not only accept but also embrace and contribute to the design of the technology brought to market [79].

Despite older adults encountering difficulties in many activities of daily life, a robot has been judged as an interesting solution only in some circumstances [20, 71]. Older adults worry about being bothered by companion robots while resting; however, experts think that older adults might feel lonely and need companionship in these situations [80]. A similar study showed that older adults are more positive toward the listening robot than the speaking robot [81]. Monitoring and managing emergencies, helping with reaching, fetching, and carrying objects that are too heavy or positioned in unreachable places: These are tasks for which robotic support has been widely accepted, while tasks involving direct physical contact between the person and the robot are not appreciated [71]. This is also related to the ethical issue where it is necessary to provide older people the authority to choose tasks to be entrusted to the robot.

Currently, limited evidence demonstrates that robots enable aging people to continue living at home [82]. Recent reviews have reported that many technological intervention studies targeting older people lack quantitative outcomes as a part of their evaluation process, and there is a lack of consensus as to which outcomes to use [32, 83]. Several studies were conducted in laboratories and hospital clinics. For robots supporting independent living of older adults, most were found to be under development or in the concept phase, and only a few robots turned to be commercially available [51]. Further, existing research focuses on the internal validity of robots. There is significantly less research investigating their external validity, such as organizational or wider contextual factors affecting their implementation in real-world practice [69]. More research is required to confirm the usefulness of real-world applications in older adults' residences.

Psychosocial and ethical issues, cost, safety issues, and intervention time may impede the broad use of technology

in older age. Some ethical guidelines and practical comments are available for roboticists [45, 59, 75]. The summoning of an internal ethics board can help facilitate this process, especially where users' dignity in connection with tasks the robot fulfills or interaction with a robot are concerned [59]. Involving staff and/or relatives early on can help identify ethical issues, misunderstandings, and requirements and expectations. Older adults and their autonomy must be respected by giving them choices regarding robots and their functions [45]. If the interventions change their lifestyle significantly, it is imperative to help them adapt to robots gradually. To avoid deception, informing older adults in a comprehensible way about the real capabilities and limitations of robots is essential [45, 59]. Informed consent is one tool to address privacy issues [75], and no-go zones should be defined with users and caregivers before the actual deployment [59].

It is also necessary to prepare for high purchasing costs, updates, and failure for the protection of services as well as their long-term availability. Roboticists and manufacturers can use a risk assessment assistant tool for companion robots based on hazard scenarios [75, 84]. An integrated, multidisciplinary approach could be the solution. Successful technology development requires great effort in interdisciplinary collaboration. The involved teams include clinicians, social and behavioral scientists, physiotherapists and psychotherapists, engineers, computer scientists, designers, end-users, and policy experts [8, 52].

The limitation of the present study lies in the fact that the researchers only reviewed studies published in English and Korean and full texts of which were available.

## 5 Conclusion

This study systematically analyzed the definition and described the concept of a companion robot for older adults. The objective of this analysis was to provide conceptual clarity and direction for future research and advance knowledge for formal and informal caregivers by providing an operational definition of the companion robot. A better understanding of the concept will assist caregivers in implementing interventions where necessary.

By defining attributes, antecedents, and consequences of the companion robot through a concept analysis, conceptual clarity has been obtained. It is necessary to consider users' needs, functional ability, and usage context of the robot. A great effort in interdisciplinary collaboration is necessary to integrate technology into existing health and social service systems. The conceptual clarity provided by this analysis will inform future decision making and interventions by caregivers for aging in place. The concept of companion robots for older adults can underpin future research into companion robots for different purposes and in different contexts.

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## Author and Affiliations

Jeongeun Kim<sup>1</sup> · Sukwha Kim<sup>2</sup> · Seongheui Kim<sup>3</sup> · Euehun Lee<sup>4</sup> · Yoonjeong Heo<sup>5</sup> · Cheol-Yong Hwang<sup>6</sup> · Yun-Young Choi<sup>7</sup> · Hyoun-Joong Kong<sup>8</sup> · Hyeongju Ryu<sup>9</sup> · Hyeongsuk Lee<sup>10</sup> 

Jeongeun Kim  
kim0424@snu.ac.kr

Sukwha Kim  
kimsw@snu.ac.kr

Seongheui Kim  
hemyeong@snu.ac.kr

Euehun Lee  
danbee91@kaist.ac.kr

Yoonjeong Heo  
hyjkm@snu.ac.kr

Cheol-Yong Hwang  
cyhwang@snu.ac.kr

Yun-Young Choi  
melusine@snu.ac.kr

Hyoun-Joong Kong  
gongcop@melab.snu.ac.kr

Hyeongju Ryu  
rnyoo@snu.ac.kr

<sup>2</sup> Department of Reconstructive Plastic Surgery, Medical Big Data Research Center, Seoul National University College of Medicine, Seoul, Republic of Korea

<sup>3</sup> College of Fine Arts, Seoul National University, Seoul, Republic of Korea

<sup>4</sup> Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea

<sup>5</sup> College of Music, Seoul National University, Seoul, Republic of Korea

<sup>6</sup> College of Veterinary Medicine, Seoul National University, Seoul, Republic of Korea

<sup>7</sup> College of Humanities, Seoul National University, Seoul, Republic of Korea

<sup>8</sup> Transdisciplinary Department of Medicine and Advanced Technology (TDMAT), Seoul National University Hospital, Seoul, Republic of Korea

<sup>9</sup> Seoul National University Hospital, Seoul, Republic of Korea

<sup>10</sup> College of Nursing, Gachon University, Seoul, Republic of Korea

<sup>1</sup> Research Institute of Nursing Science, Seoul National University, Seoul, Republic of Korea