

# Measuring the Acceptance of Smart Home-Based Technologies Among the Older Adults: Systematic Literature Review

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**Abstract:** The general acceptance of smart home-based technologies among older adults is investigated in this systematic literature review, aiming to provide a comprehensive understanding of the methodologies used to measure this acceptance. Given the pivotal role of housing in the wellbeing of older adults, smart home-based technologies have emerged as potential solutions to enhance their independence and safety. Despite the numerous benefits associated with these technologies, their acceptance remains a challenging aspect. The review has demonstrated that the methodology for measuring acceptance among older adults exhibits significant heterogeneity, often depending on prior utilization of a particular technology. Beyond this observation, the review identifies additional trends and serves as a foundational resource for advancing research on the digitization of home environments for older individuals.

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**Keywords:** older adults, home environment, digitalization, smart technology, technology acceptance

## 1. INTRODUCTION

Housing is considered as one of the most important factors in the quality of life and wellbeing of individuals (Kerbler & Kolar, 2018; Mandič, 2011). It is frequently associated with the concept of home, serving as a focal point for the individual fulfilment of various needs (Kerbler et al., 2017; Somerville, 1997).

Home becomes especially important in old age (Mandič, 2011; Sixsmith, 1990). As they grow old, people become strongly attached to the home environment they have spent most of their lives (Anton & Lawrence, 2014; Tuan, 1980). Therefore, older adults aspire to stay in their homes and retain their independence for as extended duration as feasible (Gobbens & van Assen, 2018; Sendi et al., 2002).

In modern digital society, the notion is that older adults should have the capacity to extend their residence in their home environment and be capable of maximal independence in their daily lives through digital technologies and systems. They make it possible to digitalize older adult's homes and transform them into smart homes. Smart homes combine a variety of devices and special interfaces (sensors) that are integrated into the user's environment unobtrusively and in the smallest dimensions possible to monitor the user's lifecycle. Through the integration of smart home technologies, specific services of particular significance to older adults can be interlinked, for instance, social assistance and healthcare, home care, safety, education, and services allowing them to maintain social contacts (Kerbler et al., 2021; Tipaldi & Natter, 2022). The digitalization of home environments thus makes it possible for older adults to

remain independent and lead a quality life in their homes (Andersson et al., 2019; Verloo et al., 2020), and above all, smart home technologies contribute to increasing the safety of the older adults (Arar et al., 2021).

Despite the advantages it offers, the digitalization of home environments of older adults comes with limitations (Kerbler, 2012). Research indicates that older adults often exhibit scepticism towards digital technologies, and maintain a low level of acceptability for such technologies and systems (see Astell et al., 2020; Berkowsky et al., 2017; Hanson, 2001). Therefore, in Slovenia, a study is currently underway to examine the digitization of home environments for older adults, with one objective being to gather extensive empirical evidence on their general acceptance of home-based technologies. In pursuit of this objective, a systematic literature review was conducted to identify studies measuring the acceptance of home-based technologies among older adults. Additionally, studies focusing on assessing the acceptance of specific technologies were included in the review. This decision assumed that valuable information and insights for addressing the measurement of general technology acceptance, as well as identifying the methodologies used for these measurements, can also be derived from such studies. Detailed descriptions of the various types of technologies are not of prime importance within the scope of the mentioned objective. The results of the systematic review, presented in this article, will be subjected to qualitative analysis, and will serve as the foundation for the referenced study.

## 2. METHODOLOGY

The protocol and process for this systematic literature review followed Arlene Fink’s, Mark Petticrew and Helen Robert’s instructions (Fink, 2019; Petticrew & Roberts, 2006). All authors engaged in discussions and contributed at every individual step. The databases Scopus, Web of Science (WoS), and PubMed, were included in the search, with no time limits (i.e., the search was conducted in December 2023). All included databases were searched using the following keywords in various combinations: *tech, digital technology, technology, measuring, assessing, quantifying, estimating, acceptance, home, elderly, older adults, older people, elders, seniors, smart home, intelligent home, automated home, digital home, home automation, home-based technology, domestic technology, household tech*. In PubMed and WoS, after the third search, no new results were found. For the Scopus database, seven different searches were conducted before no new results were found. From all the retrieved results, journal articles containing ‘acceptance’ or ‘acceptability’ in the title were transferred to a reference management database (Zotero 6.0.30). Following the elimination of duplicated articles (Fig. 1), the review process advanced according to predetermined eligibility criteria outlined in Table 1. Screening involved examining titles, keywords, and abstracts. The number of studies and the reasons for exclusion from further consideration are graphically presented in Fig. 2. After the initial scan, a limited number of studies surfaced, and these were subjected to a second screening by thoroughly reading the entire text. The content’s appropriateness and the methodological quality of the studies underwent meticulous examination. Studies that fully met all inclusion criteria were selected for qualitative analysis.

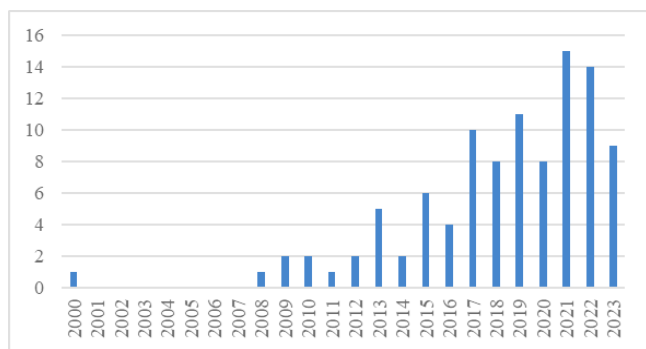


Fig. 1. The dynamics of publications containing selected key words in the publications indexed by PubMed, Scopus, and WoS until December 2023.

Table 1. Predetermined eligibility criteria

|                  | Inclusion criteria | Exclusion criteria  |
|------------------|--------------------|---|
| Publication type | journal article    | book, thesis, letter, editorial                           |
| Language         | English, Slovene   |   |
| Setting          | home               | clinical environment, nursing home, retirement community, |

|                          | environment                | community dwelling   |
|--------------------------|----------------------------|--|
| Participants or subjects | older adults over 60 years | mixed age groups, groups comprising the older adults, their caregivers, and families                                 |
| Research design          | empirical study            | review article   |
| Content                  | technology acceptance      | model presentations, model developments, factors influencing acceptance, acceptance of educational/training programs |

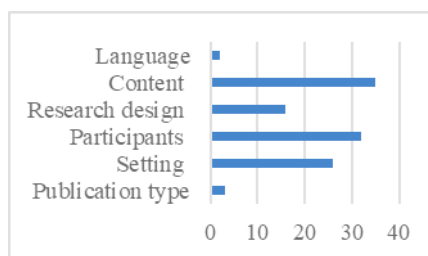


Fig. 2. Reasons for the exclusion of articles based on predetermined criteria (some studies were excluded for multiple reasons)

### 3. RESULTS

The initial combined searches produced 141 articles, and after removing duplicates, 102 articles remained. Subsequently, 15 full-text articles underwent eligibility assessment after the initial screening. The second screening revealed a limited number of studies that conform to the established criteria. The process of searching and the list of relevant studies are presented in Fig. 3.

### 4. DISCUSSION

This systematic literature review aims to identify studies that have measured the acceptance of home-based technologies among older adults, therefore, the predominant rationales for excluding studies from further consideration were related to the study setting, such as nursing homes (see, e.g. Auerswald et al., 2020; Blekken et al., 2015; Fortuna et al., 2018) or community dwelling (see, e.g. Liston et al., 2021; Luijckx et al., 2015; Nai et al., 2023) and the characteristics of the study participants, who typically represented broader age groups (Biermann et al., 2018; Currie et al., 2015; Dawson et al., 2017; Dupuy et al., 2021; Hall et al., 2019; Offermann et al., 2021; Tsung-Yin et al., 2019; Wilkowska et al., 2022).

Derived from the systematic literature review, in the final analysis, studies predominantly focus on measuring the acceptance of specific technologies involving varied combinations of sensors integrated with other technological components (Cohen et al., 2016; Etemad-Sajadi & Gomes Dos Santos, 2019; Marschollek et al., 2014; Pérez-Rodríguez et al., 2021; Rogerson et al., 2020). All participants in the

included studies possessed practical experience with the mentioned technologies and afterward, researchers measured the participants' acceptance levels toward the presented technology, applying different methodology approaches. Etemad-Sajadi and Gomes Dos Santos (2019), as well as Pérez-Rodríguez et al. (2021), employed a quantitative methodology for their research, rooted in the Technology Acceptance Model (TAM). Likewise, the study conducted by Cohen et al. (2016) is grounded in a modified theory of TAM; however, it employs a mixed-methodological approach. Rogerson et al. (2020) and Marschollek et al. (2014) initiated their inquiry with a qualitative methodology for measuring acceptance; however, they did not furnish a theoretical foundation for constructing the interview questions. Only two studies examined the overall acceptance of smart home-based technologies among the older adults. The study by Arar et al. (2021) employed a mixed-method approach, incorporating both a survey and interviews rooted in the TAM. In the subsequent research undertaken by Sitar-Taut et al. (2018), the methodology lacks a comprehensive description, leaving undisclosed the theoretical underpinnings guiding the formulation of the questionnaire for the quantitative survey. The review of all included studies showed that most research dealing with measuring technology acceptance among older adults draws from the theory of TAM (Arar et al., 2021; Cohen et al., 2016; Etemad-Sajadi & Gomes Dos Santos, 2019; Pérez-Rodríguez et al., 2021), but in some cases this methodological framework is enriched by incorporation of newer model variations (Arar et al., 2021; Cohen et al., 2016) or, alternatively subject to complete adaptation to suit particular contextual exigencies (see Etemad-Sajadi & Gomes Dos Santos, 2019).

Beyond the emphasized aspects associated with methodology, it is possible to present several other distinctive trends within the researched thematic domain. The initial observation that is highlighted is that the majority of studies, including our own, consistently identify smart home technologies as a solution for facilitating independent living among older adults within their homes despite their diminishing physical and cognitive capabilities (see Arar et al., 2021; Cohen et al., 2016; Etemad-Sajadi & Gomes Dos Santos, 2019; Pérez-Rodríguez et al., 2021; Sitar-Taut et al., 2018). In this context, a notable gap has been identified, as the older adults demonstrate reluctance towards embracing digital technologies (see González-Oñate et al., 2015; Hanson, 2001; Marquié et al., 2002; Richardson et al., 2005), just as they resist moving from their homes to which they have formed strong attachments over their lifetimes (Anton & Lawrence, 2014; Brown & Raymond, 2007; Hay, 1998; Jorgensen & Stedman, 2001; Lewicka, 2011; Mishra et al., 2010; Sampson, 1988; Tuan, 1980; Williams & Vaske, 2003). Consequently, we posit that it is imperative to further investigate which alternative resonates more closely with older adults and meticulously present the advantages that each option holds for them. Based on our current understanding, a study addressing this specific research question is currently non-existent.

The second observation pertains to the content of the examined studies. The systematic literature review reveals a predominant focus on studies concerning the acceptance of smart home technologies among older individuals, aimed at assisting them in maintaining their health (see Arar et al., 2021; Cohen et al., 2016; Etemad-Sajadi & Gomes Dos Santos, 2019; Marschollek et al., 2014; Pérez-Rodríguez et al., 2021; Rogerson et al., 2020; Sitar-Taut et al., 2018). Studies of this nature commonly depict a high level of technology acceptance. Nevertheless, an inquiry arises regarding whether older adults would manifest a comparable level of acceptance without compromised home security resulting from physical or cognitive decline. In the literature review, only one study was identified that examined the acceptance of smart home technologies among older adults, which, besides monitoring health, also facilitates or streamlines daily tasks (Arar et al., 2021). Arar et al. (2021) identified 10 key technologies that assist older adults in maintaining their homes and enhancing their safety and security. Therefore, more attention should be devoted to researching the acceptance of these technologies, which can play a crucial role in maintaining the independence of older adults at home.

Despite the limited size of the final sample, which forms the basis for this qualitative analysis, two studies included in the conclusive review, namely Arar et al. (2021) and Etemad-Sajadi and Gomes Dos Santos (2019), demonstrate inconsistent usage of the terms 'acceptance' and 'adoption'. In our study, we originated from the term 'acceptance', defining it as the willingness or readiness of older adults to utilize a specific technology, while 'adoption' is construed as the process of integrating new technology into regular use. This is a limitation that may have influenced the small number of final included studies, especially if multiple researchers did not consistently adhere to this distinction in the meaning of the term.

## 5. FURTHER RESEARCH

Upon initial examination, the digitalization of older adult's home environments emerges as an elegant prospect, offering advantages not only to older adults but also extending benefits to their informal caregivers and society as a whole. However, there is a conspicuous lack of attention to the inquiry into the acceptance of digitizing home environments for older adults, particularly concerning its comparison with other living arrangements, such as relocation to a care facility. Given the current absence of exploration into this matter, further research should delve deeper into this topic. Moreover, most studies measure technology acceptance in the context of health maintenance, with only a few examining general technology acceptance; therefore, further research is needed to address this perceived gap as well. Subsequently, acceptance will be assessed through further research, considering the health status of the older adults, and distinguishing between those deemed healthier and those classified as less healthy. Given terminological inconsistencies in certain studies, further research needs to pay particular attention to consistently using the term 'acceptance' rather than 'adoption'. A limitation of this

review is the restricted scope of included studies, attributed to narrowly defined inclusion and exclusion criteria. Given the topical relevance of the subject, encompassing older adults, ageing at home, and digitization, increased research dedicated to elucidating the interconnections among these themes is advocated for. This recommendation stems from the observation that acceptance studies frequently span excessively broad age groups, despite their primary intention to investigate technology acceptance specifically among older adults.

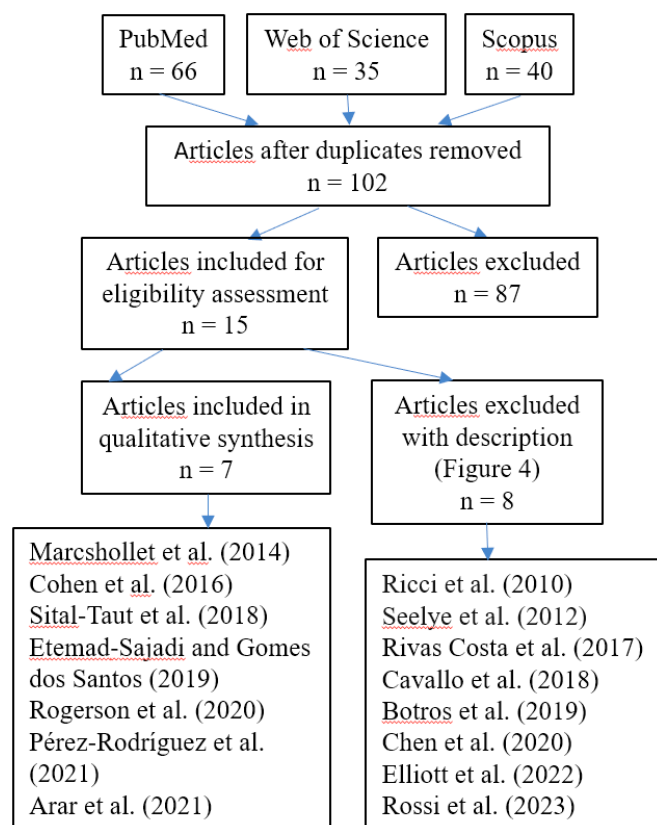


Fig. 3. The process of searching with the list of relevant studies.

## 6. CONCLUSIONS

The strong attachment of older adults to their homes, coupled with their preference for aging in familiar environments, could be realized through raising awareness of digital culture and a gradual shift in their values, beliefs, and behaviors. This transition facilitates the easier acceptance of smart home-based technologies, which importantly contributes to the transformation of their home environments into smart homes. Despite potential conflicts between older adults and smart home-based technologies, fostering digital culture among this demographic group can gradually mitigate such tensions. It is essential to highlight the advantages of smart home-based technologies for older adults, including simplifying their daily activities and notably the enhancement of home security. Furthermore, it is imperative to acknowledge the individual pace at which older adults can accept new technologies and to encourage their gradual assimilation. Within this systematic literature review, gaps

have been recognized that require thorough examination in subsequent research, considering the critical role of the ensuing information in shaping appropriate policies for older adults to foster greater digital diversity and inclusion within society.

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