



Usability Concerns and Design Solutions in Mobile Health Applications for Older Adults

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Abstract. Mobile health applications (mHealth) are known for their potential to enhance health delivery and improve health outcomes for older adults. However, despite their broad potential, significant usability concerns persist among older adults, preventing them from gaining advantages from mHealth and hindering their adoption. This paper critically examines the key usability concerns older adults face when interacting with mHealth. This research adhered to the PRISMA guidelines in the process of retrieving and selecting articles, resulting in the review and analysis of 117 articles published between 2014 and 2024. The results highlight several prevalent usability concerns, including complex navigation, overwhelming instructions, inadequate feedback mechanisms, and limited personalization options, which overlook the diverse needs of older users. Furthermore, this study identified design solutions to address these concerns, including straightforward navigation, clear instructions, and consistent layout/design tailored to older adults. Moreover, this paper established a visual representation that maps identified usability challenges to corresponding design solutions, serving as a valuable resource for researchers, designers, and developers working on mobile health applications for older adults. Integrating these solutions into the development process can significantly improve user experience and increase engagement in health interventions.

Keywords: *interface design; mobile applications; mHealth; older adults; usability.*

1 Introduction

The expansion of technology has greatly impacted global healthcare, especially during the COVID-19 pandemic, which accelerated the growth of digital health solutions. Many countries have adopted ICT and adjusted policies for contact-free interactions [1]. Consequently, mobile health applications have gained prominence since 2017, offering a range of benefits for healthcare services [2].

Mobile health applications, known as mHealth, are a subset of e-Health, which refers to medical and public health practices supported by mobile-based platforms, and have the potential to enhance healthy lifestyles for everyone, including older adults [3]. A survey conducted in October 2021 revealed that younger generations are more likely to use virtual healthcare services than older individuals. The survey suggests a need to increase awareness and knowledge about the benefits of virtual healthcare services, especially for the ageing population [4]. However, a study by [5] revealed that older adults are generally familiar with smartphones, but 70% of them primarily use smartphones only for social media and communication apps.

Moreover, previous studies have stated that one of the key factors influencing the adoption of technology by older people is its usability, as perceived in terms of its usefulness and ease of use [6]. Effective interface design is essential for enhancing usability and accessibility; therefore, the design should not overwhelm older users with too many features or complicated navigation [7]. A comprehensive analysis is necessary to address the usability challenges specific to older adults in this area. Researchers must occasionally explore how these challenges relate to interface design principles for updates. Thus, this study aims to bridge this gap by analyzing publication trends on usability issues in mHealth for older adults, reviewing key research topics/areas, and critically examining how interface design can enhance the accessibility of mHealth technologies for this demographic. This paper seeks to inform future research and guide the development of more inclusive mHealth applications by providing a deeper understanding of these issues.

The review was guided by the following research questions: 1) What are the research topics/areas in the usability of mobile health applications for older adults over the last decade? 2) What usability concerns are most discussed when using mHealth applications among older adults? 3) What solutions are recommended for designing mHealth applications for older adults?

In summary, this paper made the following key contributions: 1) identification of key research topics/areas in mHealth usability that have been highlighted over the last decade; 2) a comprehensive analysis of the usability challenges frequently encountered by older adults when interacting with mHealth applications; 3) an outline of design solutions to address the usability concern among older adults; and 4) establishment of a visual representation that associates usability concerns to corresponding design recommendation, serving as a resource for future researchers in creating mobile health applications tailored for older adults.

The remainder of this paper is organized as follows: Section 2 provides the research background, Section 3 describes the method used, Section 4 presents the

findings of this study, including usability issues, Section 5 discusses the paper's findings, and conclusions are drawn in Section 6.

2 Research Background

Usability is a critical factor that affects mobile app adoption. Users prefer apps that are simple to use, function as expected, and deliver value. A study [8] defines usability as *“the capability in human functional terms to be used easily and effectively by the specified range of users, given specified training and user support, to fulfil the specified range of tasks, within the specified range of environmental scenarios”*. Meanwhile, according to ISO 9241-11:2018 [9], the objective of designing and evaluating visual display terminal systems, products, and services for usability is to enable users to achieve their goals and meet their needs in a particular way effectively, efficiently, and with satisfaction, taking into account the context of use.

Nowadays, it is essential to research the usability of mobile applications more extensively and persistently. One early study [10] highlights the importance of usability studies in mobile applications, effectively addressing potential usability concerns to ensure that applications are user-friendly and meet users' expectations. Researchers and practitioners can effectively assess the efficiency, effectiveness, and user satisfaction of mobile applications across various sectors by implementing usability testing. This process provides valuable insights into users' needs, preferences, and behaviors, ultimately enhancing the overall user experience, interface design, and functionality of these applications.

Studies have shown that mHealth tools can positively impact the health-related quality of life of older adults, particularly in terms of health management [11]. Previous research indicates that mobile apps can help older adults and their caregivers manage medical appointments, medications, and overall health status [11,12]. However, several barriers exist to the adoption of mHealth apps among older adults. One key factor in the acceptance of mHealth apps among older adults is their usability and research in this area has increased significantly in recent years [13]. Therefore, usability studies are essential for determining the effectiveness and user-friendliness of such apps for older adults [14].

3 Methodology

This review was conducted using data retrieved from the Web of Science (WoS) database. The methodological process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [15]. Figure 1 depicts the article selection process flow diagram, where the keywords used were “usability” AND “mobile health” OR “mHealth” AND “mobile app” AND

“senior citizen” OR “older adult”. The search was limited to articles published in the English language between 2014 and 2024. Based on these criteria, a total of 2707 articles were initially retrieved.

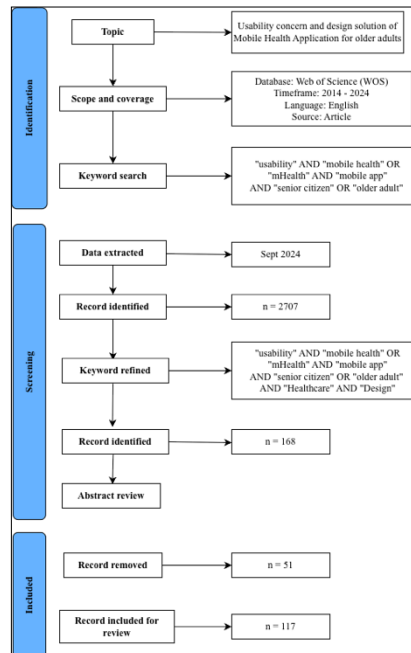


Figure 1 Methodology diagram based on PRISMA.

To focus the research scope, the search was refined by adding two additional keywords, which were “design” AND “healthcare”. This refinement yielded 168 articles. The articles were filtered by reviewing each article’s abstract to ensure its relevance to the study objective. As a result, 51 papers unrelated to mHealth technologies, usability, and older adults were excluded. The excluded papers addressed caregivers and healthcare workers using mHealth or explored other interventions, such as IoT. Finally, 117 relevant studies remained for detailed review and analysis in this paper.

4 Results

This section details the findings that respond to the research questions outlined in this review.

4.1 What are the Research Topics/Areas in the Usability of Mobile Health Applications for Older Adults over the Last Decade?

Over the past decade, there has been a significant increase in research related to mHealth for older adults, with a focus on usability and design. Data from Figure 2 indicates a rising trend in publications on this topic from 2014 to 2024 based on a selection of 117 articles.

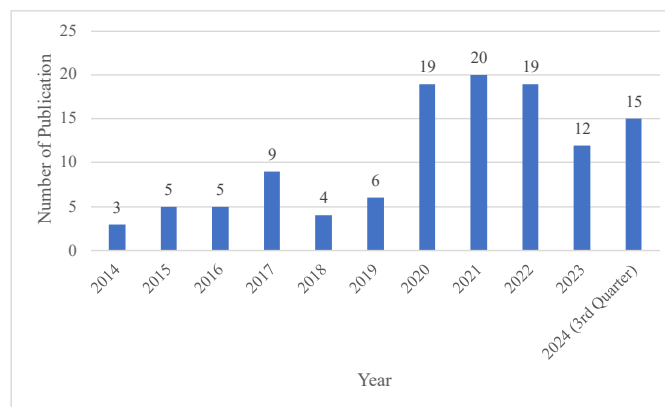


Figure 2 Number of publications from 2014 to 2024.

The years 2020 to 2022 saw the highest number of publications, reflecting increased efforts and growing attention to mHealth values, especially during the COVID-19 pandemic, when real-time information sharing and rapid decision-making became critical [16]. As of the third quarter of 2024, this research area continues to expand, with rising publication numbers and substantial citation impact proving its perceived quality and influence. Table 1 lists the most cited papers, each with over 40 citations, highlighting the variety of health issues that older adults face and that mHealth can address. However, researchers still need to be more concerned about its usability among older adults to ensure its effectiveness and increase their interest in adopting it.

The most cited project [17] examines the usability challenges of diabetes management apps, called the DeStress Assistant (DeSA). It highlights solutions to accommodate the sensory and cognitive declines associated with the rising prevalence of diabetes in older populations. It also reveals usability concerns, such as the absence of a welcome wizard, confusing icons, and a lack of error notifications, resulting in moderate ratings in their initial results. However, the

results improved in subsequent evaluations after targeted modifications. These findings highlight the necessity of involving older users in the design process, as simple modifications can enhance app usability and increase adoption. Apps designed for the general population may not be suitable for older users.

Table 1 Most-cited articles.

Article title	Year	Total citation	Research Area
Usability Pitfalls of Diabetes mHealth Apps for the Elderly [17]	2016	72	Endocrinology & Metabolism; Research & Experimental Medicine
Categorizing Health Outcomes and Efficacy of mHealth Apps for Persons With Cognitive Impairment: A Systematic Review [18]	2017	59	Health Care Sciences & Services; Medical Informatics
Human-Centered Design Study: Enhancing the Usability of a Mobile Phone App in an Integrated Falls Risk Detection System for Use by Older Adult Users [19]	2017	45	Health Care Sciences & Services; Medical Informatics
Novel mHealth App to Deliver Geriatric Assessment-Driven Interventions for Older Adults With Cancer: Pilot Feasibility and Usability Study [20]	2018	44	Oncology
Barriers to and Facilitators of the Prescription of mHealth Apps in Australian General Practice: Qualitative Study [21]	2020	42	Health Care Sciences & Services; Medical Informatics

Other listed articles highlight the importance of User-Centered Design (UCD) in developing mobile health (mHealth) applications tailored for older adults to improve usability. The project by [21] identifies barriers such as healthcare providers' lack of education and training, which affects older patients' access to mHealth solutions. While [19] emphasizes that incorporating older users' feedback enhances usability, the variability in usability metrics suggests that further evaluation is necessary to ensure effectiveness. Additionally, [18] notes that while mHealth interventions can have a positive impact on cognitive health, the evidence remains limited and requires further investigation. Meanwhile, another study [20] demonstrates the potential of mHealth apps to deliver geriatric assessments, although challenges persist in implementation. Overall, these studies agree on the need for tailored, user-friendly mHealth solutions to improve health outcomes for older adults.

4.2 What are the Most Discussed Usability Concerns when Older Adults use mHealth Applications?

This section summarizes usability concerns when older adults use mHealth. Based on 117 papers reviewed, the most frequently reported issue is the difficulty in processing complex instructions due to high cognitive load. This issue causes older adults to decline in memory and reasoning and can affect their ability to comprehend processes on the interface [22]. It also makes it difficult for them to navigate through the app. As a result, they often require assistance to complete tasks. Additionally, older adults who are less proficient in using computers or technology also feel more anxious about it. This anxiety becomes a barrier to adopting mHealth. Physical impairments also affect their ability to interact with touchscreen interfaces, as reduced dexterity makes it difficult to perform tasks, leading to errors and a decrease in overall usability. Figure 3 illustrates the percentage distribution of usability concerns identified across the selected studies. As shown, the top 3 most frequently reported challenges are cognitive load and interface complexity (16.34%), sensory and physical impairments (11.96%), and limited support or feedback mechanisms (5.98%). Other factors are recorded from 4.27% to 1.75%. Table 2 presents the corresponding explanations of the concerns, arranged from most to least.

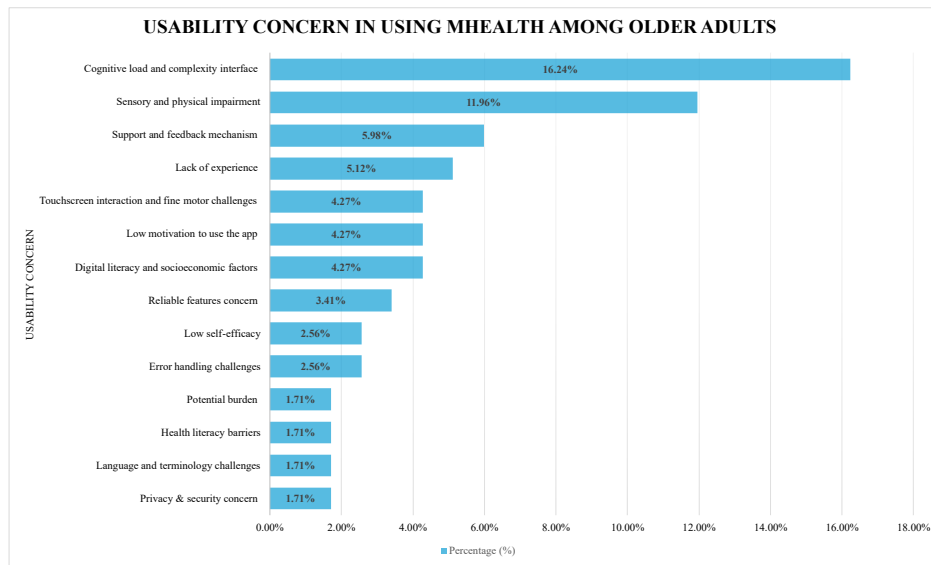


Figure 3 Percentages of usability concerns from the literature.

Table 2 Usability concerns in using mHealth among older adults.

Usability concern	Key issue summary	Paper
Cognitive load and complexity of the interface	Older adults with cognitive challenges struggle to process complex instructions and navigate multiple screens. Unclear interface elements and complicated tasks often cause them to feel overwhelmed, confused, frustrated, and error-prone, leading to loss of interest and engagement with the app.	[19,23–40]
Sensory and physical impairment	Older adults with physical impairments make errors when interacting with interfaces due to reduced dexterity and strength. Visual impairments make reading small font text, identifying buttons, and completing tasks difficult. Hearing loss hinders interaction with sound-based features.	[19,23–28,30–32,34,38,40,41]
Support and feedback mechanism	Older adults are afraid to use technology independently and require support, such as caregiver or family assistance. Unclear feedback within apps also makes it difficult for them to know whether their actions are successful.	[18,19,24,28,33,35,39]
Lack of experience	Older adults feel anxiety when using an app because they have no prior experience.	[18,26,31,39,42,43]
Digital literacy and socioeconomic factors	Older adults face difficulties in adopting mHealth technologies due to limited technical literacy, minimal formal education, and a lack of skills with digital devices, do not own smartphones, or perceive technology as costly.	[31,33,42,44,45]
Low motivation to use the app	Older adults do not feel motivated to engage with technology.	[25–27,29,46]
Touchscreen interaction and fine motor challenges	Older adults struggle with the touchscreen interface due to delayed response when tapping, causing unintended actions like activating other functions. Hand tremors hinder precise movements such as scrolling or tapping small buttons, reducing accurate interaction.	[23,29,36,38,41]
Reliable features concern	Older adults feel inconvenienced and discredited by unreliable features and features that are not related to their needs.	[18,20,42,43]
Error handling challenges	Older users may feel frustrated by the limited options for correcting errors and the absence of clear instructions.	[19,29,34]
Low self-efficacy	Older adults lack confidence in using technology, affecting their willingness to engage with mHealth services.	[42,43,47]
Privacy & security concern	Older adults worry about the privacy and security of technology and the potential mishandling of their personal health data.	[43,45]
Language and terminology challenges	Older adults often feel anxiety when completing tasks with ambiguous language. Inconsistent terminology also makes older adults feel confused.	[19,23]
Health literacy barriers	Older adults struggle to manage their health effectively due to a lack of information and skills.	[28,33]
Potential burden	Older adults can be easily burdened and discouraged from using apps that require daily input or interaction.	[28,33]

4.3 What Solutions are Recommended for Designing mHealth Applications for Older Adults?

Table 3 presents the design solutions for mHealth aimed at older adults, as discussed in most papers.

Table 3 Design recommendations to accommodate older adults.

Design Solution	Paper
Straightforward and simplified navigation; introducing the app contextually; clear instructions and explanatory icons; intuitive color scheme; visual data presentation to help older adults with cognitive challenges understand the app's purpose and functions.	[13,18–20,23–27, 29–31, 33–38, 41,42,44,45]
Consistent design and layout; step-by-step navigation to reduce user confusion and help them anticipate following interactions and improve focus.	
Large and easy-to-read text sizes; magnification, text-to-voice, or voice-enabled; high contrast between text and background colors to help older adults with visual impairment or decline in color vision.	[18–20, 23,24, 27,29,30, 33,34, 40,41,46,48–50]
Educational resources or tutorials; training and support to enhance the user's understanding of the app's functionality.	[18,26,28,33,42]
Clear and relevant feedback during task completion (pop-ups, sound tones, and visual changes (like color or texture)) to indicate successful actions enhances user confidence.	
Enhance the app's functionality to facilitate better communication and engagement between older adults and caregivers to strengthen the support system, especially those with critical diseases.	[13,18,20, 25,29,36]
A customizable interface can accommodate older adults' unique needs and preferences. Incorporate features allowing real-time data analysis and adaptation of goals based on user progress. Provide different feature levels tailored to various user types such as a more straightforward interface for basic users.	[13,17,20,24,33, 39,51]
Large buttons and eliminated scrolling screens make interaction easier for older adults with dexterity issues or visual impairments.	[17,19,29,34,36, 40,50]
Make the mobile app user-friendly with minimal complexity to cater to users who may not be very familiar with the technology.	[31,39]
Features that improve user security and address privacy concerns to convince older adults to feel safe using the app.	[45]
Clear language to help older adults understand and read content and complete tasks more effectively.	[13]
Integrating health information within the app to help older adults access relevant health information.	[28]
Facilitate accessible communication with healthcare professionals within the app, allowing users to report symptoms and receive feedback or advice.	
Reliability in performance , fast response, and accuracy in providing outcomes may increase user confidence.	
Secure in-app data export options allow users to share their results with healthcare providers, facilitating follow-up care and consultations.	[38]
Integrate with older adults' daily routines without being intrusive may increase the interest in using mHealth.	
Clear error management and recovery guidelines as easy ways to rectify mistakes can enhance user experience.	[34]
Minimize typing requirements using the input button, dropdown menus, checkboxes, or predefined options to minimize data entry.	[19]
Simplified login process with clear instructions assists users in completing the process.	
Non-intrusive design of the mHealth app to avoid overwhelming the user with constant alerts or notifications.	[49]
Minimal daily interaction is important for older adults who may find providing extensive daily input burdensome.	

An app designed with straightforward and simplified navigation can help older adults use it more efficiently, as they often experience visual and cognitive decline. Presenting text in a large font and a readable structure is also essential. Additionally, the app should provide clear and relevant feedback when a user completes a task, such as displaying a pop-up message, sound tones, or visual changes (like color and texture) to indicate a successful action; this is essential for user confidence and understanding. Furthermore, providing educational resources or tutorials within the app, along with training and support, can help older adults understand the app's functionality and features more effectively.

5 Discussion

This section discusses the establishment of a visual representation that systematically maps usability concerns to the corresponding design solution obtained from the review, as shown in Figure 4. This mapping simplifies the usability concern and the design solution.

The digital divide and socioeconomic barriers may exclude many potential users from adopting mHealth, particularly older adults who have limited digital skills, varying technical abilities, or limited access to technology. According to [52,53], personalization and customization features in mHealth can enhance user engagement by tailoring the app to meet each user's health needs and habits [57,58]. This includes adapting how data is presented to better reflect the specific behaviors and activities of the older adult, making it more relevant and easier to understand. A study by [54] agrees that the digital divide in mHealth can be narrowed by implementing inclusive design and educational initiatives to improve self-efficacy, develop literacy, and build trust, ensuring older users are capable and willing to adopt. This is consistent with a recent review that highlights the importance of addressing the digital health divide, encouraging developers to keep digital health interventions and measurement instruments up to date with the fast-paced technological changes [55]. They should also involve diverse populations in the development and evaluation of digital interventions, so that the growing use of digital technologies does not exclude those who could benefit most from them [55].



Figure 4 Visual representation mapping usability concerns to design solutions in mHealth applications for older adults.

Moreover, a major barrier is cognitive decline, which affects older adults’ ability to learn and remember how to use new technologies. They often struggle with unclear interface elements, leading to confusion and difficulty navigating mHealth applications, which are typically designed with specific features and procedures. A typical design with overwhelming instructions and functions also confuses them about what the app asks them to do [32]. A previous study [56] found that maximizing the required number of steps to complete tasks causes inconvenience to older adults because of cognitive capabilities. To address this, the mHealth app must offer a simplified navigation process and clear instructions to facilitate effective interaction for older adults without prior technology experience. Additionally, one-on-one instructional support and demonstrations, as well as integrating visual aids into written instructions can assist older adults in navigating the mHealth app effectively [48]. Consistent layout and design elements across the app help reduce cognitive load and enhance the overall user experience while helping older adults learn and remember how to navigate and enable them to predict the next steps based on previous interactions [29]. The user interface should also use color coding to make it more intuitive, logical, and user-friendly for older adults. For instance, a green color indicates progression to the next screen. This is consistent with [57], which reinforces these observations by highlighting suggestions to improve usability in mobile health, such as user-

centric design, simplifying navigation, enhancing accessibility features, offline functionality, and continuous improvement for older adult users with cognitive limitations in the context of emergency service apps that have complicated demands in urgent situations.

Older adults may experience forms of sensory and physical decline, such as vision and hearing impairments, reduced fine motor skills, physical limitations, and perceptual challenges. These changes affect their interaction with the mHealth interface, making it more difficult to read text, identify buttons, and complete tasks accurately in mHealth apps. Therefore, as stated by [58], mHealth applications should be designed with consideration for the capabilities of older adults. According to [59] using a larger font size and larger buttons and providing magnification options can assist older users who have trouble with visual impairments. For example, [60] found that a font size of 22 pt and a top-positioned button optimizes the performance of older adults when using a healthcare touchscreen device. Additionally, using contrasting colors and maintaining high contrast ratios between button, text and background in app design can enhance visibility for age-related decline in color vision. As identified by [61], warm hue colors, medium saturation, and high lightness are preferred by older adult users in the app interface, which makes them feel comfortable and provides an efficient user experience. Moreover, natural communication methods, such as voice and gestures, facilitate better interaction for older adults with such impairment. Having these features in mHealth is crucial, as mHealth often represents important tasks related to the health of older adults. Neglecting this consideration reduces the willingness of older adults to adopt mHealth [62]. Recent research reported in [63] agrees that implementing inclusive design for individuals with impairments empowers them to achieve greater independence in everyday tasks, such as health management. However, this research indicates that there are still gaps in designers' awareness of digital accessibility and challenges due to technological limitations and a lack of uniform standards [63].

Another significant concern among older adults is their dependence on caregivers because they are not confident in their ability to use apps independently. Due to their limited experience with complex technology, they often require guidance to complete tasks. For that reason, an mHealth developer or healthcare provider should consider offering a training session or tutorial to help older adults become familiar with the app's features. To further support their use, mHealth should be equipped with automated advice, reminders, and notifications, which can help users utilize apps more confidently. The features should be easily accessible and understandable within the interface [49]. According to [64], older adults expressed concern when healthcare providers did not recommend the app, as they were accustomed to conventional healthcare practices and had high trust in clinicians. Satisfaction with mHealth and willingness to adopt it may increase if

the apps are recommended by a healthcare professional [65]. Consequently, healthcare providers should be involved in developing and reviewing apps to ensure they feel confident recommending them to patients, especially older individuals. Additionally, low health literacy is another barrier that prevents them from having the motivation to use the apps. Many older adults struggle to understand basic health information and services, which are crucial for effective interaction with mHealth. The study [66] found that many adults have basic or below-basic health literacy, which is linked to medical errors, increased illness, and compromised public health. Therefore, they suggest that integrating health literacy into mHealth development is essential for improving health outcomes and ensuring these tools are effective for all users, thereby increasing older adults' trust and confidence levels. In another way, a recent study has suggested that caregivers' digital skills may be a clinical intervention pathway to support older adults' adoption of technology, as they found the existence of significant disparities in the use of technological devices and functions among caregivers and their older adult care recipients [67]

Furthermore, older adults are concerned about their privacy and security when using mHealth. The recent study [64] found that the main concern among older adults is the risk of disclosing sensitive health data. Therefore, mHealth apps must prioritize security and privacy features that protect users' personal and health information.

Despite the valuable insight identified by existing studies, several gaps remain in the evidence base. One study provided a checklist of design features to enhance user engagement for developers to refer to; however, no empirical evidence has been established regarding the relationship between these features and actual user engagement [52]. Therefore, they suggested the need for a more robust quantitative approach for further research. Meanwhile, this research has found that a participatory design method may enhance usability and satisfaction among older adults; however, challenges such as cognitive load, lack of digital literacy, and accessibility barriers still persist [53]. Therefore, they state that future research should focus on AI-driven personalization, long-term usability studies, and culturally inclusive design. In addition, although this study emphasizes user-centered design to identify usability, small sample sizes and limited representation of less tech-experienced users limit the generalizability of the results [32]. They also suggest that future work would benefit from employing qualitative methods such as interviews to gather more in-depth feedback rather than relying solely on quantitative scores. Moreover, this study emphasizes the importance of conducting a test in a real-life setting for an app dedicated to a specific disease, despite its design being tailored to user preferences [48]. Finally, according to this research, older adult users show a willingness to use mHealth, but adoption is influenced by person-related, technological-related, and

contextual barriers, as well as support from physician referrals [58]. Addressing these is essential for securing lasting acceptance and engagement among older adults.

6 Conclusion

As healthcare providers continue to utilize mHealth to support self-care, it is essential to ensure that features meet the specific needs of target populations, such as older adults. Ageing presents challenges that make it harder for older people to use mHealth compared to younger individuals. The main findings indicate that various concerns hinder older adults from effectively using mHealth applications, such as cognitive load, which hinders their understanding of the app's purpose, as it is often designed with complex navigation and unclear instructions. In addition, those with sensory and physical impairment struggle to interact with a small screen where the apps are designed with fonts and colors that do not match their abilities. Furthermore, the elderly, who often require assistance with using apps such as from children or caregivers, are less likely to be motivated to engage with an app. Despite the concerns, research on enhancing the design can address these issues and improve usability among older adults. Researchers suggest several design solutions that may make the app more elderly-friendly, such as straightforward and simplified navigation, clear instructions and explanatory text, an intuitive color scheme, educational resources, or tutorials within the app to assist older adults in effectively understanding its features. Therefore, addressing all those concerns with respective solutions is important to improving adoption, sustained engagement, and positive health outcomes among the ageing population. For that reason, designers and developers may create mHealth applications that prioritize accessibility for older adults, ensuring that all users benefit equitably from digital health innovations. Finally, some limitations of this study should be acknowledged, as it only included data from the WOS database from January 2014 to September 2024, which may have introduced bias.

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