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Challenges in health and technological literacy of older adults: a qualitative study in Isfahan

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Abstract

Objective The low level of digital health literacy skills, especially among older adults, increases their risk of limited access to health services. Health literacy plays an important role in maintaining health and improving the quality of life of people, especially older adults. According to these two factors, the importance of examining the health literacy of older adults and how they use technology to improve their health is becoming increasingly clear.

Method To address this, the study employed a grounded theory approach, aiming to uncover the challenges encountered by older adults in utilizing health-related technologies. To achieve this goal, semi-structured interviews were conducted with 25 older adults, selected through theoretical, targeted, and maximum variety sampling methods.

Result After analyzing the data, seven main categories were identified: isolation and loneliness, resistance to change, limitation of digital literacy, health literacy gap, dependence, physical disability, and facilitating access to health-related technology.

Conclusion The core category,'Seniors on the margin of digital health literacy,'was selected to encompass the other seven categories.

Keywords Aging, Health literacy, Technological literacy, Grounded theory method

Introduction

The advancements in medical and health care have led to an increase in human life expectancy, resulting in a growing older adult population. As a consequence, there is a corresponding rise in the demand for health care services among older adults [1]. The use of various technologies in daily life has significantly increased in recent years. Similarly, the skills required for health literacy have continued to evolve alongside technological advancements. Digital health literacy, specifically, is defined as the ability to assess health information from electronic sources and utilize the acquired knowledge to address or resolve health-related issues. Consequently, it has been recognized as a crucial aspect of overall health literacy [2]. This phenomenon has had a wide impact on people, including older adults. In today's societies, with the expansion of new technologies such as the use of the Internet and mobile devices, people have access to various health information [3] Information and communication technologies are widely used in the field of health care [4] Health literacy is crucial for maintaining wellness and enhancing individuals'quality of life. Central to healthy aging is the capacity for self-care, underscoring the significance of health-related education [5]. In light of these factors, it becomes increasingly evident to explore the health literacy obstacles faced by older adults

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and their utilization of technology to promote health and well-being.

Currently, nearly 7% of the world's population is aged over 65, and projections suggest that by 2050, this demographic will increase to 20% [6].

According to the 2016 census data from the Iran Statistics Center, approximately 6.1% of Iran's population consists of individuals aged over 65 years old [7]. Population projections by the United Nations in 2002, assuming an average population growth rate, indicate that by the 2040 s, this demographic group will comprise around 18% of Iran's population[8]. In 2016, The literacy rate among older adults in Iran was approximately 36%, significantly lower than the literacy rate of other age groups, which exceeds 95%. This disparity has been consistent across previous censuses as well [9]. The aging population poses additional challenges for health and social care systems, as aging is influenced by various factors including health status, social dynamics, technological advancements, and psychological factors.

The impact of health literacy, whether adequate or lacking, is particularly pronounced among vulnerable populations, including individuals with low literacy, older adults, women, immigrants, the unemployed, those residing in remote rural areas, and those living with HIV/AIDS. These groups, often constrained by poverty and other structural limitations, typically face greater health disparities and encounter barriers to adopting proactive health measures [10].

Previous research in the field of health literacy among older adults has garnered significant attention in recent decades. A study conducted by Tavousi and colleagues in Iran revealed that half of the country's population has limited health literacy, with this limitation being more prevalent among vulnerable groups such as older adults, housewives, unemployed individuals, and those with limited general literacy. Consequently, these groups are at a heightened risk of health-related misconceptions and behaviors that may compromise their well-being [11].

The results of the meta-analysis conducted by Mirmohammadkhani et al. [12] showed that the average level of health literacy among older adults in Iran is low at 45.8% [12]. The study of Safdari et al. has shown that the main challenge of older adults in using mobile health[1] is the lack of electronic literacy and resistance to the use of technology [13].

Previous studies have consistently demonstrated that low health literacy levels are associated with various health risks. Individuals with low health literacy often exhibit lower levels of self-efficacy, increased mortality rates, poorer health statuses, and reduced overall quality of life. In a study by Bakhsa et al. (2019), conducted in Tehran, it was found that the older adult population displayed a higher-than-average level of technology acceptance, with a noteworthy intention to utilize information and communication technology tools. However, the primary limitation hindering technology acceptance was identified as the lack of ease of use in accessing information and communication platforms [14].

Despite the valuable quantitative studies conducted in the realms of health literacy and technology use, particularly concerning older adults, there has been a recognized need for a qualitative investigation to delve deeper into the challenges faced by this demographic. Hence, this study was undertaken with the aim of addressing the overarching question: What are the specific challenges encountered by older adults in utilizing health-related technologies?

According to the most recent census data from 2016, 10.6% of the population in Isfahan province is aged over 60 years old [7]. Notably, Isfahan province ranks sixth among provinces with a high percentage of population aged over 60 years. Consequently, the city of Isfahan was selected as the research field.

The current research provides us with insights into how to empower older adults in these fields and which policies should be adopted to alleviate their burden. This has the potential to improve their health and quality of life, consequently seeking to reduce healthcare costs.

Conceptual framework

In qualitative research, the theoretical framework is not employed in the conventional manner seen in quantitative research. However, pioneers in the field, such as Strauss and Corbin, with the concept of theoretical sensitivity, believe that the theories we have in mind affect our research in different ways, and we need to use accumulated knowledge to analyze data. Hence, it should not be entirely disregarded. The amassed knowledge within the subject under investigation serves as an analytical tool and provides a valuable resource for stimulating reflection on its characteristics and posing conceptual inquiries [15].

Given that this study employs a qualitative methodology, it is designed to explore theories, aiming to enhance theoretical sensitivity and to provide guidance for researchers in conducting semi-structured interviews.

Researchers endorse Lilly's model as a suitable framework for leveraging healthcare resources. This model encompasses three distinct competencies: computer literacy, scientific literacy, and health literacy, alongside three analytical skills: traditional literacy, media

[1] Mobile health is a term used for medical and public health applications supported by mobile communication devices.

literacy, and information literacy. It serves as a tool for assessing the ability to search, evaluate, and apply health information in addressing adult population health issues. Nonetheless, it is noted for its weakness in identifying individuals with low literacy levels and limited internet skills [16].

One theory pertinent to behavior change in health education, which acknowledges the influence of both individual and environmental factors on behavior control, is the theory of social cognition, established by Bandura [17]. This theory underscores the significance of social interactions and highlights learning through observation in health-related behaviors. Technology serves as a platform for information exchange and social interactions, potentially enhancing individuals'health literacy through online health-related communication, mass media, and group support [18].

The Information Processing Theory posits that individuals process health information and make decisions based on their cognitive abilities and the available information. Technologies such as the Internet and mobile applications can either facilitate or challenge information processing, depending on their design and presentation [19].

The theory of the digital divide underscores the disparity in access to technology and the Internet. Individuals with limited access to technology may experience lower health literacy due to restricted access to online health information. This theory highlights the crucial need to bridge the digital divide to enhance health literacy for all [20, 21].

Health Information Seeking Behavior explores how individuals search for and utilize health information. With the advent of technology, there has been a shift in the way people seek health-related information, transitioning from traditional sources like healthcare providers and printed materials to online resources and health programs [22].

Theories of Health Behavior Change encompass various frameworks, including the health belief model, the metatheoretical model, and the theory of planned behavior, which elucidate the impact of technology on health behavior change. Technology can serve as a tool to deliver interventions and support individuals in adopting healthier behaviors [23].

The Theory of Reasoned Behavior (rational action) and the Theory of Planned Behavior prioritize the concept of"behavioral intention,"which is influenced by a person's expectations about the outcomes of a behavior, attitudes toward the behavior, and normative beliefs. The Theory of Planned Behavior expands upon the original Theory of Reasoned Behavior by introducing the concept of perceived behavioral control, which further influences intentions and subsequent behavior.

The Theory of Planned Behavior seeks to accommodate factors beyond individual control, such as resource limitations, lack of skills, and barriers to behavioral performance. Its structure closely resembles the concept of self-efficacy outlined in Social Cognitive Theory, albeit operationalized in slightly different ways. In the context of health, it is crucial to assess how individuals perceive the attitudes of family members and friends, whether positive or negative, regarding behavior change [23].

In summary, the relationship between health literacy and technology is intricate and multifaceted. Various theories and concepts offer insight into understanding and addressing the challenges and opportunities presented. Technology holds the potential to both enhance and impede health literacy, contingent upon factors such as design, accessibility, and user skills.

Research method and data

The Grounded Theory method has been employed in this research. Grounded theory refers to a theory developed from systematically collected and analyzed data gathered during the research process. In this approach, the collection and analysis of data are closely intertwined with the theory eventually derived from the data [24].

Sampling has been done using the gradual sampling strategy which is generally based on"theoretical sampling"and also the snowball sampling strategy, sampling with maximum variety has been done. Theoretical sampling, invented by Strauss and Glaser [25], refers to the simultaneous process of collecting data needed for theorizing and analyzing them; In this way, in this process, the researcher decides what data to collect and from whom in the next step, and in fact, the theory is being formulated that guide and controls the process of data collection [26].

The sampling method employed in this study utilizes a combination of gradual sampling, primarily based on theoretical sampling, and the snowball sampling strategy to ensure maximum variety. Theoretical sampling, pioneered by Strauss and Glaser [25], involves the simultaneous collection and analysis of data necessary for theory development. Through this iterative process, the researcher determines which data to collect and from whom in subsequent steps, guiding and controlling the data collection process in line with theory formulation [26].

The study employed a semi-structured interview method for data collection. Participants were purposively selected to include individuals aged 60 years and older, representing diverse socio-economic backgrounds, educational levels, and residing in various areas of the city to

ensure a breadth of perspectives. The selection process involved a combination of theoretical sampling and the snowball sampling strategy. The sampling method used was targeted snowball sampling, in which we purposefully selected participants who had relevant knowledge and engagement with our topic. Participants were eligible to join the research sample based on being age 60 or older and their willingness to participate in the interview process. Initially, two participants were identified by visiting a senior citizens'club at one of the city's cultural centers. After obtaining their consent, we scheduled an appointment for cooperation. In subsequent stages, each participant introduced the next participant. The number of participants was increased until theoretical saturation was achieved, meaning no new data emerged. Data saturation occurred with a total of 25 participants, encompassing both sexes.

The interviews were conducted by a trained interviewer under the supervision of the researcher. Following data collection, transcripts were generated, and the analysis was conducted using Strauss and Corbin's method, involving three levels of coding: open coding, central coding, and selective coding. The basis of this type of coding is to construct concepts from data obtained through interviews and observations. In this article, we first transcribed the interview data into text. Then, we divided the text into segments and assigned a concept to each part based on the meaning of the participants'statements. This stage corresponds to open coding, during which we identified 110 concepts. In the next step, we combined the initial concepts that were similar in meaning into more abstract concepts, thereby forming main categories. In this type of coding, we determined the dimensions of each concept and the relationships between them. During the development stage of the categories, all information was organized into seven main categories, taking into account the repeated codes."Finally, in the selective coding stage, we created the final category of the research, which emerged from the categories and concepts developed throughout the study. This category,'Seniors on the margin of digital health literacy',encapsulates the primary phenomenon of our research: resistance to change.

To ensure credibility, the study followed Lincoln and Guba's [27] criteria, which encompass four key aspects: credibility, transferability, reliability, and verifiability. The research employed various strategies to enhance data reliability, including prolonged engagement, observation, and continuous communication with the research field and participants. Additionally, a member-checking technique was utilized, wherein selected participants reviewed the analyzed findings, concepts, and categories to validate their accuracy. To ensure rigor and trustworthiness, the study underwent external evaluation by scientific experts and specialists in digital literacy and older adult healthcare. These experts provided critical feedback on the methodology, data analysis, and findings, helping to refine the study's conclusions and enhance its credibility.

Given that qualitative research relies heavily on human interactions, ethical considerations are often more nuanced and sensitive compared to quantitative research. In this study, ethical issues were carefully observed across three dimensions: subjects, researchers, and social obligations. The research protocol was approved by the Research Ethics Committee of Isfahan University, and the study adhered to the ethics code IR.UI.REC.1402.140.

Findings

In this study, semi-structured interviews were conducted with 25 individuals aged 60 years and older, comprising both men and women. The participants'education levels ranged from illiterate to university education. Regarding living arrangements, the study subjects were categorized into four groups: living alone, living with a spouse, living with a spouse and children, and living with children. Tables 1 and 2 illustrates the characteristics of the respondents.

Interviews were conducted in person with individuals, each lasting approximately 30 to 45 min. Permission was obtained from the interviewees to record the sessions, which were then transcribed. The text from these interviews underwent analysis through three levels of coding: open, axial, and selective, facilitated by the use of MAXQDA2020 software.

During the initial stage of open coding, the data was categorized into main coding and conceptual classes. Following this, axial coding was employed, organizing the data around a central phenomenon, with classes focusing

Table 1 Characteristics of participants in the research

Characteristics		Frequency (%)
Gender	Male	11 (44)
	Female	14 (56)
	Single	7(28)
Live with whom	Together with the spouse	8 (32)
	Along with spouse and children	6 (24)
	Without a spouse and with children	4 (16)
	Illiterate	5 (20)
Education	Elementary	10 (40)
	High school and diploma	6 (24)
	University educated	4 (16)
	Working	5 (20)
Job	Housewife	8 (32)
	Retired	12 (48)

Table 2 Concepts and categories extracted from the interviews

Concepts	Subcategories	Main categories	Core category
Feeling lonely (11[a])	A sense of helplessness	Isolation and loneliness	
Being unimportant to others (10)			Seniors on the margin of digital health literacy
Sense of confusion (9) Feeling intense fear (21),	Anxiety and stress		
Disconnection from the surrounding environment (4)			
Preference for in-person visits (8)	Preference for traditional methods	Resistance to change	
The emptiness of cyberspace (7)	Lack of trust in cyberspace		
Fraud in cyberspace (6)			
Not knowing about the Internet (20)	Lack of electronic literacy	Digital literacy limitation	
Inability to connect to online spaces (8)			
Low level of education (19)	Low education		
Possessing traditional literacy (11)			
Lack of training in Internet usage (11)			
Inability to afford health expenses (15)	Economic-social gap	Intergenerational health literacy gap	
Disregard for advice or online services (4)			
Unexpected health-related expenses (22)			
Ignorance about one's health status (9)	Educational and information gap		
Lack of education and learning during younger years (6)			
Failure to recognize health priorities (8)			
Feeling burdened by others (28)	Sense of Despair	dependency	
Being the cause of trouble for others (20)			
Feelings of self-anger (15)	Self-distrust		
Sense of inadequacy (16)			
Increased susceptibility to illness with age (2)		physical disability	
Physical weakness (11)			
Impairment of vision and hearing (6)			
Unavailability of using the Internet (8)	Impossibility of access	lack of means/skills to use digital technology	
Absence of a smartphone (8)			
Inability to use health-related applications (18)	Inability to use		
Inability to use digital health measuring devices (16)			

[a] The number of repetitions of concepts

on causal conditions, interventional and contextual conditions, strategy, and consequence. Finally, selective coding was utilized to connect the classes of the model.

From the analysis, seven primary categories emerged from the data:

1. Isolation and loneliness
2. Resistance to change
3. Digital literacy limitation
4. Intergenerational health literacy gap
5. Dependency
6. Physical disabilities
7. lack of means/skills to use digital technology

Isolation and loneliness

Are feelings experienced by older adults due to their inability to utilize digital devices or the Internet for health-related purposes. The digital divide can contribute to social isolation and loneliness among older adults. Without the ability to effectively engage with social media or smart devices, they may lose connections and support networks, exacerbating feelings of isolation and loneliness. These feelings can lead to both physical and mental

health issues, significantly impacting the individual's quality of life and social well-being. Participants in this research expressed feelings of helplessness, anxiety, a sense of insignificance, and confusion, as well as a disconnection from their environment.

Participant 1, 67 years old, with primary education, living with an older adult husband

> *"My husband has an underlying illness, and our children are not here. When either my husband or I feel unwell, I truly don't know what to do. We lack access to resources and guidance. I feel utterly helpless. It's incredibly challenging. I long for the feeling that someone cares about us, whether we're alive or deceased."*

Resistance to change

With age, individuals often exhibit resistance to change, preferring to adhere to established habits and routines. Additionally, older individuals may find it challenging to trust new or unfamiliar circumstances.

Participant 2, aged 62, holds a diploma and resides with her husband and children

> *"I prefer to make appointments in person. Sometimes, when they don't answer the phone, I get annoyed, and it wastes my time. But I don't have the patience for the challenges of dealing with cyberspace and the Internet. How can I be sure my money won't be stolen, or that I won't end up on a fake website? I'd rather take a taxi and go in person; it feels safer and more reliable."*

Participant 3, 72 years old, with a diploma education, retired employee, living with an older adult husband

> *"As a former employee of the Ministry of Health, I find it challenging to trust much of the information available on the internet nowadays. While there is an abundance of information online, its scientific validity is often unclear."*

Digital literacy limitation

The limitation of digital literacy refers to individuals'proficiency in effectively utilizing digital technologies and associated tools for tasks such as searching, transferring, interpreting, and utilizing information, including computer and communication skills. Digital literacy plays a crucial role in enabling individuals to access online information resources, particularly concerning health-related information. This proficiency empowers individuals to access credible medical information, critically evaluate online content, and utilize it to inform health-related decisions. Older adults often face limitations in digital literacy, despite possessing academic literacy skills. They may struggle with internet search capabilities and utilizing health measuring gadgets effectively.

Participant 4, 65 years old, with a secondary education, lives with his wife

> *"I'm not heavily involved in these matters. I have a basic phone. My blood pressure fluctuates, and when I notice it, I either visit the clinic or my wife administers a sublingual tablet to me. My daughter is at home and can monitor my blood pressure, but my wife and I are unaware of it.*

Participant 5, a 68-year-old single older adult woman with a diploma (a retired teacher)

> *"I struggle to handle these matters. It's difficult for me. They offered a training course at the cultural center to learn how to search for such things, which I attended, but due to my limited proficiency in English, I am unable to utilize it effectively. Occasionally, I attempt to search on the internet, but I cannot claim to use it extensively. Nevertheless, I take care of myself by adhering to my diet and engaging in daily walks."*

Intergenerational health literacy gap

The intergenerational health literacy gap refers to the differences in the understanding and interpretation of health-related information among people of different generations. This gap can result from various causes, including different life experiences, environments, and cultural and technological changes**.**

Members of different generations have unique experiences and life histories, which can significantly influence their understanding of health issues. For instance, individuals born in different historical eras have encountered distinct health challenges and societal changes. From the participants'perspective, this gap may arise from socio-economic disparities between previous and newer generations, as well as educational and informational discrepancies. Younger generations often have greater access to technology and the internet, facilitating easier access to health information. This accessibility can enhance understanding of health issues and access to informational resources.

Participant 6, aged 78, retired, and residing with his wife and children

> *"In our time, there was little information about medicine, treatments, and illnesses. Hygiene practices were not as observed as they are now. When someone fell ill, remedies often included decoctions and prayers. However, there is now greater awareness, and we are less familiar with such practices.*

Our children, having received education, now assist us in navigating these changes."

Participant 7, 70-year-old housewife and illiterate, with her husband and child

"We didn't have access to the wealth of information that people have today. Learning opportunities were limited, and information wasn't readily available at our fingertips. Nowadays, children have everything at their disposal, and families provide them with the necessary resources. If I encounter a problem, my child quickly searches the internet to find out what it is, what to eat, and which doctor to consult."

Dependency

Dependency in old age encompasses the social and familial relationships that older adults rely on. This dependency reflects the need for support, social connections, and interactions with others. Social dependence is a crucial component of the quality of life for older adults. With recent social, technological, and medical advancements, older individuals require more support from their neighbors and relatives in managing health-related tasks than ever before. The older adult participants in this research occasionally experienced feelings of helplessness, which impacted their ability to care for their health and led to a sense of self-doubt.

Participant 8, 75 years old, retired with primary education, living with a child

"When I fall ill, I rely on others to assist me with transportation, ensuring I receive my medications promptly. I have diabetes and require insulin, which adds to the difficulty of managing my tasks independently. It's tough for me not being able to handle my own responsibilities. Additionally, my child has his own issues, and I often find myself waiting for his assistance."

Participant 9,68 years old, housewife, primary education, living with her husband

"My children live abroad, and my husband is also an older adult. I fell in the bathroom and had to be hospitalized. My sister's daughter came to help me. I hope you never have to rely on others like I did. I became a burden to my family and neighbors."

Physical disability

As individuals age, they commonly experience physical challenges that can hinder their mobility and participation in medical care. Poor vision, hearing impairments, and limited movement among older adults make accessing health information and utilizing digital tools or the internet for medical services difficult. This group often faces barriers to accessing healthcare resources, which can impact their overall well-being.

Participant 10, aged 63, holds a diploma and is a housewife living with her children

"I have been living with Parkinson's disease for several years now, and unfortunately, my condition is progressing. I have a strong desire to go to the park, but I am unable to do so alone. I require constant companionship and assistance. Fortunately, my daughter lives with me, and she takes care of all matters related to my medication, doctor appointments, monitoring my condition, and ensuring I have proper nutrition.

Lack of means/skills to use digital technology

Digital technology serves as a primary source of information and resources across various domains, including health, news, entertainment, and more. Lack of access to these resources deprives older adults of valuable information and benefits. Participants in this research identified challenges such as the inability to access the internet, difficulty using mobile applications, and struggles with digital health measuring devices. Simplifying the use of digital devices and providing training on device and software usage can be effective solutions to empower older adults in this area.

Participant 11, aged 69, has a primary education and is a housewife living with her husband

"My phone is one of those simple phones. I only use it to call my children. I have no knowledge about the internet and such things. We have a fever monitor, a blood pressure monitor, and some devices for measuring blood sugar at home, but I am unsure how to use them".

Participant 12, aged 72, with secondary education, is retired and lives alone

"I have installed several applications on my phone, but I don't use them much. It's not very convenient for me, even though they explained how to use them before. I still don't know much about them. Instead, I mainly read a series of articles about health, skincare, and similar topics on Instagram and Telegram channels".

"Seniors on the margin of digital health literacy"

The core category is created in the selective identification process. The core category includes the main theme of the research, it is separate from other research categories, and it includes all concepts and categories [28]

In this research, the core category"Seniors on the margin of digital health literacy"was chosen, which is the main focus of the research. This category shows the presence of older adults on the margin of digital health literacy. It indicates the vulnerability and challenges of this group of society in the era of technological and medical advances.

The categories obtained in this research can be shown in a paradigm diagram as follows Fig. 1.

Discussion and conclusion

The world population is rapidly aging. It is predicted that the proportion of people aged 65 and above will increase from 9% in 2019 to 16% in 2050, meaning that one out of every six people in the world will be 65 years or older [29].

Therefore, improving the health behaviors of the older adult population and empowering them to take control of their health status independently are of great importance. Performing healthy behaviors may be defined as the ability to search for, obtain, and evaluate health information from various sources such as healthcare professionals, web pages, or other digital platforms more efficiently and effectively. This enables individuals to communicate with health professionals more appropriately and make informed decisions [30].

In the digital age, it is imperative that older people possess the ability to access health information available on digital platforms and utilize the acquired knowledge to address or solve health problems and make informed health decisions [31].

Findings from this qualitative study shed light on the complex challenges older adults face with health-related technologies, particularly digital health literacy. This study showed several key factors that play a role in creating these challenges and their consequences for the older adult population of Isfahan. Seven main categories were identified: isolation and loneliness, resistance to change, limitations in digital literacy, gaps in health literacy, dependency, physical disability, and lack of means/skills to use digital technology. Each of these categories represents a unique aspect of the challenges faced by older adults in using health-related technologies. The paradigm model highlighted that intergenerational health literacy gaps and digital literacy limitations were crucial drivers of resistance to change. Physical disabilities add to the challenge of adapting to change, and limited digital proficiency acts as a barrier, exacerbating dependency and contributing to feelings of isolation and loneliness.

In the study by Neter and Brainin [32], It was shown that individuals with poor health literacy are frequently among the older adult population and suffer from chronic diseases. [32] This aligns with the results of our research. According to Oh and Bae[33], older adults with low digital literacy are more vulnerable to social isolation than the younger generation[33]. Akhtyan et al. [34] identified information inequality and educational levels as key obstacles for older adults to attain digital literacy [34]. According to Tran et al. [35], individuals with strong digital skills and easy access to family support were more likely to have higher digital health literacy [35].

In this study, participants identified physical disability as one of the obstacles hindering their health literacy. The findings of Kılıç et al. suggest that older adults who maintain higher levels of physical activity and overall health also exhibit higher levels of literacy [36]. In another study by Dahany and colleagues, it was shown that physical and social activities allow older adults to gain more knowledge and experience through interaction with others [37].

Older adults experiencing poor health literacy or struggling with the use of digital devices often encounter feelings of isolation, loneliness, and dependence. Jang and Je study has also confirmed this, according to findings from Jang and Je study, implementing digital literacy training programs for older adults is recommended to alleviate loneliness and enhance quality of life, along with promoting health-related behaviors [38].

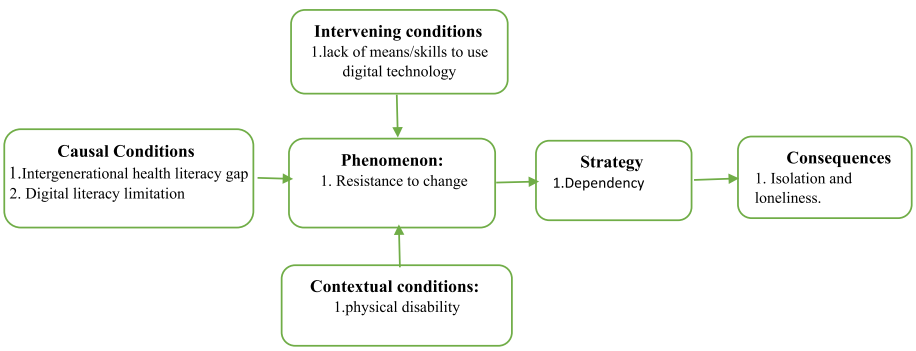

Fig. 1 Extracted Paradigm model according to grounded theory for Seniors on the margin of digital health literacy (Self-compilation)

The core category addressed in this research is'Seniors on the margin of digital health literacy'. This research underscores the urgent necessity of tackling issues surrounding the health and technology literacy of older adults, not only in Isfahan but in numerous other regions as well. older individuals often find themselves on the periphery of the digital health revolution, placing their health and well-being at significant risk. Addressing this gap requires targeted interventions, including educational programs tailored to the unique needs and capabilities of older adults. These interventions should prioritize the promotion of both digital health literacy and traditional health literacy, while also considering the interplay between the two. Furthermore, healthcare providers and technology developers must strive to implement user-friendly infrastructures for health-related technologies.

Various studies underscore the importance of attending to the health literacy of older adults. Wang and Luan [39] characterize the lack of digital health literacy among older adults as a pressing issue requiring urgent attention [39]. Similarly, Antonio and Tuffley [40] arrived at comparable conclusions in their study, highlighting that older individual generally exhibit a heightened need for health-related information. However, their health literacy their ability to acquire, comprehend, and apply health information to make informed decisions is notably low across all age groups. Research indicates that only approximately 3% of older adults possess the knowledge required to access health information [40]. Oh and Bae [33] discovered that using information and communication technology was positively linked to healthy aging. Specifically, the more older adults used technology, the fewer chronic illnesses they had, the less their physical function declined, the lower their depression levels, the higher their life satisfaction, and the more they participated in social activities [33].

In summary, this study represents a valuable addition to the expanding research on the challenges confronting older adults within an evolving digital healthcare landscape. By comprehending these challenges and devising strategies to alleviate them, we can strive towards ensuring equitable access to the advantages of modern healthcare technologies for the aging population. This, in turn, promises to enhance their health outcomes and overall quality of life. Enhanced digital and health literacy among older adults can contribute to more effective self-management of chronic conditions, resulting in fewer hospital visits and reduced emergency care usage. Empowered with digital skills, older adults are more likely to utilize telehealth services, which are more cost-efficient than traditional in-person visits. Furthermore, fostering independence through digital proficiency can decrease reliance on caregiver support, lowering associated long-term care expenses. These findings suggest that targeted interventions to boost digital health literacy can play a critical role in reducing overall healthcare costs and improving resource allocation within the healthcare system. This study highlights the difficulties older people face in adapting to a digital age. It stresses the urgent need for solutions that help them overcome the digital divide. Further research should examine how specific interventions affect health outcomes to ensure older people can fully benefit from modern healthcare. By addressing the lack of means and skills to use digital technology, we can work towards ensuring equal access to healthcare and a better quality of life for older people.

Suggestions

Providing digital literacy training specifically designed for older adults can significantly improve their ability to use digital tools and navigate online platforms. These training programs should be tailored to their learning pace and include hands-on practice to build confidence. By equipping older adults with essential digital skills, they can better access healthcare services, manage their health records, and stay connected with their communities.

To facilitate the adoption of digital technology among older adults, it is essential to provide user-friendly and uncomplicated digital devices. These devices should feature simplified interfaces, large fonts, voice commands, and easy navigation options to accommodate their needs. Ensuring accessibility through such technology can encourage more older adults to engage with digital platforms, reducing barriers to modern healthcare and communication services.

Establishing and maintaining local social networks dedicated to older adults can play a crucial role in fostering social support and reducing isolation. These networks can facilitate in-person and virtual interactions, enabling older adults to share experiences, receive guidance on digital literacy, and strengthen their sense of community. By promoting social engagement, these initiatives can enhance mental well-being and encourage greater participation in digital and healthcare services.

Ensuring the availability of accessible telephone and online services tailored to the needs of older adults is vital for improving their access to healthcare and other essential information. These services should include health-related consultations, appointment scheduling, and guidance on using digital toolsBy offering reliable support channels, older adults can seek assistance conveniently, stay informed about their healthcare options, and overcome challenges associated with digital accessibility.

Implementing these strategies can bridge the digital divide among older adults, empowering them to navigate

modern technology with confidence while improving their overall well-being and healthcare access.

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Authors' contributions
Zahra Shams Ghahfarokhi conducted the research, analyzed the data, and wrote the manuscript.

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Data availability
Data available on request.

Declarations

Ethics approval and consent to participate
In this research, ethical considerations were addressed across three dimensions: subjects, researcher, and social commitment. The study was approved by the Research Ethics Committee of Isfahan University, with the ethics code IR.UI.REC.1402.140. Data collection was conducted with the consent and trust of the interviewees, who were informed about the objectives and nature of the research and assured of the confidentiality of their information. Participation in the research was entirely voluntary, with all subjects fully aware of the interview process before agreeing to participate. This research does not involve a clinical trial.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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