Health literacy, health literacy interventions and decision-making: a systematic literature review

Maedeh Ghorbanian Zolbin
Department of Information Studies, Faculty of Social Sciences, Business and Economics, Åbo Akademi University, Turku, Finland

Isto Huvila
Department of ALM, Uppsala University, Uppsala, Sweden, and

Shahrokh Nikou
Department of Information Studies, Faculty of Social Sciences, Business and Economics, Åbo Akademi University, Turku, Finland and Department of Computer and Systems Sciences, Stockholm University, Stockholm, Sweden

Abstract

Purpose – The purpose of this paper is to assess the relationship between elderly people's health literacy skills and those people's decision to make use of digital health service platforms. Despite the substantial influence of digitisation on the delivery of healthcare services, understanding how health intervention strategies might help empower elderly people's health literacy skills is critical.

Design/methodology/approach – This paper analyses the existing trends in research on the convergence of health literacy, health intervention programmes and digital health service platforms by reviewing 34 studies published between 2000 and 2020.

Findings – The findings of the review indicate three primary themes (health literacy skills, health management competency and attitude/confidence), which provide a summary of the current literature, and in all three the results show that health intervention programmes help to enhance health literacy skills of elderly people. Based on the review results and by organising the fragmented status quo of health intervention research, the authors develop a comprehensive research model and identify future research directions for research in this domain.

Practical implications – The findings will be useful to health professionals in two ways: (1) the findings provide practical information about the growing need to implement health literacy intervention programmes to satisfy elderly people's appetite for accessing health services due to cognitive and physiological impairments, and (2) the finding help them to understand that with digital health platforms, elderly people have quicker access to health services, improving the quality of care provided to them.

Originality/value – This paper presents a comprehensive research model for analysing the impact of health literacy skills on older people's ability and intention to access digital health information sources, considering various health intervention approaches.

Keywords Health literacy, Elderly people, Health decision-making, Health interventions, Digitalisation, E-Health services

Paper type Literature review

1. Introduction

Over the last few years, the average human lifespan has increased, and the number of individuals aged 65 and over has risen significantly (Bhattarai and Phillips, 2017). As people age, they become more susceptible to difficult conditions (e.g. arthritis, heart disease, cancer and diabetes) (Martin *et al.*, 2010), which may contribute to impaired quality of life and an increased likelihood of fatality (Mueller *et al.*, 2020). One way to tackle this issue and help elderly people to enjoy a healthier life is to empower them with the essential skills and abilities to use available digital health services (e.g. e-health or m-health) (Jackson *et al.*, 2020). Digital health services provided through digital health platforms enable individuals to access a large amount of health-related information and allow them to manage their chronic diseases more easily (Sarfati *et al.*, 2018). For example, by using online health information and digital health platforms, elderly diabetic patients could considerably improve their understanding of their health condition(s) (e.g. diet, exercise, medication adherence) and gain better control over such conditions (Long and Gambling, 2012). Therefore, it is important to understand how elderly people's quality of life can be improved by using digital health services and online health platforms. And it is also important to understand the skills needed to empower elderly people to use digital health services and absorb the available health information on digital platforms and apply the knowledge gained to manage their own health, address their potential health problems, and make more appropriate and informed health decisions (Goeman *et al.*, 2016).

The empirical evidence in the literature demonstrates that to access and use digital health services, literacy skills – particularly health literacy or e-health literacy – are vital (Gross *et al.*, 2007; Xie *et al.*, 2020; Zimmerman, 2021). Both terms "health literacy" and "e-health literacy" in the contemporary literature and in practice refer to the ability of individuals to deal with health information (Del Giudice *et al.*, 2018), these two terms will be used interchangeably in this paper. The literature indicates that health literacy skills are often less well developed among elderly people (65+) (Yang *et al.*, 2019); therefore, they utilise fewer technology–based-health services and online health platforms (Xie *et al.*, 2020). In this regard, several researchers emphasise that one way of overcoming such problems is to improve health literacy among elderly people; for instance, through intervention programmes (Banbury *et al.*, 2019; Kim *et al.*, 2014). The research results have shown that improvement of health literacy skills from pre-to post-intervention phases among elderly people (Xie, 2012), empowers them to locate and identify trustworthy health resources (Xie and Bugg, 2009), maintain or enhance their self-management skills (Vogt *et al.*, 2017), reduce risky behaviours (Liu *et al.*, 2015), resolve health-related problems, and make informed health decisions, which in turn lead to a better quality of life and improved health status (Park *et al.*, 2018).

While there has been a noticeable increase in the number of publications regarding digitalisation, and the health literacy of elderly people in recent years (Shi *et al.*, 2021; Watkins and Xie, 2014). However, there is a lack of studies that holistically examine and synthesise the relationships between health literacy, intervention programmes, use of digital health services, and health decision-making in the context of elderly people. This gap in the research is even more obvious when it comes to personal (lack of experience with digital health platforms) and infrastructure (limited access to digital tools) obstacles, as well as how intervention programs might help elderly people to improve their health status. Thus, this paper performs a systematic literature review with threefold objectives: (1) reviewing state-of-the-art literature concerning the relationship between health literacy, elderly people, intervention programmes, use of digital health services, and health decision-making to identify the outcomes of such relationships at both personal and societal levels; (2) exploring the strategies (methods) used in existing health literacy interventions and determine which form of content mediation style (type of information delivery) might be more effective in improving health literacy among elderly people; and (3) identifying barriers (personal and infrastructural) hindering the improvement of health literacy among elderly people via the

implementation of intervention programmes. The research questions we answer in this paper are as follows:

RQ1. How does health literacy contribute to the ability of elderly people to use digital health services and thus their ability to make informed health decisions?

RQ2. How do health intervention strategies and different content mediation styles contribute to an improvement in literacy skills among elderly people, and which have been the most popular ones?

RQ3. What obstacles and challenges are faced in efforts to enhance the health literacy skills of elderly people?

This paper makes two important contributions. First, by providing a timely assessment of the literature, we identify the present state of knowledge and highlight options for combining various streams of research at the confluence of health literacy, health literacy intervention, and digital health services usage in the context of elderly people. In addition, based on the review results, three themes and trends relating to health literacy skills, health management competency, and attitude and confidence are identified and analysed. By providing such insights, we highlight the importance of empowering elderly people to become health literate as a prerequisite to use digital health services. Considering that elderly people are more likely to be at higher risk of various health-related issues and more susceptible to disease, the findings show the necessity to pay greater attention to empowering elderly people to acquire or improve their health literacy skills. Second, the review results indicate that we should, in parallel, focus more on to different styles of health intervention, as intervention programmes are essential in enabling elderly people to cope more effectively with their health conditions and technology-based healthcare systems. This study begins by developing a proposed research model. Next, the research methodology is discussed. Then we summarise the descriptive, and narrative results, followed by the discussions on the findings from the reviewed and analysed studies. Finally, we discuss the possible practical implications and conclude the research by proposing a framework, outlining the theoretical and methodological contributions, limitations, and suggestions for a future research agenda.

1.1 Research model

Healthcare is moving towards an ever-increasing deployment of technology-based services and new technologies (e.g. e-health or m-health) are increasingly being incorporated into healthcare service portfolios (Pita Barros *et al.*, 2019). The emergence of e-health services increases the availability of medical online information and digital health-related tools for patients (Faggini *et al.*, 2019). This requires individuals – especially those in greater need of healthcare services – to motivate themselves to improve their ability to navigate digital health platforms and make use of digital health services (Alami *et al.*, 2017). To intensify and strengthen people's ability to use digital health services (tools and platforms), one suggested strategy is to focus on providing those with a potentially increased need for healthcare services with educational programmes that aim to enhance their health literacy (Nahm *et al.*, 2018). In addition to improving health literacy, educational programmes contribute to the enhancement of other skills, competencies, and attitudes, including digital literacy skills (Xie, 2012), self-efficacy (Broering *et al.*, 2006) and attitudes towards adopting technology and using digital health services (Xie, 2012). Based on the literature, the provision of health literacy training programmes can also promote self-efficacy among elderly persons by refining their awareness and knowledge of their health (Kim *et al.*, 2014), and empowering them with the skills needed to adopt and use digital technologies (Xie, 2012), coupled with positive changes in their attitude regarding technology-based healthcare services (e.g. less

stress, more interest) (Xie, 2011b). Change in attitude towards using digital health services can also contribute to an increased adoption of such services since elderly people have sometimes been observed to hold a negative attitude towards technology (Hoffman-Goetz *et al.*, 2006). Thus, it can be expected that health literacy intervention programmes may lead to an improvement in skills and a tendency towards more positive attitudes that could prompt and assist elderly people to use digital health services to make informed medical decisions (Mancuso, 2008). Based on the current literature, we developed the following framework (see Figure 1), which we used to analyse the corpus of literature retrieved for the systematic review.

2. Method

First, we conducted a systematic literature review in accordance with the PRISMA guidelines (Preferred Reporting Items for Systematic reviews and Meta-Analyses. Following the procedure described by Steinmetz *et al.* (2021), the search process involved four main steps: identification, screening, eligibility, and inclusion. We began the review process by performing searches of the main sources and repositories of the electronic databases Scopus, MEDLINE, Web of Science, EBSCO, and PubMed, as they are the most comprehensive databases in terms of scientific articles. The search was restricted to articles published in English. Inclusion criteria were as follows: (1) the study had to describe and include a health literacy intervention(s) and use of digital health services; (2) the study participants should include elderly people (65+); and (3) the study had to be published between 2000 and 2020. With regards to the overall objectives of the paper and research question stated earlier, the following search terms were used to screen the most relevant studies:

("health literac*" OR "health information literac*" OR "ehealth literac*" OR "e-health literac*" OR "digital health literac*") AND (?lder* OR "senior citizen*" OR "senior population" OR "old people" OR elderly OR "aged adult") AND ("health service*" OR "digital health service*" OR "ehealth service" OR "e-health service*" OR "health information service*" OR "ehealth information service*" OR "e-health information service*").

In addition, articles were excluded if (1) the study population did not comprise elderly people (65+); (2) the study population was comprised entirely of individuals with diagnosed cognitive or mental health impairments; and (3) the study was focussed solely on improving mental health literacy. The initial database searches yielded 1892 articles (from journals, conference proceedings, books, and book chapters): 909 articles were retrieved from PubMed, 339 from Scopus, 295 from EBSCO, 227 from Medline, and 122 from Web of Science. In addition, five articles were identified through other sources, so the total number of articles retrieved was 1897. After eliminating duplicates ($n = 566$), 1,331 articles remained.

In the second step (i.e. screening), we examined the articles by screening the titles and abstracts of the 1,331 articles. We began the initial screening phase by checking the title, abstract, and keywords of each study. In this step, 1,118 papers were excluded. In the third step (i.e. eligibility), we checked the full text of all the remaining 213 articles; each of these articles was read in full. In the fourth step (i.e. inclusion), after applying strict inclusion/ exclusion criteria, articles that met the primary selection criteria were then critically appraised based on their relevance to the research questions. We finally retained 34 articles (see Appendix) for inclusion in the systematic literature review: 29 studies were retrieved from database searches and five studies were retrieved from other sources by crosschecking of the citations. A PRISMA flow diagram describing the search selection process is shown in Figure 2, and depicts the four main stages of identification, screening, eligibility, and inclusion. It is important to mention that the first author began the initial search, screening, and data extraction. In addition to the lead author, another senior researcher double-checked the entire work. In the following section, the results of the literature review are described.
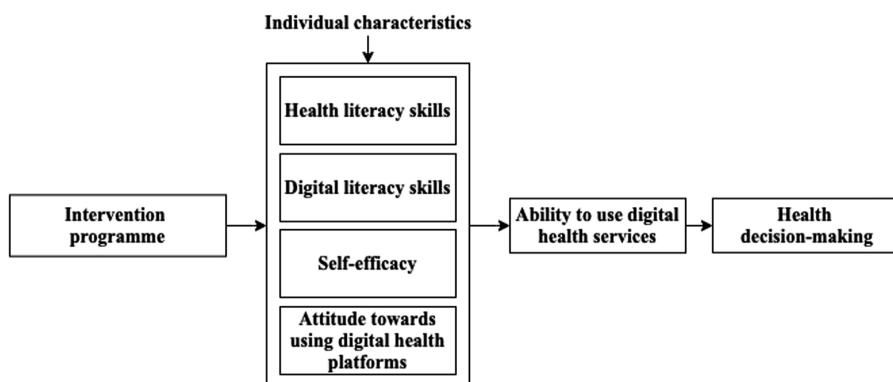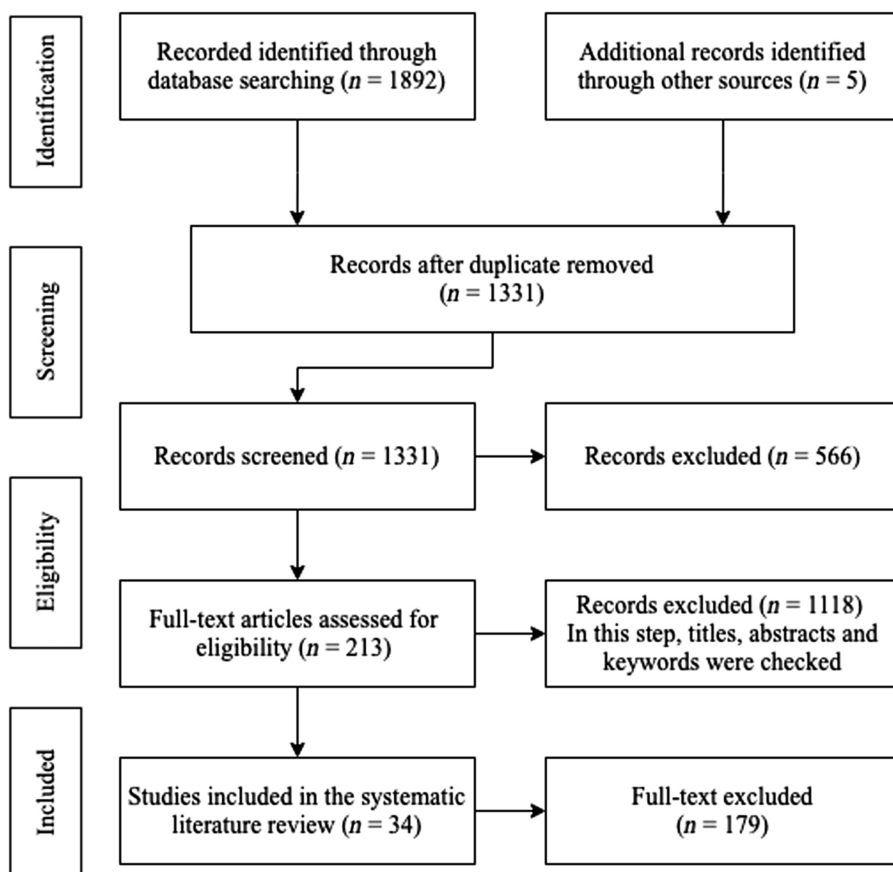
Figure 1.
Research model

Figure 2.
PRISMA flowchart of
the selection procedure

3. Results
The reviewed studies were categorised based on intervention strategy, study setting, content mediation styles, study design, and the potential barriers (obstacles) to improving literacy skills among elderly people.

3.1 Intervention strategies
The analysis revealed that the retained studies were found to have applied two major intervention strategies to improve the health literacy skills of the elderly participants, labelled as "collaborative" and "individualistic" strategies. These two strategies were applied using two different approaches, either tailored or untailored. Studies applied different content mediation styles ranging from individual uptake/consumption (watching a video and listening to audio) to the teach-back learning method.

3.1.1 Collaborative versus individualistic strategy. Within a *collaborative strategy*, participants work collaboratively with other members to help each other learn, they work together to solve a problem, complete a task, or create a product (Xie, 2011a). This strategy requires the active engagement of the participants in the learning process by jointly performing meaningful activities and reflecting collaboratively on what they are learning (Xie, 2011b) and by being involved in discussions or interacting with each other (Banbury *et al.*, 2019). This learning strategy had been used in 14 of the reviewed studies (e.g. Strong *et al.*, 2012; Xie, 2012). With an *individualistic* (i.e. independently working) strategy, participants are working on their own with little or no interaction with others (Xie, 2011c). This strategy had been used in 17 of the reviewed studies (e.g. Parker *et al.*, 2018; Redfern *et al.*, 2020). In addition, three studies applied both approaches simultaneously (Goeman *et al.*, 2016; Xie, 2011a, c).

3.1.2 Tailored versus untailored intervention. A *tailored intervention* is based on individuals' personal characteristics (e.g. personality, needs, preferences, and experience) (Tse *et al.*, 2008). Tailored messages attract more attention and are more likely to be read, elaborated upon, recalled, and understood deeply. Therefore, this method is more suitable when it is necessary to improve the knowledge of the sample group in a critical field or to convey an important message (Watkins and Xie, 2014). Seven of the reviewed studies used this intervention method (e.g. Campbell and Nolfi, 2005; Broering *et al.*, 2006). In comparison, an *untailored intervention* does not address an individual's characteristics. This approach presumes that a method can be employed for any individual or group without the need to consider their personal differences. Based on the review results, 27 of the reviewed studies used the untailored intervention method (e.g. Masi *et al.*, 2003; Broering *et al.*, 2006).

3.2 Study design
In this section, the reviewed studies were assessed based on their study design, and two general approaches were identified: First, all the study participants were engaged in a training programme, making it possible to compare pre-and post-intervention outcomes (*one-group* study design). Second, the study sample was divided into different groups (two groups or more). Some groups received educational material (intervention groups), and some did not receive such material (control groups). Studies which compared the results between intervention and control groups adopted an approach known as a *multiple-case* study design. Twenty-one studies used a *one-group* study design (e.g. Goeman *et al.*, 2016; Chiu *et al.*, 2016), and the improvement in this category was measured using pre-and post-tests. Thirteen studies adopted a *multiple-case* approach (e.g. Masi *et al.*, 2003; Kim *et al.*, 2014), and the improvement was measured by comparing the results of the intervention group with the control group.

3.3 Content mediation styles
Content mediation style refers to the way in which educational materials can be communicated to the trainees. A wide variety of different strategies have been used in the reviewed studies. Most of the styles adopted include handouts (reading materials) to back up the learning process. (1) *Individual uptake/consumption*: Participants are exposed to educational materials, in the form of videos or audio. Individuals in the intervention group have the opportunity to learn either by watching prepared videos or by listening to the audio, both of which are effective ways to capture lecture content and present direct instruction. This method was used in seven of the reviewed studies (e.g. Xie, 2011a). (2) *Lecturing:* One of the commonest ways to communicate educational content is lecturing, since it is both economical and practical. This method is especially practical when there are many participants, and when resources are limited. This method was used in ten of the reviewed studies (e.g. Masi *et al.*, 2003). (3) *Hands-on (on-the-job training):* In this method, elderly participants are provided with the opportunity to participate in workshops, and to learn by practising. This method may be very useful for samples involving very elderly participants, who might very easily forget the content of the learning material. This method was used in 13 of the reviewed studies (e.g. Willis *et al.*, 2018). (4) *Comprehensive:* Comprehensive support is used especially in preventive care, which is a complex process. The core objective of this method is to promote active, authentic, flexible, and scenario-based learning. This method is used in three of the reviewed studies (e.g. Serbim *et al.*, 2019). (5) *Teach-back:* This is the least popular method and was used in only one of the reviewed studies (Goeman *et al.*, 2016). Here, health information providers, such as nurses, assume full responsibility for the training process.

3.4 Study setting
In order to implement health literacy interventions among elderly people, scholars have selected different channels (modalities) such as face to face and online (remotely via ICTs) at different venues (e.g. public libraries or senior centres). Among the 34 reviewed studies, 22 relied on face-to-face learning to communicate educational content. Moreover, our analysis revealed that among the 34 reviewed studies, 18 were conducted in the form of informal learning settings (e.g. public libraries or senior centres) (e.g. Susic, 2009). In addition, three studies were conducted in clinical settings (e.g. Edwards *et al.*, 2012) and one study was carried out in a university setting (e.g. Czaja *et al.*, 2013). Twelve of the reviewed studies were administered remotely via ICT systems, including online tutoring delivered via video or telephone conferencing (e.g. Redfern *et al.*, 2020). Based on the results, recent studies have shown that ICTs are being utilised more frequently. This indicates that technology is being increasingly used in educational settings in recent years to communicate educational content to elderly people. Taking this forward, online channels could potentially be integrated into all intervention strategies. In addition, online channels, which are more cost-effective could be adapted for larger populations (Watkins and Xie, 2014).

3.5 Barriers to improving health literacy skills among elderly people
In this section, we review the reviewed studies based on barriers identified as obstacles towards improving the health literacy of elderly people. Some authors, such as Watkins and Xie (2014), argue that before implementing any intervention or learning programme aimed at improving the health literacy of elderly people, any potential barriers and obstacles should be identified and tackled. According to the existing literature, the obstacles could be related to the individual characteristics (e.g. personal characteristics or living circumstances). Based on the review findings, we have identified two barriers: personal obstacles and infrastructural obstacles.

3.5.1 Personal obstacles. Some of the obstacles were related to the personal characteristics of the participants. We categorised these into information interaction, cognitive and physical, technology self-efficacy, and learning education obstacles. Each of these obstacles makes difficulties for elderly people to seek, evaluate, understand, and use health information from digital platforms.

(1) *Information interaction obstacles*: poor acceptance and compliance, reliance on health professionals for information, emotional issues (shock, fear), avoidance of information (Edwards *et al.*, 2012), lack of trust regarding online information (re) sources (Perestelo-Perez *et al.*, 2020), and lack of ability to evaluate medical webpages and find reliable information on the Internet (Tse *et al.*, 2008; Xie *et al.*, 2020).

(2) *Cognitive and physical obstacles*: vision or hearing problems and limited dexterity (Bertera *et al.*, 2007).

(3) *Technology self-efficacy obstacles:* lack of experience in using digital platforms (Broering *et al.*, 2006; Strong *et al.*, 2012); or even lack of experience in basic computer/Internet operations (e.g. opening a web browser or scrolling horizontally) (Xie, 2011b); a negative attitude towards technology-based health services (Hoffman-Goetz *et al.*, 2006); reluctance to use digital health platforms (Banbury *et al.*, 2019; Czaja *et al.*, 2013); computer anxiety; lack of self-esteem, lack of self-efficacy; lack of personal motivation; lack of computer interest; and lack of efficacy (Campbell and Nolfi, 2005; Goeman *et al.*, 2016; Manafò and Wong, 2013).

(4) *Learning-related obstacles:* lack of sufficient prior education (Chiu *et al.*, 2016), reluctance to learn (Goeman *et al.*, 2016); decreased learning capabilities, leading to prolonged learning time, especially when using digital health services (Chu *et al.*, 2009; Xie, 2011a).

3.5.2 Infrastructural obstacles. Several obstacles were related to infrastructural issues. We categorised the infrastructural obstacles into three groups:

(1) *Accessibility-related obstacles:* limited access to computers or digital resources (Gross *et al.*, 2007; Susic, 2009), and unaffordability of the digital tools (expenses) (Hoffman-Goetz *et al.*, 2006).

(2) *Education-related obstacles*: lack of sufficient trained staff and supports to design and implement intervention programmes for elderly people (Nahm *et al.*, 2018; Xie and Bugg, 2009), use of inappropriate learning programmes, or use of overly complex intervention methods (Parker *et al.*, 2018).

(3) *Technology-related obstacles*: overly complex technical medical terminology significantly discourages elderly people from searching for online medical information (Aspinall *et al.*, 2012). In addition, complexity of the medical websites (Manafò and Wong, 2013) and other technical problems make difficulties for elderly people (e.g. difficulty in navigation) (Broering *et al.*, 2006).

4. Research themes

To understand the thematic distribution of the literature, we clustered the reviewed studies into the following three categories (themes): (1) literacy skills, (2) management competency perspective, and (3) attitudes and level of confidence. In the following, we discuss and elaborate on these themes.

4.1 Literacy skills
Unsurprisingly, the predominant research theme in the reviewed studies was literacy skills, which can be further categorised into three types of literacies: (1) health literacy, (2) e-health literacy, and (3) digital literacy. All reviewed studies (34 articles) dealt directly or indirectly with how to empower elderly people with the ability to navigate digital health platforms in order to access digital health platforms, to find trusted health information on the Internet, to evaluate obtained information, and to understand health information sufficiently to know what to do and how to use online health-related information (e.g. Aspinall *et al.*, 2012; Parker *et al.*, 2018).

4.1.1 Health literacy. William *et al.* (1995) defined health literacy as the ability of people to find health information, interpret it, and apply it to health-related decisions. The first concept used by most of the authors was health literacy (e.g. Czaja *et al.*, 2013). The theme covers studies on e-health literacy interventions and their outcomes. For example, Serbim *et al.* (2019) demonstrated the practical feasibility of delivering a comprehensive education programme aimed at improving health literacy skills among elderly people. In this study, health literacy encompasses the ability to access, understand, and evaluate health information. In this study, all participants had basic computer skills and the ability to use the Internet, but they were not able to search for relevant health information effectively before the training sessions. However, the study results validated the long-term usefulness of the training programme. In a study of health literacy intervention programmes conducted by Long and Gambling (2012), the authors aimed to equip individuals with a greater knowledge and understanding of diabetes by navigating healthcare systems to find information and self-manage certain elements. In addition, Parker *et al.* (2018) implemented an intervention programme focussing on better preventive care for overweight and obese patients with low health literacy among elderly people in Australia. Three different time points (baseline, six months, and 12 months) were compared to observe changes. The results of the study showed changes in some factors as primary outcomes, such as in health literacy, lifestyle behaviours, weight, waist circumference, and blood pressure between baseline and other time points. Both Kim *et al.* (2104) and Gross *et al.* (2007) indicated that the improvement in health literacy skills among elderly people observed in the post-intervention step was helpful in enhancing the healthy behaviours among elderly people.

In two of the studies – conducted by Aspinall *et al.* (2012) and Strong *et al.* (2012) – the intervention process improved the health information literacy skills of the elderly people in addition to other literacy skills (e.g. health literacy and digital literacy). Health information literacy can be comprehended as a similar concept to health literacy, in terms of refereeing information behaviours, including needs, along with seeking and using medical information.

4.1.2 E-health literacy. Norman and Skinner (2006) define the concept of e-health literacy as the ability of an individual to seek, find, understand, and appraise health information from digital (re)sources and apply the knowledge gained to address a health issue. E-health literacy is gaining attention worldwide owing to its high Internet penetration rate and massive Internet usage around the world. The theme covers studies on e-health literacy interventions and their outcomes. For example, Xie (2011a, c) employed both collaborative and individualistic interventions, which were theory driven and found improvement in e-health literacy from pre-to post-intervention among elderly people, leading to positive changes in their own healthcare. Xie (2011b) showed the usefulness of a theory-driven collaborative e-health literacy intervention among elderly people which could increase the ability of elderly people to cope successfully with digital health platforms. Furthermore, Nahm *et al.* (2018) applied self-efficacy theory to a theory-based patient portal e-learning programme that aimed to improve e-health literacy and found that the e-health literacy skills of participants in the intervention group had increased in the post-intervention phase. Moreover, Chiu *et al.* (2016)

showed an increment in the level of e-health literacy for elderly people in Taiwan after their participation in eight weeks of training sessions.

4.1.3 Digital literacy. Regarding empowering elderly people to enhance their digital literacy skills, Strong *et al.* (2012) argued that to encourage the use of digital health services by elderly people, their digital literacy skills must be increased simultaneously with their health literacy skills. Digital literacy refers to "[t]he ability to use ICTs and the internet" (Martin and Grudziecki, 2006). Xie (2011b, c and 2012) and Masi *et al.* (2003) found that with e-health literacy intervention program, the level of computer/web knowledge and ability to use information technologies increased significantly from pre-to post-intervention among elderly people. Some other scholars have demonstrated significant improvement in elderly persons in their use of computers (digital literacy skills) to access digital platforms via e-health literacy interventions (Strong *et al.*, 2012), or in their use of Internet or medical webpages to answer health-related questions (e.g. Fink and Beck, 2015; Manafò and Wong, 2013; Perestelo-Perez *et al.*, 2020; Tse *et al.*, 2008). In addition, several other studies (e.g. Bosworth *et al.*, 2009; Kim *et al.*, 2014; Parker *et al.*, 2018) have reported the positive outcome of such interventions and have demonstrated that e-health literacy intervention programmes are effective at enhancing the knowledge that elderly people need to work with digital health tools effectively. Chiu *et al.* (2016) found that the implementation of a health literacy training course enabled elderly people to be able to use certain health applications, including the Internet preregistration system for clinic visits, and medication reminders.

In summary, this theme focusses on how health literacy intervention programmes can increase the level of computer/web knowledge among elderly people and empower them to use authoritative medical online (digital) platforms to find, evaluate, and utilise accurate and medical information. It has been found that such empowerment enables elderly people to better manage their health conditions and enhance their ability to practise preventive self-care. In addition, this theme indicates that the implementation of health literacy intervention programmes for elderly people could have a long-reaching effect.

4.2 Management competency perspective
According to the reviewed studies, management competency refers to the ability of elderly people to make appropriate health decisions or resolve health problems to manage their own health condition by having access to sufficient online health information (Banbury *et al.*, 2019; Bertera *et al.*, 2007; Broering *et al.*, 2006; Manafò and Wong, 2013; Xie, 2011a) or using digital health tools (Parker *et al.*, 2018).

Some studies refer to general conditions. For example, Xie (2011b, c) studied e-health literacy interventions, in which participants were empowered with their ability to locate information from medical websites to determine the recommended treatment for an illness or better manage their health condition. Some authors, such as Masi *et al.* (2003), Susic (2009) Willis *et al.* (2018) and Xie and Bugg (2009) demonstrated the usefulness of health literacy intervention programmes regarding the ability of elderly people to "surf the web" and develop the skills they need to promote their health and well-being by making informed health decisions. In addition, a telephone coaching session was found to help enhance participants' knowledge regarding the use of resources and tools (e.g. *my snapp*) to develop and maintain their motivation towards a healthier lifestyle, to promote self-monitoring of diet, physical activities, and weight, and to resolve health problems (Parker *et al.*, 2018).

Some studies have explored patients' ability to have more control over a specific medical condition. For example, intervention programmes help elderly people to resolve their health-related problems (Goeman *et al.*, 2016; Kim *et al.*, 2014) or manage their own health status and take care of themselves independently (e.g. by taking responsibility for checking their own blood pressure with use of a blood pressure monitoring tool) (Bosworth *et al.*, 2009; Sarfati

et al., 2018). Another health literacy intervention study conducted by Gross *et al.* (2007), who focussed on a specific health issue (e.g. stroke) of the participants. However, as there was no data reported on the participants' pre- and post-intervention stroke knowledge, its effectiveness remains uncertain. In addition, changes in health literacy capacities within an individually targeted intervention programme devised by Long and Gambling (2012) were evident in the shift from specific to more general knowledge, lesser reliance on external support, greater self-responsibility, and enhanced confidence, resulting in more control in their self-care decision-making (e.g. monitoring glycaemic variability, diet, exercise, and medication adherence).

Some of the reviewed studies focus on shared decision-making, referring to the practical reconciliation of respect for persons (autonomy) and the monopoly and power of physicians. For example, Serbim *et al.* (2019) add to the weight of evidence in support of the notion that delivering an intervention leads to increased use of existing services and resources and provides meaningful improvements in health behaviours (e.g. diet or physical activities). This, in turn, better equips elderly people to make a range of more autonomous decisions relating to their health, or at least engage in the process of making health decisions. Moreover, in other studies (Aspinall *et al.*, 2012; Edwards *et al.*, 2012; Nahm *et al.*, 2015, 2018) participants in an intervention group developed more autonomy in their decision-making – from developing their health knowledge to becoming more active communicators and decision makers in their healthcare. In addition, Hoffman-Goetz *et al.* (2006) and Xie (2012) focussed on shared decision-making and argue that health literacy training sessions for elderly people have led to an improved understanding of Internet search strategies, increased ability to search independently for cancer resources (increasing knowledge), and active participation in the healthcare process. Moreover, a study conducted by Perestelo-Perez *et al.* (2020) found that a series of massive open online health literacy courses facilitated shared decision-making processes among elderly people by progressing their health literacy skills and enabling them to use digital health platforms.

In contrast to several favourable findings, however, Redfern *et al.* (2020) found no evidence of a positive impact of intervention programmes and no indication of improved health behaviour (e.g. improved medication adherence) among the intervention group participants, suggesting that the study participants' health management competency did not improve as expected.

In summary, this theme focusses on how intervention programmes could empower elderly people to take control over their personal medical situations, resolve their health problems in the post-intervention stage, and take advantage of digital medical tools. In addition, this theme concentrates on enhancing the ability of the participants in the intervention programmes to engage in their medical decision-making process (shared decision-making with their healthcare professionals) by utilising health information technologies.

4.3 Attitude and confidence
The final research theme identified in the material consists of two different sub-themes: attitude towards using digital health services, and self-efficacy.

4.3.1 Attitude towards using digital health services. In total, twelve of the reviewed and analysed studies focussed on attitude towards use. To measure attitude towards using digital health services two different aspects were considered: (1) anxiety about using digital tools and services, and (2) interest in using digital tools and services. According to the statistical information provided in the reviewed studies during the intervention programme, there was an upward trend in all the identified sub-themes with the exception of the computer or web anxiety. Scholars have identified that health literacy training programmes may lead to lower levels of anxiety in elderly people when they are using computers to search for online health

information (Chiu *et al.*, 2016; Chu *et al.*, 2009; Xie, 2011b; Xie and Bugg, 2009). Specifically, when elderly people underwent a health literacy training programme, their levels of stress and anxiety – in relation to using computers and webpages – were decreased. Furthermore, Xie (2012) demonstrated a negative association between computer anxiety linked to computer use and technology adoption after implementation of an e-health literacy intervention programme. The second sub-theme concerns the level of interest of elderly people in using digital tools and services, which refers to the interest in accessing health information via the Internet or computer/web usage. Some studies have shown that after implementation of a health literacy intervention programme, there was an increase in elderly people's level of interest and intention to adopt technology and use a computer and the Internet (digital platforms) to identify online health information (Campbell and Nolfi, 2005; Tse *et al.*, 2008; Xie, 2011b, 2012).

4.3.2 Self-efficacy. Self-efficacy refers to individuals' beliefs about their ability to perform (Nahm *et al.*, 2015), or confidence in one's ability to perform an action (Fink and Beck, 2015). Self-efficacy involves the person recognising, owning, and internalising the need for and adoption of specific self-care behaviours, which could impact elderly people's health-related decisions. With health literacy interventions, the self-efficacy of elderly people could be improved in terms of them gaining the skills and knowledge necessary to use digital health services or computers for self-care, intention to adhere to medication and decision-making purposes (Kim *et al.*, 2014; Long and Gambling, 2012). In general, the reviewed studies reveal that health literacy training programmes could increase the self-efficacy and confidence of elderly people by the following means:

(1) *E-health literacy efficacy* refers to "skills and comfort with using the internet for health information and decision-making; for instance, [I know how to find helpful health resources on the internet]" (Xie, 2011b, c). Studies by Broering *et al.* (2006), Kim *et al.* (2014), Hoffman-Goetz *et al.* (2006) and Manafò and Wong (2013) showed an improvement in the efficacy and self-efficacy of elderly people when evaluating medical webpages. In another study, conducted by Nahm *et al.* (2018), intervention group participants showed higher levels of self-efficacy when using patient portals, as their findings revealed that after the intervention programme, the elderly people believed that they could use the technology and reap benefits from doing so independently. Unexpectedly, and in contrast to the findings of other studies, the study by Chiu *et al.* (2016) found that the participants expressed lower levels of confidence in using the Internet after participating in a health literacy training course. In addition, Fink and Beck (2015) found no difference in the level of self-efficacy between the intervention and the control group regarding the use of digital health platforms after providing the intervention group participants with educational materials.

(2) *Computer efficacy* could be viewed as elderly people's level of confidence in using computers to find online health information (Perestelo-Perez *et al.*, 2020). For example, the studies conducted by Perestelo-Perez *et al.* (2020) and Xie and Bugg (2009) showed significant improvements in computer efficacy when pre- and post-training efficacy levels were compared. In other studies (e.g. Bertera *et al.*, 2007; Chu *et al.*, 2009), elderly people who participated in a five-week programme on retrieving and evaluating online health information succeeded in enhancing their confidence and self-efficacy levels regarding computer and Internet usage.

In summary, this theme focusses on the extent to which health literacy intervention programmes are useful for (1) reducing elderly people's stress and anxiety levels regarding computer or Internet usage, (2) increasing elderly people's interest, intention, and willingness

to use computers and the Internet, (3) enhancing the self-efficacy and confidence of elderly people regarding the use of technology and reaping the benefits of doing so independently. All these factors result in higher intention and ability to locate medical information via digital platforms.

5. Discussion

This review paper analysed the current literature at the nexus of health literacy intervention, elderly people, and the use of digital health services. We performed a systematic literature review of 34 academic articles published from 2000 to 2020. The review results revealed that the dominant part of the literature consists of studies demonstrating the effectiveness of implementing health literacy intervention programmes to enhance the ability of elderly people (65+) to cope effectively with available health information on digital platforms or use digital medical tools. It found that intervention programmes are helpful and enhance the ability of elderly people to better manage their health condition(s) and make appropriate medical decisions. However, while most of the studies reported positive results, the study by Redfern *et al.* (2020) found no positive outcomes regarding health literacy improvement in elderly people's health-related behaviour. In addition, a study conducted by Chiu *et al.* (2016) showed negative results regarding elderly people's self-efficacy at the post-intervention stage. Even so, it is possible that there was a positive bias in the reviewed studies.

All the reviewed studies reported health literacy interventions among elderly people (65+). The studies were reviewed for their intervention strategies, study settings, and study designs. The results revealed that the studies employed two different health literacy intervention strategies: collaborative and individualistic. In addition, three studies (Sarfati *et al.*, 2018; Xie, 2011a, b) used a mixed strategy. Some scholars argue that owing to age-related changes (e.g. cognitive and physiological impairments), specific intervention strategies (tailored interventions) should be applied to elderly people in a manner that considers their own unique skills, learning abilities, and personal characteristics (Bosworth *et al.*, 2009; Long and Gambling, 2012). In other words, generalised health literacy intervention programmes may not be appropriate for elderly people (Xie, 2012). However, it can be speculated that owing to the difficulties concerning the design of intervention programmes (e.g. monetary and temporal issues), a noticeable percentage (79.41%) of the reviewed studies used untailored intervention strategies.

Five different content mediation styles were used in the reviewed studies. Some of the studies demonstrated the usefulness of communicating educational content through individual uptake and consumption style, while others relied on using traditional teaching methods (lecturing). On the other hand, some authors (e.g. Bertera *et al.*, 2007) believe that elderly people learn better by doing (13 studies used a hands-on style). Three studies used a comprehensive style and only one used the teach-back method, which charges teachers with the responsibility for successful learning. This style needs considerable effort on the part of the teachers and cannot be achieved rapidly; therefore, it is unsurprising that this style is unpopular. Regarding the study setting, educational content was communicated to the participants in the intervention programmes through online and face-to-face channels. Most of the studies used face-to-face channels (64.70%); moreover, the number of studies using ICTs seems to have increased in recent years. Of the 34 studies which were reviewed in this paper, 12 of them reported having used online channels. When employing face-to-face channels, intervention processes were typically implemented in informal learning settings (e.g. libraries and senior centres), universities, or health centres. Among these three, informal learning settings were most commonly used (52.94%). Furthermore, two different research designs were used to implement intervention programmes. While 61.76% of the reviewed studies used one group study design, with all participants in the study participating in the

intervention programme, 38.23% of the studies used multiple (at least two) groups: an intervention and a control group. Using one group study design is more popular, as it may be assumed it is easier to have only one group. Also, with a single-group design, there are no group-wise differences to consider in relation to the intervention process (Fink and Beck, 2015).
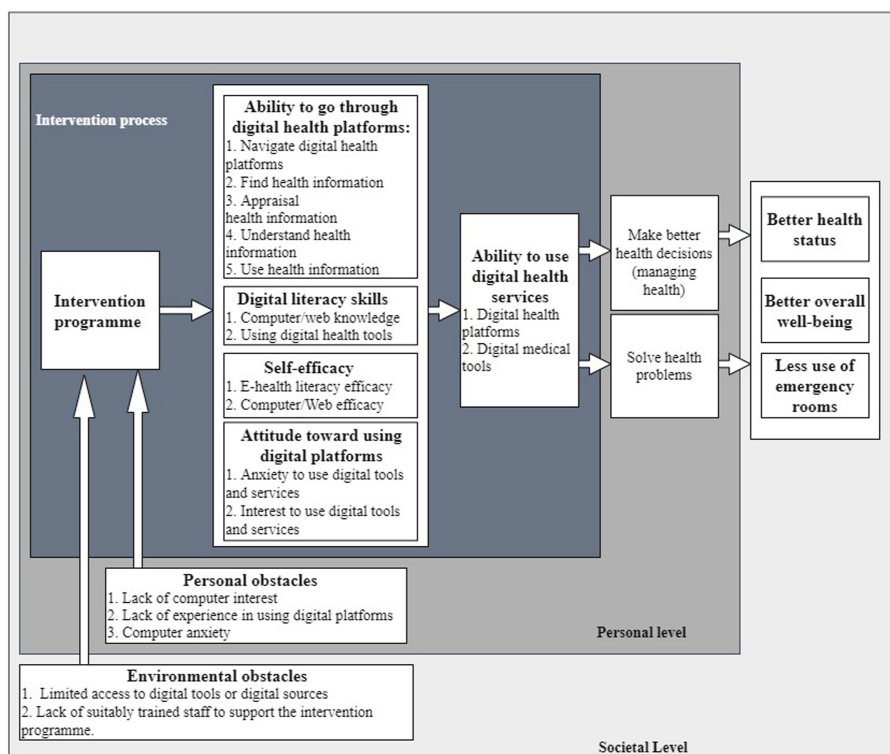
5.1 Intervention process

The reviewed studies report various changes in the skills, attitudes, beliefs, and confidence of elderly people as a result of interventions. In other words, the implementation of health literacy intervention programmes on different participants results in *four* principal outcomes, as described below.

(1) Those who have participated in a health literacy training programme have been trained to use digital platforms to find, evaluate, understand, and use trusted and accurate online health information (Xie, 2011a, 2012). Obtaining these skills has been found to be crucial for elderly people to be able to manage their health conditions and make medical decisions through the use of digital health information platforms (Banbury *et al.*, 2019; Czaja *et al.*, 2013).

(2) Knowledge regarding the use of computers, the web, or other digital devices and services has been found to increase among elderly people when pre-and post-intervention programme outcomes were compared (Xie, 2011a, c). Owing to a noticeable advancement in technology, the healthcare sectors have increasingly transformed their services towards being digitalised across the globe. Therefore, it is vital that elderly people have the basic knowledge to work with digital tools.

(3) A noticeable change in the attitudes of elderly people post-intervention was reported in the reviewed studies. In the post-intervention phase, studies reported a higher level of interest and less anxiety when working with digital tools and using digital health platforms (e.g. Xie, 2012). Also, personal attitude appears to be a pertinent factor affecting the use of digital health services.

(4) The health literacy interventions were useful in enhancing elderly people's competency for utilising technology and retrieving online health-related information. The higher levels of confidence and self-efficacy among elderly people after interventions seem to act as a driving force that motivates them to use digital health services (Nahm *et al.*, 2018). However, the studies by Chiu *et al.* (2016) and Fink and Beck (2015) did not report any improvement in self-efficacy. Therefore, the impact of self-efficacy (improved confidence) was not conclusive in all the reviewed studies.

The intervention process is expected to have both individual and societal outcomes. The personal outcomes mostly concentrate on the effect of the intervention process on individuals, while the societal outcomes demonstrate the effects of the intervention process on societies. Based on an analysis of the examined studies and discussions presented above, this research presents a holistic research model consisting of three layers: the intervention process, individual layer, and societal layer (Figure 3). This integrative framework, which takes into account personal and environmental factors, highlights which abilities might change as a result of an intervention programme and which benefits might be gained.

5.2 Individual level

The review results show that health literacy interventions have direct and indirect effects on elderly people's health behaviours. After participating in the health literacy training sessions

and learning how to use digital health services (platforms and tools), elderly people can participate more actively in their medical decision-making, since they will be able to obtain sufficient, and appropriate, medical information via digital health platforms. Furthermore, it is expected that health-literate elderly people could better resolve their health problems when they are more able to use digital health services. Owing to a higher likelihood of cognitive and physical impairments, elderly people face various health issues, which increase their need to access health services. Therefore, health literacy intervention programmes are of practical benefit to them. Despite the impact of health literacy interventions on elderly people, at the individual level there are several obstacles, which are mainly related to personal attitudes, thoughts, and characteristics (e.g. computer anxiety; lack of experience at working with digital devices). These obstacles could withhold or prolong the process of implementing health literacy interventions and enhancing elderly people's learning; therefore, addressing any obstacles arising in the pre-intervention phase is vital (Watkins and Xie, 2014).

5.3 Societal level
The third and final layer of the research model is the societal level, denoting the expected society-level outcomes and consequences of implementing health literacy intervention programmes among elderly people. The overall results of the review reveal that the two positive consequences of intervention programmes – transparent at the societal level – are having better health status and better overall well-being (Parker *et al.*, 2018). As demonstrated in the literature, the higher the ability to manage one's personal health life,

the better one's health status and well-being (Long and Gambling, 2012). At a deeper level, the intervention process in the core layer could positively influence medical decision-making or problem-solving ability among elderly people, which subsequently results in a higher quality of life in society as a whole.

In addition, improved health literacy and decision-making among elderly people may result in reduced use of emergency rooms and lower medical costs. Furthermore, such positive health outcomes for elderly people will contribute to the overall economic growth of the country, with reduced dependency rates and positive effects on the economy (Huang *et al.*, 2019). This layer also encompasses the existing barriers present in societies which adopt a passive stance to adopting and using digital health services for elderly people (e.g. limited access to digital tools or digital sources, lack of impetus to support intervention programmes). All these obstacles may jeopardise the healthy life of elderly people and make it difficult for them to access digital health services (Chu *et al.*, 2009). Authorities are responsible for creating these obstacles and so must find ways to tackle them since these problems are not within the control of the individuals.

6. Conclusion

The aim of this systematic review was to provide an updated and comprehensive assessment of the state-of-the-art academic knowledge on the effectiveness of health literacy interventions in relation to the use of digital health services. The object of the research was elderly people (65+), and the overall objective was to assess how intervention programmes enhance their ability to make informed medical decisions. In this review study, 34 articles were retained for analysis; below we describe the main contributions.

Our first contribution concerns the insights provided into several streams of research that focus on elderly people's literacy skills (health literacy, e-health literacy, and digital literacy), attitude, and confidence towards the use of digital health services and their competency at managing their health conditions. Three main themes were extracted. The themes demonstrate that the most significant part of the existing literature has concentrated on the impact of health literacy skills on the ability of elderly people to cope successfully with available online health information and to manage their health conditions. Owing to the speed at which digital health services (e-health and m-health) and digital health platforms are developing, as along with elderly people's appetite for accessing healthcare services and medical information, there is an increasing need to implement additional health literacy intervention programmes.

Furthermore, the reviewed studies report positive change in self-efficacy and attitude towards using digital health services when intervention programmes were implemented. Elderly people were found to have more confidence and a more positive attitude (more interest and less stress) towards using digital health services after participating in training sessions. Such findings answer the first research question.

Secondly, based on the analysis of the literature and the themes that emerged, we propose a research integrative framework. This framework can be used to explain how the health literacy intervention process can empower elderly people's abilities to navigate, find, evaluate, understand, and use available online medical information from digital information sources. The proposed framework is holistic, providing an overall overview and outlook of all the factors that change between the pre- and post-intervention stage (literacy skills, confidence, and attitude towards using digital health services). This framework considers two essential levels (personal and societal levels) to show how the health literacy intervention process can affect individuals and societies in a positive manner.

Thirdly, the results of the literature review enabled us to categorise the intervention strategies and identify the most commonly used intervention method. Our analysis indicates that to

implement a health literacy intervention, researchers have applied different strategies – individualistic and collaborative. Both strategies were employed almost equally in the reviewed studies. In other words, intervention designers have had diverse priorities, and different factors have played out in selecting strategies. The two strategies have utilised two different approaches (tailored and untailored). Since an untailored approach was used in most of the reviewed studies (27 studies), we may conclude that the untailored health literacy intervention is the most popular in the reviewed corpus of literature. However, three studies that used both strategies at the same time did not demonstrate any significant differences in the outcome.

In addition, five content mediation styles have been used to communicate educational content to elderly people, which differ in the level of responsibility placed upon the trainees and trainers. Among these five styles, the hands-on method was found to be the most popular (13 studies). Such findings answer the second research question. Finally, despite all the advantages and opportunities offered by health literacy interventions for elderly people, there are several obstacles that have to be considered when planning for the implementation of intervention programmes. These obstacles could impede the process of implementing health literacy intervention programmes for elderly people. Our analysis of the reviewed studies reveals two major categories of obstacles: personal and infrastructural. Personal obstacles mostly relate to the attitudes and perspectives of elderly people and the digital divide issue, while infrastructural obstacles mostly relate to accessibility and affordability aspects. Such findings answer the third research question.

6.1 Practical implications
This study also suggests several practical implications.

(1) There is an increasing need to implement additional health literacy intervention programmes, for two reasons: (1) to satisfy elderly people's appetite for accessing health services on account of their cognitive and physiological impairments, and (2) to make digital medical platforms, widely available globally, applicable for elderly people, thereby providing them with rich medical information (re)sources. In this way, the consequences of the lack of information (e.g. increased use of emergency rooms, increased health expenditure) are mitigated. As a result, we suggest that government and healthcare organisations should design free and public health literacy training sessions for elderly people and promote the usefulness of the existing platforms.

(2) Healthcare providers should also be aware of the importance of digital technologies and strive to motivate elderly people to utilise digital information services. One solution is to consider the capability of elderly people when designing, implementing, and developing information services. The best services must make it more convenient for its users to access information. In other words, the medical platforms must be sufficiently user-friendly for elderly people.

(3) Healthcare professionals and other stakeholders must be aware of the importance of intervention programmes in terms of empowering elderly people to improve their health literacy as well as in their effects on the adoption and use of digital information (re)sources. However, implementing successful training sessions for elderly people is challenging for several personal and infrastructural reasons. It is vital to tackle the obstacles before initiating any training programmes.

6.2 Limitations and suggestions for the future research agenda
This systematic literature review has several limitations. First, only studies with full text written in English were included in the sample. Second, this review paper only considers

empirical studies. Third, we only included studies published between 2000 and 2020. The tentative research model (Figure 3) is offered as a basis for future empirical research and validation. Similarly, as we did not focus on identifying any correlation between theories and intervention strategies, further research on the relation between theoretical frameworks and health literacy interventions – especially among elderly people – could bring clarity to theories concerning the development of successful interventions. Moreover, demographic variables (e.g. education, gender, age, and income) were not analysed in this systematic literature review. Therefore, in future investigations, scholars should consider the impact demographic variables on the success of health literacy interventions and health decision-making among elderly people. Moreover, this study did not quantitatively validate the relationships in the suggested model. Thus, in future investigations, we suggest scholars aim to affirm these relationships.

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(The Appendix follows overleaf)

Appendix

	Authors	Title	Journal/Publishing	Keywords	Citation
1	Xie (2011a)	Experimenting on the impact of learning methods and information presentation channels on older adults' e-health literacy	*Journal of the American Society for Information Science and Technology*	No keywords	62
2	Xie (2011b)	Older adults, e-Health literacy, and collaborative learning: an experimental study	*Journal of the American society for information science and technology*	No keyword	110
3	Xie (2011c)	Effects of an eHealth literacy intervention for older adults		Health literacy; lifelong learning; aged; technology	203
4	Xie (2012)	Improving older adults' e-health literacy through computer training using NIH online resources	*Library and Information Science Research*	No keywords	95
5	Strong *et al.* (2012)	Senior CHAT: a model for health literacy instruction	*New Library World*	Academic libraries, Health literacy, Senior citizens, Community outreach, Computer instruction, Computer studies, United States of America, Elderly people	35
6	Manafò and Wong (2013)	eSEARCH©: a tool to promote the eHealth literacy skills of older adults	*Journal of Consumer Health on the internet*	eHealth literacy skills, health promotion, older adults	16
7	Perestelo-Perez *et al.* (2020)	IC-health project: development of MOOCs to promote digital health literacy: first results and future challenges	*Sustainability*	Digital health literacy; MOOCs; open education; co-creation; eHealth; shared decision-making	12
8	Serbim *et al.* (2019)	Improving health literacy among older people through primary health care units in Brazil: feasibility study	*Health Promotion International*	Health literacy, intervention, community health promotion, elderly	8
9	Czaja *et al.* (2013)	Factors influencing use of an e-health website in a community sample of older adults	*Journal of the American Medical Informatics Association*	No keywords	140
10	Goeman *et al.* (2016)	Optimising health literacy and access of service provision to community dwelling older people with diabetes receiving home nursing support	*Journal of Diabetes Research*	No keywords	34
11	Banbury *et al.* (2019)	Adding value to remote monitoring: co-design of a health literacy intervention for older people with chronic disease delivered by telehealth – The Telehealth Literacy Project	*Patient Education and Counselling*	Health literacy, telehealth, videoconferencing, older people, chronic disease self-management, health education, remote patient, monitoring	34
12	Edwards *et al.* (2012)	The development of health literacy in patients with a long-term health condition: the health literacy pathway model	*BMC Public Health*	No keywords	263

Table A1.
Selected studies

(continued)

	Authors	Title	Journal/Publishing	Keywords	Citation
13	Sarfati *et al.* (2018)	BetaMe: impact of a comprehensive digital health programme on HbA1c and weight at 12 months for people with diabetes and pre-diabetes: study protocol for a randomised controlled trial	*Trials*	Diabetes mellitus, Self-management, mHealth, Mobile, Online, Māori, Pacific, Indigenous	10
14	Hoffman-Goetz *et al.* (2006)	Evaluation of a Public Library Workshop: Teaching Older Adults How to Search the internet for Reliable Cancer Information	*Journal of Consumer Health on the internet*	Cancer education, Internet, seniors, library, consumer training	32
15	Parker *et al.* (2018)	Preventing chronic disease in patients with low health literacy using eHealth and teamwork in primary healthcare: protocol for a cluster-randomised controlled trial	*BMJ open*	No keyword	13
16	Chiu *et al.* (2016)	The attitudes, impact, and learning needs of older adults using apps on touchscreen mobile devices: Results from a pilot study	*Computers in Human Behaviour*	Touchscreen mobile device Mobile applications (apps) Older adults Technology acceptance model Diffusion of innovation theory Mixed-method approach	86
17	Nahm *et al.* (2018)	The effects of a theory-based patient portal e-learning program for older adults with chronic illnesses	*Telemedicine and e-Health*	Patient portal, older adults, e-learning, chronic illnesses, usability	21
18	Aspinall *et al.* (2012)	Health literacy for older adults: using evidence to build a model educational program	*Medical Reference Services Quarterly*	Evaluation, health communication, health information, health literacy, information seeking, senior health	28
19	Bosworth *et al.* (2009)	Two self-management interventions to improve hypertension control: a randomised trial	*Annals of Internal Medicine*	Hypertension; Lifestyle; Clinical Trial; Self-management; Adherence	314
20	Gross *et al.* (2007)	Senior citizen access to trusted stroke information: a blended approach	*Journal of Consumer Health on the internet*	Stroke, cerebrovascular disorders, Internet resources, consumer health, senior citizens, seniors, patient education	13
21	Long and Gambling (2012)	Enhancing health literacy and behavioural change within a tele-care education and support intervention for people with type 2 diabetes	*Health Expectations*	Behavioural change, health literacy, self-care, tele-health, type 2 diabetes	61
22	Fink and Beck (2015)	Developing and evaluating a website to guide older adults in their health information searches: a mixed-methods approach	*Journal of Applied Gerontology*	Older adults, mixed methods, web-based health information, online education	37
23	Susic (2009)	NIH senior health classes for senior citizens at a public library in Louisiana	*Journal of Consumer Health on the internet*	Health literacy, Internet, NIH Senior Health, public libraries, seniors, user instruction	16
24	Xie and Bugg (2009)	Public library computer training for older adults to access high-quality Internet health information	*Library and Information Science Research*	No keywords	220

(continued)

Table A1.

	Authors	Title	Journal/Publishing	Keywords	Citation
25	Kim *et al.* (2014)	The effect of a community-based self-help multimodal behavioural intervention in korean american seniors with high blood pressure	*American Journal of Hypertension*	Behavioural intervention; blood pressure; community-based participatory research; health disparity; health literacy; high blood pressure; hypertension; Korean Americans	62
26	Tse *et al.* (2008)	E-health for older people: the use of technology in health promotion	*Cyberpsychology and Behaviour*	No keyword	94
27	Redfern *et al.* (2020)	A digital health intervention for cardiovascular disease management in primary care (CONNECT)-randomised controlled trial	*Digital medicine*	No keyword	13
28	Chu *et al.* (2009)	Partnering with Seniors for "Better Health": computer use and Internet health information retrieval among older adults in a low socioeconomic community	*Journal of the Medical Library Association*	No keyword	130
29	Masi *et al.* (2003)	Internet access and empowerment, a community-based health initiative	*Journal of General Internal Medicine*	Community, participatory, health, empowerment, technology	95
30	Campbell and Nolfi (2005)	Teaching elderly adults to use the Internet to access health care information: before-after study	*Journal of Medical Internet Research*	Aged; health; patient participation; health information system; Web-based services; Internet; attitude to health; physician-patient relations	166
31	Nahm *et al.* (2015)	The effects of an online theory-based bone health program for older adults	*Journal of Applied Gerontology*	Theory-based intervention, online study, bone health, physical activities, diet	21
32	Bertera *et al.* (2007)	Training older adults to access health information	*Educational Gerontology*	No keyword	46
33	Broering *et al.* (2006)	Outreach to public libraries, senior centres, and clinics to improve patient and consumer health care	*Journal of Consumer Health on the internet*	Community outreach, electronic access, alternative and complementary medicine, acupuncture, Oriental medicine, Web page links, resource links, wireless communication	19
34	Willis *et al.* (2018)	Search smart for your health–a state-wide health literacy campaign	*Journal of Consumer Health on the Internet*	Adolescents; elderly; consumer health; health disparities; health information seeking; health literacy; online health information; young adults	1

Table A1.

Corresponding author
Shahrokh Nikou can be contacted at: shahrokh.nikou@abo.fi