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Towards Accessible Websites to support Health Information Among Older People

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ABSTRACT

Web-based health information as one of health information media sources, can effectively promote healthcare for older people when it fit their needs. To benefit older people, appropriate accessibility features should be applied to these types of websites together with good quality information content.

   The aim of this study was to provide a description of use of the Internet and the practice of web accessibility evaluation based on Web Content Accessibility Guidelines (WCAG) 2.0 particularly within the scope of web-based health information for older people. This study explored web accessibility's significant role in engaging older people on the Internet and focusing on health information related to older people.

   The data were collected from two different sources: a regional survey for older people's well-being and from health webpages related to memory impairment. In the regional survey. The methods of data analysis used were both of qualitative and quantitative mixed methods. The study consist of four phases: (1) Analyzing older people's demographic characteristics that are associated with the use of the Internet by using older people well-being or Ikääntyminen ja hyvinvointi Pohjois-Savossa

(IKIPOSA) data, (2) Analyzing the quality and accessibility of websites related to older people's healthcare information by using data from websites based on search engine top lists, (3) Analyzing the national WCAG2.0 policy effectiveness of websites focusing on older people related healthcare information by using country-specific websites and (4) Summarizing each phase based on study framework.

The study results from the first phase showed that lower education, old age, low level of work experience, and financial status were barriers among older people on the Internet use. The second phase study results memory impairment related health information sources for older people with quality labels were still incompliance with the WCAG 2.0 standard and they still contain information that older people find difficult to read. The third phase study results showed ineffectiveness of the local practice of implementing WCAG2.0 by showing no significant differences between countries with or without a WCAG2.0 policy and the last phase of the study showed interconnected among ineffective policy implementation through WCAG2.0 incompliances caused existed gap for certain demographic characteristics of older people in utilizing the Internet.

In conclusion, in the implementation of web-based health information for older people, the role of web accessibility should be strengthened through enforcement of the accessibility standard. The accessibility standard should be a major concern for all stakeholders. To protect older people sufficiently, governments should take the main role in building, implementing, and monitoring web accessibility policies. These are keys to minimizing web technology access gaps among older people in using the web-based health information. Actions should begin by implementing accessibility policies on websites and ensuring the better outcome of these policies that existed when people with various demographic background are able to access the websites.

TIIVISTELMÄ

Terveystietoja tarjoavat verkkopalvelut voivat yhtenä terveystiedon medialähteenä tehokkaasti edistää ikääntyneiden tarvepohjaista terveydenhuoltoa. Jotta ikääntynyt väestö hyötyisi verkkosivustoista, niissä tulisi olla asianmukaiset saavutettavuusominaisuudet sekä laadukasta tietosisältöä.

Tämän tutkimuksen tavoitteena oli arvioida ja kuvata Internetin käyttökokemuksia ja verkkosisältöjen saavutettavuuden toteutumista WCAG 2.0 -kriteerien perusteella. Huomiota kiinnitettiin erityisesti ikääntyneelle väestölle suunnattujen ja verkkopalvelujen tarjoamien terveystietojen saavutettavuuteen sekä siihen, miten ikääntynyttä väestöä koskevat terveystiedot tavoittavat ikäihmiset Internetissä.

Tiedot kerättiin kahdesta eri lähteestä: ikäihmisten hyvinvointia koskevasta alueellisesta kyselystä ja muistin heikkenemistä käsitelleiltä terveyssivuilta. Alueellisen kyselyn tietojen analysointia lähestyttiin monimenetelmällisesti sekä laadullisia että määrällisiä metodeja hyödyntäen. Tutkimus koostui neljästä vaiheesta: (1) Ikääntyneiden Internetin käyttöön liittyviä väestöominaisuuksia analysoitiin Ikääntyminen ja hyvinvointi Pohjois-Savossa (IKIPOSA) -tutkimuksen tietojen avulla; (2)

ikäihmisten terveydenhuoltotietoihin liittyvien verkkosivustojen laatua ja saavutettavuutta analysoitiin käyttämällä tietoja, jotka saatiin hakukonetuloksissa parhaiten sijoittuneista verkkosivustoista; (3) kansallisten WCAG 2.0 -käytäntöjen tehokkuutta analysoitiin tarkastelemalla maittain määritettyjä verkkosivustoja, jotka käsittelivät ikääntyneen väestön terveydenhuoltoa; (4) kustakin vaiheesta laadittiin tutkimuksen kehyksen mukainen yhteenveto.

Ensimmäisen vaiheen tutkimustulokset osoittivat, että alhaisempi koulutus, korkea ikä, vähäinen työkokemus ja taloudellinen asema olivat ikäihmisten Internetin käytön esteitä. Toisen vaiheen tulokset osoittivat, että vaikka ikäihmiselle suunnatut ja muistisairauksia koskevat terveystietolähteet olivat laatumerkittyjä, ne eivät olleet WCAG 2.0 - standardin mukaisia ja ikääntyneet kokivat niiden tietosisällön lukemisen vaikeaksi. Kolmannen vaiheen tutkimustulokset osoittivat WCAG 2.0 - käytäntöjen paikallisen käyttöönoton tehottomuuden, sillä tutkimuksessa ei havaittu merkittäviä eroja WCAG 2.0 -käytäntöjä määrittäneiden maiden ja muiden maiden välillä. Tutkimuksen viimeinen vaihe osoitti myös, että WCAG 2.0 -käytäntöjen noudattamattomuus vaikutti negatiivisesti ikääntyneen väestön Internetin käyttöön.

Yhteenvetona voidaan todeta, että ikääntyneelle väestölle terveystietoja tarjoavien verkkopalvelujen saavutettavuutta olisi parannettava saavutettavuusstandardin täytäntöönpanon kautta. Kaikkien sidosryhmien tulisi suhtautua saavutettavuusstandardin erittäin vakavasti. Jotta ikääntyneen väestön tarpeet pystyttäisiin huomioimaan riittävästi, hallitusten tulisi ottaa päävastuu verkon saavutettavuuskäytäntöjen laatimisesta, täytäntöönpanosta ja seurannasta. Nämä keinot ovat avainasemassa, kun terveystietoon liittyvän verkkoteknologian käyttöaukkoja halutaan minimoida ikääntyneen väestön parissa. Ensimmäiseksi tulisi varmistaa verkkosivustojen saavutettavuuskäytäntöjen toimeenpano sekä käytäntöjen entistä parempi toimivuus eri väestönosia edustavien henkilöiden käytössä.

Avainsanat: Verkkosivusto; terveys, tieto, ikääntyneet, ihmiset, saavutettavuus, laatu, käytäntö

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1 Introduction

Since the invention of the Internet in which enable the computer to communicate with others through network (Beal, 2015), there have been many alternative ways in accessing the information online. World Wide Web (WWW) is one of among communication types that connect documents (web pages) and other web resources through hyperlinks and Uniform Resource Locators (URLs) (Beal, 2015). Development of the WWW has started in 1991 by the application of web static where the contents in which were delivered to the consumers from the server are not changing, or it was known as web 1.0 (Choudhury, 2014). Later, in 2002 the era of web2.0 was begun where the web has more advanced features such as self-generated content (Cormode & Krishnamurthy, 2008).

As the right to access information has been a vital role in many public services, it has been one critical issue in many countries and the implementation of accessibility now is not only limited to the physical matters as the cause of the digital divide, but also it is extended into various aspects and one of them within the web accessibility view. Benefit of web-based information for example, in healthcare context, where accessible information can result in the public's overall awareness of and improved knowledge about important health issues. Moreover, with accessible information, every people can understand and learn the high-quality health information content appropriately with the equal opportunity as well as people without disability with renewed strategy that covered eight areas (accessibility, participation, equality, employment, education and training, social protection, health, and external action (EU, 2015). To have accessible information, the standard of decent quality and accessibility information should be applied to protect the right of people to have an equal opportunity to access information (Ismail & Kuppusamy, 2016;De Lara et al., 2010).

Regarding increasing number of older people in the world (United Nations, Department of Economic and Social Affairs, 2017) and the lower

proportion of oldest age groups in using the Internet, there are some improvements in the online information to reach the growing older population. As older people are the specific users within this study, the operational definition of older people in this study is based on chronological age according to WHO where people at the age 65 and above were older people (WHO, 2001). Other definitions beside chronological age such as life expectancy-based definition is an alternative to define the old age. However, in this study, the term not including the other definitions where this life expectancy definition can be different between developed and developing countries because of various socio-economic conditions (Rogers & Wofford.S, 1989). In addition, the gerontologists age definition was under three non-chronological age definitions: biological age (related to life span), social age (social role and habits with several demographics view factors such as socio economics status, education, sex, and race) and social-psychological age (consist of subjective age, personal age, and other perceived age) (Barak & Schiffman, 1981). The term "elderly" is seen as not appropriate particularly within gerontologist point of view, however in this study the term is used interchangeably with "older people" or "old people", likewise in the keywords for review literatures, and the articles. However, in this summary, the term "older people" is used.

It is important to note that older people with certain characteristics due to their aged condition have been categorized under a disability category that has caused them to be unable to access the web-based health information in the same way as people with other disabilities. These older people are viewed as a population that should have the opportunity to access health information equal to that of other groups. Disability should be viewed as a demographic characteristic like gender or education level (Jonathan Lazar et al., 2015). Therefore, the technology should be accessible to meet older people needs and avoid their exclusion from digital society.

Accessing the WWW should consider every individuality because accessibility is a human right according to United Nations Convention on the Rights of Persons with Disabilities (UNCRPD) which was supported by the European Disability Forum (EDF) (Greco, 2016). Herein, the definition of

accessibility refers to WWW Consortium Web Accessibility Initiatives (W3C WAI) that promote an equivalent user experience for people with disabilities (W3C WAI, 2016). Also, the UNCRPD in 2008 encouraged the use of technology to cope with social problems and through the UN initiatives, national legal frameworks, and the European Union (EU) legal framework have reformed their regulations concerning people with disabilities (Ferri & Favalli, 2018). It is still to be seen whether the national regulations or EU policies in terms of web accessibility have significantly improved web accessibility in practice. Government agencies were the main actors in promoting web accessibility as lawmakers and the national policy of web accessibility was enforced by government institutions (Waddell et al., 2003). Raising the awareness of web accessibility, which is defined as the ability of people with disabilities to perceive, understand, navigate, and interact with websites and online tools and other technologies, has become a main concern. As a result, several initiatives were employed to encourage the implementation of web accessibility (W3C WAI, 2016). The aim of these initiatives was to address the need to improve the level of social inclusion of people with disabilities, which can be enhanced by information technology. A main concern of all stakeholders is to promote web accessibility.

Earlier studies related to the implementation of Web Content Accessibility Guidelines (WCAG) have focused on diverse topics such as e-health services (Martins et al., 2017), library services (Getts & Stewart, 2018), government services (Acosta-Vargas et al., 2018) and e-commerce (Sohaib & Kang, 2016). The emergence of research themes in the fields of health informatics was due to user needs to have proper content, better accessibility, more credibility, and understandability for the general population with easy level of readability. Moreover, the study of quality evaluation of web-based health information has been a popular theme, as well as the popularity of health information among information seekers. With the benefit of web-based health information, older people can take part more actively in maintaining their health through better knowledge and more interactive communication with health care professionals or their peers. It is important to notice that WCAG version 2.0 has been acknowledged by the UN for recommended

accessibility standard and it was accepted as an International Organization for Standardization (ISO) standard of ISO/IEC 40500:2012 (W3C WAI, 2021). With its popularity among online information seekers, health information is also very important for older people because they are more cautious about their health and want to improve their knowledge due to their health problem vulnerabilities. The online sources were used also by their family carers and health professionals who may be taking care them at home (Alpay et al., 2004). With the Internet's health information sources, the information can be disseminated more widely, and all the benefits of the Internet can be realized such as connectedness, satisfaction with discovering a wealth of information at their fingertips, utility, and positive learning experiences (Gatto & Tak, 2008). The online health information in this study is limited to web-based health information which is defined as health information on a website. With health information popularity, the number of health information webpages has been growing rapidly (Godlee et al., 2004) and older people should be able to benefit from these alternative sources like others.

Proposed web accessibility content guidelines such as customized education, various assistive technologies and design that focuses on older people's needs have been developing (W3C WAI, 2008). Concerning accessibility of the Internet, W3C has provided guidance to reach the vision of providing information for all included in the vulnerable population. The WCAG guidance has evolved from WCAG1.0 to WCAG2.0 to be more robust, measurable, and not depend on technology (Urban & Burks, 2006).

In the meantime, the use of the Internet has been growing globally. In Finland, 82% of the population reported frequent use of the Internet among those aged 16-89 years old (OSF, 2020). Based on age group category, the groups 16-24 and 25-34 years old were on top of the list followed by middle-age groups from 35-54 years old (OSF, 2020). Based on age group category, the groups 16-24 and 25-34 years old were on top of the list followed by middle-age groups from 35-54 years old (OSF, 2020). However, frequent Internet use among the oldest groups, 65-74 and 75-89 years old, was reported as only 62 percent and 30 percent, respectively

(OSF, 2020). Moreover, the lesser percentage in using more advanced services of the Internet such as online shopping, making Internet calls and social networks were existed. For the most advanced Internet service, which was online shopping, only 8 percent of seniors aged 75-89 used it (OSF, 2020). Meanwhile, most web1.0 features were still in dominant use, especially web-based information and email reaching 89 % among all types of Internet applications in all age groups in Finland (OSF, 2020). Despite Finland had the second rank in the EU Digital Economy and Society Index (DESY) 2017, which assesses the EU countries through several indicators, namely connectivity, human capital, use of the Internet, integration of digital technology and digital public services (EU, 2017).

The technology advancements in accessing devices have brought more impact for people with disabilities by their accessibility features (Crossland et al., 2014). Disability itself has many different definitions. The UNCRPD defines people with disabilities as "those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full effective participation in society on an equal basis with others". Another definition from the US Americans with Disabilities Act defined it as "a physical or mental impairment that substantially limits one or major life activities of that person" (Jonathan Lazar et al., 2015). Regarding the older population, a growing number of disabilities have been associated with ageing that require shared political priorities (Naue & Kroll, 2010). Assessing the Internet now can be done through many communication devices not only from a personal computer but also from a mobile phone, tablet, smartwatch, smart TV, etc. The more ease of use designed of the Internet devices has been continuously improving, providing a higher level of convenience, even for people with disabilities (Crossland et al., 2014). In addition, the accessibility features which have a key role in better performance of Internet devices have been used for many people, not only people with disabilities (Kimball & Cohen, 2003). One important thing to notice is that web accessibility has not only related to assistive technology, but also the websites need to have accessibility features (Petrie et al., 2015).

This study focuses on evaluation of quality and accessibility of older people-related health information on the websites using the web accessibility. The quality of health information within this study was more specific in information context compared to previous study of quality of computer system-based healthcare (Hasman et al., 2003). With the ageing condition, the need to maintain health is urgent. Therefore, having websites with the proper quality and accessibility enable older people to benefit from the Internet as alternative health information sources, and other age groups also benefit from this. This study is within the field of health and human services informatics within the field of the use of ICT where the practice of website accessibility and quality were based on users' needs. The aim of this study was to provide a description of the use of the Internet and the practice of web accessibility evaluation based on Web Content Accessibility Guidelines (WCAG) 2.0. Further, content quality for health information and accessibility criteria for older users were integrated in evaluating the health information websites for older people.

2 Study framework of web-based health information for older people

2.1 Quality and accessibility of web-based health information

Accessibility of web-based health information is one major factor to engage older people in utilizing online information sources (Kamoun & Almourad, 2014). As older people have been the least common among all age groups to regularly use the Internet (OSF, 2020), good quality and accessibility of websites should accommodate the needs of aged people particularly in their accessibility, readability, and navigational capacities. Many quality factors have been previously studied, including information relevancy that required navigational capacity (Lee et al., 2014), reliability and relevance of health information (Boyer & Geissbuhler, 2005),usefulness and accessibility of information (Choudrie et al., 2013) and readability (Tahir et al., 2020).

The initial development of web accessibility was started in April 1997 where the World Wide Web Consortium (WWWC) introduced the Web Accessibility Initiative (W3C WAI, 1997). In 1999 WCAG 1.0 (first version) to address web content became a WWWC recommendation (W3C WAI, 2000). A year later, authoring tool accessibility guidelines (ATAG)1.0 to address author tools had been recommended, and in 2002 user agent accessibility guidelines (UAAG) 1.0 were implemented to address web browsers, media players and some assistive technologies (W3C WAI, 2000). The following describes the relationships among accessibility tools : ATAG was used as a guideline by content producers or developers in creating the web content ; WCAG was used as a guideline by content producers and other stakeholders to evaluate the web content; and UAAG was used as guidelines in providing user agents tools such as web browsers, media players and/or assistive technologies (W3C WAI, 2000). In addition, tool

developers facilitated features and functionality in authoring tools, evaluation tools, and user agent's tools (Chisholm, W.A, Henry, 2005).

WCAG1.0 was the initial version of WCAG which consisted of fourteen criteria that encompassed the general principle of website design with a total of sixty-five checklists and each checklist had a priority level on a scale from 1 to 3 based on accessibility role (W3C WAI, 1999). WCAG1.0 has many shortcomings such as ambiguity, html-dependence, lack of guidance, unclear terms, and difficulty to understand and to apply (Kamoun et al., 2013).

Since the release of WCAG1.0, there were initial efforts to adopt it into local or regional accessibility regulation, such as in the US with section 508 of the Rehabilitation Act, with the scope of implementation being within the public sector and the type of law being a non-discrimination law (W3C WAI, 2021). However, the implementation was not executed by most states (Fulton, 2011; Jonathan Lazar & Olalere, 2011). Another effort within the EU, the web accessibility directive 2016/2102 (European Union, 2016), required accessibility statements, feedback mechanism and regular monitoring of public websites of member states (European Union, 2016).

The revised version of WCAG1.0 proposed in 2008, WCAG2.0, has been more simplified, includes guidelines and uses only four principle categories: perceivable, operable, understandable, and robust (W3C WAI, 2008). Moreover, it was easier to interpret with more detailed descriptions of accessibility criteria, use and evaluation both in manual evaluation through human assessment and in automatic evaluation through an accessibility testing tool (Termens et al., 2009; W3C WAI, 2008). Even though it was simple, WCAG2.0 included more disability types, especially low-vision and reduced-mobility users (Termens et al., 2009). Despite the more improved version, WCAG2.0 was still vague, included an excessive amount of information, and did not involve people with disabilities in creating and in evaluating the guidelines (Kamoun et al., 2013).

It is important to note that the role of the web accessibility standard, which in this study refers to WCAG2.0 as the only acknowledged standard by the UN, is to guide or regulate developers to accommodate user's

needs. Those needs were grouped in accessibility criteria and there were several criteria requirements. In addition, WCAG2.0 has been approved as an ISO standard with the code ISO/IEC 40500 (W3C WAI, 2021). A previous study has suggested that unclear guidelines were one of the main barriers according to a webmaster's survey together with lack of training, lack of client and management support and inadequate software (J Lazar et al., 2004).

In general, the legal adoption of WCAG2.0 has encompassed many sectors from the government to the public and private sectors, including various laws (W3C WAI, 2018). Moreover, better accessibility means potential profit for private sector (Giannoumis, 2018). The implementation of web accessibility standards to improve web accessibility have been studied in various types of website information such as education, tourism, government, library, e-commerce and transportation in various countries (Akram & Bt Sulaiman, 2020; Balaji & Kuppusamy, 2016; Getts & Stewart, 2018; Hallo et al., 2017; Sohaib & Kang, 2016; Taylor, 2019; Teixeira et al., 2019; Westin et al., 2018). The WCAG2.0 standard has been used by several countries (W3C WAI, 2018) and it has been taken into local or regional web accessibility policy such as section 508 in the US (Y J Yi, 2015) and the EU web accessibility directive 2016/2102 (European Union, 2016).

It has been suggested that web accessibility includes complex and multicomponent concepts with connections to other concepts such as web usability, user experience and/or web quality. Because of its wide range of concepts, it needs a definition that encompasses those (Petrie et al., 2015; Yesilada et al., 2012) . Petrie et al. (2015) has reviewed many definitions of web accessibility and noted they contain various used definitions through a unified definition of web accessibility and suggested four interconnected elements in any context of web accessibility: users, mainstream technologies, websites, and assistive technologies. Figure 1 below shows how users within certain contexts access the websites through mainstream technologies directly or indirectly with the help of assistive technologies.
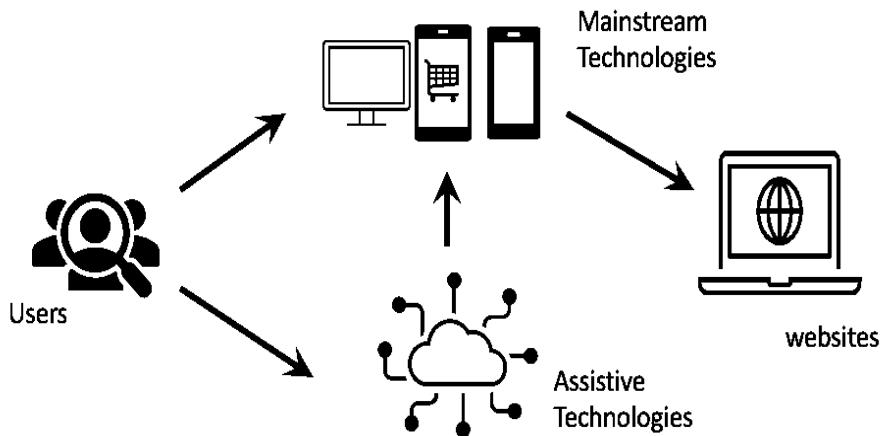
Figure 1. Unified definition of web accessibility (Modified picture of Petrie et al., 2015)

Usability itself was defined as "the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (Petrie & Bevan, 2009). In the context of usability, accessibility means the extent to which a product can be used by anyone to achieve specified goals with effectiveness, efficiency and satisfaction in any context (Waddell et al., 2003).

Web accessibility with the related elements as seen in figure 1 is defined as any individuals, including disabled and older people, can use the websites either directly by the mainstream such as computer, tablet or smartphone or with the help of assistive technologies, which is made possible through proper web design and supported by any assistive technologies (Petrie et al., 2015). Improving the accessibility of websites can be conducted through two principles: utilization of access technology and adopting good practices in interface design (Brophy & Craven, 2007). This study used Petrie definition by focusing on older people as users, mainstream technology in the context is personal computer and use of the

websites particularly for health information. In addition, adopting good practice in interface design here refers to interface design based on WCAG2.0 guidelines.

In terms of quality of web-based health information, most quality criteria were : (1) accurate with regard to how precise the information is on the web with the best evidence; (2) completeness with regard to the proportion of predefined elements or key elements covered or mentioned ;(3) readability as the complexity level and length of words ;(4) design as the visual aspect of the site or layout; (5) disclosure, which was a transparency criteria ;and (6) references (those last two criteria were also called technical criteria) (Eysenbach et al., 2002). This study implied that accessibility was a component of quality within the scope of design criteria and readability criteria (Eysenbach et al., 2002). Another study regarded the information content quality, where quality of health information was assessed based on several criteria including writing quality, unbiased and evidence-based articles (Kinkead et al., 2020). Because quality of health information websites refers not only to the content of information, good information content alone cannot convince the users of a website's usefulness (Eysenbach et al., 2002; Kinkead et al., 2020), especially for lay people or older people because good information content was only one e-service quality criteria among other criteria for website design (Li & Suomi, 2009; Santos, 2003). However, in the context of accurate health information, content quality was crucial because it can affect people's lives. In addition, the six criteria for website design should be addressed in order of their rank, the first as the highest priority until the sixth as the lowest priority: use, content, structure, linkage, search, and appearance (Santos, 2003). Thus, good-quality, and comprehensive website design should also address issues like appearance and readability (Kinkead et al., 2020) or in other words high accessibility should be provided with all other quality criteria of website design.

There were several terms related to health information websites. Firstly, web-based health information seeking is defined as interactive messages with or without intention in a self-defined network community to gain

knowledge about health and to construct a network both of an individual and social sense for health with the Internet as the media channel (Tardy & Hale, 1998). Media channel or communication media here refers to data or information transfer both in delivering and receiving formats (Techopedia, 2017).

Disabilities have various meanings in different contexts. For example, the Americans with Disabilities Act (ADA) defines disability more in legal terms as a person who has physical or mental impairment that substantially limits one or more major life activity, including people who have a record of such impairment and for individuals who are regarded as having disabilities (ADA, 2021). In contrast, the UN through the UN Convention on the Rights of Persons with Disabilities defined disabilities as those who have long-term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others (UNCRPD, 2006). The UN definition has more inclusive coverage of disabilities than the US ADA, as the UN definition covered not only physical and mental disabilities but also intellectual and sensory impairments. Particularly in the field of human computer interaction, disabilities are categorized into three different types based on functional need to operate the computer: perceptual disabilities (vision and hearing limitations), motor and physical disabilities (limited use of hands, arms, and speech), and cognitive disabilities which are regarded in a computer centric view (Jonathan Lazar et al., 2015). In conjunction with older people, there were certain demographic characteristics of older people that can be categorized as disabilities both in cognitive and physical capacities. People with disabilities should be viewed as equal to those of others in information access, as suggested by Jonathan Lazar et al., (2015). This equal opportunity for services use should be seen as good service quality from the perspective of citizens, the government and other providers (Jonathan Lazar et al., 2015) in which diverse users, including people with disabilities, have technology that is based on the principles of universal access and design for all (Jonathan Lazar, 2007).

2.2 Older people as the users of web-based health information

The review to identify and map older people as the users of web-based health information revealed three related themes that were compiled from the study findings: (1) demographic factors, (2) benefit of health information websites, and (3) older people's experiences and attitudes toward web-based health information. More detail on review process can be found on appendixes 1 and 2. Table 1 below shows the associated themes related to older people in using the Internet as a health information source.

Table 1. Extracted themes on older people as the users of web-based health information

Themes	Factor	Finding	Reference (Author, Year)
Demographic Factor	Education	Older people with higher education level use the Internet more frequently than those with lower education level. This factor was also significant in younger age groups. Existed not only in short age range but also in longer age span.	Bujnowska-Fedak & Mastalerz-Migas, 2015, Chung, Gassert & Kim, 2011a, Sally J McMillan & Macias, 2008, Crouch & Gordon, 2019.
	Physical limitation or disability	Barrier to accessing the Internet. Presence of any chronic diseases has different finding,	Chung et al., 2011a, Bujnowska-Fedak & Mastalerz-Migas, 2015a, Gracia & Herrero, 2009,

	better self-rated health has positive influence, but other studies implied that having one or more chronic conditions led to higher odds of using online health information.	Tavares, 2020, Crouch & Gordon 2019, Sally McMillan & Macias 2008, Yuan, 2020.
Chronological age factor	Younger age group were more frequent internet users (using digital information, searching for health information, interest in internet-based tools and mHealth) than users above 60 years old.	Bujnowska-Fedak & Mastalerz-Migas, 2015a, Crouch & Gordon, 2019, Gordon & Crouch, 2019, Sally J. McMillan & Macias, 2008, (Nguyen et al., 2018).
Financial situation	High cost was the internet use barrier: those with higher income have greater potential to be Internet users, mobile phone owners and have computer access.	Chung et al., 2011a, Crouch & Gordon, 2019, Sally J. McMillan & Macias, 2008, Zajac et al., 2012 Bujnowska-Fedak & Mastalerz-Migas, 2015a, Yuan, 2020.
Gender	Findings were mixed among males and females regarding accessing health information websites.	Campbell & Nolfi, 2005, Stephanie Medlock et al., 2015,H. Shim, Ailshire, Zelinski, & Crimmins, 2018, Zajac et al., 2012.

			Bujnowska-Fedak & Mastalerz-Migas, 2015a,Chung et al., 2011a, Sally J. McMillan & Macias, 2008.
	Marital status and/or having family	Older people need help using the Internet which can be from spouse or family member.	Crouch & Gordon, 2019, Merkel & Hess, 2020, Bujnowska-Fedak & Mastalerz-Migas, 2015a.
	Living location	Different findings in showing significance of location, whether in remote or urban area.	Haase, Sattar, Holtslander, & Thomas, 2020., Merkel & Hess, 2020.
	Working status	Active workers were more frequent Internet users, and Internet work experiences influenced the potential for using the Internet in later life.	Merkel & Hess, 2020, Tavares, 2020. Wong, Yeung, Ho, Tse, & Lam, 2014.
	Organizations member	Becoming part of institutional care communities or organizations help older people who need help in using the Internet.	Chung et al., 2011a, Crouch & Gordon, 2019.
Benefit factors	Better understanding	Older People gain better understanding of health with the Internet as	Haase et al., 2020, S Medlock et al., 2013, Takahashi et al., 2011, Campbell &

	supplemental information.	Nolfi, 2005, Peng & Chan, 2020, Seçkin, Hughes, Yeatts, & Degreve, 2019. (García-Camacha et al., 2020)
Increased self-belief, confidence, and self-efficacy.	Using the Internet increased or maintained self-belief, confidence, and self-efficacy.	Campbell & Nolfi, 2005, Chu et al., 2009, Takahashi et al., 2011, S J McMillan & Macias, 2008.
Better self-health judgment	With the Internet as a trusted source, people have better self-health judgment.	Seçkin et al., 2019.
Raising healthcare awareness.	Awareness of Healthcare was enhanced by online sources.	Stephanie Medlock et al., 2015.
Help in decision-making.	Web-based health information can be used for decision-making particularly for highly educated and younger older people (boomers).	Stephanie Medlock et al., 2015,Chung et al., 2011a.
Better managing self-health.	Boomers use the web-based health information for managing their health.	Haase et al., 2020.
Increased the use of healthcare.	Different findings in terms of the effect of Internet use, positive	Clarke et al., 2017, Shim et al., 2018.

Experiences and Attitudes	Perceived ease of use or feel the complexity of the Internet.	effect for healthy older people	
		Older people who perceived ease of use have positive behaviour intention to use the Internet with features such as font size, contrast, and short paragraphs. Negative experiences when the Internet was complicated and resulted in higher cost or was inefficient.	Wong et al., 2014, Chu et al., 2009. Chung et al., 2011a, Nguyen, Minh Hao Smets, Ellen M.A. Bol, Nadine, Loos, Eugène F. Van Weert, Julia C.M, 2018.
	Prefer to seek online information than communicate to the health practitioners.	Older people prefer to seek information on the Internet due to their hesitance to communicate with health practitioners.	Haase et al., 2020.
	Less confident because of lack of skills.	Negative attitude caused older people to not use the Internet because they felt they are not capable to use it.	Bujnowska-Fedak & Mastalerz-Migas, 2015a, S Medlock et al., 2013.
	Prefer comprehensive content.	Older people prefer to have comprehensive content.	Chu et al., 2009, Nguyen, Minh Hao Smets, Ellen M.A. Bol, Nadine Loos, Eugène F.

		Van Weert, Julia C.M, 2018,
Concern over Internet safety.	Despite the importance of the Internet as an alternative health information source, older people can be reluctant to use it because of the Internet safety concern.	Bujnowska-Fedak & Mastalerz-Migas, 2015a.
Internet Importance depends on trust.	When older people believed the Internet was credible, fair, and information comparable to health practitioners, they would have positive experiences and the Internet is perceived as important.	Seçkin et al., 2019, Sheng & Simpson, 2015, S Medlock et al., 2013, S J McMillan & Macias, 2008.

The reviewed studies found higher education and work experience using computers were associated with older people being frequent Internet users. Better health, typically a characteristic of younger age, was positively associated with Internet use. Another general finding was a better financial situation had a positive influence on the Internet use, or in other words, higher expenditures on the Internet services and related equipment can be barrier to the Internet use. One significant factor, gender, has shown various trends indicating greater rates of the use of the Internet by females in some cases and males in others.

The second theme, benefits of web-based health information for older people, from previous findings was related to how online health information benefits older people. Table 1 above shows several benefits which can affect older people's healthcare and those benefits can be earned at the same time or in order. Older people having a better understanding and higher self-confidence in using the Internet can result in better self-health judgment, which also raises their health awareness. Better self-health judgment helps older people in utilizing the Internet as a decision-making tool and improves older people's capabilities to manage their own health care.

The third theme was older people's experiences and attitudes toward the web-based health information. This third revealed theme was related to older people's attitudes and experiences toward the web-based health information. Attitude was defined as "summary evaluation of an object of thought"(Vogel et al., 2014). To analyse the attitudes, a combination of Goldsmith and Senior Net 2002 criteria has been used as suggested in previous studies (Iyer & Eastman, 2006). It proposed three more general criteria to determine positive attitude: (1) using the Internet is fun (Fun) in which there are advantages compared to other media, the risks were less and safety was enhanced, (2) convenience in using the Internet (Convenience) in which benefits offered by using the Internet, such as staying connected, enhanced network, information seeking and mobility (anywhere and anytime) and (3) the Internet is efficient (efficient) in which the advantages were that the use of the Internet made tasks less time consuming and purchasing products was cheaper. This concept was being utilized as a basis for analysing older people's attitudes in the reviewed studies. The positive experiences and attitudes resulted from Internet engagement. The relationship among themes from demographic, older people's experiences and attitudes toward benefits can be seen in Figure 2 below.

Figure2. Relationship among demographics, experiences and attitudes, toward benefits of web-based health information for older people

Demographic characteristics have determined older people's Internet use and how they benefit from web-based health information. As a result, older people with negative or positive experiences and attitudes because of their demographic situations, that have or have not been accommodated in web-based health information quality and accessibility, led to them to remain unbenefited or benefited from the web-based health information.

2.3 Quality and accessibility evaluation of website of health information for older people

The review to identify and map quality and accessibility evaluation of websites of health information for older people revealed three related themes that were compiled from the study findings: (1) assessment method, (2) quality of health information websites, and (3) accessibility and readability of health information websites. More detail on review process can be found on appendix 1 and 2. Table 2 below shows associated themes related to second element of the web-based health information for older people.

Table 2. Extracted themes of quality and accessibility of web-based health information for older people

Themes	Factors	Findings	Reference (Author, Year)
Assessment Method	Search engine	Popularity of websites in search engine is one criterion to select the websites for initial quality and accessibility analysis.	P. Chang, Hou, Hsu, & Lai, 2006, Harland & Bath, 2007, Sundeep Chumber et al., 2015, Seymour et al., 2015
	Manual evaluation	Manual evaluation use in questionnaire, self-developed checklist, HON scoring, JAMA assessment, readability, content quality and accessibility.	Harland & Bath, 2007, Bedaiwi, Alfaraj, & Pines, 2018, Sundeep Chumber et al., 2015, Seymour et al., 2015, Fuzzell, Richards, Fraenkel, Stark, & Politi, 2019.
	Automatic Testing	Compliance of the websites to quality and accessibility standard can be performed using automatic testing tools.	D. T. Chang, Abouassaly, & Lawrentschuk, 2016, Valizadeh-Haghi & Rahmatizadeh, 2018, Tahir et al., 2020b, Panagiotopoulou & Tsirintani, 2020, Sundeep Chumber et al., 2015, Harland & Bath, 2007, Saraswat, Abouassaly, Dwyer, Bolton, & Lawrentschuk, 2016, Daraz et al., 2019, Davaris

		et al., 2017, Valizadeh-Haghi & Rahmatizadeh, 2018, Bedaiwi et al., 2018, Bompastore, Cisu, & Holoch, 2018,Reynolds, Hoi, & Buchanan, 2018.
Combination of automatic and manual testing	Performing both manual and automatic tools to compare the assessment results.	Chumber et al., 2015.
Combination of both generic and disease-specific tools	Specific tools were more convenient and objective in analysing specific cases. One case recommended using both tools for the best assessment.	Daraz et al., 2019; Saraswat, Abouassaly, Dwyer, Bolton, & Lawrentschuk, 2016, Bedaiwi et al., 2018, Harland & Bath, 2007, Garfinkle et al., 2019b, Fuzzell et al., 2019, Bompastore et al., 2018.
Specific-purpose tool	Specific-purpose tool has better accuracy and was used for more specific functionality.	Reynolds et al., 2018.
Combination quality and accessibility tools	Most studies were limited on information content quality, and accessibility tool based on WCAG2.0 and readability tool have been applied.	Valizadeh-Haghi & Rahmatizadeh, 2018, Bedaiwi, Alfaraj, & Pines, 2018; Bompastore, Cisu, & Holoch, 2018, Seymour et al., 2015, Kaur,

			Dani, & Agrawal, 2017, Panagiotopoulou & Tsirintani, 2020, Battineni et al., (2020).
Quality of Health Information Websites	Top list on the search engine	Potential high-quality websites were on the first two pages of popular search engine.	P. Chang et al., 2006, Sundeep Chumber et al., 2015.
	Health portal, academic and professional types In addition, one study suggested government websites were of good quality and suitability	Health portals and professional portals have better reliability than patient group, commercial and other websites. In one case government websites were better in total score than academic, non-profit, and private sites.	Sundeep Chumber et al., 2015, Daraz et al., 2019, Harland & Bath, 2007, Saraswat et al., 2016. (Garfinkle et al., 2019)
	Updated factor	Many websites have shown deficiencies in updating their information.	Harland & Bath, 2007.
	Reference factor	Many websites are low quality based on JAMA criteria.	Daraz et al., 2019, Bedaiwi et al., 2018.
Accessibility and Readability of Health Information Websites	Complexity of the reading level	Reading level was complex and beyond the recommendation of grade 6 level.	Seymour et al., 2015, Valizadeh-Haghi & Rahmatizadeh, 2018, Bedaiwi et al., 2018, Bompastore et al., 2018, Fuzzell et al., 2019, Y. Sun et al., 2019.(Garfinkle et al., 2019)

Lack of alternate text	Lack of alternate text was another accessibility problem for people with eyesight impairment.	Valizadeh-Haghi & Rahmatizadeh, 2018.
Inaccessible form	Inaccessibility form that required design improvement.	Valizadeh-Haghi & Rahmatizadeh, 2018
One database has better navigation compared to other	MedLine database have better navigation and easy to read.	Fuzzell et al., 2019.

Previous studies have suggested the importance of accessibility with its evaluation that refers to many aspects of website design besides quality and readability assessment. However, readability assessment has several weaknesses in determining whether the text is easily understood or not (Seymour et al., 2015). Moreover, Seymour et al., (2015) also have discussed inadequacy of readability tool application that was limited to text only analysis. Therefore, S Chumber, Huber, & Ghezzi, (2015) suggested the need to accommodate the accessibility of information as a more comprehensive criteria of quality, but it was merely being applied to a limited extent; only to readability assessment. It is important to note that WCAG2.0 has included the readability factor within its evaluation criteria; therefore, using the WCAG2.0 standard to evaluate the website has encompassed not only design of a website but also readability and in addition to other accessibility criteria.

Websites with HONcode certification have good quality when reassessed with a more concrete evaluation tool such as DISCERN as suggested by Bompastore et al., (2018). However, in a different study focusing on information accessibility of Systemic Lupus Erythematosus (SLE) information, no significant association was found between HONcode presence and good quality in a re-evaluation using the similar DISCERN tool (Reynolds et al., 2018). All studies in this second scoping review have

limited quality assessment only to the content or text quality of the websites. In addition, HONcode-certified websites have slightly better accessibility (Valizadeh-Haghi & Rahmatizadeh, 2018).

In relation to the web accessibility framework (Petrie et al., 2015) , the selected studies were particularly focused on interface design and not on assistive technology. Most studies used a combination of tools in evaluating the quality and accessibility of websites. Accessibility assessment in most studies has utilized the tools in more simple evaluations, such as readability level assessment, where the results showed that none of the studies have an appropriate readability level for all people. HONcode was the most dominant tool in selected studies with some studies using it for initial filtering of website quality before performing further analysis. The use of WCAG2.0 as accessibility evaluation guidelines has been found useful for some studies, however the readability evaluation was more dominant despite WCAG2.0 having a more advanced accessibility analysis. In addition, none of the studies have combined the use of WCAG2.0 and readability tools.

It is important to note that the selected studies mostly analysed the quality of web-based health information, together with the readability analysis for accessibility evaluation. Only one study used a combination both of accessibility analysis based on WCAG2.0 recommendations and quality analysis. Figure 3 below shows how they were interconnected.
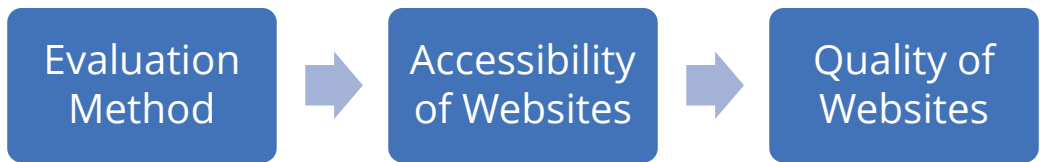
Figure 3. Relationship among themes in evaluating quality and accessibility of health information websites

The evaluation method of quality and accessibility of health information consist of both automatic and manual ways and the quality of websites can be assessed as well as accessibility/readability of websites as an unseparated part of quality. As Accessibility should be part of quality, therefore the quality of websites should be included both of accessibility and content quality.

2.4. WCAG2.0 implementation for older people-related health information websites

The review to identify and map WCAG2.0 implementation on health information websites for older people revealed three related themes that were compiled from the study findings: (1) barriers, (2) advantages, and (3) recommendation. More detail on review process can be found on appendix 1 and 2. Table 3 below shows associated themes related to the third element of the web-based health information for older people.

Table 3. Extracted themes of WCAG2.0 implementation for health information websites for older people

Themes	Factors	Findings	References (Author, Year)
Advantages	Building the web accessibility platform	With the WCAG2.0 standard the possibility to build web accessibility platform to evaluate websites simultaneously.	Martin, J; Gooncalves, R, Branco, F, Pereira, J., Peixoto, J., Rocha, 2016, Martins, Gonçalves, & Branco, 2017. Youngblood & Brooks, 2018.
	Promote the web accessibility effort	Evaluation encourages the effort to improve web accessibility.	Martins, Gonçalves, & Branco, 2017.
	Business value	Web accessibility has long-term business value.	Martin, J; Gooncalves, R, Branco, F, Pereira, J., Peixoto, J., Rocha, 2016.
Barriers	Complexity in analysing	The complexity to perform WCAG2.0 evaluation remains.	Martin, J; Gooncalves, R, Branco, F, Pereira, J., Peixoto, J., Rocha, 2016.
	Requires both automatic and manual analysis for deep analysis	Automatic testing tool has limitation, and the necessity of manual evaluation was crucial for further analysis.	Martins et al., 2017, Acosta-Vargas et al., 2018.
	Properly selecting the	Various software to measure web	Martins et al., 2017.

	right evaluation tool	accessibility and there is no the best option.	
	Require more skilled website developers and creators	The accessibility of websites depends on developers' and creators' capacities and manual evaluation requires specific groups and enough experts.	Martins et al., 2017
	Websites requires various testing	With its multimedia features, websites should be tested in various perspectives of evaluation.	Martins et al., 2017, Youngblood & Brooks, 2018.
	Difficult to interpret the standard	Although the standard has been developed to be more simple, it was still difficult to interpret.	Martins et al., 2017
	Passive attitude	Require more active attitude.	Acosta-Vargas et al., 2018
	Manual analysis was hard to perform	Manual analysis consumed more time and resources.	Acosta-Vargas et al., 2018, Kaur et al., 2017.
Recommendations	To improve analytic tool measurement	The necessity to develop measurement capacity to better measure in average group of	Martin, J; Gooncalves, R, Branco, F, Pereira, J., Peixoto, J., Rocha, 2016.

	health service websites.	
To prioritize on simply recurrent errors.	Initial step to improve web accessibility in practice was simply to correct the recurring errors.	Martins et al., 2017, Yong Jeong Yi, 2020.
To refer to international standard.	The best option to adopt or use in evaluation as they have been tested and well proven.	Martins et al., 2017.
To perform more comprehensive evaluation	To have better assessment, a more comprehensive evaluation is necessary.	Martins et al., 2017.
To apply the standard on early stage of website design	To increase sustainability of web accessibility practices, the policy should be applied at earlier stage.	Acosta-Vargas et al., 2018
To embed web accessibility in the curriculum	Better knowledge of web accessibility preparation can be started through curriculum embedment.	Youngblood & Brooks, 2018, Kaur et al., 2017.
To allocate funding in promoting the web accessibility	Funding should be allocated to encourage web developers or web masters and	Yong Jeong Yi, 2020.

| | | to perform the web accessibility testing. | |

This third supporting study theme is related to the improvement of better website quality and accessibility and to accommodate older people's needs in accessing online health information. All selected studies have investigated merely hospital information websites and none of them focus solely on web-based health information which signifies the different focus on previous studies related to the WCAG2.0 standard. These studies mostly only focused on the implementation of WCAG2.0 for web-based hospital services and none of them studied the web-based health information services.

The six included studies for review covered various countries as the owners of the websites. For example, Acosta-Vargas, Acosta, & Lujan-Mora, (2018) assessed hospital websites from the US, Germany, Taiwan, France, Brazil, and the Netherlands; among those countries, only Brazil has no local WCAG policy adoption (W3C WAI, 2018). Another study analysed website compliance with WCAG in India where WCAG 2.0 has been adopted into their local policies (Kaur et al., 2017). One study analysed two countries, Portugal and Spain, which have only referred to EU WCAG2.0 policy (Martins et al., 2017). In addition, using manual evaluation instead of an automatic evaluation tool has been performed in one study in a country with local WCAG2.0 adoption. These have shown that WCAG2.0 has been practiced in several developed and developing countries.

The results have shown no significant impact of WCAG2.0 and mostly recommended the strategy to promote web accessibility standards more intensively for all stakeholders and to raise their awareness of the long-term benefit of websites with better accessibility, despite the initial effort and cost needed to improve website accessibility. Moreover, the smaller number of studies related to this issue, particularly for health information,

indicated more studies are needed to elaborate this web accessibility phenomenon by considering its importance for all people, including older people. Various proposed recommendations ranging from financial aspects, education, measurement method, method of standard application and priority have been elaborated that signify the need to improve the practice of employing WCAG2.0. Figure 4 below shows the associations between those themes.
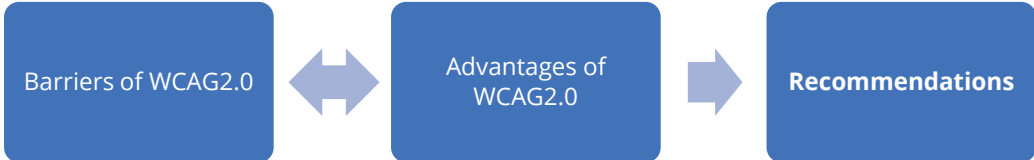
Figure 4. Relationship among themes in WCAG2.0 practices in web-based health information for older people

The barriers and advantages should be considered, and they should be compromised where the association is reciprocal means implementing the web accessibility add some barriers but provide added value as well such business value in long term. As consequences, recommendations were made based on this negative and positive value added. However, in the practice of the WCAG2.0 standard, it was important to be noticed that the right of older people to have equal access opportunities in web-based health information should be the top priority that outweighs any barriers to implementation.

2.5. Summary of the study framework

Using the WCAG2.0 standard to improve web accessibility of web-based health information for older people was required to provide equal access to all people. There were certain demographic backgrounds, namely education, physical limitations, age, financial situation, gender, marital status, having family, living location, working status and organization membership that should be accommodated to provide equal accessibility for those older people.

Quality and accessibility of health information websites for older people have many deficiencies in accessibility and quality that become barriers and can prevent older people from having the benefit of websites within the health information context. With the poor quality and accessibility of the current web-based health information for older people, negative experiences and attitudes about the Internet existed that caused low Internet engagement among this old age group. This creates a gap in equal access and the Internet benefits for older people. WCAG2.0 was adopted and there were many more quality and accessibility evaluation tools that can be used to improve web accessibility and quality of health information. Those tools have various advantages and disadvantages. However, the quality evaluation of web-based health information was limited to text quality assessment and the study mostly combined the text quality assessment and text readability level, whereas the accessibility using the WCAG2.0 and quality of health information on the websites both used automatic tools. However, websites as one type of e-service have more potential and required various quality criteria that have been included in the accessibility as part of quality criteria. Based on this, evaluation required a combination of both WCAG2.0 and quality evaluation.

The implementation of WCAG2.0 policy has several disadvantages but also some benefits. Minimizing the barriers and exploring the advantages of the practice of implementing WCAG2.0 can improve older people's accessibility to web-based health information and assure their right to equal access to web-based health information. Suggested

recommendations depicted many sides of potential improvements of WCAG2.0 policy in practice for older people's health information where improvements can be performed concurrently and in order of priorities. Content quality and accessibility should be performed especially for health information where the information is vital for older people's lives.

These relationships have been shown in Figure 5 below as three interconnected elements with a hierarchical relationship.

Older People as Users	• Demographic Characteristics. • Experiences and Attitudes. • Benefits.
Quality and Accessibility of Web-based Health Information for Older People	• Evaluation Method. • Quality of Websites. • Accessibility/Readability of Websites.
WCAG2.0 Policy	• Barriers. • Advantages. • Recommendations.
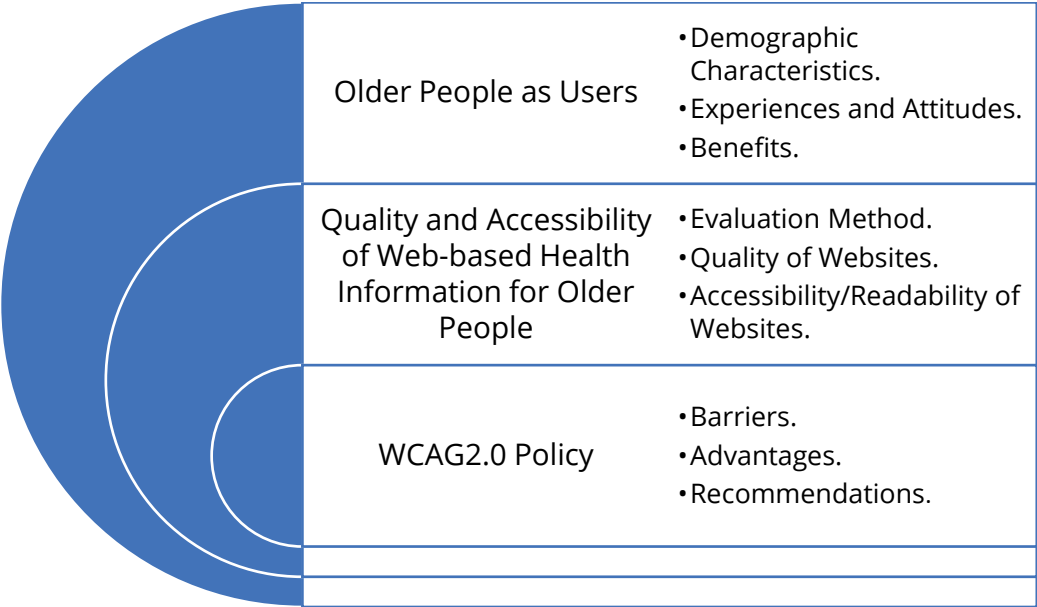
Figure 5. Summary of the study framework

In the core level is WCAG2.0 policy that refers to policy adoption of WCAG2.0 into local policy and the implementation of the local policy which would enable the rights of older people, regardless of their demographic characteristics, to have equal access in web-based health information with WCAG2.0 compliance and good-quality websites. Therefore, older people as the targeted users, based on various demographic characteristics, can benefit from the Internet.

3 Aim of the Study

The aim of this study was to provide a description of the use of the Internet and the practice of web accessibility evaluation based on Web Content Accessibility Guidelines (WCAG) 2.0 particularly within the scope of web-based health information for older people. This study explores web accessibility's significant role to engage older people on the Internet and with focusing on health information related to older people based on the WCAG2.0 standard.

Based on the aim of the study, four research questions were formulated as follows:

1. What is the influence of older people's demographic factors in utilizing the Internet? (Article I).
2. What are the quality and accessibility of popular health information websites related to older people? (Article II).
3. What is the effectiveness of the practice of the local policy of Web Accessibility Content Guidelines (WCAG) version 2.0? (Article III)
4. What are the associations among web accessibility and quality in the practice of web-based health information for older people based on the study framework? (Article I –III, Summary).

The phases of each study have been mapped with the specific aim, data, method, and publication plan as shown in Figure 6 below.
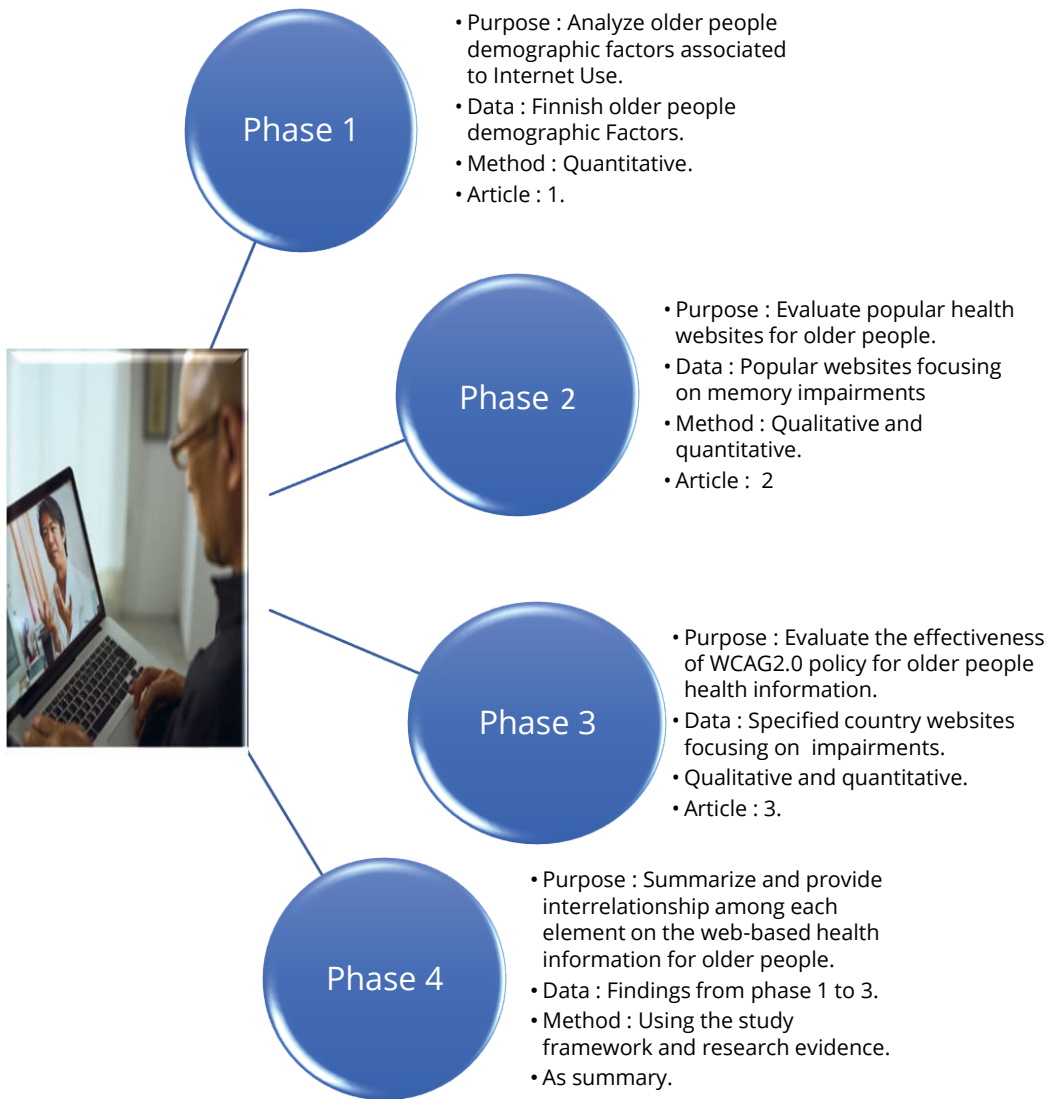
Figure 6. Research phase map

This study consists of four phases of study and the last phase of this study (see Figure 6) is to analyse all findings related to elements that are interconnected. Web accessibility was based on Petrie's definition (2015) with the WCAG2.0 as the key to evaluate whether the web accessibility has been properly applied according to the user's demographic backgrounds,

and web quality as the crucial aspect in health information. The user's demographic backgrounds have been studied in the initial phase to determine how crucial the accessibility factor is for older people. A summary is provided to propose recommendations to improve the web accessibility and web quality based on the findings from each study phase.

4 METHODOLOGY

4.1 Methodological Approach

This study falls under the health and human service informatics (HHSI) paradigm (Figure 7) which consist of four basic entities – action, data, actors, and technology (Saranto et al., 2017; Saranto & Kuusisto-Niemi, 2011). The HHSI paradigm is an information resources management system that consists of the activities, actors, and methods involved in providing services in health and welfare where resources can be data repositories, systems, applications, devices, communications tools and models, and people as sources and the users of services (Kinnunen & Saranto, 2018).
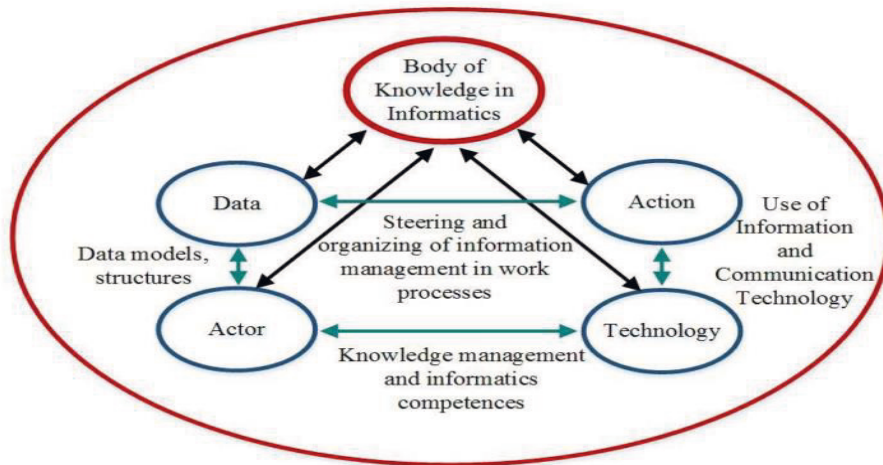
Figure 7. The health and human service informatics paradigm (Saranto & Kuusisto-Niemi, 2011).

Based on the core concept of connected entities, the HHSI paradigm constitutes four research areas: 1) Steering and organizing information management in work processes, 2) Use of information and communication technologies (ICT), 3) Knowledge management and informatics competencies, and 4) Data models and structures (Saranto et al., 2017).

This dissertation is within the area of use of ICT that encompasses the concept of action and technology. The concept of technology in this context means social and technological procedures in processing, analysing, storing, or retrieving data related to actions (Saranto et al., 2017). In this study, the social and technological procedures in designing web-based older people-related health information was based on WCAG2.0 guidelines. In addition, the action which refers to the planning, implementation, evaluation or use of services (Saranto et al., 2017) in this study is manifested as the evaluation of the use of web-based older people's health-related information according to older people's characteristics. The elements of web accessibility are manifested in the action as how to improve the practice of WCAG2.0 for older people with well-structured policy planning and implementation and to regularly monitor the implementation of WCAG on the web-based older people-related health information. In addition, the technology concept is the application of web accessibility according to WCAG2.0 in websites of older people-related health information.

4.2   Data Collection and Analysis

Various research methods have been applied in this study as shown in Table 4 which includes both qualitative and quantitative methods. This dissertation consists of three original publications and this study employs various study designs: (1) Cross sectional survey study, (2) Web accessibility evaluation and (3) Web accessibility policy effectiveness analysis by comparative study. The study objectives, data collection, context, type of the study, methods and data analyses of Article I-III and summary are described in Table 4 below.

Table 4. The study process based on the aim of the study

Study Elements	Data	Method	Article
Users characteristics related to Internet use	Older people in 60s and 70s, N = 2508	Regression analysis, descriptive analysis (quantitative)	1
Website accessibility and quality of Health Information for older people	Memory impairments related websites (n=300)	Web accessibility test, readability test (qualitative), and Descriptive analysis (quantitative)	2
Effectiveness of WCAG2.0 in health information websites for older people	Websites focusing on memory impairment related within country with accessibility policy and without accessibility policy (n=20).	Web Accessibility Test (qualitative), Differential analysis (quantitative)	3
Combination of all study elements	Older people, web accessibility and quality in popular search engine and national web health information.	Used study framework to provide the relationship among previous study phases.	Summary

Phase 1 (Article 1)

This phase used Finnish population data from the IKIPOSA (Age Innovation) Project in the years 2012-2014. The questionnaire process details are included in the article. The various question variables were selected as a follow-up from the study framework and study design. In addition, several demographic variables which are related to older people and the use of the Internet were selected. The questionnaires consisted of several measurement types ranging from the Likert scale to the nominal scale, which can be in a close-ended format and open-ended format. The

questionnaires were developed and validated by various experts in the field of gerontology. The total number of respondents was 2508 (60s, n = 1515, 70s, n = 990).

The analysis of data used quantitative analysis through cross tabulation and binomial logistic regression. In conducting the analysis, some variables have been transformed and converted from the Likert scale to a nominal variable. The regression process has been conducted in two ways, firstly by unadjusted effect and the forward LR method to measure the influence of specific variables. In addition, multicollinearity analysis has been performed during the preliminary analysis to test whether there is an effect of multicollinear or not. The independent variable was the use of the internet, and the selected dependent variables were age, gender, have children, have grandchildren, education level, have sufficient financial means, live with none, marital status, live in a single-family house, live near the city, work experienced (entrepreneur, leading position, higher level collar, lower-level collar, blue collar, agricultural entrepreneur, stay or working from home and social relation satisfaction). This analysis on article 1 was conducted to confirm the previous findings from the literature review.

Phase 2 (Article 2)

In this study, searching Web-based data for free text keywords related to memory impairment was conducted on three popular search engines: Yahoo, Google, and Bing. There were 300 websites in total and 150 websites for each keyword. A filtering process was used based on availability of a HON code, duplication, library portal, journal, and websites for healthcare professionals. In addition, a selection process was done using the following inclusion criteria: English language with content about "what is dementia and symptom and diagnose". Final selection resulted in 38 websites for further analysis.

The data was analysed by mixed methods, both qualitative and quantitative analysis. The qualitative analysis was performed through content analysis in selecting the websites that fulfil the criteria while the

quantity analysis was used to quantify the output of the evaluation tool and readability test and for further descriptive analysis.

Phase 3 (Article 3)

This study was focused on collecting data on web-based resources related to memory impairment. In addition, the popular search engine Google was used for collecting data and had been adjusted to search based on specific language and from specific countries: Indonesia and Indonesian language as the local language, and UK and English as local language to obtain the data based on each country case. Indonesia was selected as a contrast in terms of policy and country type with UK, which represented a country with a policy of WCAG ver2.0 and as a developed country. Ten websites from the top list of search engines that met all the criteria for each country were selected for further analysis (n = 20 in total). Further detailed information can be found in Publication 3. The search engine was set according to the country and the language of the selected information used and the national languages where in this case Indonesian language for Indonesia and English for the UK.

The data was analysed by mixed methods, using both qualitative and quantitative analysis. The qualitative analysis was performed through content analysis in selecting the websites that fulfil the criteria while the quantity analysis was used to quantify the output of the evaluation tool and readability test and for further analysis in a non-parametric differential analysis.

Phase 4 (Summary)

This last phase summarized all findings from previous phases and those findings were associated under the study framework. Further, the association among each study's data can provide a concrete description of practice of web accessibility for older people's healthcare related web-based information.

For summary purposes, the findings were categorized and associated according to study framework as shown in Figure 8. The association among older people's needs, current web-based health information utilization and WCAG2.0 standard implementation will be described and the findings from the research phase will be discussed based on a conceptual study that deploys an empirical approach in three separate literature reviews. Further study findings were developed with more focus on of older people's demographic characteristics. The resulting proposed web accessibility practice recommendations are aimed at addressing the importance of older people having better accessibility to health information websites. Below, Figure 8 depicts the relationships among each phase and the summary will be presented within the role of WCAG2.0 as an enabler for older people's rights and needs to access the web-based health information at a level equal to others. These needs and rights were manifested within the quality and accessibility of websites of health information.
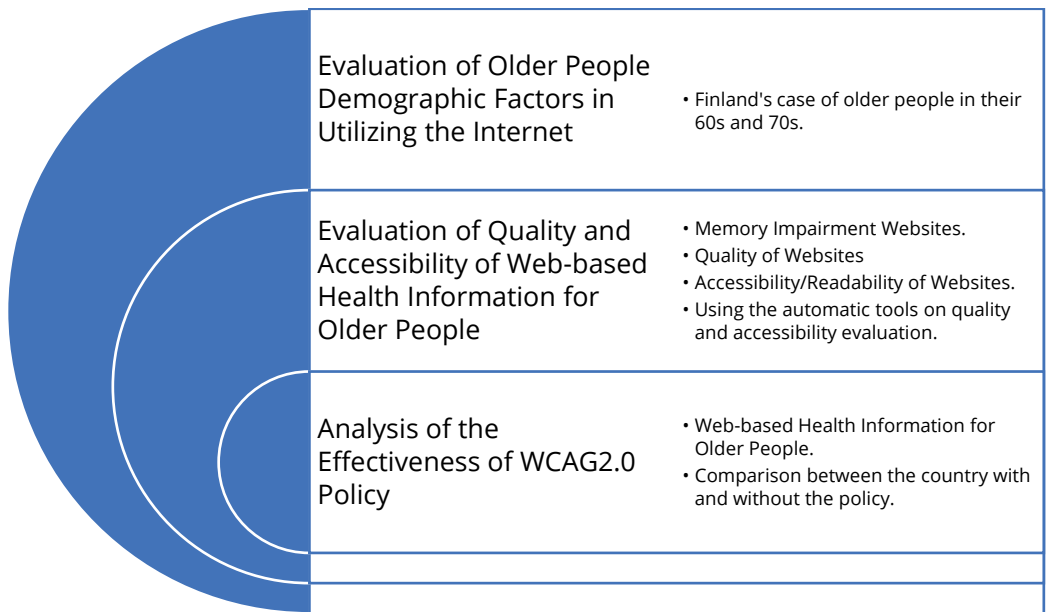
Figure 8. Study process foundation

5   RESULTS

In this chapter the main study results are summarized based on the study framework that has been manifested in the research design. The three major categorizations, namely users, web-based health information (in this case the health information is related to memory disorders) and web accessibility policy were described and implied within the results from the study phases. How the web accessibility standard (WCAG2.0) as a mediator to bridge older people's needs and improve the accessibility of information about memory impairment on the websites were presented.

5.1 Demographic characteristics of older people as users and non-users of the Internet

Based on the study design of the first theme within the influential factors in Internet use for older people, several demographic factors where scrutinized. In addition, other factors from the IKIPOSA survey have been selected and studied as an enhancement based on the theoretical background.

From Table 5 below, it can be implied that the older people in Finland that potentially need proper accessibility were those people who were very old (70s), have basic level education, people who have no children, people with an insufficient financial situation, people who were not working as entrepreneurs, not in a leading position, had no higher-level white-collar experience and no lower-level white collar experience.

Table 5. Demographic factors of Older People Associated with the Internet Use (Article1)

Older people demographic Background	Description	Effect on the use of web-based information (Significant = p<0.001, OR = Odd Ratio)
Age	Two groups aged in 60s and 70s.	Significant with OR 1 /0.18
Gender	Male and female	Not significant
Education	Three levels: basic, secondary, and higher education.	Significant with OR 1/4.442/2.311
Live with none	Yes or no	Not significant
Marital status	Single or no single	Not significant
Have children	Yes or no	Significant with OR 1/0.488
Have grandchildren	Yes or no	Not significant
Sufficient financially	Yes or no	Significant with OR 1/0.530
Live in single-family house	Yes or no	Not significant
Live near the city	Yes or no	Not significant
Entrepreneur experienced	Yes or no	Significant with OR 1/0.428
Leading position experienced	Yes or no	Significant with OR 1/0.245
Higher level white collar experienced	Yes or no	Significant with OR 1/0.185
Lower-level white collar experienced	Yes or no	Significant with OR 1/0.223
Blue collar experienced	Yes or no	Not significant
Agricultural Entrepreneur experienced	Yes or no	Not significant
Stay at home or working from home	Yes or no	Not significant
Social relations satisfactions	Yes or no	Not significant

5.2 Quality and accessibility of web-based health information for older people

The evaluation of quality and accessibility of web-based older people-related health information has shown many recurring problems of web accessibility based on WCAG2.0 and readability level. In this memory impairment-related information, quality, accessibility, and readability assessment have been performed as shown in Table 6 below. Table 6 shows that the recurring problems of text font that does not resize, no alternate text for images and insufficient colour contrast exist in almost all popular websites. In addition, among these popular websites, only 31% have health content quality certification that guarantees the trusted sources and updated content. Moreover, all websites under evaluation include aspect that make them difficult to read for the general population.

Table 6. Quality, accessibility, and readability of websites related to memory impairments (Article 2)

Quality	Accessibility	Readability
206 out of 300 websites have no HON code	Using two automated tools: 25 websites and 32 websites failed the accessibility tests by Achecker and Axe tools, respectively.	Using readability tools, the average Flesch-Kincaid Grade (FKG) score 8.2 (13 to 15 years old students' level).
	Only two websites have no errors at all by Achecker and none by Axe test.	Simple Measure of Gobbledygook (SMOG) average score 7.4 (between sixth grade and seventh grade level).
	The most common problem by Achecker: resize text (n = 19), no alternate text for image (non-text content), n = 17, attribute unique, n = 17, and by Axe, insufficient colour contrast n = 35, lack of content in landmark region n = 33, not having discernible text n = 27 for websites with links and n = 15 for websites with button.	

5.3 Effectiveness of WCAG2.0 standard for national health-related websites

The third study to assess the effectiveness of WCAG2.0 local policy has been performed by comparing a country with local policy, the UK, and a country without WCAG2.0 policy, Indonesia. The effectiveness of used WCAG2.0 standard was evaluated by using the differential analysis on web accessibility practices of older people-related healthcare web-based information between the UK and Indonesia. The results have been tabulated in Table 7 below with 4 levels of incompliance to WCAG2.0 based on number of incompliance where low level has 0 to 20, medium level has 21 to 50, high level has 51 to 100 and very high level has over 100 number incompliance (Article 3).

Table 7. WCAG2.0 compliance of several types of websites related to memory impairments Information (Article 3)

Website Type	Incompliance Level to WCAG2.0	
	Country With Policy	**Country Without Policy**
Newspaper	Low Level, n = 2 Medium Level, n = 0 High Level, n = 2 Very High, n = 2	Low Level, n = 0 Medium Level, n = 4 High Level, n = 0 Very High, n = 0
Government Agency	Low Level, n = 1 Medium Level, n = 0 High Level, n = 0 Very High, n = 0	Low Level, n = 0 Medium Level, n = 0 High Level, n = 0 Very High, n = 0
NGO	Low Level, n = 1 Medium Level, n = 2 High Level, n = 0 Very High, n = 0	Low Level, n = 0 Medium Level, n = 2 High Level, n = 0 Very High, n = 0
Medical Company	Low Level, n = 0 Medium Level, n = 0 High Level, n = 0 Very High, n = 0	Low Level, n = 0 Medium Level, n = 2 High Level, n = 1 Very High, n = 1

The results of the third phase have suggested four types of website providers that are popular among older people who are health-related information seekers. The sources were newspapers, government agencies, NGOs, and medical companies. Using the Mann Whitney test, there were no differences between countries with or without WCAG2.0 compliance policies. However, in the UK, government agencies and NGOs have good compliance with WCAG2.0. On the other hand, none of websites were in good compliance in Indonesia. Popular websites in UK for information seekers were newspapers and NGOs, while in Indonesia they were newspapers and medical companies. The results have shown that the policies of WCAG2.0 have been performed well only by Government agencies because they were held to the standard by law, while NGOs have a higher level of accessibility awareness even without enforcement by law.

5.4 Relationship among users, WCAG2.0 policy and web-based health information

The relationship among the elements can be seen in the disadvantage of older people who as a result have higher odds of not using the Internet, as shown in the findings from phase 1. In fact, older people urgently needed proper web accessibility to access health information on the websites due to their more vulnerability on health. Figure 9 below shows how the poor effectiveness of WCAG2.0 policy affects the quality and accessibility of web-based health information, with the incapacity to regulate the web-based health information that resulted in poor quality and accessibility on the websites that caused the gap within certain demographic characteristics of older people.
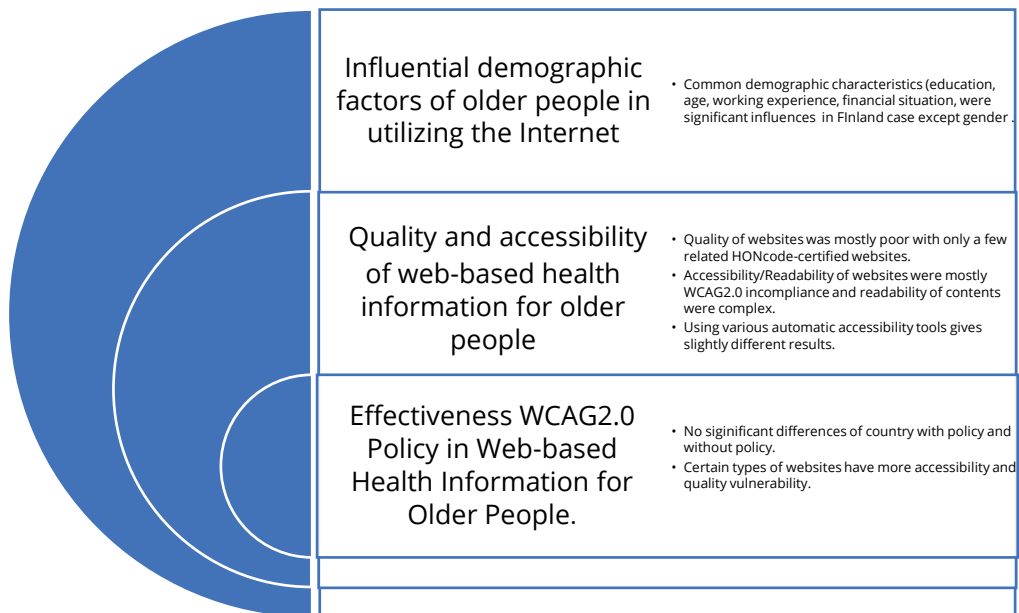
Figure 9. The relationship of WCAG2.0 policy, quality and accessibility of websites, and older people as users based on study

The associated results from each study phase, as shown in Figure 9, depicted certain older people demographic characteristics, namely those aged in their 70s, basic level of education, no family, insufficient financial situation, not having entrepreneurial experience, no experience in a leading position and people who were in low-level jobs. These were the major factors affecting older people and highlight the need for proper web accessibility and good-quality websites in general. Specifically, websites related to health information were shown to have poor accessibility compliance, even websites labelled as HON compliant. In addition, the readability levels were very complex. The third study has shown the ineffectiveness of WCAG2.0, especially for commercial types of business such as medical companies and newspapers.

6 Discussion

6.1 Older people's demographic characteristics for accessible websites

This study, which was based on phase 1, has implied that despite living a developed country, older people in Finland still share the same challenges as other countries related to the Internet use. The first study findings suggested that older people's Internet use was related to and influenced by common demographic factors such as education level, age, financial situation and living situation. Accessing the Internet for many purposes required Internet and computer skills which have been a privilege among people with high education, people who have work experience using the Internet. In the past higher level technology skills were only performed by people in high-level working positions and the study findings have shown certain middle- to high-level working experiences have a significant influence on the use of the Internet in people's later life (Article 1). Education was also confirmed as an important factor in previous studies, as higher educated older people have better abilities to use the Internet (Bujnowska-Fedak & Mastalerz-Migas, 2015; Chung et al., 2011). Computer and Internet skills can be gained during formal education or during white-collar office-based work or gained through informal education because of working requirements (Article 1). In addition, older people can study computer and Internet skills and those with previous experiences often learn very easily (Blažun et al., 2012). Moreover, older people with previous computer and Internet skills experience have more confidence increases their interest in keeping up to date with the latest ICT advancements compared to older people who have no similar experiences.

Older people lacking Internet and computer skills were often people with a lower level of formal education (Article 1) or they did not have informal computer and Internet training because their previous typical working environments may not have required those skills (Article 1). Such

jobs are typical in the agricultural sector or in blue-collar work and these older people were less active Internet users (Article 1). Those older people should be accommodated by providing tailored accessibility and maintaining the quality criteria of the websites especially in health information.

Another significant factor related to age which has shown barriers to utilizing the Internet is declining physical and cognitive capacities of aged people, as shown in our study findings (Article 1). A gap was seen between older people who have more vulnerabilities and other younger age groups that have better functionality both in cognitive and physical functionalities. In fact, in Finland, aged people with a lower education level have been unlikely as the Internet users (Article 1).

These access gaps in conjunction with demographic characteristics gaps can be reduced with the proper level of web accessibility to give people with these characteristics the opportunity of equal access to web-based information. Therefore, they can benefit from the Internet. In fact, aged people such as people who were in their 70s needed health information even more to maintain their declining health. With tailored web-based health information according to their needs, a lower percentage of non-Internet users can be expected.

The crucial nature of proper web accessibility was also seen in the effectiveness of utilizing the web-based health information. A lack of web accessibility can lead to costly information-seeking and may result in low accuracy of health information due to poor quality. This could be reduced in situations where the Internet would be more affordable, as the high costs associated with Internet use becomes a barrier for low-income older people (Article 1) which in line with previous study (Crouch & Gordon, 2019) with easy to access and good quality information. This financial situation demographic can be seen as another significant factor in the Internet use. High income older people in Finland have been positively associated with the use of the Internet and this is supported in similar previous studies in other countries (Chung et al., 2011; Crouch & Gordon, 2019; Sally J. McMillan & Macias, 2008; Zajac et al., 2012).

Having family, which in this study referred to marital status and/or having family, was analysed. It was thought that partners or family members could help older people in utilizing the Internet or technology use may arise from their communication needs (Article 1). In this study, having family has been analysed separately into groups who have children, have grandchildren, live alone or not and marital status (single or not) and the only significant factor was having children, which may be closely related to having family in previous studies (Bujnowska-Fedak & Mastalerz-Migas, 2015; Crouch & Gordon, 2019). Meanwhile, marital status was not a significant predictor of Internet use in Finland, unlike in South Korea (Chung et al., 2011) which was significant because of lack of accessibility of the web-based health information required family help and reduced older people independency as previous study of acquiring health information that required someone's help to do (Crouch & Gordon, 2019). Moreover, because of the need for additional other help, this can increase the financial burden of Internet use and low motivation to use the Internet.

In Finland, non-significant factors on the Internet use namely marital status, gender, living alone, having grandchildren, blue collar workers, agricultural entrepreneurs, stay-at-home people and living location which also mean the problem of accessibility and quality of websites cannot be associated to these factors. Gender, for example, was not found to be a factor influencing Internet use due to more gender equality in education or working environments, which was a rather different result compared to previous studies (Bujnowska-Fedak & Mastalerz-Migas, 2015; Chung et al., 2011; Sally J. McMillan & Macias, 2008).

The use of the Internet in general, like in this study (Article 1), was comparable to the use of the internet for health information especially for older groups (Bujnowska-Fedak & Mastalerz-Migas, 2015), except in an Australian case for the factors of age and social economic status (Zajac et al., 2012). It can be implied that older people need customized web-based health information in terms of web accessibility. This can bridge the gap between those who have not been Internet users because of age, low level of education, financial situation, lack of previous computer and Internet

experiences and not having a family. This seems to be a necessity and a global problem, including in Finland. Other insignificant factors such as gender and marital status were probably other considerations in other countries where equal opportunities in web accessibility are of importance.

Differences between countries in the developed world, where in the Finnish case (Article1) the most dominant factors that contributed to older people's Internet use were education and age and these findings were in line with Australian (Zajac et al., 2012). However, the financial factor in Finland was least dominant, unlike in Australia (Zajac et al., 2012). This implied that the Internet in Finland can be accessed by low-income people, which was a realized benefit of the Internet itself, as it reduced associated costs through providing affordable websites service (Brodie et al., 2000). Meanwhile gender, which has been an influential variable in some studies (Bujnowska-Fedak & Mastalerz-Migas, 2015; Zajac et al., 2012) was not significant in Finland (Article 1). This was supposed to be more common in developed countries that have more equal opportunity for both women and men.

Education and age are the most dominant factors (Article1) influencing Internet use by older people in Finland and should therefore be the focus of the country's web accessibility policy development. There is also a need to address concerns about older people's cognitive decline and low computer and Internet skills. These characteristics and issues affecting older people should call for urgency in accessibility improvement and improved quality of websites in general. Age itself affects cognitive capacity and education and these factors both influence Internet literacy and should signify the need to accommodate developing and promoting web accessibility for older people so they are able to find needed web-based health information.

6.2   Quality and accessibility of websites of health information

The quality and accessibility of web-based older people's health information have many inadequacies, especially in compliances with the WCAG2.0 standard (Article 2).Those common accessibility problems such as font size and alternate text and colour contrast still existed even though the more clear web accessibility guidelines have been suggested (Article 2), which is in line with the previous study (Valizadeh-Haghi & Rahmatizadeh, 2018). With this situation, older people who prefer attractive websites cannot access some websites for healthcare information (Nguyen et al., 2018).

   The automatic evaluation of web accessibility based on WCAG2.0 used the tools recommended by W3C WAI. This study in phase 2 (Article 2) combined HONcode certification, automatic accessibility evaluation tools (Achecker and Axe) and a readability tool in evaluating the quality and accessibility of web-based health information for older people. Readability is one important accessibility criterion (W3C, 2016). In fact, there were gaps in previous studies since most quality studies used a combination of quality evaluation and readability assessment but not web accessibility assessment. Although more advanced evaluation cannot be performed when using an automatic evaluation tool, this study used various evaluations to cover many parts within accessibility and quality of web evaluation as suggested from previous study (M. Shim & Jo, 2020). Moreover, the used of automatic tools in evaluating web accessibility based on WCAG2.0 and quality has many advantages, as suggested in previous studies, such as reliability, cost effectiveness, less time consuming and high popularity (Valizadeh-Haghi & Rahmatizadeh, 2018; Yong Jeong Yi, 2020). The potential of automatic tool to be developed is enormous especially for monitoring vast number of websites with high volume of content in which cannot be performed by manual evaluation.

   The selection of search engine was based on previous studies that used popular search engines for lay people which were Google, Bing and Yahoo (Chumber et al., 2015; Saraswat et al., 2016; Seymour et al., 2015).

Interestingly, Google, the most popular search engine, emphasized user-friendly websites as one of its high-ranking factors (Krrabaj et al., 2017). Moreover, Bing as the second most popular search engine put fresh content, which was one quality criterion, in one of its lists of top criteria (Krrabaj et al., 2017). In fact, older people used search engines for health information seeking as much as other age groups. Therefore, there was potential for search engines to improve their methods in ranking the websites in their top list, especially for important information such as health information to filter better-quality websites into their top lists ass users mostly only access the top pages of search engines (Bedaiwi et al., 2018).

This study used information related to memory impairment since little is known about the quality and accessibility of this information, whereas previous studies have focused on various issues such as diabetes, osteoporosis (Fuzzell et al., 2019), stroke, high blood pressure(Tahir et al., 2020) and/or thoracic spine issues (Davaris et al., 2017). Good information quality is associated with user satisfaction (M. Shim & Jo, 2020) where positive experiences tend to improve users' engagement and benefits of the Internet can be realized. In addition, there was a high number of memory impairment-related websites when using keywords such as dementia or Alzheimer's (Article 2).

HON is one quality evaluation tool which has been used in selecting quality websites as a first analysis to avoid more subjective assessments when conducting manual evaluation, as it saves more time in evaluation, especially when evaluating a high number of websites. With HONcode certified websites, quality of websites can be determined as well as manual quality assessment tools (Bedaiwi et al., 2018) means HONcode assessment is quite similar with those manual assessment tools. This study showed that among around 300 websites from the top lists of Google, Bing and Yahoo, only a few websites have a HONcode certification for quality of health content (Article 2) and this was in line with previous studies (Chang et al., 2006; Saraswat et al., 2016). In addition, the websites with HON certification were not guaranteed to have good web accessibility (Article 2),

which was similarly confirmed in the previous study (Valizadeh-Haghi & Rahmatizadeh, 2018).

The findings from the study (Article 2) suggested more improvement in websites design to comply with WCAG2.0, where simply accessibility features were not available such as resized text, alternate text, and colour contrast. It was the same pattern from previous studies for different health information (Valizadeh-Haghi & Rahmatizadeh, 2018;Yi, 2020). Despite that selected websites were based on top lists of search engines that are potentially well-designed and of good-quality (Krrabaj et al., 2017), the websites were mostly lacking in web accessibility compliance (Publication 2). Moreover, readability analysis showed that websites for memory impairment information had complex reading levels (Article 2) that impacted older people, especially very old people with cognitive decline and low-educated people (Article 1). As consequences, they were more likely to rely on other types of media than the Internet (Article 1).

Finally, the need to increase the awareness of accessibility as part of quality criteria should be strengthened likewise one study which suggested more concrete information quality that should encompassed readability, accuracy, and design (M. Shim & Jo, 2020) Previous studies have shown the focus on quality criteria assessment on health information websites were limited only on text content. Because of lack in interpreting the websites as e-service, the evaluation was fragmented with only partial measurement. For example, HONcode which was claimed to be quality assessment has not considering the accessibility aspect such as ease of use, appearance, linkage, and structure. Similarly, previous studies have also suggested that many studies have focused websites only on the content even though websites have many information modes (Nguyen et al., 2018). As a result, there is uncertainty regarding whether good-quality websites have better accessibility or not and it can mislead the Internet users. This was shown in the study (Article 2) where websites with HON certification still lacked accessibility compliance. In short, as the meaning of accessibility has been extended from the simple meaning which referred only to having physical access devices to be what WCAG2.0 suggests which referred to how the

information can be meaningful and be easy to use for all people. In addition, quality of information in the websites should be viewed not only from the content quality perspective but also by considering the websites as a multimedia communication channel. Therefore, the quality of information on the websites should be encompassed from the content quality to the accessibility of websites. With a solid and unbiased perception of website quality, one vision to improve website quality can be expected

6.3   National standard of WCAG2.0 practice for health information

The policy of WCAG2.0 as the web accessibility guideline in regulation can promote the web accessibility for local agencies and other website health information providers. This study was conducted to create a better understanding of the practices of WCAG2.0 in health information related to older people. Little is known related to the effectiveness of the WCAG2.0 policy for health information. This study was performed with the initial effectiveness evaluation based on the outcome of the policy which was websites in compliance with described standards. In fact, there were no significant differences between countries with and without policy (Article 3). Therefore, the regulation needs better improvement in promoting and monitoring the web accessibility policy. Limited implementation of standard only on the government agency can be one cause of less impact on local health information web-based providers (Leitner et al., 2016). However, NGO's have better web accessibility awareness even though they are not obligated to follow web accessibility law (Publication 3). This is possibly because they have more close relations to older people within their communities and/or have international affiliations that already have advanced experience in providing web accessibility and internal policies regarding web accessibility.

Several types of website providers were vulnerable to web accessibility incompliance such as newspapers and medical companies (Article 3). This phenomenon was related to the large demand on newspapers to update their content. In addition, medical companies may have a different focus on providing web-based health information, like not considering the advantage of web accessibility or because of barriers to practicing web accessibility.

Simple WCAG2.0 compliance issues, such as alternate text for image and sufficient colour contrast have existed (Article 2 and 3) showed that the similar simple recurring problems remain largely unresolved, as was also shown in previous studies (Valizadeh-Haghi & Rahmatizadeh, 2018; Yong Jeong Yi, 2020). More initiative and motivation may be required to improve website accessibility through actions such as funding allocation and / or awareness of business value in the long term. Previous studies were mostly related to health service accessibility evaluation and this study elaborated the health information web accessibility and content quality evaluation. Both findings highlight a similar lack of quality and accessibility features.

6.4 The role of WCAG2.0 policy for older people and web-based health information

The lack of practices following WCAG2.0 for web-based health information (Article 2 and 3) have resulted in a lack of accessibility of the related websites. The quality of websites has also declined due to the lack of regulation in popular commercial websites (Article 2). Moreover, with their popularity, those of lack quality and accessibility websites may have many users access the websites with unsatisfactory experiences and low trust. Especially for older people with the existing disadvantages caused by the lack of policy, individuals that require accessible websites based on their

needs on accessibility and quality of the information cannot get the benefit of the Internet despite their more crucial health condition.

Therefore, local policy should be built and implemented based on how important these phenomena are to society, particularly for a significant number of older people and other people with disabilities. As the findings of the studies from each phase showed, people in need of properly designed and easily viewed website content have a low proportion of Internet use because the websites, particularly health information websites, have a lack of WCAG2.0 compliance and are of poor quality. This exists because of a lack of WCAG2.0 policy implementation, also confirmed in previous studies by comparing countries with and without a local web accessibility policy (Martin, J; Gooncalves, R, Branco, F, Pereira, J., Peixoto, J., Rocha, 2016). Moreover, this study further contrasted countries with and without WCAG2.0 and suggested there were no significant differences on the improved web accessibility where those incompliance to WCAG2.0 have similar in those countries (Article 3), which implies poor policy implementation. Limited law imposed only to government agency can be seen in one case in government website type in UK which was under policy imposed has good WCAG2.0 compliance therefore the WCAG2.0 policy have enabled people right in obtain proper access in health information websites whereas other website types such as newspapers type, or commercial type websites have many lacks WCAG2.0 compliance because of beyond the law. As the policy of web accessibility does not regulate websites other than government websites, improving the other website types of policies should be extended to initiate general website improvement.

Elements of web-based health information for older people within each study phase showed interconnected associations where WCAG2.0 policy was still lacking in implementation through limited enforcement, less funding allocation, improper measurement, lack of awareness, lack of evaluation tools and not accommodating people's needs. Meanwhile, older people with very old age characteristics, low level of education, and lack of computer experience (through lack of certain work experiences) require a

proper website design that fits their needs, which were good accessibility features, readable content, and good-quality content. Governments should assure the right of equal opportunity to information access. With the growing numbers of older people and the current situation even in developed countries, factors related to education level and age-associated challenges were significant also in other countries. This study emphasized the need to strengthen, promote and accommodate older people's needs for proper accessibility and quality of web-based health information were finding of this study have shown still lack of accommodating older people right. Moreover, EU accessibility regulation have suggested accessibility that needs to be followed (European Union, 2016).

The necessity to integrate web accessibility as a main quality criterion and to have a clear consensus of quality evaluation on the websites, particularly on health information, can bring a better understanding and clearer strategy in promoting the good quality of websites. Previous studies have shown many approaches to studying website quality and accessibility that caused bias and complexity for websites developers and government agencies as well as many other parties. With a solid foundation for quality and accessibility, better quality and accessibility practices can be implemented and backed by proper policy as well. The potential of websites as multimedia information services should be explored. Considering a website as merely the way to access information limits the potential of the ongoing development of the website. Utilizing websites' capacities for providing richer information that can be customized according to people's demographic characteristics may far outweigh other conventional information sources and provide equal accessibility for everyone.

6.5   Limitations, validity and reliability of the study

This study limited its data collection to only questionnaire data and web-based data. Further studies are needed analyze older people's experiences, real benefit, problems, and more explorations of their online information activities. Usability data should be applied through direct user testing. Interview and a greater diversity of website quality and accessibility tests can provide more specific and in-depth analysis.

This study has not considered all demographic factors based on the study framework due to the limitation of the questionnaire as the data source for study phase 1. However, some factors have many expansions influencing the data sources such as working experience, having family and housing type.

On the other hand, more observations are needed in evaluating policy adoption and implementation. As a result, the process within policy adoption and implementation can be evaluated to anticipate the outcome of the policy. This study limited its framework to selecting only WCAG2.0 is due to its well acknowledgment standard that covers many aspects of web accessibility from content to design and it has been available for website testing. Moreover, recommended automatic accessibility evaluation tools that can be used to evaluate the websites with less time consumed were under WCAG2.0 tools recommendation.

In questionnaire study bias is difficult to avoid and is a common risk (Article 1). The data on the observation is too broad in analysing the older people for Internet use (Article 1) instead of more specific on the web-based health information. More balance comparison over certain websites type to analyse the differences was also potential bias (Article 3). Automatic testing relies on a generic formula to analyse web accessibility and it can only analyse basic web accessibility compliance (Youngblood & Brooks, 2018). To have more precise quality and in-depth web accessibility evaluation, a specific disease analysis tool and manual evaluation is needed. In addition, bias can be riskier in evaluating among website data due to the different number of pages and the used of figures and

embedded web applications for each website (Article 2 and 3) that can cause incompliance.

In terms of the scoping reviews, the data of selected articles only used two databases (Scopus and PubMed). Number of searched articles were title-based search using Scopus and PubMed automatic title filter due to the large number of articles especially related to older people and web-based health information. Moreover, not many intervention studies have been found among the selected articles nor randomized controlled trials.

Further study should explore more of people's expectations through direct interview or intervention. In addition, web developers and government agencies should be studied more to better understand their perception on web accessibility and web quality for health information. Therefore, policies can be more customized and concrete strategies can be performed. In addition, to have more in-depth analysis of Finland's case, the websites' evaluations and policies should be focused on Finnish websites and Finland's local WCAG2.0 policy.

The data were validated through questionnaire testing and the number of respondents who returned the questionnaire was high and quite balanced between males and females as well as between the 70s and 60s age group (Article 1). The collected websites were based on related keywords with predefined inclusion and exclusion criteria. The websites were searched using three popular search engines and the filtering process was described (Article 2). Number of selected websites were balanced and high in number.

The study framework was based on the scoping review where the collected data was performed through a well recommended database for good-quality articles (Scopus and PubMed). Articles apply various research methods and include various countries. The articles were filtered and reported using Prisma report and the scoping review used the Joanna Briggs Institutes (JBI) guidelines (Aromataris & Munn, 2021). The selected articles were discussed, and the searching processes were performed by an information expert.

Reliability in Article1 selected variables that were chosen based on multicollinearity analysis and the selected variables were based on previous literature. The data were analysed by logistic regression with two models, with and without an adjustable effect model.

Data on study phase 2 and 3 (Article 2 and 3) have been analysed concurrently by two automatic web accessibility evaluation tools and the results have been crosschecked and compared. The evaluation of web accessibility has been performed repeatedly until the results of evaluations were similar. Due to the nature of website data, this study can be repeated and retested using the free automatic tools that are proposed under the recommendations of W3C. Therefore, this study is replicable through the availability of data and testable with the free automatic tools that are supposed to be more reliable with more consistent measurement and that are freely available. All data analyses throughout these studies have been performed by the first author as this dissertation author.

This study used contrasting cases when evaluating a country with and without WCAG2.0 by analysing the differences in website accessibility. For comparison, measuring better implementation can be performed.

7 Conclusions and Recommendations

This study concluded that in implementing web-based health information for older people, the role of web accessibility should be further strengthened through enforcement of the WCAG2.0 standards to assure the right of older people and every individual to have equal access and to view accessibility from the perspective of e-service quality. Even in developed countries like Finland, there were still certain characteristics of older people beyond age itself, namely education and or work experiences, which required web accessibility practices.

Accessibility standards should become a major focus, not only among government and other public services but also any other providers related to health information content as these sites were immensely popular as sources of information. To protect older people sufficiently, governments should have the main role in building, implementing, and monitoring web accessibility policies. The key to minimizing accessibility gaps among older people in accessing web-based health information should begin from the implementation of policy into the websites.

There are several recommendations based on the study, as follows :

Recommendations for government

1. Generic WCAG2.0 to be used into local policy should be adjusted based on significant demographic factors that may not be similar in every country.
2. To build awareness of web accessibility, the policy implementation should be focused firstly on basic accessibility criteria considering it is easy to monitor and execute.
3. The WCAG2.0 policy should not be only limited to government agencies but be extended to other information providers.

4. Funding allocation to promote web accessibility should be provided to protect older people's rights, improve web-developers' skills, subsidize certain information providers and consider long-term benefits.
5. Regular monitoring of web accessibility should be provided. With automatic tools, the evaluation can be conducted for regular monitoring, especially to simply reduce web accessibility errors as an initial effort to improve web accessibility practices.

Recommendation for any other stakeholders

1. The role of the search engine is vital; people mostly used search engines in finding information. Improving search engines featuring web accessibility and quality would create significant impact to engage older people in web-based health information.
2. The integration of accessibility aspects in quality assessment should be considered as criteria of quality evaluation on health websites, not only for information content but also information accessibility.
3. Redefine quality in the context health information websites to improve and develop the evaluation.
4. For further studies, more in-depth analysis of the practices of web accessibility and quality should be performed by exploring people's perceptions as users, developers of websites, and government agencies.

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Appendices

APPENDIX 1. SCOPING REVIEW BASED ON JBI

1. Topic: older people's Internet use for web-based health information

   Research Questions:

   1. What are factors that determine older people's use of web-based health information?
   2. What are older people's experiences of and attitudes toward web-based health information?

Table 1. Inclusion and exclusion criteria for older people's Internet use

Criteria	Criteria for inclusion	Criteria for exclusion
Study language	English	Not English
Study population	Older people	Not elderly, too young, e.g. youth
Study concept	Online health information, Web Accessibility, Quality, Website Content Accessibility Guidelines	Something else, but not online and not health information
Study context	Information for older people	Information for someone else
Method	Qualitative and quantitative studies	No limits
Article	Peer-reviewed published articles	Editorial or theoretical study, not journal, study protocol
Availability	Electronically available article	Not electronically available
Time limit	No limits	

Keywords: Elderly, senior, older people, aged, website, internet, online, health, healthcare, and information

2. Topic: quality and accessibility of web-based health information related to older people.

Research questions:

1. What are the current levels of quality and accessibility of web-based health information related to older people?
2. How does the assessment of quality and accessibility of web-based health information relate to older people's behaviors?

Table 2. Inclusion and Exclusion Criteria for the second topic

Criteria	Criteria for inclusion	Criteria for exclusion
Study language	English	Not English
Study population	Websites of health information	Other media channel
Study concept	Online health information, web accessibility, Quality, Website Content Accessibility Guidelines	Something else, but not online and not health information
Study context	Information for elderly	Information for someone else
Method	Qualitative and quantitative studies	No limits
Article	Peer-reviewed published articles, review articles	Editorial or theoretical study, not journal, study protocol
Availability	Electronically available article	Not electronically available
Time limit	No limits	

Keywords:

Quality, accessibility, online, health, information, digital, portal and website.

3. Topic: the practice of WCAG2.0 policy in health information.

   Research Questions:

   (1) What are the current WCAG2.0 policy practices of web-based health information related to older people?

   (2) What are the efforts or recommendations to improve the policy practices of WCAG2.0?

Table 3. Inclusion and Exclusion Criteria for the third topic

Criteria	Criteria for inclusion	Criteria for exclusion
Study language	English	Not English
Study population	Web Accessibility, WCAG2.0	Other than WCAG2.0
Study concept	Online health information, Web Accessibility, Quality, Website Content Accessibility Guidelines	Something else, but not online and not health information
Study context	Information for elderly	Information for someone else
Method	Qualitative and quantitative studies	No limits
Article	Peer-reviewed published articles	Editorial or theoretical study, not journal, study protocol
Availability	Electronically available article	Not electronically available
Time limit	No limits	

Keywords:

website, accessibility and WCAG

Prisma Charts of Scoping Review 1, 2 and 3
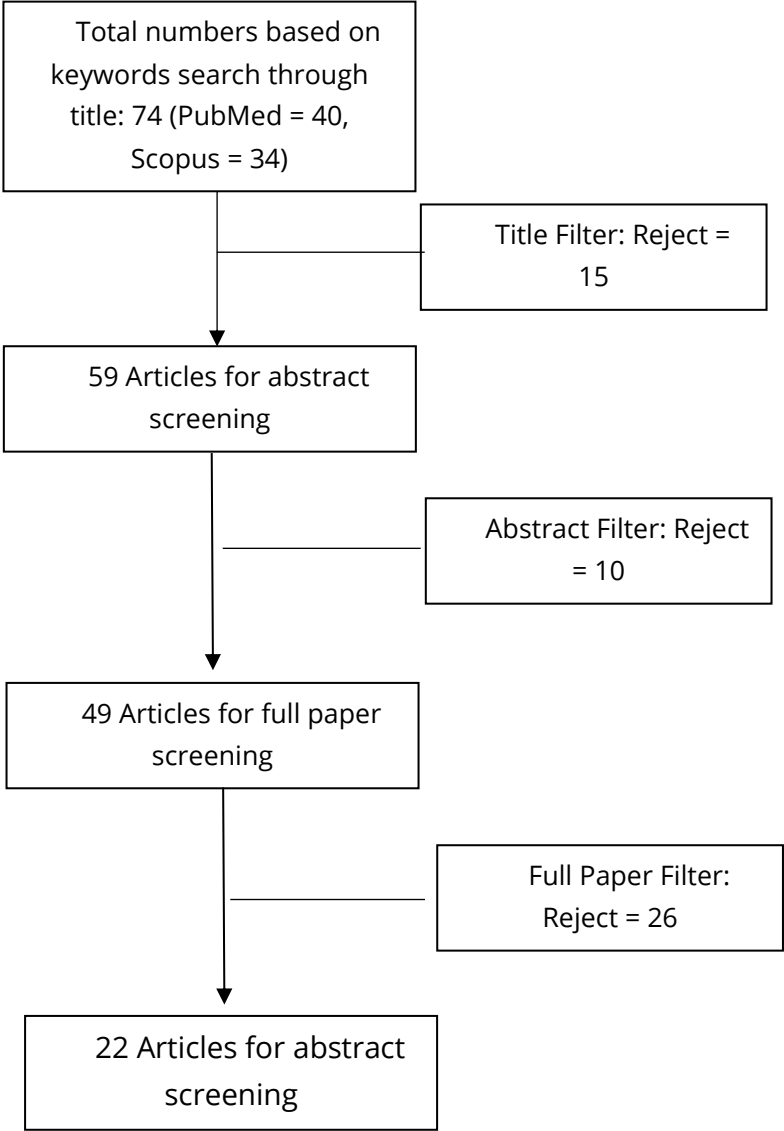
Figure 1. Prisma chart of first theme

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│  keywords search through    │
│   title: 120 (PubMed = 61,  │
│        Scopus = 59)         │
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│   108 Articles for abstract │
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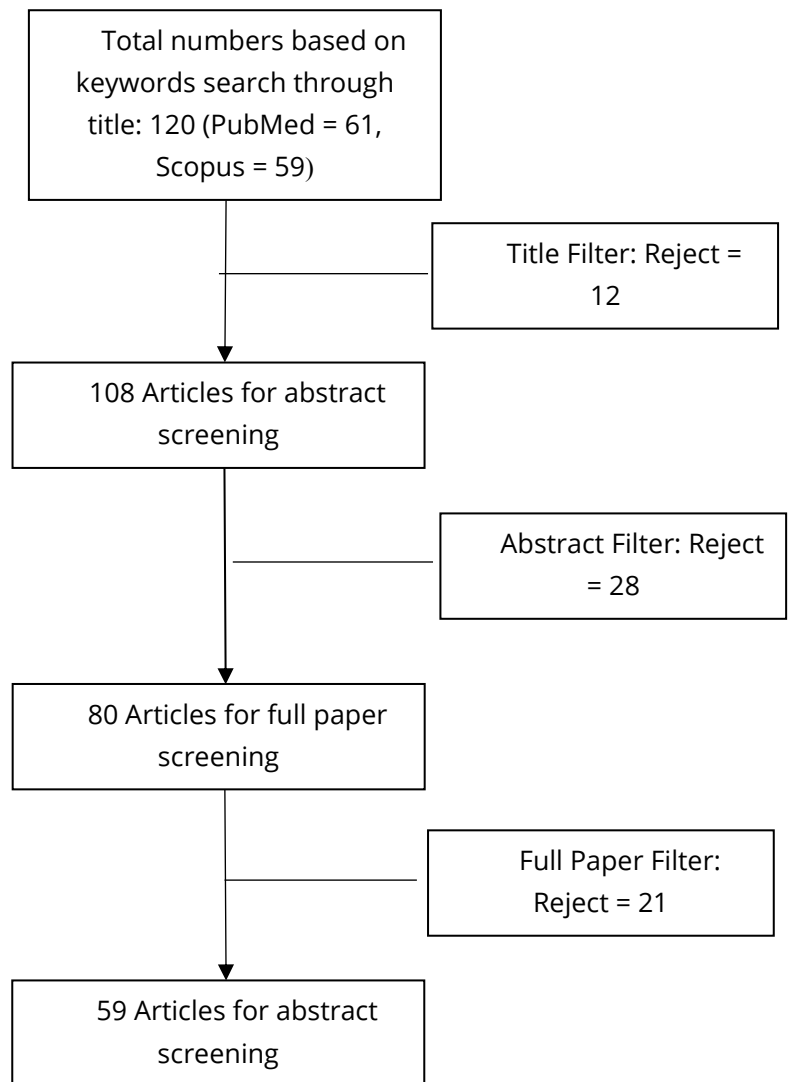
Figure 2. Prisma chart for second theme
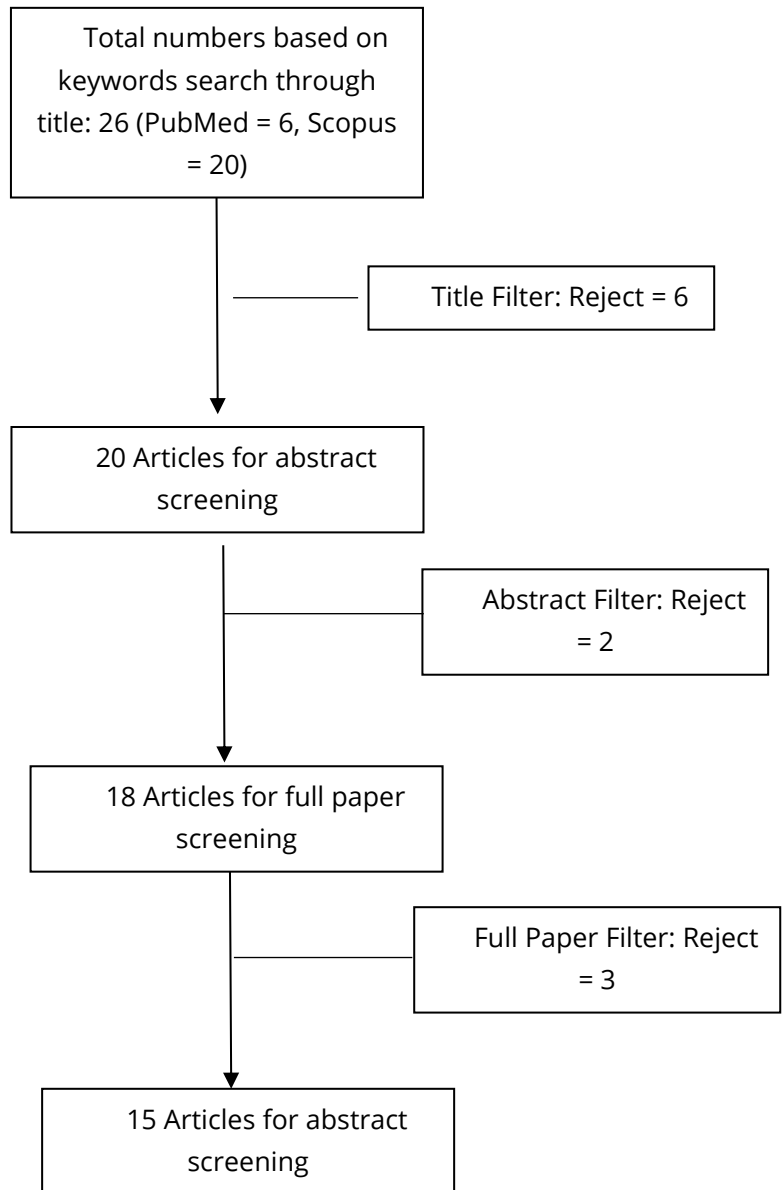
Figure 3. Prisma chart for third theme

Appendix 2. List of selected papers

Table 1. Older people's use of websites for health information

Author, Year	Methods	Purpose	Finding
Campbell & Nolfi, 2005	Training for 5 weeks and survey after one year.	To examine changes in participant's perceptions of their health, perceptions of their interactions with healthcare providers, health information-seeking behaviours, and self-care activities.	No significant differences found in both genders in external and internal health locus of control and health opinion. Internet use only for general information and for healthcare decisions, demographic and situational variables may have significant roles.
Reddick, 2006	Using data set from the Kaiser Family Foundation eHealth and the Elderly public opinion.	To determine whether online health seekers have changed their behaviors from the information they found online.	The boomers marginally use online health information more than seniors. The boomers and seniors who are aware and have positive feelings toward online health information would use it more to manage

			health.
Chu, Huber, Mastel-Smith, & Cesario, 2009	Randomized controlled, two groups, pre-post, repeated measures. Intervention group received training.	Measure the psychosocial influences of computer anxiety, confidence, and self-efficacy.	Reduction in computer anxiety and increase in confidence and self-efficacy.
Gracia & Herrero, 2009	Survey of digital divide and quality of life across two age groups (55-64 and 65-74 years).	To examine the association between internet use and self-rated health among older people and determine whether this association holds independently of socioeconomic position.	Internet users have better self-rated health than nonusers but not significant when social class was included.
Chung et al., 2011	Interview of 91 community dwelling older adults from 10 seniors centers. The adult age was 65 years and older, and questionnaire.	To describe how older adult Internet users accessed, used online health information, and perceived barriers in using the Internet.	50% of Internet users had used online health information and found it was helpful. Barriers: not interested, complicated, no experience, too expensive, or disability. Quality finding revealed literacy and education level were the

Takahashi et al., 2011	Cross sectional survey of Japanese general population aged 15-79 years.	This study aimed to measure the prevalence of internet information compared with other sources, and to examine the effects on user knowledge, attitudes, and activities with regard to Internet use for health-related information.	major barriers. Japan moderately used the Internet via personal computers for health purposes and seldom used the Internet via cell phones. Older people with lower incomes or lower education levels were less likely to use cell phones for Internet use. The Internet moderately improved users' health knowledge and attitudes.
Zajac et al., 2012	A random sample of urban older Australians aged 50 to 74 years received a questionnaire via email and were asked to complete questions concerning variables related to Internet usage.	To determine the proportion of Australians aged 50-74 years who have internet access, and the characteristics of Internet usage, current online health information seeking behaviour, and the willingness to receive unsolicited health information via the Internet.	The majority of urban Australians aged over 50 have access to the Internet and 60% of them use the internet for health-related purposes. People who are older, less educated, and less financially well off would have been disadvantaged in online health information

			provision.
Hallows, 2013	Literature review	To determine whether the existence of the Internet has had a significant impact on health information literacy among elderly in developed nations.	Mixed results, where the Internet has not totally influenced the elderly's ability to make informed health decisions.
Wong, Yeung, Ho, Tse, & Lam, 2014	Survey for participants from a local academic institute for older people and three community centres for senior citizens.	Investigating the predictors of Internet use to search for online health information among Chinese older adults.	Perceived ease of use and attitudes influence behavioral intention of Internet use.
Bujnowska-Fedak & Mastalerz-Migas, 2015	Survey Polish Elderly population (age of 60 and above)	To investigate the use of the Internet for health-related purpose among Polish elderly.	The Internet was a less important source of information. Health Professionals, family, and friends. Male gender, younger age, higher education, living with family, mobile phone users, good health self-assessed.

Medlock et al., 2015	Surveys to assess information needs and preferences for involvement in health decisions. Participants are from local senior organizations.	The aim was to determine which information resources seniors who use the Internet use and trust for health information, which sources are preferred, and which sources are used by seniors for different information needs.	Health professionals, pharmacists, and the Internet were the most commonly used and trusted sources of health information. Users with higher Internet use also use other sources at a higher rate.
Sheng & Simpson, 2015	Questionnaire that targeted seniors and retirees, the primary purpose of the questionnaire was to determine the economic impact of the wintering visitors on the regional economy but also had the purpose of examining perceptions of these seniors in utilizing online health care	Examined factors that impact seniors' usage of the Internet for healthcare information.	Age, education, income, perceptions about their health and about the importance of health information access on the internet, beliefs in internal locus of control over health impact trust towards health information websites had direct impacts on seniors' behavior of using the Internet for health information support. Age negatively affected trust in health information

	information.		websites.
Clarke et al., 2017	Questionnaire and follow up 3 and 6 months of participants aged 65 and above in community dwelling older adults.	To investigate the relationship between the frequent internet use and pattern of health or social care resource use in primary care attendees.	In the healthy population, positive association between internet use and the use of community-based health services. No significant benefit between Internet users and non-users in use of healthcare.
Nguyen, Smets, Bol, Loos, & Van Weert, Julia C. M., 2018	5 versions of the websites (mode tailored vs non tailored, text only, text with visual and text with audio-visual and combination.	To test the effects of mode tailoring when users can adjust the mode of information presentation via textual, visual, and /or audio-visual information on evaluative outcomes that are considered important for health websites.	Mode tailoring positively influenced satisfaction with the attractiveness and comprehensibility of the website and the effects are not different between younger and older adults.
Shim, Ailshire, Zelinski, & Crimmins, 2018	Collected data from a technology module from community dwelling older Americans aged 52	This study aimed to determine whether the use of the internet for health information is associated with health service utilization	The use of Web-based health information was associated with higher health service use. For chronic health conditions,

	and above.	and whether the association is affected by specific health conditions.	using Web-based health information had significantly fewer doctor visits.
Seçkin, Hughes, Yeatts, & Degreve, 2019	Survey of demographic backgrounds, eHealth information seeking, eHealth literacy, eTrust and eHealth consumerism, satisfaction with perceived changes in medical encounters, and positive health perceptions.	To explore the influence of eTrust, eHealth literacy, eHealth information seeking and eHealth information consumerism on medical satisfaction and positive health perceptions.	e-health information seeking has an indirect effect on both medical satisfaction and positive health perceptions through its significant direct effect on ehealth consumerism.
Crouch & Gordon, 2019	Survey of Northern California health plan members aged 45 and 85 years.	To estimate prevalence of use of the Internet, health plan patient portal, and Web-based HIA among middle aged and older adults; and examine how sociodemographic and	Internet use declines with age, education is a significant factor of Internet use, Internet literacy, the use of patient portals and web-based Health Information and Advice.

		Internet access factors drive disparities in eHealth resource use among adults who use the Internet.	
Gordon & Crouch, 2019	Cross sectional survey of Northern California members aged 45 to 85.	To examine how use of digital information technologies and preferred methods for obtaining health information and advice varies by age group and education among middle aged older adults with chronic health conditions.	Adults who used digital IT, obtained health information and advice from an Internet based resource and were interested in using online health information and advice by mHealth modalities declined with age.
García-Camacha, García-Camacha, Martínez-Andrés, Notario-Pacheco, &	Educational interventions, peer group activities, online platforms to support healthy lifestyles.	To evaluate the impact of the healthy ageing supported by the Internet and Community training programme for acquiring the knowledge and skills.	The results showed the effectiveness of the programme

Rodríguez-Martín, 2020			
Haase, Sattar, Holtslander, & Thomas, 2020	Secondary analysis of qualitative data addressing the multidimensional nature of Internet information use amongst people over age 55 with cancer.	To have insights regarding the unique ways older adults use the Internet for health information, and its role in the patient-provider relationship.	Older adults use cancer related online information despite hesitation with technology. Older adults were less likely to seek cancer online information.
Merkel & Hess, 2020	Using data from the Special Eurobarometer.	This study examined if and how elderly people are using digital services to access health and social care.	Younger age, better education, high social class and living in urban areas were positive associations with high internet use for health and social services.
Tavares, 2020	Data from Survey of Health, Ageing and Retirement (SHARE) in Europe wave 6.0.0	To find the relationship between self-assessed health and Internet use by older people and to ascertain whether this relationship	Older people who use the Internet tend to report better health status.

		differs in countries with more developed eHealth policy.	
Yuan, 2020	Uses data from large scale samples of aged 60-80 years. Measures mental health problems with the 10-item version of Hopkins Symptom Checklist, Internet use assessed by 4 item scale and chronic diseases with 12 item scale.	This study investigates whether the impact of Internet use on old adults' mental health problems differs across health conditions and income groups.	Elderly who uses the Internet more frequently have substantially lower odds of having mental health problems. More significant effect of frequent Internet use for reducing mental health problems is in the low-income group.

Table 2. Collected papers for quality and accessibility of web-based health information for older people

Author (Year)	Method	Purpose	Finding
Chang, P, Hou, I C, Hsu, C L, Lai, H F 2006	Two portals, Google and Yahoo, 6 common diseases. 800 searched websites.	To examine the ranks of 50 awarded health websites (with better information quality and web usability) in Taiwan against the search results.	Quality of health websites is not always reflected on the top list on search engine results.
Harland, J, Bath, P, 2007	Using Google and Yahoo using keywords multiple sclerosis, ms, neurological disorder. A purposive sampling strategy and using catch the web for snapshot.	Aimed to test the validity and reliability of existing tools for websites quality evaluation and to evaluate the quality of multiple sclerosis online information.	Generic tools did not always match up with the specific tools. Specific tools provide more objective measurement.
Chumber, S, Huber, J, Ghezzi, P, 2014	Using Google, Yahoo, Bing, and Ask and MedlinePlus (Gov website), using 2 instruments JAMA and HON.	The purpose is to evaluate the criteria used to assess the quality of information on diabetic neuropathy on the internet.	Professional websites or health portals have better quality; JAMA and HON produced different results.

Author	Method	Aim	Finding
Seymour, N, Lakhani, R, Hartley, B, Cochrane, L, Jephson, C, 2015	Selected patient-information websites were ranked from three major search engines, using DISCERN, and the readability score based the Flesch-Kincaid and Gunning-Fog index.	To measure website quality content of cochlear implantation.	The quality is varied, and the reading level is above the recommendation.
Saraswat, I Abouassaly, R Dwyer, P Bolton, D M Lawrentschuk, N, 2016	Google search for female urinary incontinence in English, French, German, and Spanish. First 150 websites were selected for each language, examined HON certificate.	To compare the quality of current Internet information for common layperson terminology of female urinary incontinence across four languages.	Very few websites with HON certificates, English and French were the highest proportion.
Chang, D T Abouassaly, R Lawrentschuk, N, 2016	HON principles to evaluate the quality of information. 15 Keywords related to urolithiasis searched through Google.	To compare the quality of health information on the Internet related to urolithiasis across four different languages.	The top list websites on the search engine have potential to be better quality. Almost 30 % of selected websites were not validated.

Davaris, Barnett, Abouassaly, & Lawrentschuk, 2017	HON, Using English, French, Spanish, and German Google search engines.	To quantify website quality in a multilingual setting using an international standard for assessment.	HON percentage for all keywords range 7 to 8 %. HON certified for the first 50 website list has the largest HON.
Valizadeh-Haghi & Rahmatizadeh, 2018	Using Google, Yahoo and Bing, Using Accessibility testing tool, HON, Alexa for website popularity.	To assess the quality of health websites related to kidney transplant and to evaluate the accessibility of websites based on Guidelines (WCAG2.0).	Know problem where scripts must have functional text, text equivalent, accessible forms, and text links for server-side image map. Government and Organizational websites have lesser average errors in accessibility.
Bedaiwi, I I Alfaraj, S Z Pines, J M, 2018	Descriptive study of the content, quality and readability, and popularity using DISCERN, JAMA, HON and readability Flesch-Kincaid. Use Google, Yahoo and Bing.	To assess online health information for patients and families on stroke and TIA (transient ischemic attack).	Readability is higher than recommendation, JAMA score was low, few the quality is highly varied.

Bompastore, Cisu, & Holoch, 2018	Three search engines (Google, Bing, and Yahoo), HON, readability and Quality using the DISCERN, accuracy by urologist.	To characterize the online information related to Peyronic disease and evaluate its readability, quality, accuracy, and respective association with HON and website category.	The readability level on average above 11 grade, DISCERN score indicated fair quality and the information accuracy range 25 - 50%. HON certified websites were good quality.
Reynolds, M Hoi, A Buchanan, R R C, 2018	Use Google, Bing, and Yahoo. DISCERN (quality), JAMA (reliability) and Gunning Fog Index (readability), HON.	To assess the quality, readability, and reliability of online information of systemic lupus erythematosus.	Almost similar results from three search engines. Overall quality was fair, reliability was poor. HON and popularity of websites did not determine better score and Readability is higher than recommendation.
Fuzzell, L N, Richards, M J, Fraenkel, L, Stark,	Using 4 search engines (Google, Yahoo, Ask and Bing), two raters assessed for information	To assess the content and quality of osteoporosis treatment information on the Internet	The quality of the websites varies. High quality websites have better navigation, more

S L, Politi, M C, 2019	content, design interface and balance information.		detailed information and are easy to read.
Sun et al., 2019	Systematic literature review in Digital databases: Medicine, Psychology, Communication, and Library and Information Science.	To identify the criteria to evaluate the quality of online health information and indicators that customers use to support the evaluation, and to explicate the relationship between indicators and criteria to provide clear guidelines for designers of consumer health information systems.	25 criteria and 165 indicators have been identified with the most dominant criteria (trustworthiness, expertise, and objectivity. The indicators' theme (source, content, and design).
Garfinkle, R., Wong-Chong, N. Petrucci, A., Sylla, P., Wexner, S. D., Bhatnagar, S.,Boutros, M., 2019	Using Google, Yahoo and Bing, Readability, Suitability, Quality, Accuracy and Content.	To review current online health information on LARS.	Website material, incomplete content, and quality below the standard.

Daraz et al., 2019	Using Prisma, systematic review, NIH Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies, DISCERN and HON	To evaluate the overall quality of online health information for patients and the public.	DISCERN tool results 37- 79% are good rating, although only 18% have a HON certificate. Quality of online health information is suboptimal.
Shim, M Jo, H S, 2020	Survey of users National Health Information Portal,	To examine the role of quality over benefit perceived on health websites.	Information quality and service quality influence users satisfaction, and information quality and users satisfaction influence user intention to reuse.
Battineni et al., 2020	Literature review, selected 24 articles for review.	To analysis the trends in the use of health websites, assessment quality and reliability level	Reliability of online health information is major issue; it might need doctors to guide people for more trusted source.

Panagiotopoul ou, M Tsirintani, M, 2020	Qualitative survey, Accessibility analysis, search engine analysis.	To investigate people with disabilities, using state healthcare structures and to identify accessibility deficiencies.	Internet sources for health information are not always available and have no validity. Design is not user friendly. Only 20% of the websites and files have full accessibility.
Tahir et al., 2020	Using DISCERN and Flesch-Kincaid Tools by two groups Health Professionals and Lay Persons	To evaluate the quality and readability of Online Health Information related to High Blood Pressure.	The quality of websites in general below the standard and almost 50% websites above the recommended readability score, even though there were 6 out of 11 in them have excellent DISCERN score.

Table 3. Selected article for WCAG2.0 implementation on health websites for older people

Author, Year	Methods	Purposes	Findings
Martins_et al., 2017	Automatic web accessibility evaluation with ACCESSWEB again WCAG2.0.	To analyse the Iberian eHealth websites in relation with the accessibility and usability guidelines and standards.	The websites were not compliant with the standard. Policy Implications: Creating a reference for both organization and Web developers who can therefore apply the assessment to their own websites. In addition, increase awareness and concern of the topic for all actors.
Kaur et al., 2017	Websites were selected from the hospital directory of National Health Portal. Automated tools Website Optimization, Measure text readability, usability tool analysis Built with tool and TAW	To evaluate the accessibility, usability, and security of hospital websites in metro cities in India.	There are significant differences between the public and private sector for the total unfulfilled accessibility criteria of WCAG2.0. Hospital websites were under the standard of the performance and quality criteria. Policy Implications: Hospitals need to tackle accessibility problems and solve them properly.

Author/Year	Method	Aim	Findings
	for analysis of websites based on WCAG2.0		
Acosta-Vargas et al., 2018	Applied standard of webometrics rating criteria and perform evaluation based on WACG2.0 standard with the Website Accessibility Conformance Evaluation Methodology (WCAG-EM) and Automatic tool WAVE and TENON tools.	Evaluate the accessibility of 22 hospitals based on Webometrics ranking	The websites did not comply with acceptable standards according to WCAG2.0. Policy Implications: Regulatory institutions should ask the information providers to follow the requirements where the basic rules should be clear to all people; therefore, the design will improve.
Youngblood and Brooks, 2018	Used machine-based accessibility SortSite Professional based on US Section 508 standards and international	To access accessibility for 166 Veteran Affairs Medical Centre websites	Limited problems were found on each website. Policy Implications: Practitioners and educators should integrate accessibility into curriculum.

	WCAG2.0 guidelines		
Martins et al., 2016	Used ACCESSWEB as an accessibility evaluation platform	To evaluate the accessibility levels of the Iberian healthcare institutions.	None of the websites complied with the WCAG2.0 Policy implications: The organizational leader should encourage the production of high-quality and high-interactive online health information and should regulate those websites to be accessible to all.
Yi, 2015	User testing according to local standard KWCAG 2.1 which is an adoption of WCAG2.0.	To evaluate the accessibility of government and public agency healthcare Websites in Korea.	The accessibility problems were found in each of 4 principles of WCAG2.0 Policy Implications: Government, public agencies, and Web developers should be aware of the importance of accessibility.

ARTICLES

ARTICLE I

Arief, M., Rissanen, S. & Saranto, K. (2018). Influence of previous work experience and education on Internet use of people in their 60s and 70s. *Journal of innovation in health informatics, 25* (3) , 132-141. 10.14236/jhi.v25i3.868.

ARTICLE II

Arief, M., Kinnunen, U. M., & Saranto, K. (2018). Accessibility and readability of dementia-related information on websites. In *Data, Informatics and Technology: An Inspiration for Improved Healthcare* (pp. 229-232). IOS Press.

ARTICLE III

Arief, M., Rissanen, S., & Saranto, K. (2020). Effectiveness of Web Accessibility Policy Implementation in Online Healthcare Information. *Studies in health technology and informatics*, *270*, 1108-1112.

ARTICLE I

Arief, M., Rissanen, S. & Saranto, K. (2018). Influence of previous work experience and education on Internet use of people in their 60s and 70s. *Journal of innovation in health informatics, 25* (3) , 132-141. 10.14236/jhi.v25i3.868. Reprinted by permission from BMJ Publishing Group.

Research article

Influence of previous work experience and education on Internet use of people in their 60s and 70s

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ABSTRACT

Background Internet use among the elderly is influenced by various demographic backgrounds, social life and health factors.

Objective This study aims to identify the impact of several demographic features on 60- to 79-year-old individuals' intention to use the Internet.

Method Finland population data (N = 2508) from the 2012 IKIPOSA project was used with two cohorts: 60s group (n = 1515) and 70s group (n = 990). Descriptive statistic and two binomial logistic regressions have been used with the unadjusted effect and Forward LR method to measure each predictor's contribution to the model. In addition, a preliminary analysis to measure the multicollinearity was performed.

Result Of the 18 independent variables, only nine predictors, namely, age, education, financial situation, having children, entrepreneurship, a leadership position, a higher level white-collar worker and a lower level white-collar worker, were significant factors in predicting the Internet use. Meanwhile, gender, having grandchildren, living alone, marital status, house location and type, stay-at-home mother or father, blue-collar worker, agricultural entrepreneur and social relations satisfaction were not significant predictors. The most significant predictors were education and age, which contributed 19% and 10%, respectively, to the model. Other significant predictors, lower level white-collar worker, higher level white-collar worker and financial situation, had less impact with only around 6%.

Conclusion Education and age were influential factors among elderly to use the Internet in their later life. Certain work experiences affect elderly people's engagement with the Internet after retirement.

Keywords: demographic factors, elderly, Internet use

INTRODUCTION

The populations of developed and developing countries are ageing rapidly due to higher life expectancies and lower birth rates in developed countries.[1] Finland, the subject of this study, ranked fifth in the world since 26.1% of its population are aged 60 or over.[2] Middle-income countries are currently home to two-thirds of the world's older people, and the least developed countries have seen a gradual growth in their aged population.[2]

Although the Internet has become popular worldwide[3] as a source of information and for socialisation,[4] older people still demonstrate far lower internet usage rates than other ages. In the EU in 2011, only 49% of citizens aged 55–64 and just 28% of those aged 65–74 were Internet users.[5] In Finland in 2013, the percentages of those aged 65–74 and 75–89 who had used the Internet in the previous 3 months was 65% and 27%, respectively.[6] In comparison, the figures for those aged below 54 were between 97% and 100%.[6]

In developing countries, the gap in the Internet usage between older people and younger people can be very wide. For instance, in Hong Kong, elderly had less access to the Internet.[7] Previous studies have determined several demographic factors that impact the Internet usage.[8,9] Several predictors of Internet use have been considered such as social satisfaction levels and work experience because of the complexity involved in explaining the digital divide.[10,11] Previous studies have determined common demographic factors that may impact the digital lifestyles of the elderly, including age,[10] education, gender, ethnicity and socioeconomic situation. However, several contradictory results have been highlighted, like gender and race.[12–15] Moreover, the impact of factors that affect elderly's Internet usage may vary by age group among the elderly. For instance, Americans aged 75 and over have shown lower Internet use due to numerous factors.[16]

The Internet can provide a social life for people who struggle to interact with others[17] or are unable to remain socially active. Media offers an alternative form of socialising.[18,19] Barnes et al.[20] explained that older people are socially excluded of older people for several key reasons, including limited modes of transportation, limited mobility and health issues to name just a few. The Internet can reduce loneliness and depression among the elderly, which are common problems, and improve their social support and self-esteem.[21–27] However, as previously suggested by Blažun et al.,[28] the elderly people need computer skills to successfully engage in digital life.

Several demographic factors of people in their 60s and 70s were evaluated to obtain a better understanding of how to more effectively encourage the Internet usage among elderly. Due to the complexity of factors that determine the digital divide as well as the heterogeneity of the elderly,[20,29] we assumed that different Internet usages could not be explained by referring only to age, gender and education.[8]

MATERIALS AND METHODS

The data in this study was collected from the Ageing and Well-being in Northern Savo study, which was conducted by the University of Eastern Finland in 2012 as part of the Age Innovation Project 2012–2014 (IKIPOSA). The purpose of this project was to investigate ageing in relation to age, functional capacity, social relations, hobbies and exercise habits, health and attitudes towards the future of elderly people in Northern Savo, Finland. This study focused on identifying certain factors that influence elderly's Internet usage. The target population of this cohort study was individuals in their 60s and 70s living in Northern Savo. The respondents represented different phases of life: pensioners, the recently retired or retiring and those who were still active workers. The contact information of the population was taken from the Finnish Population Register Centre. Several experts from different fields assessed the questionnaire's appropriateness as part of the validation process, and it underwent small-scale testing.

Variables

This study selected 18 variables from the 2012 Older Citizen Well-being Survey distributed by the IKA Innovation project. People were asked to state how frequently they used the Internet, social media or email in their spare time. A five-point Likert scale, whose responses ranged from 'daily' to 'never', was used. The scale was recoded into dichotomous variables in which 'daily use' and 'weekly use' were categorised under *Frequent Internet user*, while 'monthly use', 'less often', 'never' and missing data were categorised as *Other Internet user*.

The age variable was classified into two groups, individuals in their 60s and those in their 70s. Gender is used as a predictor variable because previous studies have noted the role of gender in the Internet use.[8] Another common predictor, education was classified into three categories: basic education, which covered elementary, middle, civic or comprehensive school; secondary education, which covered vocational school or upper secondary school; and higher education, which covered university of applied sciences and university education.

Marital status was considered since people might use the Internet to look for a partner or to keep in contact with their spouses who live elsewhere.[29] Financial circumstances may also influence the Internet usage because daily necessities might require a greater proportion of their income. As previous studies have found that loneliness is common among older people,[28] whether people lived alone was another examined predictor. It is also relevant to evaluate the effect of having children or grandchildren in terms of triggering older people's motivation to use the Internet. In addition, because older people have less mobility, the individuals' housing conditions were taken into account.

Previous work experience was converted into seven new variables: entrepreneur, leading position, higher level white collar, lower level white collar, blue collar, agricultural

entrepreneur and working from home or stay at home. All these variables were dichotomous.

Descriptive statistics were used to summarise all data, and crosstab analysis was conducted and binomial logistic regression predicted the Internet use with respect to several demographic factors. A preliminary analysis was conducted to evaluate whether there were multicollinearity problems among any of the predictors to ensure that the predictive factors were not excessively influenced by each other. The regression process for analysing the association between frequent Internet use and several demographic factors was conducted in two parts. First, the unadjusted effect of all demographic variables was tested. After that, the effects of the interacted variables were tested using the Forward LR method in binomial logistic regression. In addition, separate binomial logistic regressions based on the age category were conducted to evaluate the characteristics of each age group related to their Internet use. Statistical software SPPS version 23 was used for these analyses. Hosmer–Lemeshow was used to test model fitness with the data.

RESULTS

A total of 3902 and 1920 questionnaires were sent by post to the 60s and 70s age group, respectively, at the end of November 2012. In January 2013, 2849 and 1176 additional questionnaires were distributed to the 60s and the 70s age groups, respectively. The total number of respondents was 2508 people ($n = 1515$ for individuals in their 60s and $n = 990$ for individuals in their 70s).

The result of the preliminary analysis was that none of the variables exhibited multicollinearity, with a tolerance range from 0.219 to 0.948 (>0.1). Therefore, the independent variables have small correlations among them, which improves the effectiveness of the regression equation.[30]

Figure 1 depicts the frequency of older people using the Internet. The sample represents the Northern Savo population very well, with a good balance between age and gender distributions. The age distribution between those in their 60s and 70s was 60.4% (1515) and 39.5% (990), respectively, and the gender distribution was 44.5% (1116) and 55.5% (1391) for males and females. In terms of the education level, those with a basic education dominated in the older group, as 51.1% (481) of the 70s group had basic education, whereas 34.9% (503) of the 60s group had basic education. In the younger group, the education level was quite balanced at around 30% for three different levels of education. However, when split by gender, basic education was dominant for both males and females, with 44.09% (474) and 39.0% (510).

Figure 1 shows the proportions of frequent and non-frequent Internet users with respect to the seniors' individual characteristics. It can be seen that younger age category has almost double the Internet usage at 77.8% compared to the percentage of the older group category, 47.6%. Another significant result was that 70%–90% of individuals who had secondary and higher educational background used the Internet
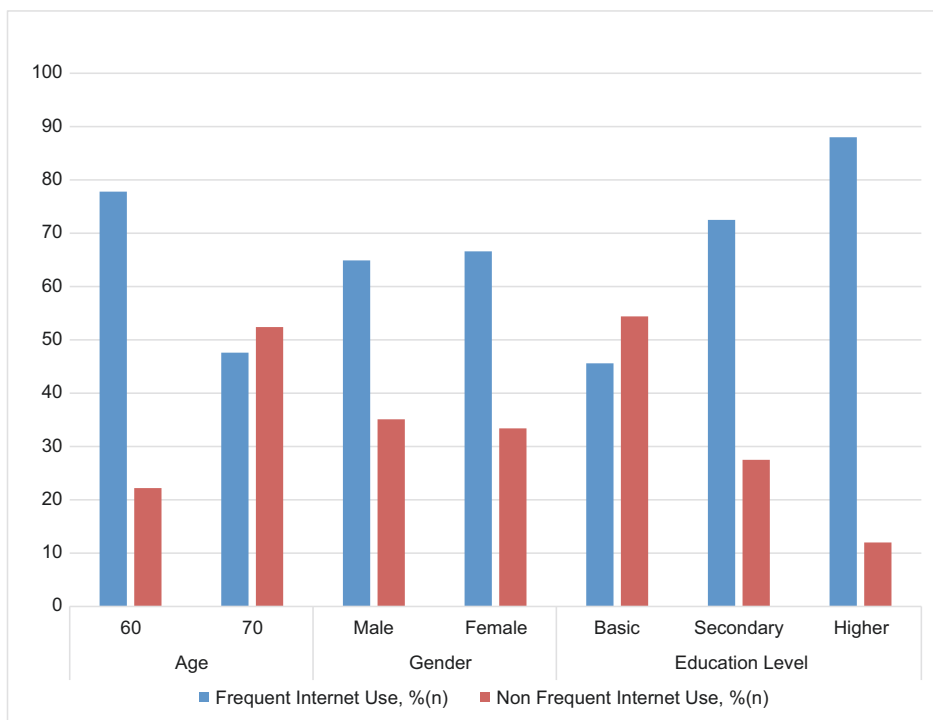

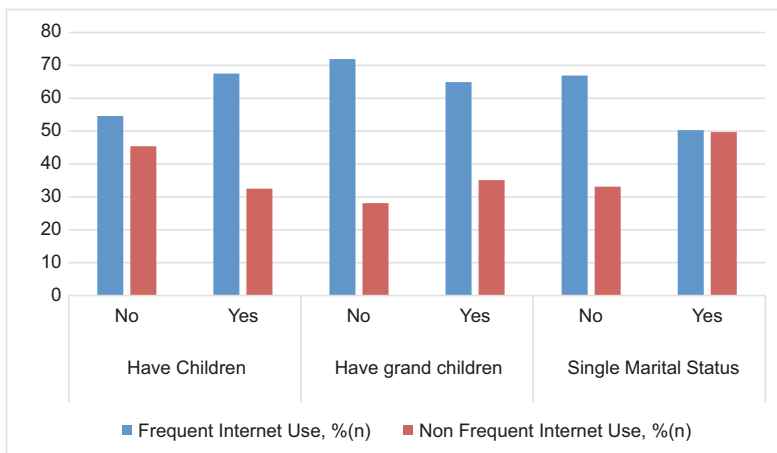**Figure 1 Individual characteristics in Internet use**

Figure 2 Family characteristics in Internet use

regularly, while only 45% of individuals with basic education used it regularly.

In terms of family characteristics (see Figure 2), there were no differences among the three characteristics of the elderly. Most of the categories showed a high proportion of frequent Internet use.

Those who lived in a single-family house and near the city showed no differences with those who did not live in a single-family house and lived far from the city. Most of the participants tended to have a higher proportion in regular Internet use than rare Internet use (see Figure 3).

Interestingly, those individuals with an agricultural background were less frequent Internet users in their later life compared to those who had worked in other sectors. Moreover, 90% of individuals with a higher level white-collar background demonstrated frequent Internet usage (see Figure 4).

As shown in Figure 5, all items in current financial status and social relationship satisfaction levels showed high proportions of Internet usage, which suggests that the current financial status and social relationship satisfaction levels did

not have much effect on elderly Internet use. However, only 55% of older people with low financial status were frequent Internet users compared to about 69% of older people with a higher financial status.

Binomial regression analysis

Table 1 shows the results of the logistic regression main effect tests for frequent Internet use. The effects of variables in the models are presented by odd ratios (ORs). The unadjusted effect, which appears in the second column in Table 1, reveals that the variables of age, education, living situation, financial condition, existence children, whether the individual worked at home, whether the respondent is an agricultural entrepreneur and whether the respondent is a blue-collar worker are significant, while other variables are not significant. The education variable followed by working from home, being an agricultural entrepreneur and being a blue-collar worker sequentially had the strongest effects on Internet use.

Model 1 shows that the education variable can explain 19.3% of the variance in frequent Internet use. This is
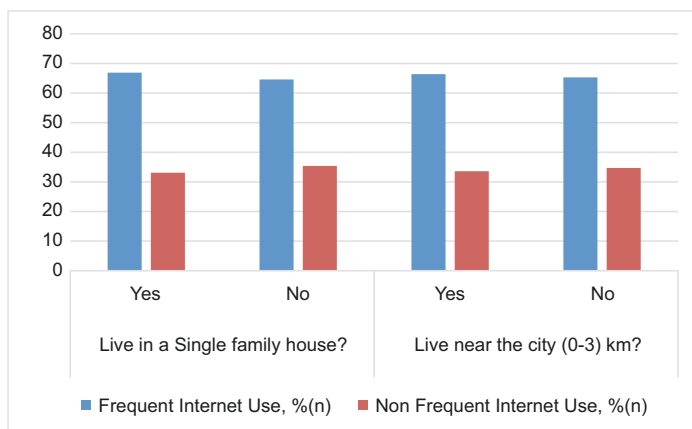
Figure 3 Housing characteristics related to Internet use
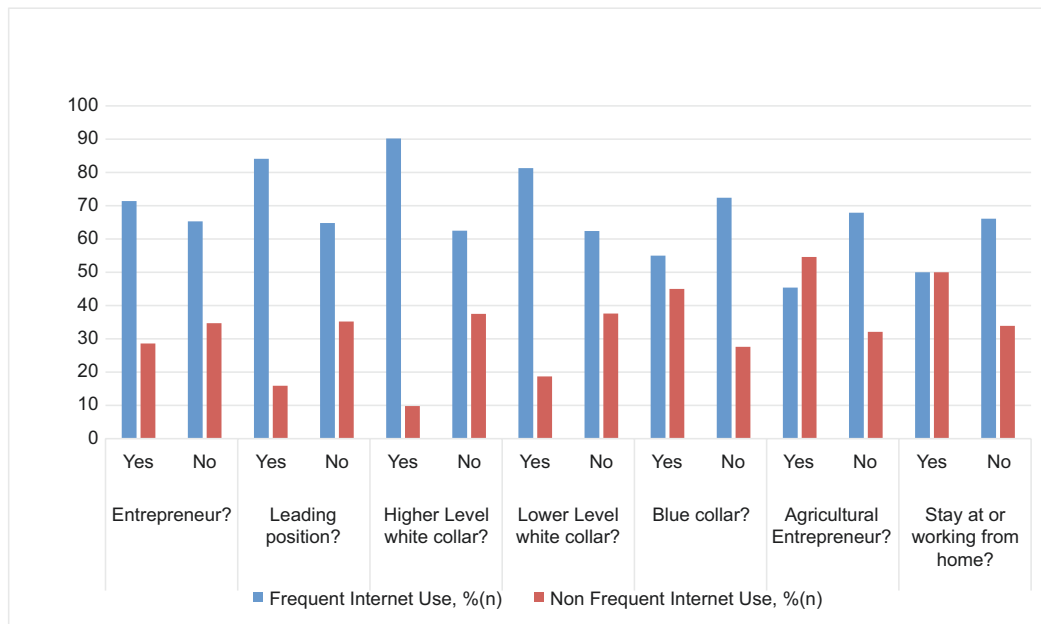
Figure 4 Internet use based on previous work experience

illustrated by the sizeable contribution of education in the unadjusted data for age. All variables contributed 36.7% to Internet use.

In Model 2, the effect of age is adjusted. This affects the secondary education variable, which has less contribution to explain the dependent variable but is still the highest predictor. Those with a secondary education background were 8.8 times more likely to use the Internet than those with basic education. Higher education OR increased to reach 3365. People in the older age group were 0.245 times less likely to utilise the Internet. The model shows that higher education contributes 29.3% of the variance in frequency of Internet use when taking education and age factors into account.

Model 3 included the variable of lower level white collar, which slightly increased the variance contribution in explaining Internet use predictors from 29% to 31.2%, where the likelihood of engaging in digital life was 0.395 times higher for people who had not worked as lower level white-collar workers. Those with both higher and secondary education levels were still between three and eight times more likely to utilise the Internet than basic educated people. In Model 4, the experience of working as a higher level white-collar worker was adjusted, which significantly affected the education variable odds. Those with a secondary education were only 5.687 times more likely to use the Internet than those with a basic education. The model contribution increased slightly by 1.6%.

In Model 5, there was a significant increase of 34.2% in contribution factors to Internet use with the additional variable of sufficient financial means. People who had good financial
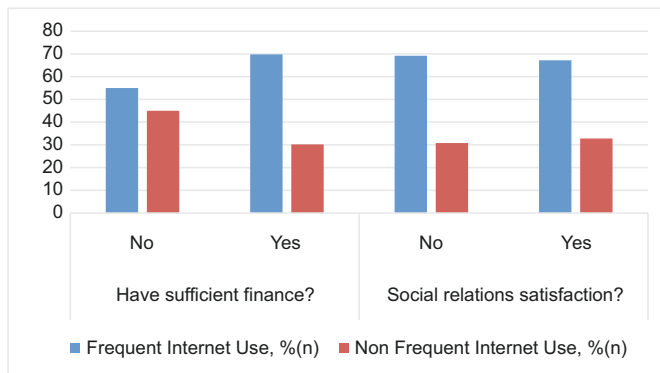
Figure 5 Proportion of Internet use based on financial status and social relationship satisfaction

Table 1 Logistic regression model with Internet use as the explained variable

Main effects	Unadjusted effects	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
	OR	OR	OR	OR	OR	OR	OR	OR	OR
Age: 60	1*		1*	1*	1*	1*	1*	1*	1*
70	0.18		0.245	0.227	0.211	0.195	0.184	0.178	0.172
Gender: Male	1ns								
Female	0.984								
Have children:									
No	1*						1*	1*	1*
Yes	2.047						2166	2.082	2.06
Have grand children:									
No	1ns								
Yes	0.889								
Education level:									
Basic	1*	1*	1*	1*	1*	1*	1*	1*	1*
Secondary	4.442	9.016	8.86	8.375	5.687	5.332	5.549	4.618	4.281
Higher	2.311	2.967	3.365	3.716	2.817	2.682	2.796	2.403	2.248
Have sufficient financial means:									
No	1*					1*	1*	1*	1*
Yes	1.886					1.91	1.949	1.903	1.898
Live with none:									
No	1ns								
Yes	0.878								
Marital status, Single:									
Yes	1ns								
No	1.204								
Live in a single family house:									
Yes	1ns								
No	0.933								
Live near the city (0–3 km):									
Yes	1ns								
No	0.927								
Entrepreneur experienced:									
Yes	1*								1*
No	0.428								0.504
Leading position experienced:									
Yes	1*							1*	1*
No	0.245							0.323	0.284
Higher level white collar experienced:									
Yes	1*				1*	1*	1*	1*	1*
No	0.185				0.283	0.288	0.293	0.249	0.217
Lower level white collar experienced:									
Yes	1*			1*	1*	1*	1*	1*	1*
No	0.223			0.395	0.337	0.341	0.329	0.302	0.271

Table 1 (Continued)

Main effects	Unadjusted effects	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Blue collar experienced:									
Yes	1[ns]								
No	0.759								
Agricultural entrepreneur experienced:									
Yes	1[ns]								
No	0.977								
Stay at home or working from home:									
Yes	1[ns]								
No	1.108								
Social relations satisfaction:									
No	1[ns]								
Yes	0.32								
Pseudo R^2	0.367	0.193	0.293	0.312	0.328	0.342	0.35	0.357	0.354

[*]$p < 0.001$, **ns** = not significant.

support were twice as likely to be involved in online communication as those who had less financial means. In Model 6, the variable of having children was adjusted, and it reached 35% in terms of explaining the predicted variable. Senior citizens who had children were 2.166 times more likely to use the Internet than older people with no children.

In Model 7, working in a leadership position was added, and it only slightly increased the total contribution of predictors of Internet use to 35.7% despite previous assumptions that people who used to work in a leadership position had a greater chance of getting involved in online hobbies.

Finally, Model 8 included the work experience factor of entrepreneurs and explained 36.4% of Internet use. Older people who had no experience as an entrepreneur were 0.504 less likely to use the Internet than older people who had. However, this additional independent variable had little effect on the model's accuracy. Based on the Hosmer–Lemeshow test, all models adequately fit the data ($p > 0.05$).

Figure 6 depicts all the models of Internet use. The highest increment can be found in Models 1 and 2, which concern the variables of education and education combined with age, respectively.

Binomial regression analysis with reference to each age group

In this analysis, the data were separated by age groups, individuals in their 60s and individuals in their 70s, to provide a
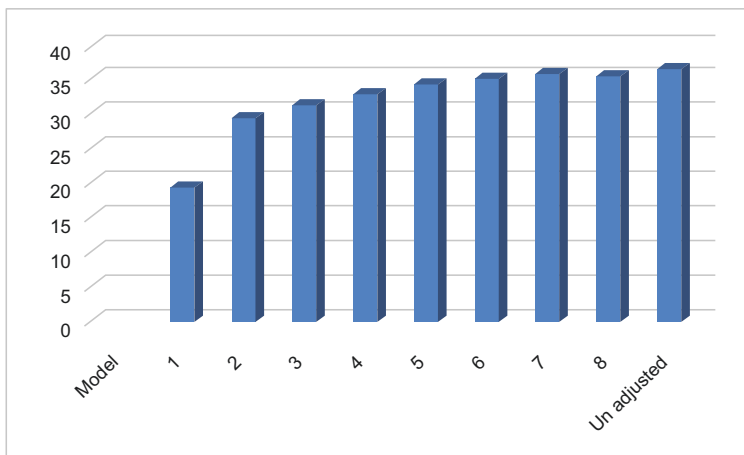

Figure 6 Contribution of predictors in explaining Internet use (%)

clearer picture of how different influential factors affect the Internet use.

Table 2 indicates that the separated binomial logistic regression model more effectively explained Internet usage for individuals in their 70s and in their 60s. There were no differences in gender and education patterns between the groups. Working as an entrepreneur or blue-white-collar worker was not a significant predictor of Internet use with individuals in their 70s.

Table 2 Individuals in their 60s and 70s in relation to predictive factors for Internet use

Main effects	Unadjusted effects (OR)	
	60s	70s
Gender: male	1[ns]	1[ns]
Female	0.969	0.929
Have children:		
No	1[*]	1[ns]
Yes	2.216	1.891
Have grand children:		
No	1[ns]	1[ns]
Yes	0.929	0.842
Education level:		
Basic	1[*]	1[*]
Secondary	4.485	4.159
Higher	2.469	2
Have sufficient financial means:		
No	1[*]	1[*]
Yes	2.162	1.557
Live with none:		
No	1[ns]	1[ns]
Yes	0.985	0.786
Marital status, single:		
Yes	1[ns]	1[ns]
No	1.010	1.484
Live in a single family house:		
Yes	1[ns]	1[ns]
No	0.817	1.033
Live near the city (0–3 km):		
Yes	1[ns]	1[ns]
No	0.850	1.030
Entrepreneur experienced:		
Yes	1[*]	1[ns]
No	0.257	0.676
Leading position experienced:		
Yes	1[*]	1[*]
No	0.164	0.362
Higher level white collar experienced:		
Yes	1[*]	1[*]
No	0.067	0.321
Lower level white collar experienced:		
Yes	1[*]	1[*]
No	0.103	0.384
Blue collar experienced:		
Yes	1[*]	1[*]
No	0.452	1.180
Agricultural entrepreneur experienced:		
Yes	1[ns]	1[ns]
No	0.516	1.783
Stay at home or working from home:		
Yes	1[ns]	1[ns]
No	0.832	1.184
Social relations satisfaction:		
No	1[ns]	1[ns]
Yes	0.500	0.000
Pseudo R^2	0.261	0.291

[*]$p < 0.001$, [ns] = not significant.

DISCUSSION

This study found that that education has a greater impact than any other factors in predicting elderly's internet use. Blažun et al.[28] found that because older people can effectively learn Internet skills, customising training to better meet the needs of older people is one of the best practices to encourage the Internet use. Another individual characteristic factor, gender, was not significant for predicting Internet use among elderly people in Finland.[12] For developed countries like Finland and the US, gender may not be as influential because of the greater gender equality that exists there in terms of work and education. As a result, women have equal opportunities to learn the computer. The gender factor is likely more influential in developing countries or places where gender inequalities exist.

In terms of family characteristics, those who had children were more likely to use the Internet than those with none. Since the Internet is used to communicate with others, older people with children are potentially more motivated than those without children to use the Internet.[31]

The variables of housing type and location from city centre had no significant effect on internet use. This finding may indicate that older people in Finland, particularly in the area around Northern Savo, have no barriers in accessing the Internet. In addition, the type of housing had no impact on elderly Internet use in Finland.

This study found that the previous work experience can contribute to elderly Internet use. Those who worked in office settings were more likely to use the Internet than those who worked in the agricultural sector. Perhaps, they were more familiar with the computer and the Internet since office work might have required them to learn and keep up with the latest technologies. Older people in the younger age category had greater opportunities to use the Internet during

their professional lives and possibly more of an interest or improved digital abilities as compared with those who are older.[4,32] Finally, this study showed that in Finland the majority of elderly in both their 60s and 70s still rely on other methods of communication more than the Internet.

CONCLUSIONS

The model fits the data and suggests that education and age are the most significant predictors of Internet use among the elderly in their 60s and 70s. The social relations variable has no significant effect on older people's digital life. In addition, working in an office at the white-collar level was a potential factor in influencing older people's use of the Internet.

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ARTICLE II

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Accessibility and Readability of Dementia-Related Information on Websites

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Abstract. The study aimed to identify websites with dementia-related content and evaluate their readability and accessibility. A purposeful sample of 300 websites, which provided information on dementia, were identified from searches using the Google, Yahoo and Bing search engines. Two generic evaluation tools based on WCAG2.0 were used to assess the accessibility of information on dementia and two readability tests (Flesh-Kincaid Grade level and SMOG) were used to evaluate the websites. Only 94 websites have a HON certificate (31.3%), while 38 of the finally selected websites have an average of 56.89 and 32 problems in relation to the Axe and Achecker tools respectively. The most common problems (for images on 19 and 17 of the websites respectively) were related to text resize and the lack of text explanation, and an insufficient color contrast was found on 35 websites. The readability score was 8.2 (FKG) and 7.4 (SMOG) on average, which meant that the sites in question were not recommendable for the general population.

Keywords. web accessibility, dementia, readability level

1. Introduction

In 2017, the world's population was almost 7.6 billion and the number of people aged 60 and above was 962 million, or 13% of the world population [1]. At the same time, with a rate penetration of 54.4%, the number of internet users in the world reached 4,156,932,140 [2]. At the same time, there is still no effective treatment for dementia, which is a common problem among the elderly. An estimated 50 million people around the world have dementia and it is forecast that 10 million new cases will arise each year [3]. Meanwhile, online health information from various sources is growing rapidly, as the Internet develops apace [4]. Despite the global risk posed by dementia[3, 4] and the rapid growth of the world's elderly population [1], the elderly have low Internet utilization rates due to a number of factors, such as low internet literacy, less trust in information sources, physical limitations etc [5]. However, little evidence has been gathered, based on valuation studies, on website accessibility for the purposes of elderly healthcare focusing on dementia. The aim of this study was to evaluate the accessibility and readability of dementia information on the Internet, using accredited tools to provide recommendations for related stakeholders. Two research questions must be resolved: (1) What is the average accessibility level of online dementia-related information? (2) What is the average readability level of online dementia-related information?

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2. Materials and Methods

Three popular search engines (Google, Yahoo and Bing) were used to identify the websites in question. A search of all sites was conducted on 7 May 2018. The search keywords "dementia" and "Alzheimer's" were used as based on the glossary term, dementia [6]. Only the top 50 websites listed by each search engine were selected based on how people tend to search online [7]. Inclusion and exclusion criteria were used to select each website for evaluation analysis. The selection process and analysis method are shown on Figure 1 below.
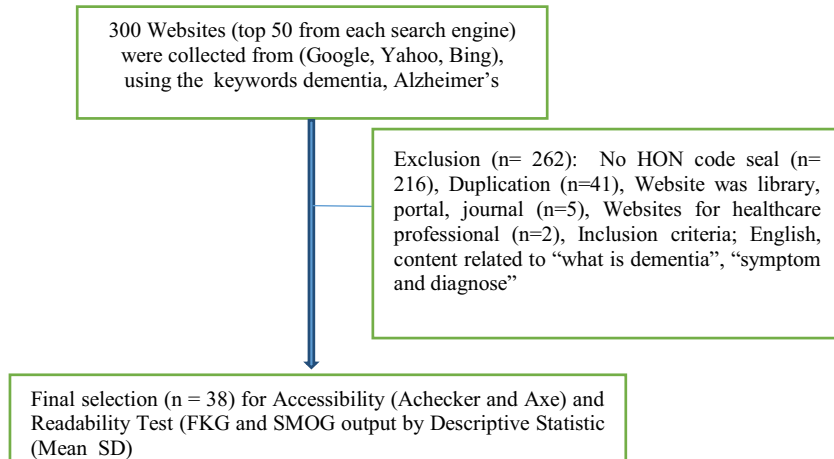
```
┌──────────────────────────────────────────┐
│ 300 Websites (top 50 from each search     │
│ engine) were collected from (Google,      │
│ Yahoo, Bing), using the keywords          │
│ dementia, Alzheimer's                     │
└──────────────────────────────────────────┘
                    │
                    │        ┌──────────────────────────────────────┐
                    │        │ Exclusion (n= 262): No HON code seal  │
                    ├────────│ (n= 216), Duplication (n=41), Website │
                    │        │ was library, portal, journal (n=5),   │
                    │        │ Websites for healthcare professional  │
                    │        │ (n=2), Inclusion criteria; English,   │
                    │        │ content related to "what is dementia",│
                    │        │ "symptom and diagnose"                │
                    ▼        └──────────────────────────────────────┘
┌──────────────────────────────────────────┐
│ Final selection (n = 38) for Accessibility │
│ (Achecker and Axe) and Readability Test    │
│ (FKG and SMOG output by Descriptive        │
│ Statistic (Mean  SD)                        │
└──────────────────────────────────────────┘
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Figure 1. Material and method analysis

Axe and Achecker were the WCAG recommended tools for web accessibility evaluations based on WCAG 2.0 level A, AA [8]. The readability test tool, Flesch-Kincaid Grade level, was developed by Rudolf Flesch and J.Peter Kincaid, based on reading comprehension ranging from that of 5[th] grade children (very easy to read for the average 11-year-old student) to college graduates (very difficult to read, best understood by university graduates) [9]. Another readability tool, SMOG, was developed by G.Harry McLaughlin in 1969, based on a grade scale from 5 to 18 [10]. The online calculation tool source for measuring FKG and SMOG was based on WebpageFX [10].

Validation of the Automatic Evaluation tool was based on the Diaper and Worman approach of comparing results, generated by two different tools, from the same websites[11]. For this study, two WCAG tools and two readability tests are compared.

3. Results

Among the 38 selected websites, 25 and 32 failed to fulfill the WCAG 2.0 criterion, as evaluated using the Achecker tool and Axe tool respectively. On average, for every website, 56.89 (SD: 26.75) and 32 (SD: 32) violations were identified by Axe and Achecker, respectively. Of 38 websites, only two websites passed the Achecker test, but none were found to be without violations by the Axe tool. The most common problem identified by the Achecker tool related to Success Criteria 1.4. Distinguishable.

In particular, '1.4.4. Resize text (AA Level) require italic element is not available' was detected on 19 websites. This was followed by the Success Criterion 1.1.1 violation, 'No text alternatives for all non-text content' and the violation of Success Criterion 4.1.1. 'Attribute must be unique', which were not available on 17 websites.

Using the Axe tool, the most common problem found was insufficient color contrast on 35 websites (n=38) under Criterion 1.4.3. This was followed by 'Problem of lack of content in a landmark region' (33 websites). Similarly to the Achecker tool, violations related to not having discernible text were observed in respect of 27 websites with links (Success Criteria for 1.1.1 Non Text Content, 4.1.2 Name, Role and Value, 2.4.4. Link Purpose) and 15 websites with buttons (4.1.2. Success Criteria). In addition, of 300 websites searched using two keywords via three search engines, only 94 websites have HON seal certificates (31.3%).

The average FKG (Flesch Kinclaid Grade) readability score was 8.2, which means that the text can be easily understood by 13 to 15-year-old students and the SMOG average score is 7.4 for a reading age between that of sixth graders (11–12 years old) and seventh graders (12–13 years old). This fails to meet the recommendations of the American Medical Association and National Institute of Health, which specify that text should not exceed the reading ability of sixth graders in terms of their difficulty [12].

4. Discussion

Physical limitations among the elderly are an unavoidable problem due to the ageing process [13]. Complete and easily understood information is therefore required for people with cognitive problems or memory loss, in particular. Based on these findings, improvements in website design, in order to make web pages attractive to elderly people with physical limitations, should fulfill the criteria of WCAG 2.0. Websites with critical information such as healthcare content should be regulated at national level, based on international law enforcement standards [14]. Information content should be simpler, in order to avoid confusing people whose cognitive abilities have deteriorated.

Two common website problems which have been found in terms of accessibility level were the color contrast and incomplete information to navigate the text as a result collaboration is required among information content providers (authors), web developers and users of information. Such collaboration should focus on the user on the basis of knowledge sharing, with a priority on accessibility for lay people [14]. When designing websites, developers should be guided by user experiences and should adopt WCAG standard more comprehensively in order to reduce the accessibility problem [15]. In addition, the authors of information content should provide plainer information in order to engage poorly educated readers, or elderly people with lower brain function. Regarding finding on readability level which was still difficult to understand for elderly, creating more comprehensible information, authors, who are mainly health experts, should consult language editors. In addition, because of previous studies have shown that elderly readers were concerned about the complexity and reliability of online information [16], websites should be certified to have more legal trust.

In further studies, the measurement of information content should be customized by experts on the topic of the content. A customized tool would improve the content and accuracy of evaluation, enhance the research results and contribute to the development of guidance on the topic.

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ARTICLE III

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Effectiveness of Web Accessibility Policy Implementation in Online Healthcare Information

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Abstract. UN have recommended the adoption of Web Content Accessibility Guidelines (WCAG) version 2.0 from W3C to guarantee that web content is more accessible to everyone. This study aims to evaluate the effectiveness of WCAG 2.0 implementation by comparing the country with and without WCAG2.0 policy adoption. The objective is to compare the impact of adopting the WCAG 2.0 standard in health information provision by analyzing the differences between countries that adopted the WCAG 2.0 standard and those that did not, specifically for health information related to the elderly. To this end, searches were performed on the Google search engine for online health websites with the keyword "Alzheimer" and the specific country settings for Indonesia and UK, in the local language of each country. Website evaluations were performed for ten websites found with this search by using the WCAG 2.0 measurement tool Axe. Statistical analysis using descriptive and Mann-Whitney analysis to measure the impact of the WCAG 2.0 showed a predominance of low violation occurrences in the UK with 40% from selected websites compared to 80% medium violation occurrences and no low violation occurrences in Indonesia. Although the country with WCAG 2.0 implementation had a lower frequency of violation, no significant differences were found between countries and the media type in WCAG 2.0 evaluation, implying the need to improve the effectiveness of policy implementation.

Keywords. Web Accessibility, Alzheimer, Policy, Online, Information

1. Introduction

Seeking health information online has become the most popular Internet activity among patients [1] and mobile phone users [2]. Previous studies have shown that the majority of people used commercial websites (71.8%), followed by search engines (11.6%), while only 5.5% use government websites for health information [3]. In addition, users with serious health problems and/or disabilities were more enthusiastic about online health information regarding their own health condition [4][5]. Previous studies have suggested that older people use the Internet the least due to many determinants such as age, physical limitation, education, social economic situation and social situation [6].

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Proper accessibility of online information related to health is a necessity for individuals who seek out health-related information due to their physical conditions.

Meanwhile, the World Wide Web Consortium (W3C) have designed the Web Content Accessibility Guidelines (WCAG) in collaboration with international figures and institutions to create international general standard of web accessibility that is suitable with any institutions, public and governments [7]. The guidelines have targeted web developers, web authoring tool developers, web accessibility evaluation tool developers, and others (individuals, decision makers, administrators, scholars. etc.) [7]. WCAG 2.0 has been approved as an ISO standard (ISO/IEC 40500:2012). WCAG2.0 encompasses web pages, web applications, mobile device applications, phones and tablets, digital TVs, wearables, devices in car dashboards and airplane seatbacks, household equipment, and other Internet of Things (IoT) [7], [8]. WCAG 2.0 have four accessibility principles: perceivable, operable, understandable, and robust, which must be fulfilled to avoid violations [9]. These principles have their own success criteria that determine the type and number of violations. The perceivable principle has 22 success criteria, the operable principle has 20, the understandable principle has 17, and the robust principle has 2. The UN prioritized web accessibility in resolution 61/106, and the standards have been implemented in their system [10]. With the resolution, access to information and communication technology have become basic human rights [11]. WCAG2.0 of W3C are the only internationally recognized standards [10]. Therefore some countries have ratified the standards following this UN recognition [12], [13].

This study aims to evaluate the effectiveness of the implementation of WCAG 2.0 in country with and without policy implementation. The study compared country that adopt the WCAG 2.0 standard in health information provision with the one that do not adopt the WCAG 2.0 standard to study the particularly of policy implementation on Alzheimer Disease (AD). To reach the aim, the study addressed two research questions (1) What is the level of web accessibility of AD-related information online both in the UK and Indonesia? (2) What are the similarities or differences in the information available online for AD between the two countries, one with a policy of accessibility (UK) and one without (Indonesia)?

2. Materials and Methods

Two countries were chosen for this case study. The United Kingdom was chosen for being a country that has adopted the WCAG2.0 standard [13], [14], and Indonesia was selected as a country that has not adopted the WCAG 2.0 standard. The selected countries were chosen also based on the first author language capacity. In addition, the idea to measure the difference have become consideration to choose the countries that are very contrasting based on their economy level besides the policy adoption. Web selection was based on the inclusion criteria of local language content: Bahasa Indonesia for Indonesia and English for the UK. It is important to note that the same word "Alzheimer" is used in both local languages to refer to AD [15]. The first ten websites from each country were picked based on their rank on the Google search engine list. The method for selecting the first ten websites has been previously used [16]. Google was first set up to the country-specific language, and a search was performed using the keyword "Alzheimer", due to its high frequent used among individuals searching for information related to AD [9], and it is known that AD affects cognition and memory [17], as consequences better accessibility of online information

is required. Among the obtained results, the website should be in a webpage format, and information from the same source will be excluded. The websites should have content related to AD, and the websites should not be from a journal publisher, university, or scientific research institution with the reason they are usually for academic community.

Website evaluations were performed for ten public online health information pages using the WCAG 2.0 evaluation tool recommended by W3C "Axe" [14]. In addition, Axe tool evaluate the website compliance to WCAG 2.0 with respect to WAI-ARIA (Web Accessibility Initiative-Accessible Rich Internet Application) 1.0 that is for assistive technology such as screen reader [18]. Based on the number of violations found, the website was assigned to one of four levels: low (0–20 violations), medium (21–50 violations), high (51–100 violations), and very high (above 100 violations). The term of violation means the unfulfilled WCAG2.0 criteria for accessibility for all. Statistical analysis was carried out using SPSS version 25. Descriptive and Mann-Whitney U tests were used to measure the differences between the two countries with and without WCAG 2.0.

3. Results

Entering the keyword "Alzheimer" for Indonesia and UK searches yielded 153,000,000 and 232,000,000 results, respectively. Using Axe tool analysis on the 20 websites (10 per country search), 17 types of violations were found. These were the violations found: (1) ARIA roles used must conform to valid values, (2) Elements must only use allowed ARIA attributes, (3) hidden ARIA element must not contain focusable elements, (4) Certain ARIA roles must contain particular children, (5) ARIA attributes must conform to valid values, (6) Buttons must have discernible text, (7) Element must have sufficient color contrast, (8) IDs used in ARIA and labels must unique, (9) ID attribute values must be unique, (10) Frames must have title attribute, (11) Html must have language attribute,(12) Image must have alternate text, (13) Form elements must have labels, (14) Links must have discernible text,(15) "ul" and "ol" must only directly contain li, script or template elements (16) Zooming and scaling must not be disabled, and (17) Timed refresh must not exist. Most website violations in the UK-specific search were under the low level category, whereas none of the violations in the Indonesia-specific search were of low level. Most of the tested websites in the Indonesia-specific search were found to have medium-level violations.

In addition, the 20 selected websites could be categorized into four types: non-government organization (NGO) websites (n = 5), medical related company websites (n = 4), newspaper-type websites (n = 10), and government agency websites (n = 1) (Figure 1 below).
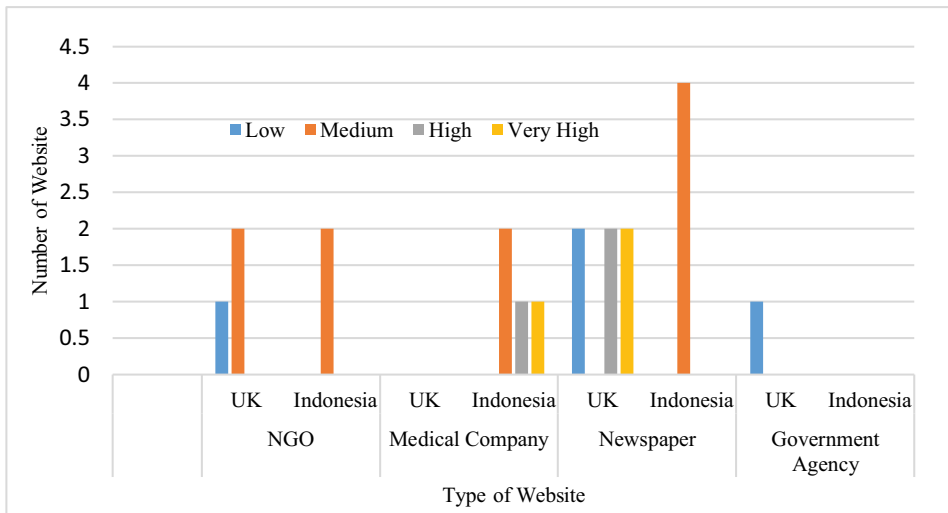
Figure 1. Violation Occurrences Based on Website Type

NGO and government websites in the UK showed good compliance. Newspaper-type websites were the most common type of website for both countries. In the UK, two of the six newspaper-type websites with AD information showed good compliance with the standard and two showed a very high level of violation. On the other hand, all four online news websites in Indonesia showed medium-level violations.

The Mann-Whitney test revealed no significant differences between countries with and without WCAG 2.0 standard implementation. In addition, the most dominant type of violations found for both countries was "element must have sufficient color contrast" and "links must have discernible text." Furthermore, "ID attribute value must be unique" was the third most violated standard in UK webpages while "image must have alternate text" was the third most violated standard in Indonesian webpages. A similar result was found when comparing newspaper-type websites and other website types.

4. Discussion

Implementing web accessibility policy globally continues to be a challenge. Despite national regulations, for example the United States Section 508 regulations requires every government agency to comply with web accessibility, accessibility problems persist [19]. In addition, the WCAG 2.0 policy has no impact outside government agencies [20]. Even within the municipal government, there are many issues such as national support and close collaboration across local administrators and external parties, citizen and other rules [21]. For example, although in the UK better accessibility was on the health administration agencies, only NGOs have slightly implemented better accessibility. Meanwhile, online newspapers were found to be the worst online channel in terms of adopting the WCAG2.0 standard.

The complexity in deploying WCAG 2.0 is elaborate, e.g., lack of law enforcement, no report or certification of WCAG 2.0 compliance, limited resources, policy content, lack of responsibility, and unclear guidelines from the department that

released the regulation [21], [19], [20]. The study revealed that the most common mistakes that should be easy to be understood, such as alternate text and color contrast in webpages still exist means whether web developers have reluctancy to comply or excessive working load with short time due to particular business characteristic.

Another factor that might influence the evaluation is the richness of website content. It is known that the richer of the website content the more potential violation might exist.

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The current study attempts to provide a description of the practice of web accessibility evaluation based on Web Content Accessibility Guidelines (WCAG) 2.0. within the scope of health information for older people. The method used in this study were both of qualitative and quantitative methods. The study framework was based on the literature review. The study findings concluded that ineffective policy associated to low quality and accessibility of Websites and cannot accommodate older people with various demographic backgrounds.

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