Socio-digital Determinants of eHealth Literacy and Related Impact on Health Outcomes and eHealth Use in Korean Older Adults: A Community-based Cross-sectional Survey

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Abstract

Background: eHealth literacy is an essential skill to pursue electronic health information, particularly for older people whose health needs increase with age. South Korea is now at the intersection of a rapidly digitalising society and an increasingly aged population. eHealth literacy enables older people to maximize the effective utilization of emerging digital technology for their health and quality of life. Understanding the eHealth literacy of Korean older adults is critical to eliminating the grey digital divide and inequity in health information access.

Objective: This study aims to investigate factors influencing eHealth literacy in Korean older adults and its impact on health outcomes and eHealth use.

Methods: This was a cross-sectional survey. Community-dwelling seniors aged 65 and above in two urban cities in South Korea were included. eHealth literacy was measured by the eHEALS scale. Ordinal Logistic regression was used to analyse factors associated with eHealth literacy and MANOVA for the impact of eHealth literacy on health outcomes and eHealth use.

Results: 434 participants were analysed. 22.3% of participants had high eHealth literacy skills. Increasing age, higher monthly income, internet use, frequency and time spent on the internet were significantly associated with eHealth literacy($p<0.01$), and social media users were 3.97 times more likely to have higher skill($p<0.002$). Higher eHealth literacy was associated with better self-perceived health and frequent use of digital technologies for accessing health and care services($p<0.001$).

Conclusions: Different levels of eHealth literacy skills derived from disparity of socioeconomic status and engagement on the internet and social media, with consequential impacts on health outcomes and eHealth utilisation. Tailored eHealth interventions, grounded on the social and digital determinants of eHealth literacy could facilitate eHealth information access among older adults and foster a digitally inclusive healthy ageing community.

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Results: 434 participants were analysed. 22.3% of participants had high eHealth literacy skills. Increasing age, higher monthly income and time spent on the internet were significantly associated with eHealth literacy(P<.01), and social media users were 3.97 times (adjusted odds ratio [aOR] 3.97, 95% CI 1.02 - 15.43, P =.04) more likely to have higher skill. Higher eHealth literacy was associated with better self-perceived health and frequent use of digital technologies for accessing health and care services(P<.001).

Conclusions: Disparity in socioeconomic status and engagement on the internet and social media can result in different levels of eHealth literacy skills, which can have consequential impacts on health outcomes and eHealth utilisation. Tailored eHealth interventions, grounded on the social and digital determinants of eHealth literacy, could facilitate eHealth information access among older adults and foster a digitally inclusive healthy ageing community.

Keywords – eHealth literacy; eHEALS; grey digital divide; eHealth information; healthy ageing

Introduction

Declining fertility rates and longer life expectancy primarily contribute to the demographic transition into an ageing population worldwide. This transition is more prominent in Asia, where Japan, South Korea, China, and Singapore entered the aged society within a period of 20 years. In 2021, South Korea hosted 8.71 million people over 65 years (16.8% of the total population), and the proportion increased by 5.1% compared to 2020 [1]. The rapid increase in the older population underscores the importance of an age-friendly environment in which older people can think or do what they value and age in a place to which they are attached.

Nowadays, with technological integration in every aspect of life, digital inclusiveness has become a basic component of an age-friendly environment. Traditional health promotion and long-term care systems could be upgraded into more productive and efficient systems with the diffusion of technology and digital devices. Gerontechnology, an emerging scientific field applying technological advances in the ageing sector, is now used to improve health and social connections among older adults [2]. It is more evident in the Covid-19 pandemic, where physical distancing was inevitable. Online health promotion activities and exercise videos were used to maintain over 20-year-old community exercise programs in Japan and preserve older people's functional mobility [3]. The application of robotic technology for social connections of residents also showed better engagement and positive user perception in long-term care facilities compared to conventional methods such as telephone communication [4]. Additionally, seniors have a positive attitude toward using digital technology and are willing to use it for health purposes and to maintain activities of daily living [5, 6].

Although older people have a positive attitude and are willing to use digital health interventions and devices, they face challenges and limitations when adopting digital technology. Firstly, having access to digital devices and networks is the initial step in adopting digital technology and its associated interventions [7]. Aged countries such as Japan, South Korea and Singapore prioritised digitalisation and promoted and implemented policies for digital inclusiveness [8]. Due to government efforts, the gap in access to digital devices and the internet has narrowed. In 2022, the digitisation level reached 76.2% among South Korea's vulnerable populations (older people, low-income individuals, people with disabilities, fishermen, and farmers), and digital access was as high as 96% of the total population [9]. Regarding seniors, 69.9% had access to digital information in 2022, increasing from 69.1% in 2021 [9]. Ownership of digital devices and access to the internet do not guarantee the actual application of digital technology for health. Another barrier for older adults to fully embrace the benefits of technology is not knowing how to acquire and use information obtained in the digital context to make effective health decisions [10].

According to Norman and Skinner, eHealth literacy is defined as "the ability to seek, discover, evaluate and appraise eHealth information and apply the acquired knowledge to solve health problems" [11]. Older adults often see eHealth literacy as a barrier to successfully utilising electronically delivered health information and interventions [10]. Due to technological advancements, health information is one click away, and older adults are faced with information overload, in which misleading information could be exposed physically and digitally. On the other hand, internet use for health-related searches by older American adults increased from 24.8% in 2009 to 43.9% in 2018 [12]. Due to the prevalence of chronic diseases and age-related disorders in older age, there are pros of searching health information online. However, older adults could be harmed by fake information online if they lack adequate skills to identify the correct source and facts. Therefore, being eHealth literate is essential and exploring the factors associated with older adults' eHealth literacy is crucial.

Extensive research has shown that age, gender, level of education, marital status, economic conditions, and social support contribute to the eHealth literacy of older adults[13]. Thomas A. et al. stated that internet use is positively associated with eHealth literacy [14]. Little published data exists

on the relationship between social media and eHealth literacy, especially in older populations. In addition, having a good command of eHealth literacy skills enhances older people's physical, mental and social well-being [15]. Higher eHealth literacy skill is a protective factor against cognitive decline and is positively associated with health-promoting behaviours and better health outcomes [16, 17]. There have been few attempts to investigate the impact of eHealth literacy on perceived health status and the use of digital devices and the internet for health, particularly in the older population. The need for scientific literature in this field is more urgent in South Korea, which is on the way to super-aged society, and the proportion of older adults is expected to be as high as 44% in 2050 [18]. Additionally, the Ministry of Health and Welfare in South Korea started a pilot project to use artificial intelligence and the Internet of Things to improve the healthcare of older adults [19]. Advanced technology is readily diffused into the daily lives of older Korean adults, and knowledge of embracing eHealth information becomes inevitable. Therefore, this study aims to fill the gap by exploring the factors associated with eHealth literacy in community-dwelling older Korean adults and the impact of eHealth literacy on health-related outcomes and digital technology use for health purposes.

Method

Participants, setting and data collection

It is a community-based survey conducted in two urban cities of the Republic of Korea, Wonju-si and Yeoju-si, in 2022. This cross-sectional study is part of the digitally inclusive healthy ageing communities (DIHAC) study, a cross-cultural study in four rapid ageing countries: Japan, the Republic of Korea, Singapore, and Thailand [20]. After obtaining ethical approval, participation in the study was announced in the study area. It was accomplished through the cooperation of local senior welfare centers and senior citizen centers. Community-dwelling older adults aged 65 years and above, both males and females with ongoing health promotion activities in residing communities were included in the study. Participation in the study was completely voluntary. The study's purposes and procedures were thoroughly explained, and written informed consent was obtained. Data were collected using a structured questionnaire in the participants' native language (Korean).

The sample size was calculated by one sample estimation of proportion in STATA SE 16, based on the proportion of internet use among older adults in South Korea. The calculated sample size was inflated by 20% for non-responses. A sample of 444 participants responded to the questionnaire, and 434 were analyzed after excluding 10 participants who were younger than 65.

The Juntendo University ethical committee and Yonsei University Institutional Review Board approved the ethics of the DIHAC study. The approval numbers were E22-0057-M01 from Juntendo University and 1041849-202304-SB-073-02 from Yonsei University.

Measures

Demographic characteristics

Demographic characteristics of age, sex, education, living arrangements and financial status were investigated. Age was described as a continuous variable for distribution and divided into four categories (65, 69,70-75,76-80, and >80) for eHealth distribution and regression analysis. Education was asked for the highest level of completed education, with four groups – Did not go to school, Primary school completed, Junior High school completed and High school and above. For living arrangements, the participants were asked whether they lived alone or with someone and categorized into living alone, living only with a spouse, and living only with children or grandchildren. Financial status included average income per month based on the four income quartiles in South Korea, which is divided into two groups of low (less than or equal to 1 million Won) and high (more than 1 million Won) and a dichotomous question on receiving a pension of any type.

Internet use and social media use

We determined internet use by a dichotomous question about the internet use derived from the internet environment and digital devices used to access the internet. The frequency is then determined by number of hours per day and number of days per week spent on the Internet. Negative responses in the dichotomous question, 0 hour and 0 days of using the internet were defined as internet non-users. Positive response in the dichotomous question, more than 0 hour and 0 days of using the internet were defined as internet users. Engagement in one or more social media platforms prevalent in South Korea determined social media use.

Health-related Outcomes and eHealth Use

Self-perceived health status was measured using a single item four-point Likert scale (1—very healthy to 4—not healthy at all). A single-item four-point scale has been used to reflect the subjective health status of community-dwelling older adults in longitudinal and cross-sectional studies and to predict mortality, health outcomes and digital use among older adults [21-24]. Annual medical checkup was measured using a five-point Likert scale ranging from never to always, and the participants were asked how frequently they participated in regular medical checkups. The technology used in health was measured by how often participants used the internet and digital technology to improve eating habits and access health care and long-term care services. The scale was a five-point Likert scale ranging from never to always. For analysis, annual medical checkups, digital technology and internet use for health purposes were regrouped according to their participation and frequency of use as never/non-user, low participation/user and frequent participation/user.

eHealth literacy

eHealth literacy was measured by an 8-item five-pointed eHEALS scale developed by Norman and Skinner [25]The scale was developed using the Lily model of eHealth literacy, which consisted of six aspects (healthy, traditional, information, scientific, media, and computer literacy). The scale tends to measure perceived skill and comfort with eHealth rather than the actual skill itself [25]. Although eHEALS was primarily developed for using computers for health purposes, it has been validated with the use of mobile devices and social media and shows good reliability [26, 27]. In this study, the scale has a Cronbach Alpha reliability coefficient (α) of 0.99, which indicates high internal consistency and reliability. For distribution, eHealth literacy is categorised into three groups - lack of eHealth literacy (eHEALS scale 8-15.9), low to moderate eHealth literacy (eHEALS scale 16- 31.9) and high eHealth literacy (eHEALS scale 32-40) [28].

Statistical Analysis

The statistical analysis was done by using Stata SE 16.0 (Stata Corp 4905, Lakeway Drive, College Station, TX, USA). Socio-demographic characteristics, the use of the internet and social media,eHealth literacy,self-perceived health, annual medical checkups and eHealth use for improving eating habits, access to healthcare services and long-term care services were described by descriptive statistics. Frequency and percentage were used to describe categorical data and mean and standard deviation (SD) for continuous data. The normality of the data was checked by using the Shapiro-Wilk test. The distribution of eHealth literacy across sociodemographic factors, internet, and social media use were described by descriptive statistics. A Kruskal Wallis one-way analysis of variance and Mann-Whitney U tests analysed the difference in mean scores.

Ordinal logistic regression was used to identify factors influencing eHealth literacy. Univariate ordinal logistic regression treated eHealth literacy as dependent variables and age, gender, education, monthly income, pension receiving status, living arrangement, internet use, and social media use as independent variables. The statistically significant variables (P<.2) and conceptually relevant

variables were included in the multivariate analysis. Association was reported as an adjusted odds ratio (aOR) and 95% confidence interval(95%CI). Statistical significance is defined as a p-value less than or equal to 0.05 with 95% CI. Age, gender, income and education were included as covariates in the multivariate analysis.

Furthermore, multivariate analysis of variance (MANOVA) was applied to assess the difference in health-related outcomes such as perceived health status, annual medical checkup, and eHealth use to improve eating habits, access to healthcare, and long-term care services among the different orders of eHealth literacy. The covariates for the impact of eHealth literacy on health outcomes and eHealth use were age and gender.

Results

The mean age was 76.8 (SD 6.6) years, and participants over 80 occupied 30% (131/432) of the total sample. Out of the total sample(N=434), 315 (72.6%) were female, and 192 participants (44%) of the sample had education in primary school or lower. Older people living alone accounted for 136 (31.5%), 341 (78.6%) had monthly income lower than or equal to one million won, and 385 (88.7%) received a pension (Table 1). Regarding digital technology usage(N=434), 208 (47.9%) participants used the Internet and 184 (42.4%) engaged in social media. The mean days of internet use in a week were 2.4(SD 2.9), and the mean hours of internet use in a day were 0.8 (SD 1.4). Over a third of the sample population spent more than 3 days a week (35.2%,142/404) and 1-2 hours a day (38.4%,155/404) online.

Table 1. Sociodemographic characteristics and digital technology use in older Korean adults (N=434)

	n (%)	Mean (SD)
Age(years)		76.8 (6.6)
65-70	94 (22)	
71-75	108 (25)	
76-80	99 (23)	
>80	131 (30.3)	
Gender		
Male	119 (27.4)	
Female	315 (72.6)	
Education		
Did not go to school	70 (16)	
Primary school	124 (28.6)	
Secondary school	93 (21)	
High school and above	147 (33.8)	
Living Arrangements		
Living Alone	136 (31.5)	
Living with Spouse	241 (55.8)	
Living with a Child or Grandchild	55 (13)	
Monthly Income		
Less than or equal to one million Won	341 (78.6)	
More than one million Won	93 (21)	
Pension Receiving Status		
Not receiving	49 (11)	
Receiving pension	385 (88.7)	
Internet use		

Non-user	226 (52.1)	
User	208 (47.9)	
Days of Internet use per week (days)		2.4 (2.9)
0 day	223 (55.2)	
1 to 3 days	39 (10)	
More than 3 days	142 (35.2)	
Hours of Internet use per day (hours)		0.8 (1.4)
0 hour	219 (54.2)	
1 hour	92 (23)	
2 hours	63 (15)	
3 hours and above	30 (7)	
Social Media Use		
Non-user	250 (57.6)	
User	184 (42.4)	

The mean and SD of the eHEALS score was 15.4(SD 10.8). Over half of the participants (66.6%,289/434) lacked eHealth literacy, and 97 (22.4%) had high eHealth literacy(Table 2).
Regarding health-related outcomes, almost every participant had an annual medical checkup (97.9%,423/434). Over half of the participants (55.8%,242/434) reported not being in good health. Regarding eHealth use(N=434), 353 (81.3%) participants did not have experience using digital technology to improve eating habits. Non-users of digital technology to access healthcare services accounted for 350 (80.6%), and those for long-term care services were 370 (85.3%) (Table 2).
Table 2. eHealth literacy, health-related outcomes, and eHealth use distribution in older Korean adults(N=434)

	n (%)	Mean (SD)
eHEALS		15.4 (10.8)
Lack of eHealth literacy (8-15.9)	289 (66.6)	
Low to Moderate eHealth Literacy (16-31.9)	48 (11.1)	
High eHealth Literacy (32 - 40)	97 (22.3)	
Perceived Health Status		
Very Healthy	65 (15.0)	
Moderately Healthy	127 (29.2)	
Not Very Healthy	150 (34.6)	
Unhealthy	92 (21.2)	
Annual Medical Checkup		
Never	9 (2.1)	
Low participation	36 (8.3)	
Frequent Participation	389(89.6)	
Digital technology and the Internet use to improve eating habits		
Non-user	353 (81.3)	

Low user	53 (12.2)	
Frequent User	28 (6.5)	
Digital technology and the Internet use to access healthcare		
Non-user	350 (80.6)	
Low user	55 (12.7)	
Frequent user	29 (6.7)	
Digital technology and the Internet use to access long-term care services		
Non-user	370 (85.3)	
Low user	53 (12.2)	
Frequent user	11 (2.5)	

Table 3 shows the distribution of eHealth literacy across different groups of socio-demographic factors and digital technology use. The results showed significant differences in mean eHEALS score across all variables except for receiving pension. The level of eHealth literacy descends with older age and ascends with daily time spent online. (Figure 1).

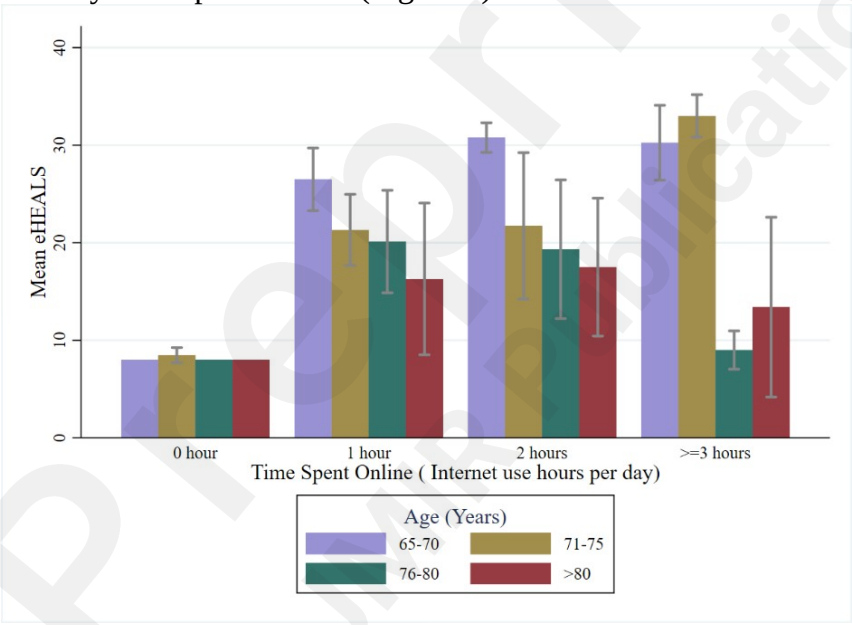

Figure 1: Level of eHealth literacy of different age groups by different categories of daily time spent online among older Korean Adults

Table 3. eHealth literacy distribution across sociodemographic factors, internet use and social media use in older Korean adults (n= 434)

	Mean eHEALS (SD)	*P*
Age		<0.001
65-70	26.9 (9.7)	
71-75	16.6 (11.3)	
76-80	11.8 (8.3)	
>80	9.2(4.5)	
Gender		0.002
Male	18.1 (11.7)	
Female	14.5 (10.4)	
Education		<0.001
Did not go to school	11.2 (7.7)	
Primary school	10.4 (6.7)	
Secondary school	13.6 (9.8)	
High school and above	23.0 (11.5)	
Living Arrangement		0.002
Living Alone	12.8 (9.1)	
Living only with Spouse	17.0 (11.6)	
Living only with Child or Grandchild	14.6 (10.3)	
Monthly Income		<0.001
Less than or equal to one million Won	14.3 (10.2)	
More than one million Won	19.8 (12.1)	
Pension Receiving Status		0.97
Yes	15.5 (10.9)	
No	15.2 (10.2)	
Internet use		<0.001
Non-user	8.3 (2.7)	
User	23.2 (11.1)	
Days of Internet use per week		<0.001
0 day	8.3 (2.4)	
1 to 3 days	23.2 (9.6)	
More than 3 days	24.7 (10.8)	
Hours of Internet use per day		<0.001
0 hour	8.1 (1.1)	
1 hour	22.6 (10.7)	
2 hours	26.1 (9.9)	
3 hours and above	25.4 (11.2)	
Social Media Use		<0.001
Non-user	8.6 (3.2)	
User	24.9 (10.6)	

Social and Digital Determinants of eHealth Literacy

Ordinal logistic regression predicted eHealth literacy from socio-demographic factors and the usage of digital technology. eHealth literacy was associated with age, income, internet use, and social media use, while other variables were controlled. Compared to the 65-70 age group, the odds of having high eHealth literacy were decreased by 76% (adjusted odds ratio [aOR] 0.24,95% CI 0.1 -

0.6) for the 76-80 age group and 88 % (adjusted odds ratio [aOR] 0.12, 95% CI 0.03-0.42) for the>80 age group. A monthly income of more than one million won per month increased the odds of having a higher eHealth literacy 2.8 times (adjusted odds ratio [aOR] 2.8, 95% CI 1.35 - 5.8) than a monthly income of less than or equal to one million Won. Univariate analysis showed internet users had significantly higher eHealth literacy (odd ratio [OR] 108.57,95% CI 42.63 - 276.54, *P*<.001). In multivariate analysis, hours spent online daily were significantly associated with eHealth literacy. Spending an hour per day was 19.2 times (adjusted odds ratio [aOR] 19.2, 95% CI 2.33 -158.81 *P* =.006), 2 hours per day 25.7 times (adjusted odds ratio [aOR] 25.72, 95% CI 2.83 - 233.47, *P* =.004) and 3 hours and more for 35.3 times (adjusted odds ratio [aOR] 35.39 95% CI 3.70 - 338.63, *P* =.002) higher eHealth literacy than non-users of the internet. Social media users had 3.9 times (adjusted odds ratio [aOR] 3.97, 95% CI 1.02 - 15.43, *P* =.04) higher eHealth literacy than non-users (Table 4).

Table 4. Univariate and multivariate analysis of factors associated with eHealth literacy in older Korean adults (n=400)

Independent variables	Univariate Analysis		Multivariate Analysis	
	OR	(95% CI)	AOR	(95% CI)
Age (65-70 as reference)				
71-75	0.18[a]	0.11 - 0.32	0.53	0.24- 1.17
76-80	0.06[a]	0.03 - 0.12	0.24[c]	0.09- 0.59
>80	0.02[a]	0.009 - 0.04	0.12[c]	0.03- 0.42
Gender (Male as reference)				
Female	0.52[a]	0.34 - 0.78	0.61	0.32- 1.18
Education (Did not go to school as ref)				
Primary School	0.78	0.34 - 1.79	.39	0.09- 1.60
Secondary	2.01	0.91 - 4.41	.99	0.26- 3.76
High School and above	11.12[a]	5.44 - 22.73	1.46	0.39- 5.47
Income (Less than or equal to one million Won as ref)				
More than one million Won	2.66[a]	1.70 - 4.16	2.8[c]	1.35- 5.81
Pension Receiving Status (Receiving pensions as ref)				
No	1.01	0.56 - 1.82		
Living status (Living alone as ref)				
Living with Spouse	2.28[a]	1.44 -3.61	1.22	0.61- 2.44
Living with Child and grandchild	1.49	0.77 - 2.93	1.02	0.35- 2.91
Internet use (Non-user as ref)				
User	108.57[a]	42.63 - 276.54	7.3	0.59- 89.67
Days of Internet use per week (0 day as ref)				
1 to 3 days	108.4[a]	37.99 - 309.31	1.52	0.26 - 8.74
More than 3 days	157.93[a]	60.25 - 413.95	1.45	0.26 -7.94
Hours of Internet use per day (0 hour as ref)				
1 hour	251.88[a]	59.01- 1075.19	19.23[c]	2.33- 158.81

2 hours	530.87[a]	119.98 - 2348.9	25.72[c]	2.83- 233.47
3 hours and above	589.94[a]	120.99 - 2876.56	35.39[c]	3.7- 338.63
Social Media Use (Non-user as ref)				
User	87.34[a]	42.56 - 179.26	3.97[b]	1.02 -15.43
Model Parameter - LR chi^2 – 390.65 (P <.001), Pseudo R^2 – 0.35 LR test of Proportionality of Odds – 199.07 (P = 0.78)				
a – P <.2, b- P <.05, c – P <.01				

Impacts of eHealth Literacy on Health-related Outcomes and eHealth Use

Self-perceived health is significantly better in participants with higher mean eHealth literacy scores (22.2(SD 12.0) for very healthy groups and 11.6 (SD 8.1) for unhealthy groups, *P*<.0001). Participants with higher mean eHealth literacy scores attended annual medical checkups frequently. Regarding the use of digital technology for health, frequent users had a statistically significant higher mean in all three measures: the use of the internet and digital technology for improving eating habits (mean 25.4, SD 11.8, *P*<.0001), access to healthcare services (mean 28.4, SD 10.4, *P*<.0001) and long-term care services (mean 23.3, SD 14.1, *P* = 0.004) (Table 5).

Table 5. eHEALS and different levels of health outcomes and digital technology utilization for health in older Korean adults (N=434)

Health Outcomes and eHealth Use	Mean eHEALS (SD)	*P*
Perceived health Status		<.001
Very Healthy	22.2 (12.0)	
Moderately Healthy	18.8 (11.6)	
Not very Healthy	12.1 (8.8)	
Unhealthy	11.6 (8.1)	
Annual Medical Checkup		.004
Never	9.9 (4.4)	
Low participation	10.0 (6.0)	
Frequent Participation	16.1 (11.1)	
Use of Digital technology and the Internet to improve eating habits		<.001
Non-user	14.3 (10.4)	
Low user	17.9 (10.6)	
Frequent User	25.4 (11.8)	
Use of Digital technology and the Internet to access healthcare		<.001
Non-user	14.3 (10.4)	
Low user	16.4 (9.6)	
Frequent user	28.4 (10.4)	

Use of Digital technology and the Internet to access long-term care		.004
Non-user	14.8 (10.6)	
Low user	18.4 (10.9)	
Frequent user	23.1 (14.1)	

The influence of eHealth literacy on health-related outcomes was analysed using MANOVA (Table 6). The result showed eHealth literacy had an effect at the multivariate level on self-perceived health status, digital technology, and internet use to improve eating habits to access health care and long-term care (*P*<.001). In multivariate analysis, eHealth literacy level did not significantly influence participation in annual medical checkups.

Table 6. The influence of eHealth literacy on health outcomes and eHealth use in older Korean adults (n=430)

	Self-perceived health status	Annual Medical Checkup	Digital Technology Use to improve eating habits	Digital Technology Use to access health care services	Digital Technology Use to access Long-term care services
eHealth literacy (beta)	-0.018[a]	0.001	0.016[a]	0.019[a]	0.008[a]
95% CI	-.027 to -.008	-.003 to .004	.01 to .02	.013 to .025	.004 to .013
a = P <.001					

Discussion

Competent in eHealth literacy skills is a characteristic of older people with healthy behaviours and those with better health knowledge and attitudes [15]. This study fills the gaps in eHealth literacy evidence by identifying social and digital determinants of eHealth literacy in community-dwelling Korean older adults and its consequential impact on subjective health status and digital technology application for lifestyle improvement and health needs.

In our study, older age, monthly income of lower or equal to one million Won, internet non-users, and those not engaged in social media have a higher risk of having poor eHealth literacy (Table 4). Furthermore, the findings indicated that eHealth literacy has a significant effect on self-perceived health and eHealth use. It was also associated with lifestyle behaviours utilizing digital resources for promoting health (Table 5,6) such as improving healthy eating habits. Using smartwatches in physical activity promotion is an ideal recent example globally [29]. Additionally, eHealth literacy enabled older persons to seek health care services digitally, and access long-term care services digitally (Table 5,6). Integrating all these findings, we can highlight the significant influence of eHealth literacy upon general wellbeing, self-care and opportunity to utilize health and social care services and health promotion through multiple evidence. The findings in other recent publications agreed with our findings [30, 31].

The eHealth literacy of community-dwelling older Korean adults is relatively low, and 66.6% need support and facilitation to improve their skills (Table 2). Since eHealth literacy is a predictor of eHealth information seeking, the disparity could result in inequity in health information access. Incompetency in eHealth literacy skills in older adults reflects lower self-efficacy in the effective

utilisation of electronically delivered information and services and the risk of exclusion from these services [10]. Therefore, regarding the country's high-paced demographic and digital transition, urgent interventions in eHealth literacy promotion targeting high-risk groups should be prioritised to ensure seniors' healthy and inclusive ageing.

The effect of age on eHealth literacy varies among different age groups (Table 4). The skill increases with age in young and middle-aged adults and declines with age in older adults. [32, 33] Younger olds are more likely to have better eHealth literacy than older olds. This may be due to an age-related decline in physiological and cognitive ability to access eHealth information. A qualitative study stated that younger olds adopt digital technology considering literacy, benefits, and support from relatives and families, while older olds are more likely to adopt with support from friends and relatives [34]. Therefore, older adults are not homogenous, and improving eHealth literacy in older adults should consider age-specific interventions tailored to the needs of different older adults.

Previous studies have stated that economic status has a significant association with eHealth literacy, which is concurrent with our study [35]. Older adults with higher incomes are more likely to adopt digital devices and have more autonomy in internet use [36]. Lower income older adults may face poor access to digital technology, leading to skill disparity. As South Korea ranked highest in old age poverty among Organization for Economic Co-operation and Development (OECD) countries [37], the relationship between financial security, social support for older adults, and eHealth literacy needs in-depth investigations to prevent the potential loss of the silver economy in a digitalised society.

Regarding other socio-economic factors, there is inconsistency in the relationship between gender and eHealth literacy, and our study did not find any significant differences among different genders (Table 4). Level of education is a significant predictor of eHealth literacy in several research [33, 38]. However, our study did not find favourable relationships between education level and eHealth literacy, except the level of education with high school and above is more likely to have higher eHealth literacy in univariate analysis (Table 4).

Internet and social media use had a strong association with eHealth literacy. The frequency and time spent on the internet lead to different levels of eHealth literacy among seniors, and those spending three hours or more have 35 times higher eHealth literacy than non-users (Table 4). The internet penetration of older people is around 90% of the general population [39] in South Korea which means that Korean older adults have favourable environmental access to the Internet, and they are more likely to adopt electronic devices [40]. In addition, having confidence in using the internet promotes the use of the internet for seeking health information and thus improves eHealth usability [41]. Therefore, comprehensive internet coverage serving as a foundation, boosting older adults' self-efficacy with digital technology and comfortability with eHealth skills, is a promising way to narrow the usability gap.

The eHEALS scale was developed before the widespread use of social media, and there were few studies regarding the validity of eHEALS on social media use. Our study showed that the social media users had 3.97 times higher eHealth literacy than non-users (Table 4), which is concurrent with Tennant, Bethany et al's findings [42]. The diffusion of social media into people's daily lives has become a channel to distribute health information and promote health, especially during the COVID-19 pandemic. South Korea and China have effectively used social media for disease notification, updating health information, and promoting preventive behaviours [43, 44]. People who use social media frequently are more likely to keep abreast with updated health information, have better eHealth literacy and be able to adopt healthy behaviours.

This study also found that eHealth literacy significantly impacts the self-perception of health (Table 6). Better levels of eHealth literacy are related to better perceived health through access to quality health information and prompt and adequate health-related decisions[46, 47]. Healthy behaviour, such as participation in annual medical check-ups, is not associated with eHealth literacy in this study population. The study population's participation in annual medical checkups is 90% (Table 2), higher than the national level of 80.3% in the group over 40 years of age [45]. Due to the well-

established health screening programs and high participation, this study could not find a significant impact of eHealth literacy on participation in health screening programs.
In addition, this study found that eHealth literacy influences digital technology use for health and care purposes. (Table 6). People with better eHealth literacy can navigate the required information correctly, whereas people with poor eHealth literacy skills lack eHealth self-efficacy and pose a barrier to the adoption of eHealth services. Moreover, a higher eHealth literacy level increases the positive impact on perceived usefulness and ease of use in technology and facilitates the adoption of digital health technology. [46] Recently, a municipality in South Korea has introduced an AI-featured call to prevent social isolation in seniors [47]. Such development affirmed that digital technology would narrow the unmet needs of health care and long-term care services in the future, provided that the users have the proper knowledge and self-efficacy in eHealth. Therefore, promoting eHealth literacy for the older population is fundamental in expanding eHealth services and eliminating the grey digital divide.

Limitations

Due to the demographics and ageing rate of the sample population and the location of the study site, generalizing the findings may underestimate internet use in the older Korean population. In addition, eHEALS measures perceived eHealth skills rather than the actual performance of utilising digital technology. The possible gap between perceived skill and actual application of eHealth literacy could not be excluded.

Conclusion

eHealth literacy is an essential skill in the rapidly digitalising world. It is important to learn about the factors associated with eHealth literacy in community dwelling Korean older adults and the impact of eHealth literacy on health-related outcomes and digital technology use for health purposes. With the application of the results from this study, interventions to improve the eHealth literacy skills of older adults can be tailored to high-risk populations and narrow the gap in the usability of eHealth services by older adults.

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Authors Contribution

Conceptualisation – M.N.A, M.Y.K, M.Y, Y.K, Data curation – all authors, Formal Analysis –, M.Y.K, M.N.A Funding acquisition – M.N.A, M.Y, Investigation – all authors, Methodology – all authors, Project administration – M.N.A, Y.K, E.W.N, M.Y, M.H.K.C, T.N.N.A, Resources – M.N.A, Software- M.N.A, Supervision – M.N.A, M.Y, S.M, T.N.N.A, Validation – M.Y.K, M.N.A, Y.K, M.Y, S.M, T.N.N.A, E.W.N, H.C.L, H.K.N, Visualisation – M.Y.K, M.N.A, Writing – original draft – M.Y.K, M.N.A, Writing – review & editing – all authors

Conflicts of Interest

The authors declare no conflict of interest.

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Supplementary Files

Figures

Level of eHealth literacy of different age groups by different categories of daily time spent online among older Korean Adults.