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Impact of cognitive functions and digital health literacy on older adults' digital proficiency

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Abstract

Background: The advancement of information and communication technologies and population aging are facts in modern society, however, occur in isolation. Several factors, such as the level of cognition, socioeconomic and health factors, may or may not contribute to the adherence to the use of technology by older adults. Seeking to understand how knowledgeable older people are in using technologies is necessary to facilitate their inclusion in society.
Objective: To analyze older adults' digital proficiency and its association with sociodemographic, psychological, and functional variables and digital health literacy.
Method: This cross-sectional quantitative study was carried out in an institutional program for older people at a public university. The study collected sociodemographic data and assessed mood with the Geriatric Depression Scale (GDS), cognition with Addenbrooke's Cognitive Examination Revised (ACE-R), functioning with the Advanced Activities of Daily Living Scale (AADLs), digital health literacy with e-Health Literacy Scale (eHEALS), and knowledge and use of mobile technology devices with the Mobile Device Proficiency Questionnaire (MDPQ). MDPQ was correlated with sociodemographic variables using the Student's t-test and ANOVA test and with the other scales using the Spearman correlation test and Pearson correlation test. The significance level was set at 5%.
Results: The final sample had 60 people aged 60 to 82 years. 68.3% of the sample had a medium level of knowledge and use of mobile devices. MDPQ was significantly correlated with ACE-R (0.003) and eHEALS (p-value < 0.001), indicating that cognition and ability to search for health data on the internet are factors that influence adults' digital proficiency in this sample.
Conclusion: Older people's digital proficiency in mobile device use was classified as medium and was associated with (and influenced by) their level of cognition and degree of digital health literacy.

Keywords: aged, digital proficiency, Information and communication technology, digital health literacy, digital inclusion

Introduction

Aging is a complex and multifactorial process with great pattern variability, as organic, biological, social, and emotional changes arise, genetically determined and influenced by the social and environmental context, which can compromise older people's functional capacity and reduce their autonomy and participation (China, 2021). Nevertheless, a large part of the older population continues to perform significant activities and remains participative. The global commitment to healthy aging aims to ensure them the opportunity to reach their potential with dignity and equality (OPAS, 2020) in the economic, political, and social spheres (Souza, 2021).

Rapid technological advancement in people's daily lives has made it challenging for older people to remain involved in society, as they are less familiar with digital media (Andrade, 2020). Information and communication technologies (ICT) are a set of technological resources, such as smartphones, tablets, and notebooks, which optimize people's performance in everyday life and facilitate communication, mobility, transport, leisure, housing, work, and access to information, culture, health, and services (Liu, 2022).

The widespread use of these digital resources has impacted people's daily lives regarding work, communication, leisure, health, and others. However, they require attention concerning older people's learning process, access, and digital inclusion (Machado, 2019). Thus, given the current importance of technology use, it is essential to ensure older people the adequate access to these resources, meeting all their needs, and promoting their full access to citizenship, inclusion, participation, and healthy and meaningful aging (Rezende, 2020).

There are many benefits to the appropriation of ICT by older people, including improved mental functions, leisure activities, promotion of social inclusion, and everyday conveniences, which are essential for the quality of life (Schuck et al., 2020; Pessoa et al., 2023). According to Queiroz (2020), social integration through access to ICT strengthens interpersonal relationships and promotes intergenerational meetings, contributing to older people's leisure activities, culture, learning, promotion of information, and use of free time (Neves, 2018; Batista, 2019; Teles, 2021; Liu, 2022). Da Luz et al. (2022) also stated that one of the reasons why older people seek digital inclusion programs is the feeling of belonging to society influenced by technology – i.e., the desire to integrate with social and cultural changes and stay up to date.

Older people's mastery and use of technology are essential as technological advances occupy different areas of daily life (Liang et al., 2022). In general, the use of the Internet for health information has grown in recent years, which is no different among older people (Weber et al., 2020; Sther et al., 2021). A study of this population in Belgrade revealed that being male and having higher education were significantly predictive factors for exploring health-related content online (Gazibara et al., 2016). Moreover, a survey carried out in China showed that 61% of people over 50 years old who used the Internet searched for health information (Liang et al., 2022).

Promoting digital proficiency – i.e., measuring how effectively individuals engage with digital technology for their benefit and develop their skills (Silva; Behar, 2019) – contributes strongly to digital inclusion and, consequently, social engagement and inclusion, thus reducing loneliness (Teles et al., 2021). However, various characteristics interrelate and influence the process of acquiring digital proficiency among older adults. As this is a very heterogeneous public, the indicators are presented multidimensionally and concern issues intrinsic and extrinsic to the individual, as chronological age is not the only factor that needs to be considered when teaching older people new skills (Gameleira, 2020).

Depressed older adults tend to have fewer affective symptoms, more cognitive and somatic changes, and loss of interest when compared to depressed young adults (Hernandez, 2019). In turn, anxiety is a construct that leads to fear and a lack of interest in using technology. Likewise, the general state of health and functionality interferes with the teaching-learning process, consequently, in the acquisition of technological skills (Carvalho, 2022). Functional capacity has been identified in the literature as one of the main components of older adults' health, establishing a new paradigm of health for the aging population (Brito, Menezes, & Olinda, 2016).

Hence, to understand older adults' level of digital proficiency, it is essential to map their main difficulties and the aspects that may interfere with the acquisition of digital proficiency. Thus, this study aimed to analyze older people's digital proficiency and its association with sociodemographic, psychological, and functional variables and digital health literacy.

Methods

Study design, time, and location

This quantitative analytical cross-sectional research was carried out from September 2022 to June 2023, in a gerontology/geriatric service in Northeastern Brazil – an institutional program at a public university that is a reference in providing continuing education courses and individual and collective care to improve older people's health status.

Sample of participants

The study included adults aged 60 years or over, of both sexes, registered in the gerontology/geriatric service. Older people who were unable to answer the questions in the assessment questionnaires due to cognitive and/or communication difficulties and nursing home residents were excluded. Also, those who took courses on the use of digital platforms were excluded to ensure homogeneity in the sample regarding knowledge of technology.

Study variables

Dependent variable

Proficiency in using mobile devices.

Independent variables

Sociodemographic profile, aspects of mood, cognitive assessment, functionality, and digital health literacy.

Data collection

Sociodemographic data, psychological and functional aspects, assessment of health literacy, and assessment of knowledge and use of technology were collected with specific instruments in individual interviews.

Assessment of sociodemographic profile

The study population was characterized according to their sociodemographic and cultural profiles, verified with a structured questionnaire, adapted by the researchers based on the socio-sanitary questionnaire from the Health, Well-being, and Aging Study (Lebrão et al., 2019). It identified their ethnic group,

Table 1. Characterization of the sample regarding sociodemographic variables

Factor assessed	**n**	**%**
Sex		
Males	7	11.7
Females	53	88.3
Age	**n**	**%**
60 to 69 years	31	51.7
70 to 82 years	29	48.3
Color	**n**	**%**
White	24	40.0
Multiracial	24	40.0
Black	12	20.0
Marital status	**n**	**%**
Married	19	31.7
Divorced	10	16.6
Single	15	25.0
Widow(er)	16	26.7
Religion	**n**	**%**
Catholic	41	68.3
Spiritist	8	13.3
Evangelical	9	15.0
No religion	1	1.7
Umbandist	1	1.7
Leisure	**n**	**%**
No	4	6.7
Yes	56	93.3
Educational attainment	**n**	**%**
4 years	2	3.3
8 years	4	6.7
11 years	30	50.0
17 years	24	40.0
Retired or pensioner	**n**	**%**
No	1	1.7
Yes	59	98.3
Current occupation	**n**	**%**
Formal employment	5	8.3
Self-employed	6	10.0
Unpaid worker	3	5.0
Unemployed	46	76.7
Number of household residents	**n**	**%**
1 resident	29	48.4
2 residents	12	20.0
3 residents	14	23.3
4 to 5 residents	5	8.3
Family arrangement	**n**	**%**
With a partner	18	30.0
Without a partner	42	70.0
Number of children	**n**	**%**
None	10	16.7
1 child	6	9.9
2 children	28	46.7
3 children	9	15.0
4 or more children	7	11.7

marital status, religion, education, occupation, housing characteristics, and income.

Assessment of psychological and functional aspects of aging

Psychological aspects were those related to mood and cognition. Functionality was assessed through activities of daily living.

(1) Mood assessment

This assessment used the Geriatric Depression Scale, developed by Yesavage et al., 1982, translated and validated for Brazil by Almeida & Almeida in 1999, with good psychometric properties for the reduced 15-item version – GDS15. This questionnaire uses yes/no answers to verify the presence of depressive symptoms, with cutoff points of 5 for the absence of depressive symptoms and above 6 for their presence – 6 to 10 indicate mild depression, and 11 to 15, severe depression. It is recommended by the Multidimensional Older People's Assessment instrument guide (Moraes, 2018).

(2) Cognitive assessment

Cognitive aspects were assessed with Addenbrooke's Cognitive Examination Revised (ACE-R) (Carvalho, 2007). With six subdomains (attention, orientation, memory, verbal fluency, language, and visuospatial abilities), it is a useful screening instrument for the initial assessment of cognitive functions. The scores for the six subdomains were distributed as follows: attention and orientation (18), memory (26), verbal fluency (14), language (26), and visuospatial abilities (16), totaling a maximum battery score of 100 points, which indicates better performance. The version of the scale validated and adapted to Portuguese was published by its authors in 2007, stipulating a cutoff score of < 78 points (sensitivity 100% and specificity 82.26%) for the Brazilian population (Carvalho; Caramelli, 2007). Abnormal results indicate the need for a more comprehensive cognitive assessment so that specialized professionals can continue the assessment.

(3) Functioning assessment

This assessment used the Advanced Activities of Daily Living Scale (AADLs), an objective, validated, and proposed scale to assess the participation of older people in advanced activities of daily living (Dias et al., 2019). AADLs is already used to investigate the association between advanced activities of daily living and cognitive performance among participants in an important multicenter epidemiological study on frailty in Brazilian older adults, the FIBRA study (Oliveira et al., 2015). Its 13 items have the following response options: "never did", "stopped doing", and "still doing". These items are scored on a scale of 1 to 3 points, with a minimum final score of 13 and a maximum of 39.

Digital health literacy assessment

Browsing skills and digital health literacy were assessed with the eHealth Literacy Scale (eHEALS), developed by Norman and Skinner

Table 1. Characterization of the sample regarding sociodemographic variables (cont.)

Type of housing	**n**	**%**
Own home	45	75.0
Rented home	9	15.0
Borrowed home	6	10.0
Household situation (person responsible for income)	**n**	**%**
Spouse/partner	6	9.9
(Step)son/daughter	1	1.7
Participating older adult	52	86.7
Other relatives	1	1.7
Family income	**n**	**%**
Less than 1 MW	1	1.7
1 to 3 MW	33	55.0
3.1 to 4.5 MW	11	18.3
4.6 to 6 MW	7	11.7
More than 6 MW	8	13.3

in 2006, with cross-cultural validity and adaptation for the Brazilian older population, attested by Yamaguchi, 2022. It aims to investigate the person's ability to search, find, understand, and evaluate health information in digital media to interpret and judge whether they are useful and safe to solve a health-related problem (Skinner, 2003). It has eight items that assess the user's perceived Internet skills to search for health information. Their answers on a Likert scale range from 1 to 5 points, in which 1 corresponds to "completely disagree" and 5 corresponds to "completely agree". Thus, the final score ranges from 8 to 40 points – the higher the result, the better the level of digital health literacy.

Assessment of proficiency in using mobile devices

The Mobile Device Proficiency Questionnaire (MDPQ) was administered to the older people included in the research to investigate their abilities to perform specific tasks on mobile devices. The instrument was developed and validated by Roque & Boot in 2016 and cross-culturally adapted to Brazilian Portuguese (Raymundo et al., 2024). It has eight domains: Mobile device basics, communication, data and file storage, Internet, calendar, entertainment, privacy and troubleshooting, and software management. Older people evaluate their ability to perform a total of 46 operations on a smartphone or tablet and assign them to a scale of 1 to 5 points, as follows: 1 = never tried (even if they think they can perform that task), 2 = not at all, 3 = not very easily, 4 = quite easily, 5 = very easily. Their score is calculated from the mean score for each domain. These mean scores are then added together to result in a measure of total proficiency that can reach up to 40 points – a higher score is likewise indicative of a better level of proficiency in using mobile devices.

Data analysis and interpretation

A database was built for data analysis in a Microsoft Excel spreadsheet, which was exported to the SPSS software, version 21. The analysis calculated percentage frequencies and constructed their respective frequency distributions to characterize the older people's sociodemographic profiles. Furthermore, the distributions of responses were obtained for each item of the scales: GDS15, ACE-R, AADLs, and eHEALS. The study also calculated the prevalence of depression and cognitive impairment among the participating older people.

MPDQ was applied to assess their level of digital proficiency, and the score was calculated for each scale domain. Scores underwent statistical analysis. The minimum, maximum, mean, and standard deviation and the percentage of digital proficiency were obtained for each person, classifying the older people according to their percentage of proficiency: high proficiency (66.6% to 100.0%), medium proficiency (33.5% to 66.5%), and low proficiency (0.0% to 33.3%). The percentage score of older people's digital proficiency was compared with their sociodemographic variables using the Student's t-test for independent samples and the ANOVA test, depending on the number of categories of the categorical variable.

The Spearman correlation test and Pearson correlation test were applied (depending on whether the Shapiro-Wilk test indicated the normality of the scales) to evaluate the scale scores

Table 2. Descriptive analysis of the questionnaire score regarding older people's knowledge of mobile device use, according to the MDPQ domains

Domains	**Descriptive statistics**				
	No. items	**Minimum**	**Maximum**	**Mean**	**Standard deviation**
Mobile device basics	9	2.11	5.00	3.81	0.73
Communication	9	1.20	5.00	2.84	1.09
Data and file storage	3	1.00	5.00	1.51	1.07
Internet	8	1.00	5.00	3.03	1.13
Calendar	3	1.00	5.00	2.10	1.21
Entertainment	5	1.00	5.00	3.01	1.18
Privacy	4	1.00	5.00	2.23	0.97
Troubleshooting and software management	5	1.00	5.00	2.48	1.14
Overall (46 items)	**46**	**1.33**	**4.98**	**2.87**	**0.87**

Table 3. Distribution of the classification of older people's level of proficiency

Classification of the level of proficiency	Range	n	%
High	66.6% a 100.0%	15	25.0
Medium	33.5% a 66.5%	41	68.3
Low	0.0% a 33.4%	4	6.7

(GDS15, ACE-R, AADLs, and eHEALS), which are correlated with the MPDQ. All conclusions were drawn considering a significance level of 5%.

A multivariate linear model was adjusted to evaluate which factors jointly influence the MPDQ. Variables with a statistical significance of up to 0.20 in the bivariate analysis entered the model, and those with a statistical significance of up to 0.05 in the final adjustment remained in the final model.

Results

Characterization of the sample

Sociodemographic variables

The final sample had 60 older adults. *Table 1* presents the sociodemographic profile distribution, in which most of those surveyed were females (88.3%), aged 60 to 69 years (51.7%), and pensioners (98.3%). %), had 11 years of schooling (50.0%), and a family income of one to three minimum wages (55.0%).

Psychological and functional variables

After calculating the depression score and applying the cutoff point, the scale indicated that 86.7% of the older people did not have depressive symptoms (52 cases), 11.7% had mild depression (seven cases) and 1.6% (one case) had a score suggestive of severe depression (Almeida; Almeida, 1999). The ACE-R classified 68.3% of the older people in the study as not having cognitive impairment (41 cases), while 31.7% had impairments (19 cases). Most participants reported they still did the following activities, according to AADLs: attending refresher courses or Open University for Older People (93.3%) and going to church or temples for religious rituals or religion-related social activities (90.0%).

Assessment of older people's digital health literacy

The assessment with eHEALS found that the following activities most older people frequently carried out with some or a lot of ease (i.e., they could browse them more easily): how to use the health information I find on the Internet to help me (60.0%); how to find useful health resources on the Internet (53.4%); and where to find useful health resources on the Internet (53.3%). Also, 50% said they did not feel safe using information from the Internet to make health-related decisions.

The data obtained from eHEALS reveals that older people performed well in their skills to use health information to help them. The majority also stated that they knew how and where to find useful health resources on the Internet. Despite the growing use – categorized in our sample as a medium level of literacy – and good browsing skills to search for health information, a large part of our research population stated that they did not feel confident in making health decisions based on information acquired on the Internet.

Analysis of older people's proficiency in using mobile devices

Table 2 presents the descriptive analysis of the questionnaire score regarding their knowledge of mobile device use, according to the MDPQ domains. It verified that older people had the highest mean digital proficiency score in Mobile device basics (3.81 points), Internet (3.03 points), and Entertainment (3.01 points).

Most older adults use mobile phones for communication. However, the Communication domain in this scale also includes the use of e-mail and social networks, which require greater mastery – and in which our population did not have good results. Also, older people tend to explore more advanced mobile device functions less often because of unfamiliarity, fear, and insecurity. It was found that 25.0% of the sample had a high level, 68.3% had a medium level, and 6.7% had a low level of proficiency (*Table 3*).

A significantly higher number of older adults classified themselves as having a medium level of proficiency in mobile devices based on the MDPQ score. It can be deduced that good proficiency in the use of mobile devices can help them use technology critically and browse the network in search of health information, which in general arouses greater interest in older people.

Association between older adults' digital proficiency and sociodemographic, psychological, and functional variables, and digital health literacy

The mean comparison test was not significant in any of the factors evaluated, indicating that the sociodemographic profile was not a determining factor in changing the level of digital proficiency in this sample (*Table 4*). Although there was no statistical difference, younger, male, black, active older people with higher education and a monthly income above 6 MW had the best score on the proficiency scale in this study.

MDPQ was significantly correlated only with ACE-R (0.003) and eHEALS (p-value < 0.001), indicating that the cognition level and the ability to search for health data on the Internet are factors that influence the digital proficiency of older adults in this sample (*Table 5*). The same results were found after adjusting the multivariate linear model.

Table 4. Analysis of the percentage score of older people's digital proficiency, according to their sociodemographic profile

Factors	Percentage proficiency level		p-value
	Mean	Standard deviation	
Sex			
Males	60.25	18.00	0.646[1]
Females	57.00	17.44	
Age			
60 to 69 years	59.94	14.05	0.246[1]
70 to 82 years	54.63	20.25	
Color			
White	57.81	16.94	
Multiracial	55.85	20.38	0.828[2]
Black	59.57	11.86	
Marital status			
Married	57.19	17.59	
Divorced	67.96	15.64	0.184[2]
Single	53.57	14.21	
Widow(er)	54.57	19.59	
Religion			
Catholic	58.74	15.48	
Spiritist	55.38	17.40	
Evangelical	55.70	26.62	0.844[2]
No religion	44.78	-	
Umbandist	45.22	-	
Leisure			
No	53.04	25.23	0.610[1]
Yes	57.69	16.96	
Educational attainment			
4 years	55.43	40.89	
8 years	51.52	9.08	0.212[2]
11 years	53.65	15.87	
17 years	63.17	17.73	
Retired or pensioner			
No	58.76	7.21	0.678[1]
Yes	57.19	18.34	
Current occupation			
Formal employment	58.61	7.82	
Self-employed	66.09	20.79	0.165[2]
Unpaid worker	73.91	10.62	
Unemployed	55.03	17.42	
Number of household residents			
1 resident	53.75	16.05	
2 residents	64.46	19.86	0.270[2]
3 residents	56.55	17.88	
4 to 5 residents	63.74	15.18	
Family arrangement			
With a partner	58.77	16.59	0.688[1]
Without a partner	56.78	17.87	

[1]p-value of Student's t-test for independent samples.
[2]p-value of the ANOVA test.

Multivariate linear model

The following variables were included in the initial model: marital status, current occupation, family income, GDS score, ACE-R score, AADLs score, and eHEALS score. It was found that only two – ACE-R score and eHEALS score – of all the variables included in the model remained significant for estimating the MDPQ score. For each unit of increase in the ACE-R score, there was a 0.407-point increase in the MDPQ, and for each unit of increase in the eHEALS score, there was a 1.047-point increase in the MDPQ score (*Table 6*).

Socioeconomic and functional factors were not significantly related, certainly because the study population is a differentiated sample, with high levels of education, income, and social participation. The association between digital health literacy results (according to eHEALS) and proficiency in using mobile devices (measured with MDPQ) was expected since security and browsing skills on devices lead to greater interest in searching and learning from the Internet. Likewise, a relationship between cognition and proficiency was expected, considering that digital proficiency requires memory and learning. The cases of cognitive impairment identified in the sample (31.7%) are possibly related to negative findings regarding proficiency with mobile devices.

Discussion

In the sample of this research, the significant difference in the proportion of individuals between sexes stands out. As studies show, predominantly older females participate in health and learning spaces (Bravalhieri, 2021; Chnaider, 2022). A systematic review of the perception of older people regarding the use of mobile devices and health applications identified important barriers, such as concern about the security of personal information, difficulty in using such technology, and fear of using it (Benavides-Guerrero, 2022). Ali et al. (2019) stated that some older people, especially the oldest ones, still feel little confident with new technologies and may not perceive them as beneficial for them, which certainly influences the level of proficiency in the devices' use.

Applying the mdpq led us to a result that classified the majority of the study population as having a medium level of proficiency in mobile devices. Roque and Boot (2016) found similar data in the scale validation process, as that group of older people obtained higher scores in Mobile device basics, Communication, and the Internet. Older adults can use mobile devices in various ways according to their interests. Studies highlight the areas of greatest interest as the use of social networks, general Internet searches, news,

Table 4. Analysis of the percentage score of older people's digital proficiency, according to their sociodemographic profile (cont.)

Factors	Percentage proficiency level		p-value
	Mean	Standard deviation	
Number of children			
None	54.57	10.60	
1 child	51.81	11.32	
2 children	60.50	17.55	0.732[2]
3 children	54.16	21.64	
4 or more children	57.83	24.07	
Type of housing			
Own home	58.94	16.74	0.231[1]
Rented home	52.69	18.98	
Household situation (person responsible for income)			
Spouse/partner	65.36	11.76	
(Step)son/daughter	54.78	-	
Participating older adult	56.31	18.03	0.622[2]
Other relatives	67.39	-	
Family income			
Less than 1 MW	28.26	-	
1 to 3 MW	56.63	17.25	
3.1 to 4.5 MW	52.33	10.47	0.101[2]
4.6 to 6 MW	59.44	18.61	
More than 6 MW	69.24	20.07	

[1]p-value of Student's t-test for independent samples.
[2]p-value of the ANOVA test.

and searches for health-related information (Gazibara et al., 2016; Diniz et al., 2020; Weber et al., 2020; Sther et al., 2021), whereas shopping on the Internet and studying are the least frequent habits (Keranen et al., 2017). Despite their growing use of digital resources, older people are still a long way from being fully familiar with them.

Unfamiliarity with technology tools is one of the main reasons why older people are integrating more slowly than other age groups (Lee, 2022). This reinforces the need to develop educational methodologies for digital inclusion specific to this population (Figueiredo, 2023).

Regarding the association between the digital proficiency of elderly people and sociodemographic variables, there was no statistical significance. These findings disagree with what was pointed out by Fung (2023) and Flauzino (2020), who stated that younger older adults (aged 65 to 70 years) with higher education and living with a partner were more likely to use technologies. Higher education levels and family income greater than three minimum wages were also important predictive factors (Fung, 2023). Cavapozzi (2021) stated in his study that retirement reduces computer knowledge and the frequency of Internet use by men and women. Personal factors (such as age and sex) and socioeconomic inequalities (such as possessions, education level, and economic status) lead to unequal distributions of social resources, generating unequal access to ICT (Van Dijk, 2020).

Table 5. Correlation analysis between MDPQ total score and GDS15, ACE-R, AADLs, and eHEALS

Factor assessed	Correlation	p-value
GDS	ρ = -0.237	0.068
ACE-R	r = 0.374	0.003
AADLs	r = 0.178	0.174
eHEALS	ρ = 0.640	<0.001

ρ = Spearman correlation. r = Pearson correlation.

The integrative review by Gallo et al. (2023) found sociodemographic characteristics that predicted the search for health information through digital means. The research pointed to a profile of younger male older people without comorbidities, with preserved cognitive abilities, physically active, and with higher education and higher income.

GDS was negatively – though not statistically significantly – correlated with MDPQ. In a study carried out in Hong Kong, participants who accessed the Internet every day had higher levels of life satisfaction and self-rated mental health those those who rarely or never used the Internet (Fung, 2023). Likewise, research showed that Internet use protected older people against depression and a decline in quality of life during the COVID-19 pandemic (Todd, 2022). The development of training programs for ICT use and digital inclusion of older people is essential to alleviate social isolation and loneliness and improve well-being and quality of life, in addition to benefiting measures of anxiety, depression, and self-confidence (Neves, 2018; Queiroz & Morais, 2020; Costa et al., 2021; Sandu, 2021; Fung, 2023).

In this study, the AADLs score revealed no influence on older people's proficiency with mobile devices. A study carried out in China investigated the relationship between older adults' digital divide and active aging, demonstrating that the greater the digital divide, the weaker their sense of physical and mental health and social participation to ensure active aging (Liu, 2022). In a technological society, the more access older people have to Internet devices, the greater their level of socialization and participation and the greater the promotion of active aging (Jin & Zhao, 2019). ACE-R and eHEALS were significantly correlated with MDPQ, indicating that older people's level of cognition and digital health literacy are associated with their digital proficiency.

The development of technological skills is a recent need for older people, which requires new

Table 6. Adjustment of the multivariate model to estimate the MDPQ score

Factor assessed	b	t	p-value[1]	95% confidence interval	
				Lower limit	Upper limit
Intercept	-2.895	-0.195	0.846	-32.640	26.850
R score	0.407	2.190	0.033	0.035	0.780
EALS score	1.047	6.094	<0.001	0.703	1.391

b = linear coefficient; t = t-test statistics.
[1]p-value of Student's t-test. Adjusted R^2 = 0.461.

learning (Cachioni et al., 2019). The process of learning new functions is fundamental to delaying cognitive decline that occurs naturally with aging and preserving cognitive functions (Gomes, 2020; Torres, 2021; da Luz et al., 2022).

The development of technical skills and abilities to assimilate information about technologies is one of the ways to contribute to reducing their digital gap (Fauzino, 2020). In an intervention study carried out in São Paulo, addressing older adults' digital inclusion with mobile devices, participation resulted in better overall performance in cognition, attention, executive functions, and visual-spatial skills and a reduction in depressive symptoms, with the possibility of technological skills increasing performance levels in various cognitive areas (Alvarenga, 2019).

A prospective Japanese study observed that older adults who used computers had less cognitive decline than those who did not use them, concluding that computer use is longitudinally associated with the protection of cognitive functions (Kurita et al., 2021).

Mastering mobile devices is important to promote healthy aging in the digital era (Han et al., 2021). Using the Internet for e-health can even reduce substantial healthcare spending (Nam et al., 2019). The World Health Organization points to digital health literacy as an important factor in the prevention and control of chronic noncommunicable diseases (Wahl et al., 2021). Therefore, according to Schrauben et al. (2020), the older population must reach a good level of digital health literacy to successfully take advantage of e-health innovations for disease management.

A study carried out in Southeastern Brazil found an association between older adults' low digital inclusion and low health literacy levels, highlighting the importance of this population appropriating digital media for their social inclusion and empowerment in modern society, enabling access to varied information (Polonski et al., 2022). Internet use by older people is associated with preventive health behaviors. Hence, digital inclusion interventions and programs are necessary to facilitate their health prevention (Nam et al., 2019).

The data obtained in this study contribute to the implementation of projects aimed at inclusion and promotion of the digital proficiency of older adults, based on specific educational strategies and approaches, with interventions that understand subjectivity and aspects of aging to be considered, taking into account that it is a biological, social and psychological process that is different for each individual. These questions are fundamental to building a more just and egalitarian society.

Conclusions

This study classified a significantly higher number of older people at the medium level of proficiency in mobile devices. The data also revealed that older adults performed their digital health literacy skills satisfactorily. Statistically, our findings suggest that older people's level of cognition and degree of digital health literacy are directly related to (and therefore influence) their proficiency in using mobile devices. Sociodemographic data, aspects related to mood, and advanced activities of daily living were not statistically significantly associated with digital proficiency.

The advancement of technology in the health field highlights the importance of bringing older adults closer to technological tools, evolving to appropriate and remaining digitally engaged in the search for health information. Digital proficiency has an impact on active aging, which cannot be minimized. It is essential to ensure the understanding of how to use digital resources for life so that technology involves older adults with the possibility of helping to achieve healthy aging.

Unlike what various social paradigms and stereotypes reveal regarding the use of technology by older adults, this study showed that the vast majority of research participants have some level of knowledge and digital proficiency on devices, bringing many challenges, as well as possibilities to make them more digitally included.

Ethical aspects

The research protocol was approved by the Human Research Ethics Committee from the Health Sciences Center of the Federal University of Pernambuc, on March 26, 2022, under CAAE: 54567721.1.0000.5208 and evaluation report no. 5.313.889.

Limitations of the study

As this is a cross-sectional study, it had a short time to observe the phenomenon, limiting the ability to make further statements. The research data were obtained through interviews, which poses a risk of

information and measurement bias. The participants in this study make up a specific sample, as they participate in a university program. Hence the results should be sparingly extrapolated to other groups of older people. Finally, the study should be expanded to different populations and research designs.

Conflict of interest
The authors report no personal or economic conflict of interest related to the content of this manuscript.

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