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Research Article

Who are the Older Adults' Users or Non-Users of the Internet before the Pandemic? Analysis of the Epifloripaageing Cohort Study (2009-2019)

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Abstract

Background: This ageing demographic transformation has been happening simultaneously with technological immersion, especially internet use in communication and health monitoring applications.

Objective: This study's primary aim was to characterize the Internet's socioeconomic and demographic factors of internet users and non-users. The second aim was to analyze which factor, modifiable or not, influenced the incidence of older adults' Internet use over time.

Methods: This study was done with 722 EpiFloripa Ageing Cohort Study follow-up of older adults. The outcome is internet use according to waves 1 to 3, and the exposures are sociodemographic. It described the characteristics of internet users and non-users, and it used a longitudinal analysis model (Generalized Estimating Equations) to estimate Incidence Rate Ratios (IRR) with 95% confidence intervals.

Results: Internet users were younger, with higher education and higher income than non-users over time. Most non-users of the Internet were women (54%) and white (93%), with an average of 66.4 years old and 14 years of study.

Conclusion: The incidence of internet use was 11, 4% in Wave 2 and 23.0% in Wave 3 and was 80% lower in older adults 80 years and over compared to other age groups. Regarding schooling and family income, the internet use incidence was higher according to the increase in education levels and income range, except for older adults with more than 10 Brazilian minimum wages. Public policies are needed to reduce inequalities in access to the Internet and promote the digital inclusion of older adults.

Keywords: Internet use; Digital divides; User characteristics; COVID-19

Introduction

Population aging has been occurring at an accelerated pace in recent years. This demographic transformation has been happening simultaneously with technological immersion, especially in communication between older people and health monitoring [1,2]. Internet use has also increased in the last ten years, spreading as an information and communication strategy. It is increasingly inserted into people's daily lives, including among older adults [3]. As benefits of the internet, there are social interaction with friends and family, access to updated information, and ease of performing different daily tasks through applications, such as banking and shopping [4,5]. Studies about social media use and its effect on older adults' health show a positive impact through its ability to keep older adults cognitively engaged, improve health communication, and increase social connectedness [2].

On average, 49% of the Europeans aged 50 years or older use the Internet, although the results have varied across the 17 countries surveyed. Croatia (27%) and Denmark (83%) were the countries that presented extreme results concerning internet use among in European population [6]. According to the Information and Communication Technology survey in households in Brazil (in Portuguese, TIC Domicílios), there has been accelerated growth in the use of the Internet in this country. Internet access by Brazilian older adults, exclusively by smartphone, increased from 20% in 2015 to 65% in 2019. This population used the Internet mainly to send messages, use social networks, make video calls and search for products and services [7,8].

Even with this growth in internet use, older adults are considered a vulnerable group for digital inclusion, and access and use of the Internet are also permeated by inequalities [9].

The COVID-19 pandemic highlighted the impact of these inequalities in the use of the Internet among older adults [8] Although it is observed that Internet use gradually decreases with age, analyses grouped by age indicate that other factors, such as education level and family income, are more significant for Internet use than age [6,10]. These factors can be called micro-elements, including race/skin color [6,11].

The gender and education inequality regarding internet use has been decreasing in recent years [6]. Among German seniors, men

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tend to use the Internet more than women, with the sex gap narrowed from 8.9% to 2.7% [10]. In Taiwan, among adults aged 55 and over, 45.0% of men and 40.7% of women use the Internet [12]. Among Brazilian adults, it is observed that 97% of individuals with higher education use the Internet, while only 16% without formal education made use of the Internet in 2019 [8].

Regarding family income, in developing countries such as Germany and Taiwan, i.e., older adults having a higher family income triples or double the chances to use the Internet, respectively [10,12]. In a city in Brazil southeast, while between 8 and 10% of the older adults who live with a family income per capita above one minimum wage do not use the Internet, the percentage increases to almost 30% among older adults with a family income below one minimum wage [13]. Thus, family income tends to exert a more significant influence on the use of the Internet among older adults [6]. Concerning race/skin color, until the present study, there were no studies about internet use by older adults.

Among the factors that can influence Internet use, there are modifiable factors such as educational level and family income that can increase access. As for the non-modifiable factors, such as sex, age, and race, it is necessary to know the influence of these factors on using and Internet and what public policies can contribute to reduce inequalities in access to digital technologies by older adults. Thus, understanding the determining factors of the use of internet by older adults can contribute to effective public policies to promote and guarantee digital inclusion for this vulnerable population.

Thus, this study's primary aim was to characterize the Internet's socioeconomic and demographic factors of internet users and non-users. The second aim was to analyze which factor, modifiable or not, influenced incidence of older adults' Internet use over time.

Methods

Participants

This study was made with EpiFloripa Aging Cohort Study data, a population-based longitudinal study of older adults (individuals aged 60 years or older) living in the urban area of Florianópolis, capital of Santa Catarina, Southern Brazil, with Wave 1 in 2009/10, Wave 2 in 2013/14 and Wave 3 2017/19. Since baseline, Wave 1 investigated health, social, and behavioral outcomes.

For sampling in Wave 1, the population was divided into clusters, with the sample selection process in two stages. The first stage units were the census sectors (census units of the Brazilian Institute of Geography and Statistics- IBGE), and those of the second stage were the households. The calculation was carried out to draw households in each sector, considering the average number of residents per home and the percentage represented by the elderly population in the municipality, with an estimated 60 houses per sector. These households were drawn systematically, and all older adults living in their respective residences were considered eligible for the research. A final baseline sample of 1,702 older adults was interviewed. Thus, Wave 1 occurred in 2009/10 (n=1,702), Wave 2 in 2013/14 (n=1,192), and Wave 3 in 2018/19 (n=736). Further details on the methodology of the EpiFloripa Aging Cohort Study are already published [14].

The older adults considered in this study were in follow-up since Wave1 (n=722). To estimate the incidence of internet use, the older adults who were Internet users at baseline were excluded.

Outcome and Exposure Variables

The outcome was internet use. The question identified the internet users in Wave 1, Wave 2, and Wave 3, "Do you use the internet or e-mail?" and answered by the older adults with binary options (yes/no). The frequency of use and the most used devices for internet access were variables also included in this study.

The exposure variables were sex, age, schooling, family income, and ethnicity. Sex was observed by the interviewer and classified by male and female. The age was self-reported, confirmed by birth data registered with a citizen card, and stratified by groups (60-69, 70-79, 80-89, ≥ 90 years). The schooling was self-reported as years of formal study and classified by the National Law of Education Guidelines and Bases (in Portuguese, Lei Nacional de Diretrizes e Bases da Educação – LDB) in groups (0-4, 5-8, 9-11, ≥ 12 years of study). The family income was self-reported by asking for all sources of income of all residents in the older adult's household, calculated as per capita income in the Brazilian Minimum Wage (BMW) unit from the year of the interview, and analyzed by groups (≤ 1, >1-5, >5-10, >10 Brazilian Minimum Wage). The race/skin color was classified by the Brazilian Institute of Geography and Statistics (in Portuguese, IBGE) with categories: white, black, brown, Asiatic, and indigenous. The Asiatic and indigenous were very few (n=7) so they were excluded from the sample analysis.

To illustrate the internet use over time according to age, schooling, and family income characteristics were used graphs were clustered by waves using the long database. The variable was used as a continuous.

Statistical Analysis

Descriptive data were summarized as frequency and proportion in each study wave. The total of the older adults indicated as follow-up sample were included in the description table (n=722). The longitudinal analysis used Generalized Estimating Equations (GEE) to estimate the effect of each exposure (sex, age, schooling, family income, and race/skin color) on the incidence of the outcome (internet use) over the follow-ups of the EpiFloripa Ageing Cohort Study. The frequency of internet use and the devices used for access in the descriptive data were not used in longitudinal analysis.

Four years was the mean time interval between the three Waves of the EpiFloripa Ageing Cohort Study. This period was used to establish a temporal relation with the exposure (socioeconomic and demographic factors) preceding the outcome (internet use). The association between socioeconomic and demographic factors in the previous Wave was calculated concerning internet use in the subsequent Wave. Crude and adjusted Incidence Rate Ratios (IRR) by covariables were estimated considering 95% confidence intervals (95% CI) at a significance level of $p < 0.05$. Wald Chi-Square Test was used to report model effect and the Quasi Likelihood under Independence Model Criterion (QIC) to report goodness of fit.

The difference

All analyses were conducted with Stata v.14.0. For visualization data, QGIS-LTR version 3.16.13 was used for the maps, and Python 3.0 for boxplots.

Results

The sample was a composite of 722 older adults to describe sociodemographic characteristics.

The sample was predominantly women since the Wave 1 (67.2%) data, and the proportion increased over time (Table 1). Regarding age, we observed the aging of the cohort with an increased frequency of the older age groups, naturally. The proportion of the schooling groups of older adults was maintained over the years. There was an improvement in the older adults' family income, especially an increase in groups of 1-5 and 5-10 minimum wages. The white skin color is the majority in the cohort, followed by the brown and black.

The difference between older adult internet users and non-users can be observed when analyzing age, schooling, and family income as continuous variables (Figure 2). Internet users were younger, with higher education and higher income than non-users, in all three waves.

Note: In Figure 2, outliers are removed. For the age variable, 18 individuals aged between 93 and 103 years were removed. For years of schooling, 19 individuals with years of schooling between 25 and 60 were removed. And, for family income, 100 individuals in the family income range of R$ 11,600 and 75,000 were removed.

The older adults who didn't use the Internet were 74.1% of the total sample (n=535). Most non-users of the Internet were women (54%) and white (93%), with an average of 66.4 years old and 14 years of study. For calculating the incidence of internet use in Wave 2 and 3, the internet users of the Wave 1 were excluded from the sample.

The incidence of internet use was 11, 4% in Wave 2 and 23.0% in Wave 3 and was 80% lower in older adults 80 years and over compared to other age groups. Regarding schooling and family income, the internet use incidence was higher according to the increase in education levels and income range, except for older adults with more than 10 BMW (Table 2).

The incidence rate ratio of older adults using the Internet is more than twice as high in the group of 5 to 8 years of schooling; 5.3 times higher in the older adults with 9 to 11 years of education; and 7.1 times higher in older adults with more than 12 years of study, compared to older adults with up to 4 years of schooling. The older adults with 5 to 10 BMWs almost doubled the incidence rate ratio of using the Internet (IRR=1.9), while those with more than 10 BMWs of family income doubled compared to those with one or fewer BMWs. Those who had 80 years and over decreased 70% the incidence of using the Internet compared to older adults between 60 and 79 years. The difference in internet use between sex and race was not significant (Table 3).

In Wave 1, the prevalence of Internet users (26.4%) was higher among downtown residents compared to other regions of Florianópolis. Over time, the continental area and the North of the Island overpass the 26,4% of the users in Wave 2. In wave 3, the East of the Island maintained above the 23,8% of internet users (Figure 3).

Discussion

The prevalence of non-users of Internet decreased over time. However, it is still higher (60.1%) than in high-income countries, as shown in a study conducted in 27 countries in Europe with 51% of people aged 50 and older, and the USA with 25% of individuals aged 65 years and older still do not use the Internet [6,15,16]. The increased number of internet users was predominantly among women, but studies vary between most women and men who are internet users [16-19].

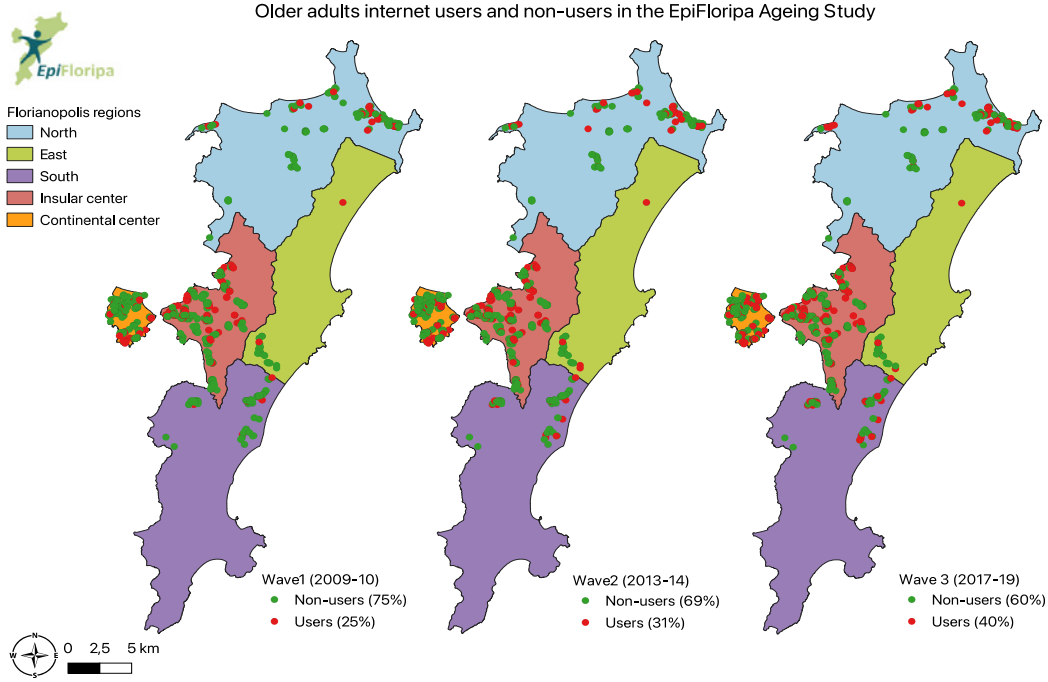

Figure 1: Proportion of older adults in the follow-up (n=722) who are internet users and non-users in the urban area of Florianópolis/SC/Brazil over time.

Table 1: Characteristics of the older adults according to the Waves of the EpiFloripa Ageing Cohort Study.

Variables	Wave 1 (2009-10)	Follow-up Wave 2 (2014-15)	Follow-up Wave 3 (2017-19)
	n (%)	n (%)	n (%)
Sex			
Women	485 (67.2)	485 (67.2)	485 (67.2)
Men	237 (32.8)	237 (32.8)	237 (32.8)
Age group			
60-69	439 (60.8)	289 (40.0)	100 (13.8)
70-79	242 (33.5)	310 (42.9)	386 (53.5)
80+	41 (5.7)	123 (17.1)	236 (32.7)
Schooling (years of study)			
0-4 years	296 (41.1)	296 (41.1)	301 (41.7)
5-8 years	122 (16.9)	122 (16.9)	142 (19.7)
9-11 years	112 (15.5)	112 (15.5)	94 (13.0)
≥ 12 years	191 (25.5)	191 (25.5)	185 (25.6)
Family income (BMW[a])			
≤ 1	79 (11.0)	154 (21.3)	98 (13.6)
> 1- 5	449 (62.2)	306 (42.4)	372 (52.5)
> 5-10	79 (11.0)	96 (13.3)	145 (20.1)
> 10	115 (15.8)	166 (23.0)	107 (14.8)
Race/skin color			
White	629 (88.0)	629 (88.0)	629 (88.0)
Black	40 (5,6)	40 (5,6)	40 (5,6)
Brown	46 (6.4)	46 (6.4)	46 (6.4)
Use of the Internet			
Yes	187 (25.9)	226 (31.3)	288 (39.9)
No	535 (74.1)	496 (68.7)	434 (60.1)

[a]BMW = Brazilian Minimum Wage

Table 2: Incidence of the internet users on Wave2 and Wave 3 according to sex, age, education level, family income, and race/skin color of the older adults at the EpiFloripa Ageing Cohort Study.

Variables	Follow-up Wave 2 (2014-15) (n=85)		Follow-up Wave 3 (2017-19) (n=123)	
	prop (%)	CI	prop (%)	CI
Sex				
Women	15.0	8.6 – 24.8	25.0	20.0 – 30.7
Men	11.3	7.7 – 16.3	19.3	12.6 – 28.3
Age group				
60-69	12.6	8.2 – 19.0	41.4	27.0 – 57.5
70-79	14.8	9.8 – 21.7	31.2	23.9 – 39.7
80+	6.7	2.7 – 15.6	8.0	4.6 – 13.3
Education level (years of study)				
0-4 years	4.2	2.2 – 7.8	9.3	5.5 – 15.3
5-8 years	8.2	3.7 – 17.4	27.4	19.4 – 37.1
9-11 years	27.6	16.5 – 42.2	46.1	30.4 – 62.6
≥ 12 years	32.0	18.6 – 49.3	50.7	38.4 – 62.9
Family income (BMW[a])				
≤ 1	4.3	1.7 – 10.7	15.0	7.6 – 27.4
> 1- 5	14.5	9.5 – 21.5	22.8	17.8 – 28.8
> 5-10	23.5	14.5 – 35.6	36.4	23.6 – 51.5
> 10	12.2	6.3 – 22.3	16.1	7.0 – 33.2
Race/skin color				
White	11.2	8.0 – 15.7	24.5	19.3 – 30.5
Black	39.0	16.9 – 66.8	33.7	14.3 – 60.7
Brown	6.7	2.0 – 20.5	8.9	3.0 – 23.3

The average years of study and family income were higher (more than ten years on average) in users compared to the non-user in all waves. In studies in high-income countries, 65-77% of internet users had some postsecondary education [17,19].

In this study, older adults who use the Internet had better family income than non-users. The study about changes in internet use shows that 35% of older adult internet users reported having a higher than average income [17]. Another study shows that the average annual household income of the older adults who uses the Internet was highest among urban residents, followed by suburban and rural residents [20].

There were a few studies about race and internet use, even more among older adults. In all the studies that compound this study that indicates race/skin color, most participants and internet users were white [19,21]. A study realized with all age groups (36.3% with 65 years and over) about report posting COVID-19 content on social media shows that Latino respondents were significantly more likely than white respondents across all age groups (18 to 29 years: P=.01, 30 to 49 years: P=.04, 50 to 64 years: P<.001, ≥65 years: P=.001). And respondents aged 65 years or older were less likely to post COVID-19 content than respondents aged 18 to 29 years; those who did post content were likely to identify as Latino [21]. Another study shows that being black and living in a rural area further decrease the odds of internet use by 36% [22].

This study was carried out with older adults in an urban area. When studies show the area of residence of the older adults, user or not of the Internet, it is referred the difference between urban (and suburban) and rural areas. In this study, the older adult internet user was centered downtown since Wave 1. Although few studies indicate the geographic area of residents of those participants, a study about the use of health applications shows that the minority lives in urban areas (24.4%) compared with suburban (42.3%) and rural (33.3%)

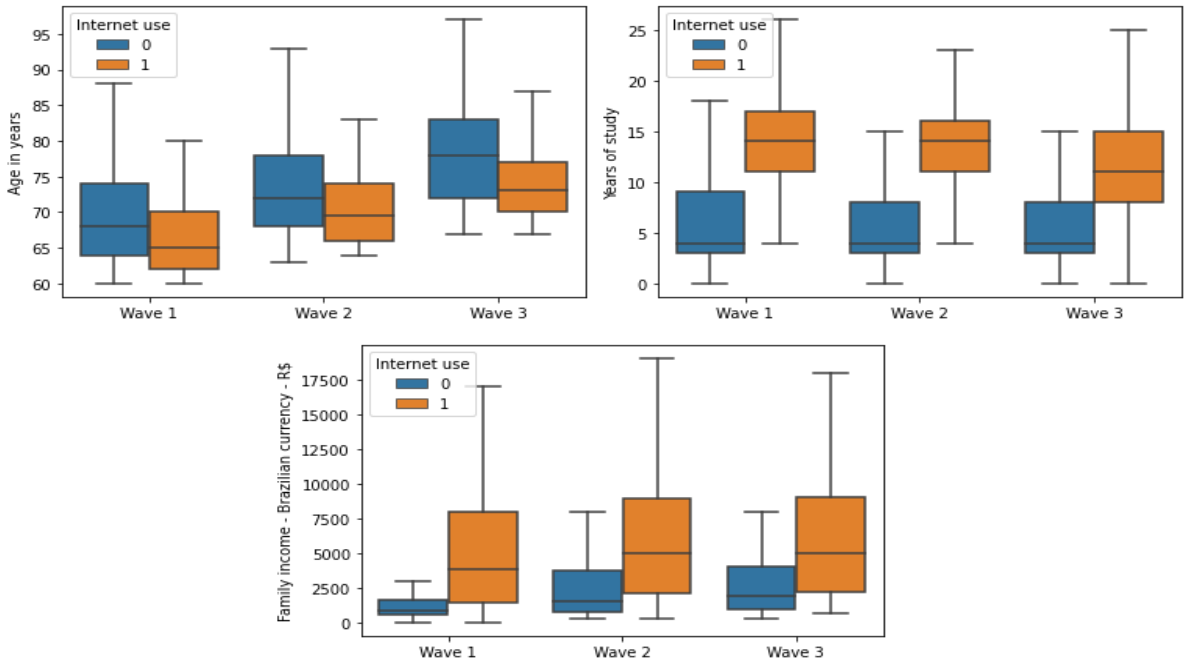

Figure 2: Internet users (orange box=1) and non-users (blue box=0) by age, education, and family income as continuous variables.

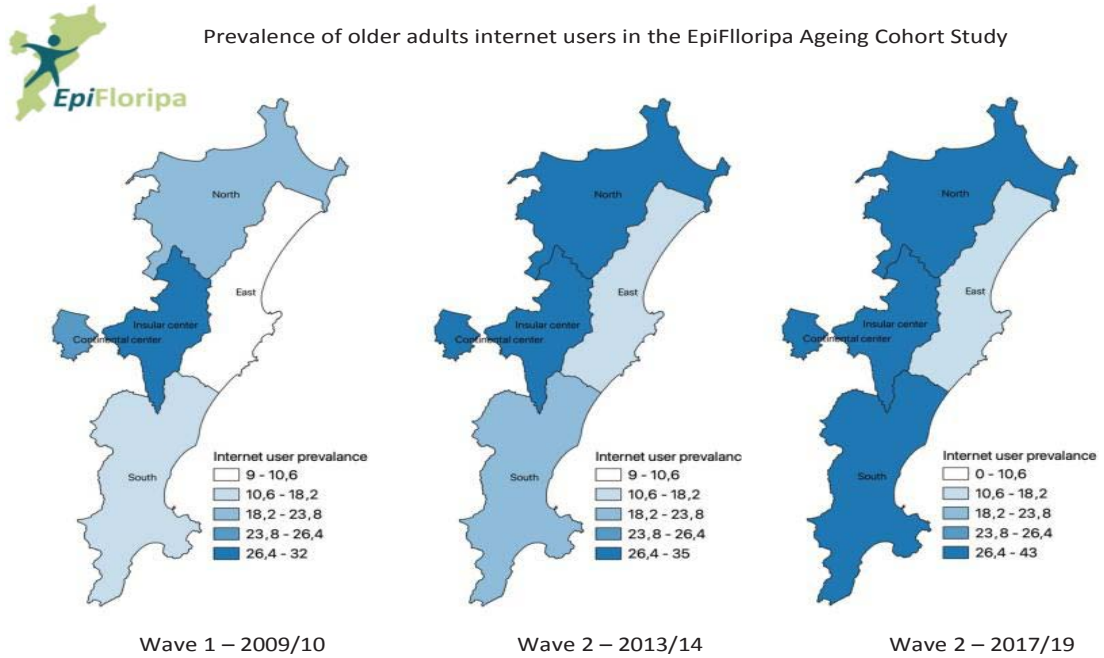

Figure 3: Prevalence of internet users by regions of Florianópolis (The software distributed the prevalence of Wave 1, which was maintained in Wave 2 and 3 for comparison).

[19]. In a study about the association between internet use and patterns of lifestyle self-rated health among older Polish adults, 22.5% live in urban areas, and 27.2% live in rural areas [16]. A study about the interaction between race and residence area shows that older adults living in urban areas use the Internet more than those who live in suburban and rural areas [22].

Since the COVID-19 pandemic onset (2019), tele health and digital health utilization rates have further increased. Several studies about older adults and internet users in the last three years are based on the application for healthcare or social media [18,23-26]. Although the percentage of older adults using apps is lower than that of young people, studies show that the older age group has more engagement

Table 3: Association of sociodemographic characteristics and incidence of internet use among older adults in Waves of the EpiFloripa Ageing Cohort Study.

Variable	IRR [b]	95%CI	*p*[a]
Sex (Female)	1.2	0.8 – 1.8	.364
Age (60-69 years)			
70-79	1.0	0.7 – 1.3	.811
80+	0.3*	0.1 – 0.6	.001
Education level (0-4 years)			
5-8	2.4*	1.4 – 4.0	.001
9-11	5.3*	3.3 – 8.6	<.001
≥ 12	7.1*	4.5 – 11.3	<.001
Family income (≤ 1 BMW)			
> 1- 5	1.3	0.9 – 2.0	.205
> 5-10	1.9*	1.1 – 3.4	.023
> 10	2.1*	1.3 – 3.5	.004
Ethnicity (White)			
Black	1.7	1.0 – 3.0	.077
Brown	0.6	0.2 – 1.3	.180

[a] Generalized Estimating Equation
[b] IRR = Incidence rate ratio
*p-value < .05

in health care apps [18].

The study that analyzes the burden of exclusion in times of COVID-19 shows that older adults risk feeling excluded: physical contact and digital exclusion [15]. The study "stress induced by Information and Communication Technology (ICT) use" shows that the technostress level in 2020 was significantly higher than in 2016. Despite people's digital participation worldwide during the COVID-19 pandemic, older adults were still excluded [15,27]. Some studies show the association between internet use and well-being during the COVID-19 pandemic. A study about the online functions that can improve well-being showed that, during the period of isolation caused by the COVID-19 pandemic, only the use of the Internet for leisure, precisely those whose use, has increased little [17]. A study with older Polish adults shows that internet use is not associated with favorable lifestyle patterns [16].

While the pandemic may have had adverse effects on older adults without the Internet, studies with pre-pandemic data have shown that older adults who use the Internet may have better mental and cognitive health and social networking [28,29].

An interesting study that discusses "When Going Digital Becomes a Necessity" indicated two crucial points: digitalization is insufficient in reaching older adults, and combining online and offline strategies is invaluable in addressing the challenges older adults face [30].

Limitations and Strengths

Most studies on the use of the Internet by the elderly were carried out in the United States or Europe. In Latin America, especially Brazil, there are few studies on older adult internet users. The use of applications in our research was not explored, only the use of the Internet. Device type and usage time were investigated only in waves 2 and 3.

This study has strengths such as data collection was performed by household interviews, a cohort with three waves with follow-up, and one phone interview during the pandemic. It prepares for the following Wave with the household interview in 2023. In addition, the methodology involves quality control, qualified training, and monitoring of interviewers.

Conclusion

In this medium size highly developed capital city of south Brazil, the prevalence and the incidence of internet use is increasing among older adults over the last ten years. Internet users were younger, with higher education and higher income than non-users, in all three waves of the EpiFloripa Aging Cohort Study. The incidence of internet use was higher for women, younger older adults, those with higher education, higher income and black. Public policies are needed to reduce inequalities in access to Internet and promote digital inclusion of older adults.

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