Who is online? A latent class analysis of Internet activities and determinant characteristics of older people

PRE-PRINT VERSION

Abstract

As Italy is the European country with the highest percentage of adults over 60's, growing concerns have emerged about the life of the ageing population in an era of increasing digitalisation. Researchers have shown that Internet can be used for various activities and benefit several aspects of daily life. However, the older people adapt slowly with the technological developments compared to the younger generations. This is the first study to explore the Internet use by the Italian older adults identifying latent groups of Internet users. We have elaborated 13,597 responses from an Italian representative annual population survey and 40 different online activities have been analysed with an Exploratory Factor Analysis and further elaborated together with sociodemographic variables in a Latent Class Analysis (LCA). Three classes of older people Internet users have been detected: Utilitarian, Familiar and Enjoyment users. The findings validated the existence of heterogeneous older adults Internet users showing, at the same time, the importance of personal characteristics to predict class membership. Being woman, widowed, having low income, being low educated, living alone and having various comorbidities predicted less online activities. From a policy perspective this study highlights that targeted training programs together with digital infrastructures' improvements are essential to increase the level of Internet activities in later life and especially the need for policies in favour of the disadvantaged groups of the older population.

Keywords: Aging; Internet use; Digital inclusiveness; Exploratory factor analysis; Latent class analysis

1. Introduction

The ageing of the worldwide population is a key issue for the policy makers in an era of increasing digitalisation (Olsson et al., 2017). When measuring active and healthy ageing, the use of Information and Communication Technology (ICT) is among the most important factors (Zaidi et al., 2017). However, the older people, in general, keep up slowly with the technological progress, remaining less competent compared to the younger generations (Buckingham and Willett, 2006). In fact, according to Cavapozzi and Dal Bianco (2021) after retirement the time allocated for Internet activities becomes less frequent, and this relationship seems to worsen in the long term.

Researchers have shown that normal Internet use (compared to addicted use) can be beneficial for several activities of daily life, and also, older users can reap more benefits compared to younger individuals as their own life is more complex (Noroozi et al., 2021). For instance, a younger healthy individual might not need to search for information about health issues. Additionally, the Internet serves multiple daily needs and its utility stretches to different directions. Through a systematic investigation of the scientific literature, Aggarwal et al. (2020) underline the importance of Internet use on the quality of life of older people. Overall, the authors argue that most studies highlight that Internet is a tool which allows communication with family and friends, maintenance of a wide social network, access to information and participation in online leisure activities. Similarly, Hilt and Lipschultz (2004) indicate that the utility of Internet expands to the use of e-mail with family and friends on a regular basis, search of information about special interests, weather, health, games, jokes, entertainment, shopping and even auctions. Finally, the technology is already used for health teleconsultation sessions (Pekkarinen et al., 2019), becoming a supplementary solution to traditional medical visits, as it has been done during the pandemic for the treatment of COVID-19 patients.

The growing concerns about the ageing population in Italy – as it is the European country with the highest percentage of over 60s and the second in the world after Japan (United Nations, 2019) – are raising urgent questions about the older people's digital life in an era of continuing technological advancements (Baudier et al., 2021). With age increase, the people tend to reduce substantially the time spent for Internet use as reported in Facchini and Sala (2019). The Internet use (even sporadic) in 2016 was 57% among the Italian older people aged 60-64 years old, 32% between 65 and 74 years old and 9% for the over 75 years old. Only if policymakers are well-informed about the familiarity of the older population with Internet use can intervene effectively with targeted policies that help them improve their capabilities and favour their quality of life (see Nimrod, 2017). Yet, as pointed out by Facchini and Sala (2019), little is known about how the Italian older people use the Internet. Existing research has studied only a few Internet activities or used samples from Italian cities that might not represent the digital behaviour of the whole population of Italian older people. To the best of our knowledge, this is the first study to satisfy both criteria. Specifically, by using Exploratory Factor Analysis and Latent Class Analysis as suitable methodology tools, we investigate a broad range of online activities to segment the older people's digital habits in Italy. As a result, the main aim of the paper is to bridge the gap between the decision-making processes of older people's Internet use and evidence-based policies that favour digital inclusiveness in later life by exploring the following research questions:

RQ.1 What is the time of Internet use and the preferred devices for Internet accessibility among the Italian adults over 60 years old?

RQ.2 In which online activities do the Italian older people allocate their time? How can these activities be grouped to create indexes that capture older adults' digital behaviour?

RQ.3 Based on the online activity habits, are there any latent groups (classes) among the Italian older people over 60s? How are the older people's socioeconomic characteristics and the digital infrastructure accessibility related to the latent class membership?

The remaining of the paper is organised as follows. The literature review is presented in Section 2. Section 3 illustrates the dataset and the methodology applied for the analysis. The results of the study are presented and discussed in Section 4. Concluding remarks, together with strengths, limitations and further research directions are outlined in Section 5.

2. Literature review

In general, the recording of the online activities demonstrates high heterogeneity among the scientific literature and the statistical authorities rendering, as such, any reliable cross-study comparison very difficult. As regards the analysis of the Internet activities, only a few researchers have performed either a factor analysis and subsequently a latent class analysis for the identification of groups of older people Internet users or performed solely one of the two methodologies.

Van Boekel et al. (2017) classified a representative sample of 1,418 people aged ≥ 65 years living in the Netherlands into four latent groups, based on 17 online activities. Their analysis produced the following names for the classes: *Practical, Maximisers, Minimisers* and *Social users*. More recently, Park and Kim (2020) analysed data from a nationally representative sample of 1,919 South Korean individuals aged ≥ 65 years suffering from diabetes. Using 10 Internet activities, three classes emerged: *Non-users, Communicating users* and *Smart users.* Finally, Chiu (2019) identified groups of Taiwanese older people Internet users with respect to 10 habitual Internet activities (Eager, Instrumental, Leisure and Sporadic users) and through multinomial logistic regressions identified characteristics associated with the Internet usage by these groups. More particularly, 32% of the survey participants belong to the Leisure users' group and are significantly socially involved (including the Eager users) compared to the remaining identified groups.

For what concerns the analysis of a large scale of online activities, we do not meet in the literature many scientific contributions. As such, Nimrod (2018) with the scope to explain the technophobia faced in later age, used a factor analysis with 12 online activities performed by 537 Israeli Internet users aged more than 60 years old. The author ended up with what calls "*Native activities*" (i.e., functions that required high trust and/or high digital presence, such as

posting opinions to forums and blogs and shopping/banking, which captured mostly the digital behaviour of the old individuals (they explained 23.49% of the overall variance of a four- factor solution). Van Deursen and Helpser (2015) used data concerning older people Internet users obtained through a nationally representative online survey in the Netherlands and investigated 23 online activities (e.g., e-mails, information search, reading news, shopping, social entertainment, downloading music/video, using civic and health services) with respect to age, gender, educational levels, household composition, traditional literacy, Internet experience and attitude. The study remains highly informative and highlights that profiling the older people according to the specific online activity tasks is a more realistic approach than investigating the general Internet use. Finally, through a wider activity analysis of Australian older people and using principal component analysis with 27 online activities, Sum et al. (2009) concluded that the Internet is used mainly for communication activities followed by seeking information, online purchases and just for pleasure.

As regards Italy, in the existing literature there is only a sparse number of studies and these are focused on specific aspects of the Internet connectivity, e.g. the time use and the socio-demographic characteristics of the users (Carlo and Vergani, 2016), the types of online activities (Colombo and Carlo, 2015; Pirone et al., 2008) and the relationship of the educational background as a determinant factor for the Internet use (Kämpfen and Maurer, 2018). Carlo and Vergani (2016) elaborated 900 responses from a representative sample of Italian older people (65-74 years old) and extracted some very interesting results about the factors associated with Internet users and non-users. Firstly, 45% of the older people over 65 years who are currently using computers had previous experience before their 50s. Secondly, among the recent older people Internet users we meet mostly women and individuals with lower income. An interesting classification of Internet use where the activities are related to the availability of time, is given by Colombo and Carlo (2015) using the same dataset as Carlo and Vergani (2016). The authors illustrated that the Italian older people reported using the Internet for activities such as banking and shopping when they want to save time, or, just for pleasure when they have more free time to spend. In the same line, Pirone et al. (2008) studied through descriptive statistics analysis the relationship of older people with ICT among adults (50-70 years old) in two Italian cities (Bologna and Napoli). Remarkably, it is demonstrated that 81.40% of the interviewed older people preferred to search information for personal interests and 70.00% information about the daily news. Kämpfen and Maurer (2018) analysed data for the Internet use of 2,160 Italians (aged 50 or more years old) from the SHARE survey and concluded that one more year of education in younger age increased by 8.00% the probability of using a computer in later age. The results of these studies will be compared in Section *Results and discussion* with the present paper findings, considering, however, that neither of them has provided a wide range of Internet activities nor has performed a complete empirical analysis.

For what concerns the online activities performed in later life and key influential variables the literature is scarce. Generally speaking, there is consensus among the researchers that better health, education, economic status and Internet accessibility favour the digital presence of the older people, while for other variables the results are inconclusive or are activity-related, e.g., the role of gender and civil status.

In the European context, Schehl et al. (2019) support that a sample of 1,222 German older adults aged over 65 years preferred informational online activities, i.e., searching the web, viewing pictures/videos, among social (writing e-mails, writing comments/reviews) and other instrumental activities (banking, shopping). Remarkably, the younger older people and more educated were more likely to perform all types of online activities. Also, men were more probable than women to perform informational and instrumental rather than social activities. Almost similar results were obtained from Leukel et al. (2020) based on the same activity categorisation. The authors analysed data about 1,079 older adults (65+) and reached the conclusion that all the aforementioned activities were preferred by men, more educated and healthier individuals. Very recently, Wan et al. (2022) analysed 11,265 longitudinal data (2008-2016) about the role of subjective health in Internet use from American older people (65-94 years old) and verified that subjective health not only determines current but also future Internet use.

Similarly with the European studies, only a few studies exist about the online activities of older people from non-European countries and each one concludes on a different range of preferred online activities and determinant factors of them. For example, Yu et al. (2015) have explored the access to social network sites using a nationally representative sample (N=18,851) of Americans over 50 years old from the 2012 Health and Retirement Study. The results reveal that younger, female and widowed men are more likely to socialise online. More, it is underlined that Internet presence is not favourable for the individuals with insufficient economic and physical capabilities. On the other hand, Gell et al. (2013) elaborated 7,609 data from the 2011 US National Health and Aging Trends Study (NHATS) showed that in the last month 56.00% of the Internet users executed personal tasks such as shopping or banking, 49.40% health-related activities and 40.20% communication (e-mails or texting messages). The Internet was used mainly by the younger older people, men, educated and married while the physical limitations seem to hinder the older people from staying in touch with technology. Selwyn et al., (2003) working with data from 352 adults aged over 60 years in the West of England and South Wales, report that sending/reading e-mails and writing or editing letters, reports and other documents are the two types of more frequent activities that are performed. Notably, Matthews et al. (2018) elaborated data from six waves (2002 - 2014) of the English Longitudinal Study of Ageing (ELSA) and reported that across all the age cohorts of the older

people in their sample, the rates of Internet use are lower for women (compared to men) and for poorer individuals (compared to the wealthier).

3. Materials and methodology

3.1 Data source and sample characteristics

For the purposes of our analysis, we used individual data provided by the Italian National Institute of Statistics (ISTAT) Multipurpose survey "Aspects of Daily Life" 2018 (ISTAT, 2020). We have used only the data related to people aged more than 60 years old while younger individuals were excluded from the analysis. Thus, the used sample consists of 13,597 units, accounting for about 31% of the full dataset.

Several socio-demographic variables, that are usually considered in the literature, were included (Wan et al., 2022; Leukel et al., 2020; Kämpfen and Maurer, 2018; Matthews et al., 2018; Carlo and Vergani, 2016; Van Deursen and Helsper, 2015; Yu et al., 2015; Gell et al., 2013): age, gender, civil status, level of education, source of income, residence location, physical limitations and type of available Internet connection.

Table 1 summarises the general characteristics of the sample, classified into three age categories: (a) 60-64, (b) 65-74, and (c) 75 years old or higher. Genders are relatively balanced, while the percentage of married people (62%) exceeds the other civil status types. As regards education, 42% do not hold any schooling certificate or has just attended the primary school. As expected, 74% earn their living from retirement pensions. With respect to the health status, 52% reports not having any physical limitations in their daily activities. Furthermore, the analysis includes variables about the digital infrastructures: the fixed broadband Internet connection is widely diffused (42%), followed by the broadband phone network with mobile phones (22%).[1] Finally, considering the geographical dispersion, the sample is represented at 42% by the Northern areas (West and East), 20% by the Central areas, and 38% by the Southern areas (including the Islands).

[1] Details about the Internet accessibility at a regional level are available in Table A (Supplementary Material).

Table 1. Descriptive statistics of the sample

Variable	Responses	Type of Variable	N (%)		Mean (SD)
Age	1 = 60-64 years old	Ordinal	2,971	(21.85)	14.17 (0.76)
(N=13,597)	2 = 65-74 years old		5,295	(38.94)	
	3 = ≥75 years old		5,331	(39.21)	
Gender	1 = Male	Binary	6,110	(44.94)	0.45 (0.50)
(N=13,597)	0 = Female		7,487	(55.06)	
Civil status	1 = Not married	Categorical	914	(6.77)	2.49 (0.94)
(N=13,494)	2 = Married		8,322	(61.67)	
	3 = Divorced		958	(7.10)	
	4 = Widowed		3,300	(24.46)	
Level of education	1 = Elementary school/no	Ordinal	5,617	(41.56)	1.99 (0.99)
(N=13,515)	qualification		3,599	(26.63)	
	2 = Middle school		3,161	(23.39)	
	3 = High school		1,138	(8.42)	
	4 = University degree				
Source of income	1 = (Self) Employment	Categorical	1,677	(13.00)	2.69 (0.75)
(N=13,377)	2 = Maintenance family		1,367	(10.22)	
	3 = Pension		9,922	(74.17)	
	4 = Allowances		303	(2.27)	
	5 = Property income		108	(0.81)	
Physical	1 = No limitations	Ordinal	6,813	(52.17)	1.61 (0.71)
limitations	2 = Reduced limitations		4,496	(34.43)	
(N=13,058)	3 = Severe limitations		1,749	(13.39)	
Internet connection: fixed broadband	1 = Yes	Binary	5,772	(42.45)	0.42 (0.49)
(N=13,597)	0 = No		7,825	(57.55)	
Internet connection: broadband mobile phone network with cell phone or smartphone (N=13,597)	1 = Yes	Binary	2,944	(21.65)	0.22 (0.41)
	0 = No		10,653	(78.35)	
Internet connection: broadband mobile phone network via SIM card or USB key (N=13,597)	1 = Yes	Binary	1,024	(7.53)	0.08 (0.26)
	0 = No		12,573	(92.47)	
Internet connection: fixed or mobile narrowband connection	1 = Yes	Binary	274	(2.02)	0.02 (0.14)
(N=13,597)	0 = No		13,323	(97.98)	

Residence location (N=13,589)	1 = North-West	Categorical	2,995	(22.04)	2.83 (1.32)
	2 = North-East		2,757	(20.29)	
	3 = Centre		2,673	(19.67)	
	4 = South		3,794	(27.92)	
	5 = Islands		1,370	(10.08)	

3.2 Measures

The analysis is based on the Internet use by older adults, considered in terms of general usage, time, and preferred devices. The first aspect is measured with the question "*Have you ever used the Internet?*", coded as an ordinal variable (1/never, 2/between three months and one year ago, 3/more than three months ago, 4/in the last three months).

As for the time use of Internet, it is explored by the question "In the last 12 months, how often have you used *the Internet*?", again coded as an ordinal variable (1/less than once per week, 2/sometimes a month (less than 4 times), 3/once per week, 4/sometimes a week, 5/every day). Lastly, the devices used to Internet access are assessed by the question "*In the last three months which of the following devices have you used to access the Internet: (a) desktop, (b) laptop/netbook, (c) tablet, (d) mobile phone and (e) other devices (media or games player, e-book reader or smart watch)*?", coded as a binary variable (0/No, 1/Yes) for each item.

The survey also includes 40 items about various online activities, coded as binary variables (0/No, 1/Yes). The three top preferred online activities by the Italian older people over 60 years old were: instant messaging for 75% of the participants of the sample, sending/receiving e-mails by 67%, and getting information, reading newspapers or magazines by 58%. Details about other activity types and their frequency can be found in Table B (Supplementary Material).

3.3 Methodology

For each research question, proper analysis methods have been adopted. Figure 1 illustrates the steps of the followed methodology. First, we used descriptive statistics for the investigation of the general time on Internet usage, the time in the last three months, and the devices by which the digital connection is achieved for different age classes and both genders (RQ.1). An Exploratory Factor Analysis (EFA), including principal components method of extraction and varimax rotation (Samuels, 2016) was employed to explore potential similarities among 40 online activities (RQ.2). As a result, the activities were reduced to 29, and five composite indexes were created, collecting Internet activities picked by Internet users in later life. Then, a few tests with the value of Cronbach's alpha (Cronbach, 1951) measured the inter-item consistency reliability of the 29 activities and of the resulting factors[2].

To test for the existence of discrete groups (or classes) of older people with similar online activity profiles (RQ.3), we conducted a Latent Class Analysis (LCA) based on the

[2] Factors containing an eigenvalue of 1.00 or above and including at least 3 items with a loading value greater than 0.40 were kept as interpretable variables to be included in the indexes (Samuels, 2016), as shown in Table 2.

indexes of the online activities that have been created with the EFA analysis. LCA methodology requires four basic steps: (a) identification of LCA indicators, (b) estimation of the latent class models, (c) evaluation of the latent class models, and d) interpretation of the results (Li, 2017). Since the most important stage of LCA regards the identification of the number of latent classes, we fitted separately several model specifications using the Akaike Information Criterion (AIC) (Akaike, 1987) and the Bayesian Information Criterion (BIC) (Schwarz, 1978) using the lowest value in one of the two indicators to select the final specification. Afterwards, the class memberships were calculated to estimate the percentages of the sample in each latent class and the item-response probabilities for the relationships between the indicator variables and the latent classes. The item-response probabilities show the probability of the indicator variables conditional on class membership (Clogg and Goodman, 1984). The names assigned to each latent class were determined by the index indicators with highest values of item-response probabilities. Finally, a multinomial logistic regression model (performed with Stata 16) was used to control for the role of socio-demographic characteristics to the class membership.

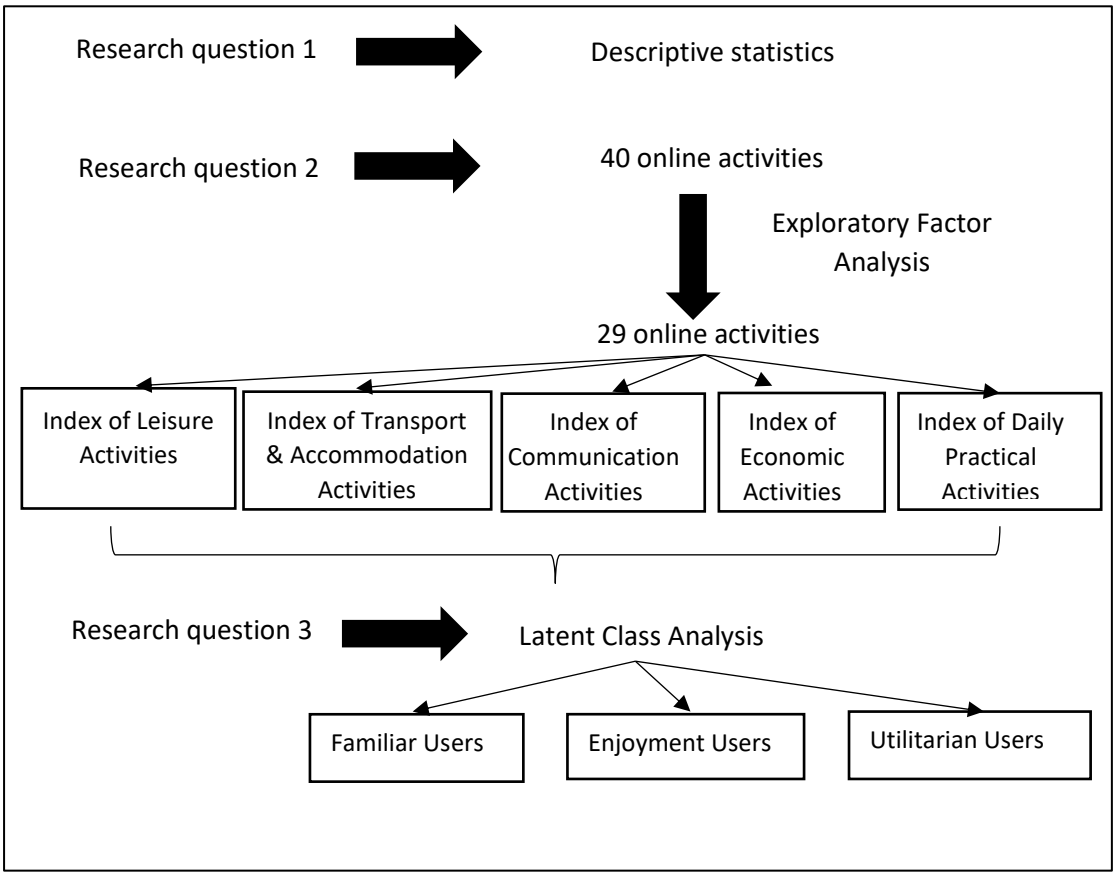

Figure 1. Steps of the methodology

4. Results and discussion

4.1 Time used for Internet and access devices: the role of age and gender

Regarding the RQ.1, in line with Facchini and Sala (2019), in our sample the younger older people (60-64 years old) are more intense users compared to other age classes. Furthermore, considering gender differences, males have used the Internet more than females in the last 3 months (Figure 2). This is in good agreement with evidence in the literature (König et al., 2018; Gell et al., 2013; Selwyn et al., 2003).

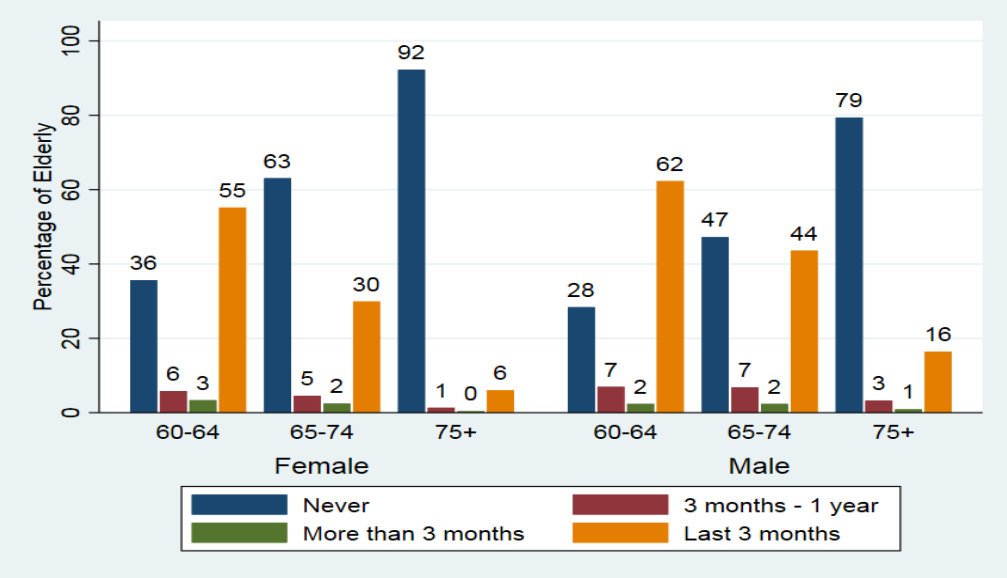

Figure 2. Internet use by age and gender of the individuals over 60 years old (Data: Multipurpose survey "Aspects of Daily Life" 2018, Authors' elaborations)

Figure 3 confirms the decreasing percentage of time for Internet use for all age groups and for both genders, even if there are activity-related divergences from the overall tendency, which will be shown in Section 4.2. As for the gender, again males seem to present slightly higher time allocation for Internet than females in line with other researchers (Matthews et al., 2018; Gell et al., 2013).

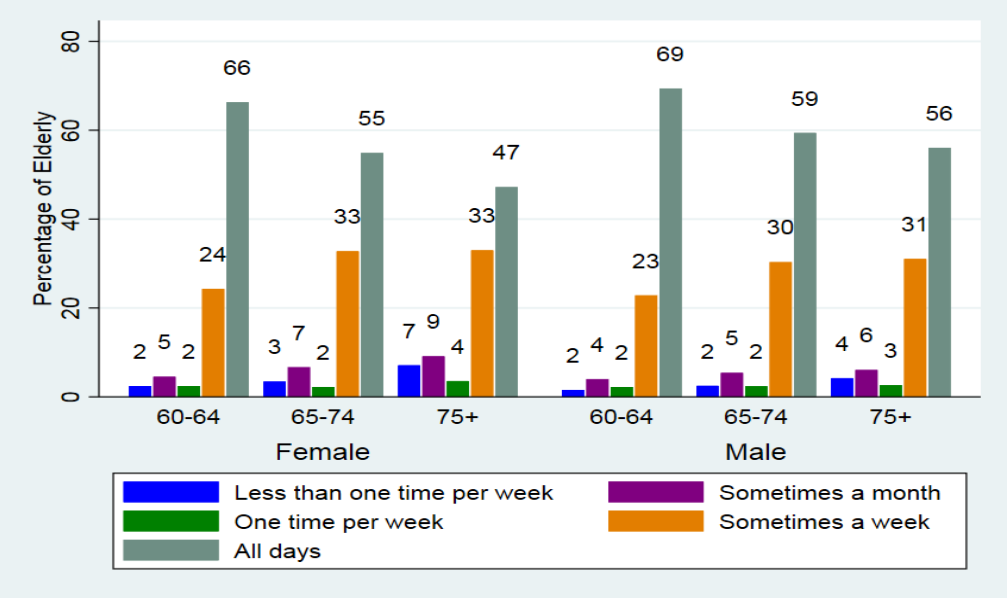

Figure 3. Frequency of the Internet use among the over 60 years old users, by age and gender (Data: Multipurpose survey "Aspects of Daily Life" 2018, Authors' elaborations)

Lastly, Figure 4 depicts the devices preferred by the Italian older people to perform Internet activities. Differences are observed both in terms of age and gender: women between 60-64 years old widely use cell phones, while men of the same age prefer tablets. Women between 65 and 74 years old prefer other devices (media or games player, e-book reader or smart watch), and men still prefer pick tablets. In the late ageing phase (75+), men tend to turn to desktops, probably due to the better readability of digital screens. On the other hand, women of the same age prefer cell phones or tablets. The findings are in line with other Italian studies (Carlo and Vergani, 2016), where among the older people Internet users, women preferred laptops and men preferred desktops.

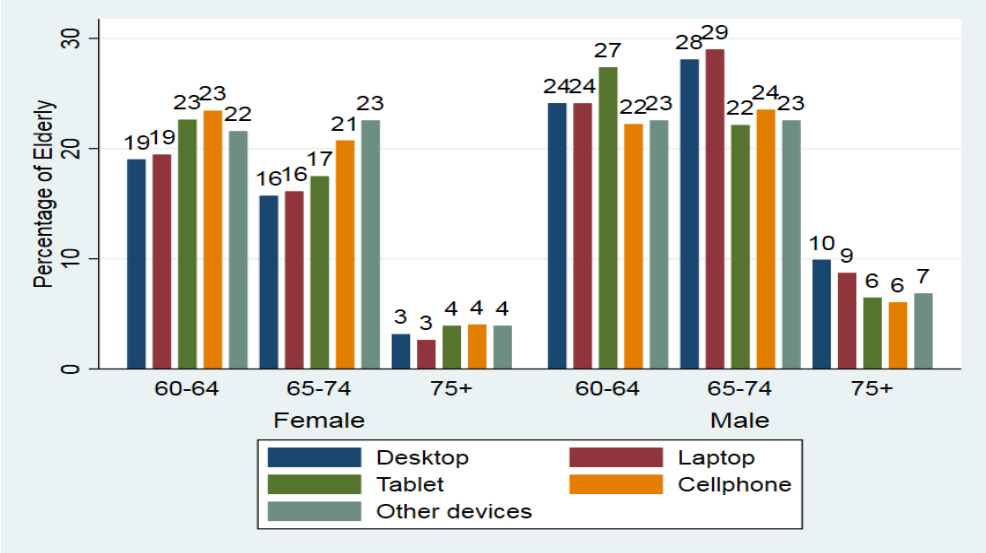

Figure 4. Devices used for the Internet connection among the over 60 years old users, by age and gender (Data: Multipurpose survey "Aspects of Daily Life" 2018, Authors' elaborations)

4.2 Online activities and digital behaviour of over 60s

As regards the RQ.2, we collected the 29 considered online activities into five indexes to create synthetical activity groups, namely *Daily Practical*, *Leisure*, *Transport & Accommodation*, *Communication*, and *Economic* activities index (see Table 2). The over 75s' age group scores low in all the indexes (Figure 5-9) and, as fairly expected, again seems to be less digitally active than the others.

Clear-cut similarities across the indexes are observed. More specifically, we got two polar results concerning the *Leisure Activities Index* (Figure 5) and the *Transport & Accommodation Activities Index* (Figure 6). While the former activities involve quite all the age classes, the latter ones, instead, display very high levels of inactivity in terms of online access, probably because, as people age, the accommodation (and related travel) choices rely on routine habits, and the mobility is often restricted to smaller geographical ranges (reachable also by walking/biking).

The *Communication* (Figure 7), *Economic* (Figure 8) and *Daily Practical Activities' Indexes* (Figure 9) are placed between the above two extremes in terms of use heterogeneity. Various communication activities, such as using social networks, sending instant messages, or making (video) calls are gathered under the index/factor *Communication Activities* (see Table 2). As stressed by Olsson et al. (2019), since the digital ways of communication spread over among the younger generations, older adults are trying to keep up with the technological developments. Under this factor, a key position is taken by the use of the Internet for sending instant messages, and very similar outcomes are observed for 60-64 and 65-74 years old age classes. Quite similar results have been identified for the *Economic Activities' Index*, which includes online purchases, the use of banking services and the communication with banking institutions, mainly exploited by the under 75s. Remarkably, the activities that are grouped under the factor/index *Daily Practical Activities* (e.g., communication with public offices, booking of medical visits, etc.) give us interesting takeaways. Although the over 75s have so far presented striking differences, with respect to the other age classes, in performing the online activities, the *Daily Practical Activities Index* shows indeed a converging behaviour, probably because most of the included activities satisfy priority needs of daily life, pushing all the older people to become more involved with technology.

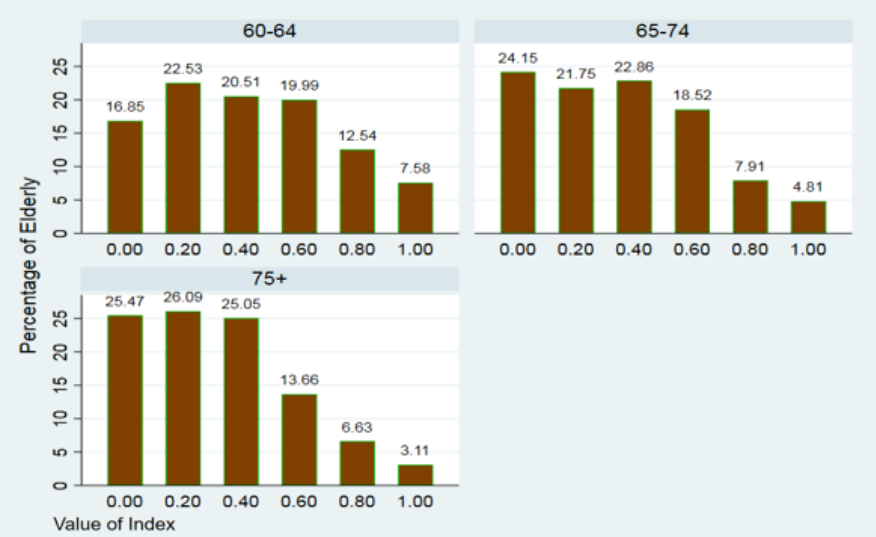

Figure 5. Index of Leisure Activities

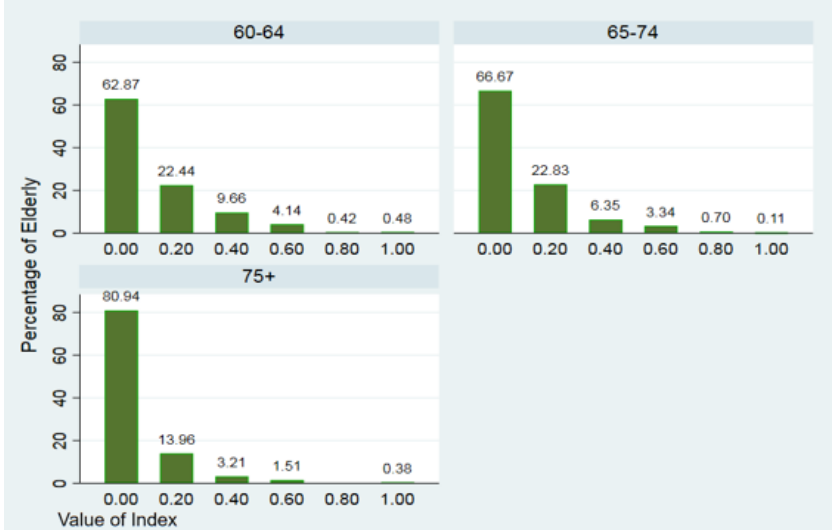

Figure 6. Index of Transport & Accommodation Activities

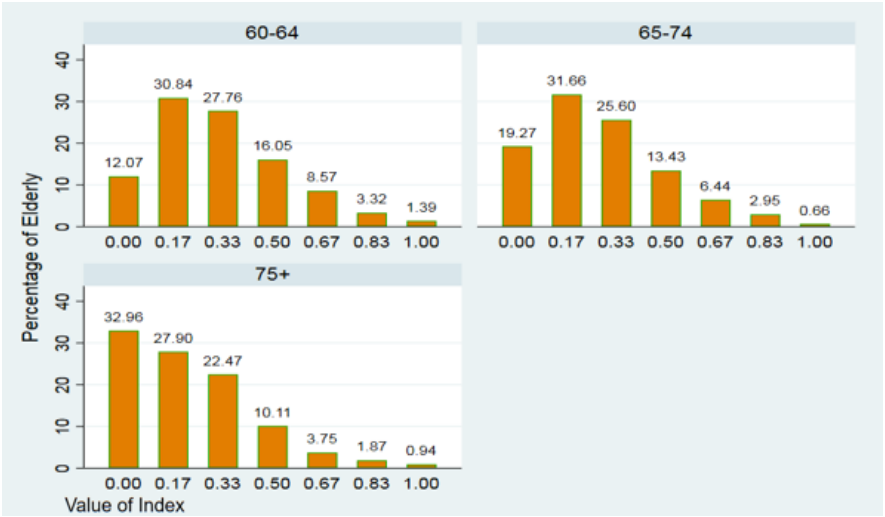

Figure 7. Index of Communication Activities

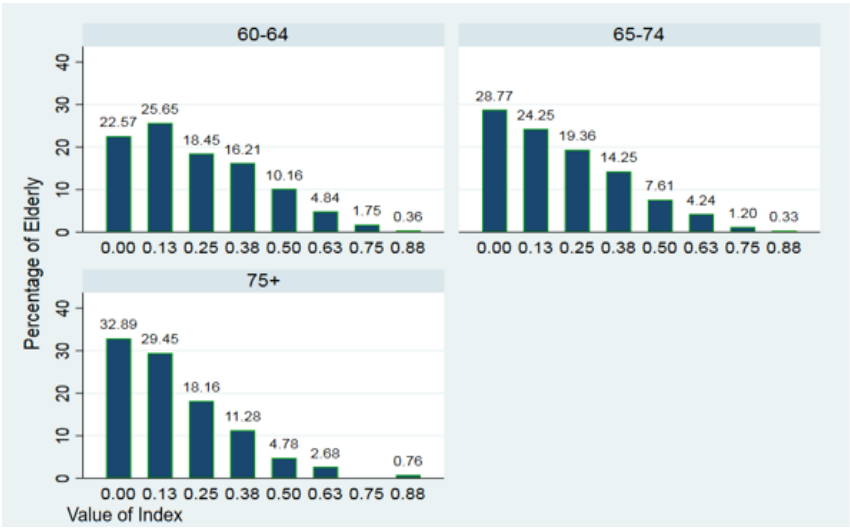

Figure 8. Index of Economic Activities

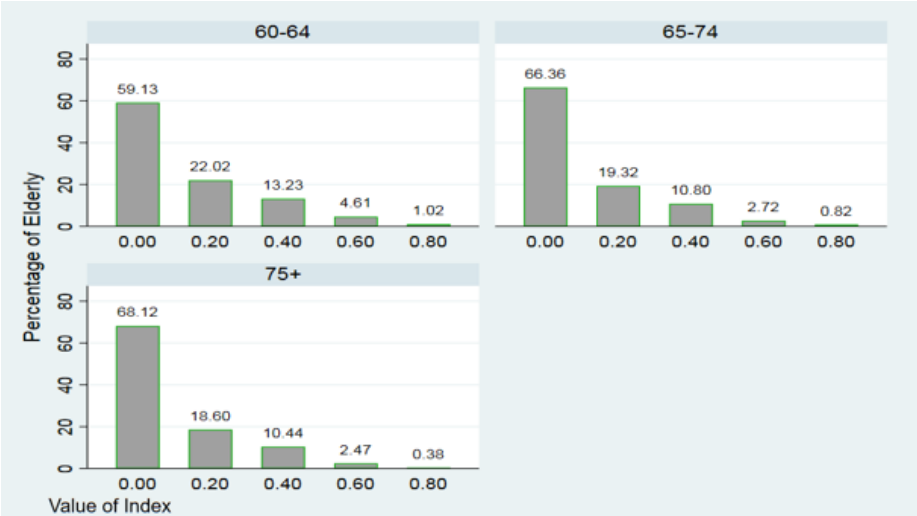

Figure 9. Index of Daily Practical Activities

Table 2. Factor loadings of the reported online activities

Items	Economic	Transport & accommodation	Communication	Leisure	Daily practical
Send or receive e-mails	0.80				
Use Internet for banking services	0.79				
Use payment services (e.g. PayPal, Braintree, etc.) to purchase goods or services	0.73				
Buy or order goods and/or services for private use	0.69				
Carry out financial transactions for private use on the Internet (excluding email): buying / selling stocks, bonds, funds or other financial services	0.67				
Carry out financial transactions for private use on the Internet (excluding e-mails):	0.64				
Use Internet storage/sharing services to save	0.54				
Download software (other than games)	0.51				
Use special websites or apps to take advantage of a transport service by contacting a		0.83			
Use other websites or apps to find accommodation by contacting a private individual indirectly (including social networking sites)?		0.77			
Use special websites or apps to find accommodation by contacting a private individual directly (e.g., AIRBNB, Home way etc.)		0.71			
Use other websites or apps to use a transport service by contacting a private individual indirectly (including social networking sites)?		0.63			
Use travel or accommodation services		0.54			
Social network participation			0.83		
Express opinions on social or political issues			0.73		
Upload content of own creation			0.64		
Send instant messages			0.62		
Participation to professional networks			0.57		
Make phone calls/video calls			0.47		
Listen to music				0.69	
Getting informed for political issues				0.67	
Watch streaming television				0.66	
Reading newspapers, information, online magazines				0.66	
Watch video content from sharing services (e.g., YouTube)				0.59	
Used a website/app that allowed to get a paid job (e.g., Freelancer, Up work, etc.)					0.95
Send completed online forms for private use to the public administration or public					0.63
Obtain information from websites of the public administration or public service					0.63
Watch video on demand					0.56
Book an appointment with a doctor					0.54
Eigenvalue	9.76	2.72	2.45	1.51	1.26
% of explained variance	20.21	12.80	12.63	10.86	10.39

Cronbach's alpha	0.74	0.56	0.59	0.68	0.49

Note: *The scale's total variance explained was 66.97% and the total Cronbach's alpha was 0.84.*

4.3 Latent Class Analysis

4.3.1 Description of the latent classes

In order to assess the RQ.3, we have applied and compared several model specifications from one-class to six-class models in order to identify the appropriate number of classes (as described in Section 3.3), Since the model with the lowest value of either of AIC or BIC criterion is preferable, we chose the 3-class specification, which displays the lowest BIC value. The summary of the model fit statistics is shown in Table 3.

Table 3. Latent Class Analysis fit statistics for indices of online activities

Number of classes	N	Log-likelihood	df	AIC	BIC
1 Class	4,117	-11384.40	5	22778.78	22810.40
2 Classes	4,117	-10672.20	11	21366.46	21436.01
3 Classes	4,117	-10646.90	16	21325.83	**21427.00**
4 Classes	4,117	-10636.00	21	21314.07	21446.85
5 Classes	4,117	-10629.37	29	21316.74	21500.11
6 Classes	4,117	-10628.82	32	21321.64	21523.98

Note: *df=degrees of freedom, AIC=Akaike Information Criterion, BIC=Bayesian Information Criterion*

Then, we estimated the average posterior probabilities of the indexes to be assigned to each latent class. This measure is the average probability of this observation belonging to a given class (Muthén and Muthén, 2000). In Table 4, Class 1 which displays a class membership probability of 0.49 and was labelled as *Familiar users* because it shows the highest item-response conditional probabilities on all the included indexes: *Economic* (0.99), *Leisure* (0.94), *Communication* (0.92), *Daily Practical Activities* (0.60) and *Transport & Accommodation* (0.58). Class 2 (with a probability of 0.29) has a high item-response conditional probability for *Communication* (0.92) and *Leisure Activities* (0.64). Since users composing this group seem to perform low in all the other activities, they have been named *Enjoyment users*. With the lowest item-response conditional probability in *Communication Activities* (0.46) and relatively high probabilities in *Economic* (0.68) and *Leisure Activities* (0.62), Class 3 (0.23 of probability) was labelled as *Utilitarian users*.

Table 5 shows the estimated percentages of the individuals classified in each class based on socio-demographic characteristics, physical limitations, and available digital infrastructure. 52% of the sample (2,029 individuals) is estimated to belong to the *Familiar users'* class. Most of them live in Northern regions of Italy (North-West: 28% and North-East: 26%), belong to the younger older people, i.e., 60-64 years old (49%), are of male gender (61%), are married (72%), with a high school (51%) or university degree (30%), are pensioners (56%) or (self) employed (36%). These

results are in line with the literature. As pointed out by other researchers, the higher the *education level* of the older people the most likely the Internet use is (Leukel et al., 2020; Kämpfen and Maurer, 2018; König et al., 2018). As for the physical capabilities, 68% do not have any limitations. The prevailing type of Internet connection is the fixed broadband (87%) while the mobile (34%), SIM/USB key (12%) and narrowband (3%) are less common.

On the other hand, considering the *Enjoyment users'* class (28%), most individuals come from the middle-age group, i.e., 65-74 years old (50%), are females (67%) and are residents in Northern Italy (West and East, 40%), followed by Southern area (29%). Compared to the other two groups (*Familiar* and *Utilitarian users*), notably, most of the older adults classified in this group are living in the South. Differently from Chiu (2019), who found that the most educated selected leisure activities and the less educated were not spending time on Internet at all, the Italian older people with education level of middle or primary school seem to opt for online enjoyment activities. The highest presence of married persons (66%) is also met in this class. Interestingly, in another study, widowed and older people housewives preferred to use the Internet for socialisation (Yu et al., 2015). Similarly, married (or living with a partner) old adults individuals are found in other works to use most likely the Internet for e-mail/texting messages (Gell et al., 2013). Similarly, Leukel et al. (2020) correlated the older people who live with two or more persons in a household as being inclined to use the Internet, as also found by Carlo and Vergani (2016) from a representative sample of Italian older people (65-74 years old). Lastly, our results agree with Sum et al. (2009) who noted that the older people living with other people tend to use the Internet more often for entertainment purposes. Furthermore, *Enjoyment users* have mostly attended the middle school (52%) and earn their living through retirement pensions (60%). Similar to the *Familiar users*, the older people in the *Enjoyment users'* class do not suffer from physical disabilities (62%). On the contrary, they prefer almost equally to get connected to the Internet either through fixed broadband (55%) or by mobile networks (54%).

Finally, the lowest levels of individuals' presence were observed in the Utilitarian users' class (19%). Most of them belong to the 65-74 years old group (47%) and are males (72%). Notably, the over 75s are mostly represented in the *Utilitarian* class with respect to the other ones. The same happens about physical limitations (11%). As observed in other classes, married people (76%) and pensioners (75%) are prevailing here as well. The fixed broadband connection (76%) is the top way of getting online and the majority lives in the North of Italy (North-West: 29%, North-East: 26%).

Table 4. Class membership and item response probabilities of online activity indexes after controlling for covariates

	Range of values	***Mean (SD)***	***Class 1 Familiar users***	***Class 2 Enjoyment users***	***Class 3 Utilitarian users***
Class Membership Probability	0.00 – 1.00	-	0.49	0.29	0.23
Economic Activities	0.00 – 0.88	0.22 (0.19)	0.99	0.34	0.68
Transport & Accommodation Activities	0.00 – 1.00	0.10 (0.17)	0.58	0.08	0.10
Communication Activities	0.00 – 1.00	0.29 (0.22)	0.92	0.92	0.46
Leisure Activities	0.00 – 1.00	0.38 (0.29)	0.94	0.64	0.62
Daily practical Activities	0.00 – 0.80	0.12 (0.18)	0.60	0.08	0.24

Table 5. Baseline characteristics of people assigned to the 3 classes (with covariates)

Variable	*Responses*	*Familiar users*		*Enjoyment users*		*Utilitarian users*		*Total*	
		N=2,029	(52.16%)	N=1,108	(28.48%)	N=753	(19.36%)	N=3,890	(100%)
Age	60-64 years old	1,004	(49.48)	435	(39.26)	148	(19.65)	1,587	(40.80)
	65-74 years old	875	(43.12)	555	(50.09)	357	(47.41)	1,787	(45.94)
	≥75 years old	150	(7.39)	118	(10.65)	248	(32.93)	516	(13.26)
Gender	Male	1,231	(60.67)	367	(33.12)	542	(71.98)	2,140	(55.01)
	Female	798	(39.33)	741	(66.88)	211	(28.02)	1,750	(44.99)
Civil status	Not married	147	(7.24)	54	(4.87)	59	(7.840)	260	(6.68)
	Married	1,464	(72.15)	736	(66.43)	570	(75.7)	2,770	(71.21)
	Divorced	276	(13.60)	118	(10.65)	51	(6.77)	445	(11.44)
	Widowed	142	(7.00)	200	(18.05)	73	(9.69)	415	(10.67)
Level of education	Elementary school/no qualification	41	(2.02)	268	(24.19)	74	(9.83)	383	(9.85)
	Middle school	350	(17.25)	571	(51.53)	165	(21.91)	1,086	(27.92)
	High school	1,025	(50.52)	226	(20.40)	411	(54.58)	1,662	(42.72)
	University degree	613	(30.21)	43	(3.88)	103	(13.68)	759	(19.51)
Source of income	(Self) employment	729	(35.93)	171	(15.43)	148	(19.65)	1,048	(26.94)
	Maintenance family	93	(4.58)	223	(20.13)	27	(3.59)	343	(8.82)
	Pension	1,141	(56.23)	666	(60.11)	561	(74.50)	2,368	(60.87)
	Allowances	38	(1.87)	36	(3.25)	9	(1.20)	83	(2.13)
	Property income	28	(1.38)	12	(1.08)	8	(1.06)	48	(1.23)
Physical limitations	No limitations	1,387	(68.36)	688	(62.09)	474	(62.95)	2,549	(65.53)
	Reduced limitations	581	(28.63)	343	(30.96)	193	(25.63)	1,117	(28.71)
	Severe limitations	61	(3.01)	77	(6.95)	86	(11.42)	224	(5.76)
Internet connection: fixed broadband	No	259	(12.76)	502	(45.31)	182	(24.17)	943	(24.24)
	Yes	1,770	(87.24)	606	(54.69)	571	(75.83)	2,947	(75.76)
Internet connection: broadband mobile phone network with cell phone or smartphone	No	1,333	(65.70)	509	(45.94)	692	(91.90)	2,534	(65.14)
	Yes	696	(34.30)	599	(54.06)	61	(8.10)	1,356	(34.86)
Internet connection: broadband mobile phone network via SIM card or USB key	No	1,792	(88.32)	948	(85.56)	656	(87.12)	3,396	(87.3)
	Yes	237	(11.68)	160	(14.44)	97	(12.88)	494	(12.7)
Internet connection: fixed or mobile narrowband connection	No	1,959	(96.55)	1,078	(97.29)	724	(96.15)	3,761	(96.68)
	Yes	70	(3.45)	30	(2.71)	29	(3.85)	129	(3.32)
Residence location	North-West	567	(27.94)	226	(20.40)	222	(29.48)	1,015	(26.09)
	North-East	535	(26.37)	221	(19.95)	199	(26.43)	955	(24.55)
	Centre	450	(22.18)	207	(18.68)	168	(22.31)	825	(21.21)

	South	331	(16.31)	318	(28.70)	115	(15.27)	764	(19.64)
	Islands	146	(7.20)	136	(12.27)	49	(6.51)	331	(8.51)

4.3.2 The association of sociodemographic factors with class membership

In order to better answer the RQ.3, we have identified potential determinants associated with membership among the three latent classes, various socio-demographic variables were inserted into a multinomial logistic regression model. The results are presented in Table 6. The less likely latent class (Class 3: *Utilitarian users*) was used as the reference category.

From the pairwise comparison with *Familiar users*, notice that for age (all subgroups), education levels (only for high school and university degrees), civil status (only being divorced), having severe physical limitations and all types of Internet connections, the difference is statistically significant. These results mean that familiar users are more likely to have higher education, being divorced, have fewer physical health issues, and have better Internet accessibility. Regarding the assessment of *health status* (physical limitations), our study confirms partially what has already been found by the available literature: when comparing *Familiar* and *Utilitarian users*, the existence of physical health limitations emerges significant. As such, Gell et al. (2013) found strong relations between increased health status levels and time allocated on Internet or sending emails/texting messages.

Similarly, when comparing *Utilitarian* with *Enjoyment users*, significant differences in terms of age, gender, education levels (high school or higher), civil status (divorced, widowed), severe limitations, income sources from family, pensions and allowances, being connected on the Internet through mobile and living in the Centre, South/Islands were detected. Our finding confirms some existing literature, while differs from some others. Notably, Chiu (2019) confirms that women are more actively involved with enjoyment activities rather than men, as the majority of the *Enjoyment users'* group are women. On the contrary, Schehl et al. (2019) found that the gender did not allow the prediction of involvement with social activities of German older people. However, when searching the *Utilitarian* with *Enjoyment users* the effects are not statistically significant. Other studies demonstrated that the better health evaluation the most probable becomes to use the Internet (Wan et al., 2022) and others more specifically for social purposes (Yu et al., 2015).

Unfortunately, since we did not have information about the exact amount of the individuals' income, but only the source of income, our results are not directly comparable with the existing evidence. Intuitively speaking, finding that *Utilitarian-Enjoyment users* differ substantially when maintained by their family or receive state allowances, we can say that the income is indeed an important factor in determining the Internet behaviour of the Italian older people. This finding is in agreement with existing literature that infers a positive relationship between economic resources and Internet use (Matthews et al., 2018; Yu et al., 2015).

Table 6. Multinomial logistic regression model. Latent class membership comparisons (with respect to the baseline Class 3 – *Utilitarian users*)

Determinant Factors	***Group 1*** ***Familiar users***					***Group 2*** ***Enjoyment users***				
Reference group: *Group 3 Utilitarian users*	Coef.		S.E.	95% CI Lower	- Upper	Coef.		S.E.	95% CI Lower	- Upper
Gender	-0.09		0.17	-0.42	0.25	-1.53	***	0.24	-1.99	-1.07
Age (ref.: 60-64)										
65-74	-0.95	***	0.19	-1.32	-0.57	-0.62	**	0.26	-1.13	-0.12
75+	-2.26	***	0.26	-2.77	-1.75	-1.52	***	0.36	-2.22	-0.82
Education (ref.: Primary school)										
Middle school	0.69	*	0.37	-0.03	1.41	-0.30		0.33	-0.95	0.34
High school	0.97	**	0.36	0.26	1.67	-2.22	***	0.37	-2.96	-1.49
University degree	1.99	***	0.39	1.21	2.76	-2.47	***	0.45	-3.36	-1.58
Civil Status (ref.: Not married)										
Married	0.08		0.28	-0.48	0.63	0.52		0.43	-0.34	1.37
Divorced	0.81	**	0.36	0.11	1.52	1.11	**	0.52	0.08	2.13
Widowed	0.24		0.37	-0.49	0.97	0.93	*	0.53	-0.10	1.97
Limitations (ref.: No limitations)										
Reduced	0.20		0.16	-0.12	0.53	0.15		0.23	-0.30	0.60
Severe	-1.24	***	0.31	-1.85	-0.63	-0.76	*	0.40	-1.54	0.02
Income (ref.: Self-employment)										
Family	-0.05		0.41	-0.86	0.76	1.62	***	0.51	0.62	2.61
Pension	0.02		0.21	-0.39	0.43	0.61	*	0.32	-0.01	1.23
Allowances	0.73		0.68	-0.60	2.05	1.82	**	0.82	0.23	3.42
Property	0.10		0.66	-1.20	1.39	0.07		1.02	-1.93	2.06
Internet connection										
Fixed broadband	1.66	***	0.28	1.11	2.20	-0.21		0.34	-0.87	0.46
Broadband mobile phone network with cell phone or smartphone	1.77	***	0.29	1.21	2.34	2.18	***	0.32	1.55	2.81
Broadband mobile phone network via SIM card or USB key	0.83	**	0.30	0.25	1.41	0.28		0.37	-0.44	1.01
Fixed or mobile narrowband connection	1.34	***	0.47	0.42	2.25	0.08		0.64	-1.17	1.33
Residence location (ref.: North-West)										
North-East	0.08		0.19	-0.30	0.46	0.12		0.29	-0.45	0.69
Centre	-0.15		0.21	-0.56	0.25	0.57	*	0.32	-0.05	1.19

South	-0.29	0.24	-0.75	0.18	1.62	***	0.34	0.96	2.28
Islands	-0.02	0.32	-0.64	0.60	1.39	***	0.42	0.56	2.22

Note: *N=3,890; Log likelihood = -9429.30; SE = standard error; CI = confidential interval, *p < .1, **p < .05, ***p < .001*

5. Conclusions and policy implications

The recent pandemic of COVID-19 underlined that the older people who are not familiar with the ICT use run high risk of being not only socially but also digitally excluded (Seifert et al., 2020; Zheng and Walsham 2021). To the best of our knowledge, this is the first study that analyses in depth the Internet use by the Italian older adults, also associating it with sociodemographic parameters. Remarkably, from a methodological point of view, two contributions are highlighted. One of its strengths is considered the wide range of the online activities analysed which allows to comprehend deeply the Internet use and in this aspect the study is considered also innovative in the whole literature about Internet use in later life. An additional strength is the use of a representative sample of the Italian population and thus the results can be generalized to the whole population of Italian older people.

Importantly, scientific evidence has shown that that the use of the Internet was consistently associated with the health performance of the older people translated into lower presence of chronic conditions and visits to health care facilities (Duplaga, 2020) or specifically higher cognition (Yu and Fiebig, 2020), implying, therefore, a lower burden for the healthcare systems. The identification of classes, grouping together users with similar characteristics, has underlined the influence of the socio-demographic determinants on the older people's digital habits, in allocating their time in very different Internet activities. The paper findings, therefore, suggest to the policymakers the need to design ad hoc measures to improve the digital capabilities in later life, considering sociodemographic characteristics (especially for the disadvantaged groups of the older population such as women, widowed, low educated, living alone, with low direct economic resources and those with existing comorbidities). Nevertheless, learning and training programs, although common interventions are not enough for the digital inclusion in later life unless properly performed to favour the psychological confidence and feelings of achievement (Lam and Lee, 2016; Gallistl et al., 2020). What is more, it has been found that the type of Internet connection i.e., fixed broadband or mobile Internet connection, are strongly associated with what activities the individuals are pursuing online (Quaglione et al., 2020). It seems clear that efficient policies require both ICT infrastructures and investments in specific training policies. Such mixtures of policies could support the older people in approaching and improving the use of the Internet for different operations and stay independent and better connected to the evolving modern societies, thus, improving their overall well-being (Lam and Lee, 2016). Otherwise, a consistent component of the Italian older people risks being excluded from the digitalisation era.

A limitation of the study that needs to be mentioned refers to the available data: despite the plurality of the included online activities, the frequency of performance of each activity was missing from the dataset. Also, all the variables about the several online activities were self-

reported by the older people, which means that a sort of underestimation or overestimation of the real online activity might be present. More, additional variables, such as the traditional literacy (Van Deursen and Helsper, 2015), previous experience with computers (König et al., 2018), and basic common age-related chronic diseases and the psychological state (Choi and Dinitto, 2013) were not collected by the survey. Additionally, apart from a few longitudinal studies (see for example Matthews et al., 2018), the researchers have principally used cross-sectional data in their research, as it was in our case. As some controversies exist in the literature with respect to the influence of some sociodemographic characteristics, e.g., devices of Internet use, gender differences etc., and full description of the online activities, future research studies need to shed further light on ambiguous aspects of the older people's digital behaviour. The application of a similar methodology to ours even in other geographical contexts could enrich the analysis, making comparable the results and underlining similarities and differences of the older people's digital behaviour according to the specific cultural features.

Abbreviations

AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
EFA	Exploratory Factor Analysis
ICT	Information and Communication Technology
ISTAT	Italian National Institute of Statistics
LCA	Latent Class Analysis

References

Akaike, H. (1974). A new look at the statistical model identification. *IEEE transactions on automatic control*, 19, 716–723.

Aggarwal, B., Xiong, Q., Schroeder-Butterfill, E. (2020). Impact of the use of the internet on quality of life in older adults: review of literature. *Primary Health Care Research & Development*, 21(e55), 1–6.

Baudier, P., Kondrateva, G., Ammi, C., Chang, V., Schiavone, F. (2021). Patients' perceptions of teleconsultation during COVID-19: A cross-national study. *Technological Forecasting & Social Change*, 163, 120510.

Buckingham, D., Willett, R. (2006). *Digital Generations: Children, Young People, and New Media*. Mahwah, NJ: Lawrence Erlbaum.

Carlo, S., Vergani, M. (2016). Risk and benefit perceptions: resistance, adoption and uses of ICT among the Italian elderly. *International Conference on Human Aspects of IT for the Aged Population*, 155-166. Switzerland: Springer.

Cavapozzi, D., Dal Bianco, C. (2021). Does retirement reduce familiarity with information and communication technology? *Review of Economics of the Household*.

Chiu, C.J. (2019). Relationship between Internet behaviours and social engagement in middle-aged and older adults in Taiwan. *International Journal of Environmental Research and Public Health*, 16, 416.

Choi, N.G., Dinitto, D.M. (2013). Internet use among older adults: association with health needs, psychological capital, and social capital. *Journal of Medical Internet Research*, 15(5), e97.

Clogg, C.C., Goodman, L.A. (1984). Latent structure analysis of a set of multidimensional contingency tables. *Journal of the American Statistical Association,* 79, 762-771.

Colombo, F., Carlo, S. (2015). Access and use of ICTs among the Italian young elderly: a field study. In J. Zhou & G. Salvendy (Eds). *Active ageing and healthy living*. (145-156). IOS press: Amsterdam Ne.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16(3), 297–334.

Duplaga, M. (2020). The association between Internet use and health-related outcomes in older adults and the elderly: A cross-sectional study. *BMC Medical Informatics and Decision Making*, 21, 150.

Facchini, C., Sala, E. (2019). Anziani e nuove tecnologie. Rischi e opportunità. *Autonomie locali e servizi sociali.* 2/2019, agosto, 151-162.

Gallistl, V., Rohner, R., Seifert, A., Wanka, A. (2020). Configuring the older non-user: Between research, policy and practice of digital exclusion. *Social Inclusion*, 8(2), 233-243.

Gell, N.M., Rosenberg, D.E., Demiris, G. (2015). Patterns of technology use among older adults with and without disabilities. *The Gerontologist*. 55(3), 412–421.

Hilt, M. L., Lipschultz, J.H. (2004). Elderly Americans and the Internet: E-mail, TV news, information and entertainment websites. *Educational Gerontology*, 30 (1), 57 – 72.

ISTAT (2020). Multipurpose survey "Aspects of Daily Life", 2018 data. ISTAT, Rome, Italy. Available at: https://www.istat.it/it/archivio/129956

Kämpfen, F., Maurer, J. (2018). Does education help 'old dogs' learn 'new tricks'? The lasting impact of early-life education on technology use among older adults. *Research Policy*, 47(6), 1125–1132.

König, R., Seifert, A., Doh, M. (2018). Internet use among older Europeans: an analysis based on SHARE data. *Universal Access in the Information Society*, 17(3), 621–633.

Lam, J.C.Y., Lee, M.K.O. (2006). Digital Inclusiveness – Longitudinal study of Internet adoption by older adults. *Journal of Management Information Systems*, 22(4), 177-206.

Li, C.R. (2017, November). Latent class analysis in Mplus. Available at: https://education.uky.edu/edp/apslab/events/#LCA

Leukel, J., Schehl, B., Sugumaran, V. (2020). To do or not to do: How socio-demographic characteristics of older adults are associated with online activities. International Conference on Human-Computer Interaction HCII 2020: Human Aspects of IT for the Aged Population. *Technology and Society*, 255-268.

Matthews, K., Nazroo, J., Marshall, A. (2019). Digital inclusion in later life: Cohort changes in Internet use over a ten-year period in England. *Ageing & Society*, 39(9), 1914–1932.

Muthén, B. O., Muthén, L. K. (2000). Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. *Alcoholism: Clinical and Experimental Research*, 24(6), 882-891.

Nimrod, G. (2018). Technophobia among older Internet users. Educational Gerontology, 44(2–3), 148–162.

Noroozi, F., Hassanipour, S., Eftekharian, F., Eisapareh, K., Kaveh, M.H. (2021). Internet addiction effect on quality of life: a systematic review and meta-analysis. The Scientific World Journal, 2556679.

Olsson T., Samuelsson U., Viscovi D. (2019). Resources and repertoires: Elderly online practices. *European Journal of Communication*, 34(1), 38–56.

Olsson., T., Samuelsson, U., Viscovi, D. (2017). At risk of exclusion? Degrees of ICT access and literacy among senior citizens. *Information, Communication & Society*, 22, 55–72.

Park, S., Kim, B. (2020). Readiness for utilizing digital intervention: Patterns of Internet use among older adults with diabetes. *Primary Care Diabetes*, 14(6), 692–697.

Pirone, F., Pratscjke, J. (2008). Un'indagine sull'uso delle Ict tra gli over 50: considerazioni su nuovi fattori di disuguaglianza sociale e territoriale *Sociologia del lavoro*, 110/2008.

Quaglione, D., Matteucci, N., Furia, D., Marra, A., Pozzi, C. (2020). Are mobile and fixed broadband substitutes or complements? New empirical evidence from Italy and implications for the digital divide policies. *Socio-Economic Planning Sciences*, 100823.

Samuels, P. (2016). *Advice on Exploratory Factor Analysis*. Birmingham City University: Birmingham, UK. Available at: http://www.open-access.bcu.ac.uk/6076/

Schehl, B., Leukel, J., Sugumaran, V. (2019). Understanding differentiated Internet use in older adults: A study of informational, social, and instrumental online activities. *Computers in Human Behavior*, 97, 222–230.

Seifert, A., Cotten, S. R., Xie, B. (2020). A double burden of exclusion? Digital and social exclusion of older adults in times of COVID-19. *The Journals of Gerontology, Series B: Psychological Sciences and Social Sciences*, 1–5.

Selwyn, N., Gorard, S., Furlong, J., Madden, L. (2003). Older adults' use of information and communications technology in everyday life. *Ageing & Society*, 23(5), 56-582.

Sum, S., Mathews, M., Hughes, I. (2009). Participation of older adults in cyberspace: how Australian older adults use the Internet. *Australasian Journal of Ageing*, 28(4), 189-193.

Schwarz, G. (1978). Estimating the dimension of a model. *The Annals of Statistics*, 6, 461-464.

Tabachnick, B.G., Fidell, L.S. (2019) *Using Multivariate Statistics*, 7th ed.; Pearson: New York, NY, USA, 2019, ISBN 978-0-13-479054-1.

Yu, D., Fiebig, D.G. (2020). Internet use and cognition among middle-aged and older adults in China: A cross-lagged panel analysis. *The Journal of the Economics of Ageing*, 17, 100262.

United Nations (2019). Department of Economic and Social Affairs, Population Division (2019). World Population Ageing 2019: Highlights (ST/ESA/SER.A/430). Available at: https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf

Van Deursen, A.J., Helsper, E.J. (2015). A nuanced understanding of Internet use and non-use among the elderly. *European Journal of Communication*, 30(2), 171-187.

Van Boekel, L. C., Peek, S. T., Luijkx, K. G. (2017). Diversity in older adults' use of the Internet: Identifying subgroups through latent class analysis. *Journal of Medical Internet Research*, 19, e180.

Van der Wardt, V., Bandelow, S., Hogervorst, E. (2012). The relationship between cognitive abilities, wellbeing and use of new technologies in older people. *Gerontechnology*, 10(4), 187-207.

Wan, X., Lighthall, N.R., Paulson, D. (2022). Subjective markers of successful aging and change in Internet use among older adults: The distinctive role of subjective health. *Computers in Human Behavior*, 127, 107064.

Yu, R. P., Ellison, N. B., McCammon, R. J., Langa, K. M. (2015). Mapping the two levels of digital divide: Internet access and social network site adoption among older adults in the USA. *Information, Communication & Society*, 19(10), 1445–1464.

Zaidi, A., Gasior, K., Zolyomi, E., Schmidt, A., Rodrigues, R., Marin, B. (2017). Measuring active and healthy ageing in Europe. *Journal of European Social Policy*, 27, 138–157.

Zheng, Y., Walsham, G. (2021). Inequality of what? An intersectional approach to digital inequality under Covid-19. *Information and Organization*, 31, 100341.