

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

Abstract

As Italy is the European country with the highest percentage of adults aged over 60, growing concerns have emerged about how the ageing population is living in an era of increasing digitalisation. According to the capability approach framework, Internet services can enable older adults to achieve social inclusiveness and independence, only if the variety of digital activities includes a large number of active ageing parameters. This is the first study that explores Internet use by Italian older adults and identifies latent groups of Internet users. We elaborated 13,597 responses from an Italian representative annual population survey and 40 different online activities were analysed using an Exploratory Factor Analysis and further elaborated together with sociodemographic variables in a Latent Class Analysis. Three classes of older Internet users were identified: Utilitarian, Familiar and Enjoyment users. The findings support the existence of heterogeneous older Internet users, at the same time showing the importance of personal characteristics to predict class membership. Being female, widowed, having a low income, being poorly educated, living alone, and having various comorbidities predicted fewer online activities. From a policy perspective, this study highlights that targeted training programmes together with improvements to digital infrastructures are essential to increase the level of Internet activities in later life as is the need for policies in favour of the disadvantaged groups in the older population.

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

1. Introduction

1.1. Background

The ageing of the worldwide population is a key issue for policy makers in an era of increasing digitalisation (Olsson et al., 2017). Due to changing demographics, ageing has increasingly become a major issue for governments and policymakers. In particular, the preservation of good psycho-physical conditions in later life is crucial to contain the healthcare needs, reducing, as a result, the burden on public expenditures (Raad and Young, 2008; Chang et al., 2015; Choudrie et al., 2018; Nikou et al., 2020).

Within this framework, the social participation and independence of the older people in modern societies can be effectively increased using digital technologies (Kao et al., 2018), to access different on-line Internet services (Wan et al., 2022).

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, from a digital divide perspective (e.g., Chen, 2020), older people often do not keep up with technological progress (Macdonald and Hülür, 2020), remaining less competent compared to the younger generations (Buckingham and Willett, 2006). Also, older users can reap more benefits compared to younger individuals, as their own lives are more complex (Noroozi et al., 2021). For instance, a younger healthy individual might not need to search the Internet for information about health issues. Additionally, the Internet serves multiple daily needs and its utility stretches in different directions. According to Cavapozzi and Dal Bianco (2022), after retirement, the time allocated for Internet activities becomes less frequent, and this relationship seems to worsen in the long term.

1.2 The Capability approach

For older people, the capability approach is particularly relevant due to the specific challenges they may face as they age. Following the capability approach (CA) framework (Sen, 2001, 1999, 1992; Nussbaum, 2006, 2000), Internet services can be seen as *resources* giving older adults the opportunity to access more *functions* (i.e., what people can do or achieve by those resources) to acquire more inclusiveness and social engagement (Alkire, 2005). Within ICT systems, the CA has been recognized as an appropriate tool to analyse the impact of digital technologies on people's improvements (Nikou et al., 2020). Overall, the capability approach framework can help in promoting a more nuanced and inclusive understanding of well-being and development of individual skills, recognizing the aspirations of older individuals and guiding policies and interventions to enhance their capabilities and quality of life.

Researchers have shown that normal use of the Internet (compared to addicted use) can be beneficial for several activities in daily life, because it could be considered as a *conversion factor*, i.e. a social mediator transforming a “resource” into a “functioning” (Sen, 1992), improving, in the case of older people, their social participation (see next section). In fact, according to Aggarwal et al. (2020), most studies highlight that the 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) indicated that the utility of the Internet expands to the use of e-mail with family and friends on a regular basis, the search for 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 has been the case during the pandemic for the treatment of COVID-19 patients.

Since Italy is the European country with the highest percentage of people aged over 60 and the second in the world after Japan (United Nations, 2019), growing concerns about the ageing population have raised urgent questions about older people's digital life in an era of continuing technological advancements (Baudier et al., 2021).

1.3 Aim and research questions

Through the lens of the CA perspective adopted in this paper, yet most of the studies on the potential impact of Internet use on older people's life have so far investigated the relationship between ICT usage and social inclusiveness, but there is still a considerable lack of information about the variety of online activities and older adults' characteristics in Italy. The Capability Approach theory provides a framework to understand the relationships between older peoples' socioeconomic characteristics and digital infrastructure accessibility. It highlights how socioeconomic factors can influence older peoples' capabilities and well-being, and how access to digital infrastructure can enhance their capabilities by providing opportunities and resources for a more fulfilling life. Overall, by a practical point of view, the use of internet enables the elderly to enhance communication and have access to wider information and services, supporting lifelong learning, managing health, providing entertainment, assisting with financial management, and facilitating social connections and support. The internet empowers older individuals to lead more independent, informed, and connected lives.

To best of our knowledge, the existing scientific literature has not yet provided an analysis of the wide range of Internet activities performed by people in later life; detailed research about the online activities of the older people is still lacking not only in Italy (Schehl et al., 2019; Vroman et al., 2015). This is confirmed by previous recent studies (Leukel et al., 2020; Lee and Coughlin, 2014), that have stressed the need for further investigation on sources of inequalities (emerging from specific individual characteristics) that can limit the older people who use the Internet. As a result, by considering Italy as a relevant study context for a better understanding of the role of Internet services to improve the older people's quality of social life, the main aim of this paper is to provide evidence-based research to inform the decision-making processes that promote older people's Internet use by exploring the following research questions:

RQ1 How much time is spent on Internet use and what are the preferred devices for Internet accessibility among Italian adults aged over 60?

RQ2 To which online activities do Italian older people allocate their time? How can these activities be grouped to create indices that capture older adults' digital behaviour?

RQ3 Based on their online activity habits, are there any latent groups (classes) among Italian older people aged over 60? How are older people's socioeconomic characteristics and digital infrastructure accessibility related to latent class membership?

The remainder of this paper is organised as follows. In [Section 2](#), a brief literature review on the older adults' digitalization from a CA perspective is presented, together with specific references on the impact of ICT usage in later life. [Section 3](#) illustrates the used dataset and the methodology applied for this research. The results of the study are presented and discussed in [Section 4](#) together with policy implications and limitations and further research directions. Finally, concluding remarks are outlined in [Section 5](#).

2. Literature review and theoretical framework

By focusing on Internet activities and related categories of older people users under the CA perspective, with this paper we contribute to three strands of literature.

2.1. Capabilities approach and Internet use

As outlined in the previous section, the first strand deals with the CA framework, which describes how people use resources to ameliorate their life ([Sen, 1992](#)). This framework is composed by three dimensions: (i) *Functionings*, i.e., people's potential states (*beings*) and activities (*doings*) that, in our case, might include “being socially connected” and “being able to conduct daily activities” ([Wells, 2012](#)); (ii) *Capabilities*, that is, the alternative combinations of functionings potentially achievable by people and that are found valuable to them, e.g., using Internet for leisure, for administrative duties, for healthcare needs, etc. ([Nikou et al., 2020](#)); and (iii) *Resources*, i.e., the goods or services available to make functionings feasible and effective. For instance, Internet services are resources allowing the functionings of social inclusiveness by means of social networks and/or on-line communities.

This approach is considered particularly appropriate to our paper goal, i.e. to study how different Internet services might enable older adults to feel socially included and independent. Despite that, to the best of our knowledge, in the literature only a few studies have applied the CA in digital contexts, and they mostly focused on independence or healthcare necessities. [Talaie-Khoei et al. \(2015\)](#) studied how capabilities impact the process of converting a technology from potentially to effectively useful in the context of independent living, while [Talalei-Koei and Daniel \(2018\)](#) investigated the perceived usefulness of ICT by the older people. In an exploratory study, [Meijering et al. \(2019\)](#), indeed, considered the contribution of

capabilities to independent living, but they ruled out the adoption choice by older adults. More recently, [Nikou et al. \(2020\)](#) applied the CA framework to develop a theoretical model of digital healthcare technologies' adoption concluding that the intention to use online healthcare portals depends on whether older people expect to enhance their capabilities for independent living by using them.

2.2. Online activities in later life and key influential variables

The second strand of literature concerned by this study regards the online activities performed in later life and key influential variables (see [Table 1](#)). There is consensus among researchers that better health, education, economic status and Internet accessibility favour the digital presence of older people, while for other variables (e.g., the role of gender and civil status) the results are inconclusive or activity-related. In the European context, [Schehl et al. \(2019\)](#) confirm that a sample of 1,222 German older adults aged over 65 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 better educated were more likely to perform all types of online activities. Also, men were more likely than women to perform informational and instrumental rather than social activities. Very similar results were obtained by [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, better educated and healthier individuals.

Working with data from 352 adults aged over 60 in the West of England and South Wales, [Selwyn et al. \(2003\)](#) reported that sending/reading e-mails and writing or editing letters, reports and other documents are the two types of more frequent activities performed. Notably, [Matthews et al. \(2018\)](#) elaborated data from six waves (from 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).

In line with European studies, there are only a few studies about the online activities of older people from non-European countries and each of them concludes with a different range of preferred online activities and determinant factors. For example, [Yu et al. \(2015\)](#) 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 widowed men, younger and female users are more likely to socialise online. Moreover, it is underlined that Internet presence is not favoured by 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), which showed that in the last month 56% of Internet users executed personal tasks such as shopping or banking, 49.4% health-related activities and 40.2% communication (mostly e-mails or text messages). The Internet was mainly used by men, younger, educated and married older people while physical limitations seemed to hinder the older people from staying in touch with technology. Very recently, [Wan et al. \(2022\)](#) analysed 11,265 longitudinal data (from 2008-2016) about the role of subjective health in Internet use by American older people (65-94 years old) and verified that subjective health not only determines current but also future Internet use.

Table 1. Summary of studies about online activities and key variables in later life.

Study	Aim	Sampling strategy	Internet measure	Country	Methodology	Results
Gell et al. (2013)	Focus on Internet use by the over 65's with physical disabilities.	7,609 data of adults 65 years old and more from the 2011 National Health and Aging Trends Study (NHATS).	Questions related to 13 Internet activities and one question about the frequency of Internet the last month.	USA	Multivariate analysis	42.7% of the older people used the Internet and 40% used it for e-mails or text messaging. The Internet was used mainly by the younger older people, men, educated and married while the physical limitations seem to hamper the older people from its use.
Leukel et al. (2020)	Sociodemographic characteristics related to Internet activities.	1,079 data from a survey conducted during the summer 2017 among all older adults (65+) living in three districts of a city in Germany.	Questions about the frequency using Internet for eight online activities.	Germany	Logistic regressions	Older people men, younger, educated and with better perceived health were more probable to perform all types of online activities included in the study.
Matthews et al. (2018)	Internet in relation to age and period effects as represented by the different waves.	10,390 (wave 1:2002-2003) and 4,627 (wave 6: 2012-2014) adults over 50 years old from the English Longitudinal Study of Ageing (ELSA).	Using or not the Internet (wave 1-wave 6) Frequency of Internet use (wave 6)	UK	Multi-level growth curve models	Internet use is higher for the younger older people and declines with age increase. Additional factors predict lower Internet use of Internet e.g., poor health and financial conditions as well as being woman.
Schehl et al. (2019)	Explore the factors that predict informational,	1,222 older adults aged 65 and over living in three districts in	Frequency of six online activities.	Germany	Ordinal regression analyses	The older people who were younger, with higher education, and

	social, and instrumental online activities.	Germany, data collected through a questionnaire-based survey.				with higher perceived behaviour control were more likely to perform all online activities. Men were more probable than women to perform informational and instrumental rather than social activities.
Selwyn et al. (2003)	The extent and nature of ICT access and use by older people.	352 adults aged over 60 years old in four local authorities in the West of England and South Wales completed a 36-page structured-survey.	Access to technological devices, type of electronic device used to access the Internet, location of Internet access, potential and actual support from family and children for ICT use, use of computers according to social or health characteristics, types of Internet activities performed, reasons for not using ICT.	UK	Descriptive statistics	The use of Internet by the older people is not only less frequent by it is related to gender, age, marital status and education level.
Wan et al. (2022)	Examine the relationship between self-perception measures (subjective age, subjective health, and life satisfaction) and Internet use among older adults.	Longitudinal data from the Health and Retirement Study (HRS) 2008–2016 waves.	Do you regularly use the World Wide Web, or the Internet, for sending and receiving e-mail or for any other purpose, such as making purchases, searching for information, or making travel reservations?	USA	Generalized linear mixed model (GLMM)	Among self-perception measures of successful aging, subjective health has a robust relationship with both current Internet use and changes in Internet use over time by American older adults. Such findings suggest that effective interventions to increase digital technology utilization require accommodations for

Yu et al. (2015)	Explore how Internet access and social network site adoption patterns vary by age.	Internet access (N=18,851) and social network adoption patterns (N=869) for a nationally representative sample of Americans over 50 years old from the 2012 Health and Retirement Study.	All respondents were asked: 'Do you regularly use the World Wide Web, or the Internet, for sending and receiving e-mail or for any other purpose, such as making purchases, searching for information, or making travel reservations? Also, 12 online activities were included.	USA	Logistic regression	older adults with poor subjective health.
						Internet accessibility remains a crucial issue in the older population but still nearly half of the respondents do not have regular Internet access. Women, those who are socioculturally, economically, and physically disadvantaged are less likely to have Internet access.

As in [Table 2](#), regarding to studies that followed the analytical approach used in this paper, few studies have investigated on-line activities of the older people by using Latent Class Analysis (LCA) and/or Exploratory Factor Analysis (EFA). For instance, [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 over 60 years old. The author ended up with what are called “*Native activities*” (i.e., functions that required high trust and/or high digital presence, such as posting opinions on forums and blogs and shopping/banking, which mostly captured the digital behaviour of the older individuals. They explained 23.49% of the overall variance of a four-factor solution. [Van Deursen and Helpser \(2015\)](#) used data concerning older 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 older people according to specific online activity tasks is a more realistic approach than investigating 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.

Specifically, as regards the analysis of the Internet activities, only a few researchers have performed a EFA and subsequently a LCA to identify groups of older Internet users to go more in depth in their analysis. [Van Boekel et al. \(2017\)](#) classified a representative sample of 1,418 people aged ≥ 65 living in the Netherlands into four latent groups, based on 17 online activities. Their analysis produced the following 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 suffering from diabetes. Using 10 Internet activities, three classes emerged: *Non-users*, *Communicating users* and *Smart users*. Finally, [Chiu \(2019\)](#) identified four groups of Taiwanese older Internet users, *Eager*, *Instrumental*, *Leisure* and *Sporadic users*, with respect to 10 habitual Internet activities. Through multinomial logistic regressions, [Chiu \(2019\)](#) identified the associated characteristics with respect to their Internet usage. More specifically, 32% of the survey participants belong to the Leisure users’ group and are significantly socially involved (including the Eager users) compared to the remaining groups identified.

Table 2. Summary of studies about older people on-line activities, using Latent Class Analysis and/or Exploratory Factor Analysis.

Study	Aim	Sampling strategy	Internet measure	Country	Methodology	Results
Chiu (2019)	Study how older adults use the Internet and how this is related to social engagement.	248 participants aged 50 years or older randomly invited from the phone book to complete a telephone survey between July and December 2014.	10 questions related to Internet activities.	Taiwan	Cluster analysis and Latent class analysis	The majority of older adults Internet users in Taiwan were considered Leisure users (32%). Others were Sporadic (26%), Instrumental (21%), and Eager users (21%). Older adults with different Internet behaviors were associated with specific sociodemographic and social engagement behaviors but further research is needed to establish a causal relationship between Internet use and sociodemographic characteristics.
Nimrod (2018)	Technophobia and Internet use patterns.	Online survey of 537 Israeli Internet users aged 60 years and over, deriving from an online panel of 50,000 Internet users owned by a commercial company.	Questions about the years of Internet use, the devices for Internet access, the hours per week, and specifically the time spent on 12 Internet activities during the previous day.	Israel	Factor analysis and linear regression analysis	Technophobia and satisfaction with life are strongly associated, thus, training programs that will make the older people more familiar with technology are highly encouraged.
Park and Kim (2000)	Identify Internet use among older people with diabetes.	Data from the 2017 Survey of Living Conditions and Welfare Needs of Korean Older Persons The sample included 1,919 respondents with diabetes who reside in the community and	Questions about 10 Internet activities.	South Korea	Latent class analysis	Different Internet users of older adults with diabetes exist based on socio-demographic and health characteristics which health care providers need to be aware in order to help older people engage in digital self-care.

		responded to the ten questions about Internet use.				
Sum et al. (2009)	Explore how Australian older adults use the Internet.	222 Australian Internet users aged 55 years or more, purposive (non-probability) sample who completed the online questionnaire over a 6-month-period.	Frequency and history of Internet use, the types of frequently used Internet applications and 27 online activities.	Australia	Principal Component analysis, ANOVA, t-tests	Participants primarily used the Internet for interpersonal communication, followed by information seeking, commerce and entertainment.
Van Boeckel et al. (2017)	Describe the diversity of Internet activities and the role of social or health-related variables for Internet use.	1,418 aged 65 years and older from Longitudinal Internet Studies for Social Sciences (LISS) panel survey., who have access to and use the Internet	10 Internet activities.	Netherlands	Latent class analysis	Older adults are a diverse group in terms of their Internet activities and four clusters were identified: Practical users (36.88%), Minimizers (32.23%), Maximisers (17.77%) and Social users (13.11%).
Van Deursen and Helpser (2015)	Reasons for Internet use and non-use by older individuals.	258 older people over 65 years old selected a nationally representative online survey.	Internet attitude, time online and 23 online activities.	Netherlands	Hierarchical logistic regression analyses, Logistic and linear regression analyses, Factor analysis	Different types of older adults were found to adopt different Internet behaviours.

2.3. Internet activities and ageing in Italy

The third and last strand we contribute to is about the linkage between Internet activities and ageing in Italy (see [Table 3](#)). The existing literature provides a sparse number of studies merely focused on specific aspects of Internet connectivity, e.g., the time use and socio-demographic characteristics of the user ([Carlo and Vergani, 2016](#)), the types of online activities ([Pirone et al., 2008](#); [Colombo and Carlo, 2015](#)) and the relationship of educational background as a determinant factor for 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 aged over 65 currently using computers had previous experience before their fifties. Secondly, among the recent older Internet users, we mostly encounter women and individuals on 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 demonstrated that 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. Along the same lines, [Pirone et al. \(2008\)](#) used descriptive statistics analysis to study the relationship of older people with ICT among adults (50-70 years old) in two Italian cities (Bologna and Naples). Remarkably, it was demonstrated that 81.40% of the older people interviewed preferred to search for information for personal interests and 70% for information about the daily news.

[Kämpfen and Maurer \(2018\)](#) analysed data for the Internet use of 2,160 Italians (aged 50 or older) from the SHARE survey and concluded that one more year of education in younger age increased the probability of using a computer in later age by 8%. With increased age, people tend to reduce substantially their time spent on Internet use, as reported by [Facchini and Sala \(2019\)](#). Internet use (even sporadic) in 2016 was 57% among Italian people aged 60-64, 32% for those between 65 and 74 years old and 9% for those aged over 75 ([Facchini and Sala, 2019](#)). Only if policymakers are well informed about the level of familiarity of the older population with Internet use can they intervene effectively with targeted policies that help them to improve their capabilities and promote their quality of life (see [Nimrod, 2017](#)). Yet, as pointed out by [Facchini and Sala \(2019\)](#), little is known about how Italian older people use the Internet. Existing research has studied only a few Internet activities using samples from specific Italian cities which might not represent the digital behaviour of the whole population of Italian older people, i.e., [Colombo and Carlo \(2015\)](#) Milan and [Pirone et al. \(2008\)](#) Bologna and Napoli.

Table 3. Summary of studies about Internet activities and ageing in Italy

Study	Aim	Sampling strategy	Internet measure	Country	Methodology	Results
Carlo and Vergani (2016)	Find differences between the Internet users and non-users older people and identify the perceived risks and opportunities for users.	900 individuals 65-74 years old representative of the Italian population. Data collected through face-to-face domestic interviews between December 2013 and January 2014.	Questions about devices and frequency of Internet use.	Italy	Descriptive statistics	Italian older people Internet users are mostly the wealthy minority aged over 65 years old with high social and economic status. Policy makers should aim to promote not only the Internet use but the social inclusion of older people.
Colombo and Carlo (2015)	Research the relationship between the young older people (65–74 years old) and the use of technologies on active ageing.	900 individuals 65-74 years old representative of the Italian population. Data collected through face-to-face domestic interviews between December 2013 and January 2014. Also, data collected from 20 in-depth interviews performed to individuals living in Milan.	Use of ICT in free time, individual background about the start of ICT use, the locations of ICT use, and time of Internet use coupled with two broad types of activities i.e., for leisure or to save time from time consuming activities.	Italy	Ethnography analysis	ICT and Internet use play an important role in the life of the young older people not only with respect to the time they dedicate daily but also with respect to the space they occupy in older people's homes. The adoption of ICT is affected by socio-demographic characteristics and inter-generational experiences.
Facchini and Sala, 2019	Overview of ICT use by Italian older people	Multipurpose survey "Aspects of Daily Life" 2001 and 2016	Use of personal computers, Internet, social networks, mobile phones and/or smartphones	Italy	Descriptive statistics	Only a few studies have analysed Internet use by Italian older people. Interestingly, although Internet use by older Italian people has increased, in 2016 only 7% aged between 65 and 74 use social networks and this percentage is less than half of the European levels.
Kämpfen and Maurer (2018)	This paper estimates the effects of early-life education on computer and Internet use among Italian older people.	Italian data from wave 5 of the 2013 Survey of Health, Ageing and Retirement in Europe (SHARE).	Participants are asked to rate their computer skills and declare the use of the Internet during the past week.	Italy	Two Stage least squares (2SLS)	One additional year of schooling resulted in an 8% increase in the probability of having used a computer and in 12% percentage increase in the probability of reporting to have at least good computer skills.
Pirone et al. (2008)	The relationship older people with ICT.	Adults between 50-70 years old residents of the	Access to Internet or to computers, reason for not using	Italy	Descriptive statistics	Italy is classified between the countries with older people with the lowest use of ICT.

provinces of Napoli and Bologna.	Internet, 11 activities performed through Internet and ways of acquiring ICT use knowledge.
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To sum up, this paper contributes to the existing literature using the CA perspective as the theoretical framework to study the variety of online activities and older adults' characteristics in Italy while the scholars have used the CA merely on the relationship between ICT usage and social inclusiveness. The literature review shows that as regards older people, the researchers have not studied yet more than 27 online activities using samples of older people from different countries and 11 online activities using samples from Italy. Notably, only a few studies have classified the older people in latent groups with similar characteristics. Specifically, by using EFA and LCA analyses in a two-step process (e.g., [Van Boekel et al., 2017](#); [Park and Kim, 2020](#)), we investigate a broader range of online activities, i.e., 40 online activities, to segment older people's digital habits in Italy. Finally, considering that Italy is the European country with the highest percentage of adults aged over 60, our paper expands the knowledge about the Internet use by the Italian older people studying both a wide number of online activities and a representative sample of Italian older adults.

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 only used the data related to people aged over 60 years old, while younger individuals were excluded from the analysis. Thus, the sample used consists of 13,597 units, accounting for about 31% of the full dataset.

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

Table 4 summarises the general characteristics of the sample, classified into three age categories: (a) 60-64, (b) 65-74 and (c) 75 years old or older. 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 school certificate or have just attended primary school. As expected, 74% earn their living from retirement pensions. With respect to health status, 52% report not having any physical limitations in their daily activities. Furthermore, the analysis includes variables about digital infrastructures: the fixed broadband Internet connection is widespread (42%), followed by the broadband phone network using 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 Internet accessibility at a regional level are available in Table A (Supplementary Material).

Table 4. Descriptive statistics of the sample

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

Residential 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 of older adults, considered in terms of general usage, time and preferred devices. The first aspect is measured using 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 spent using the Internet, this 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/several times a month (less than 4 times), 3/once per week, 4/several times a week, 5/every day). Lastly, the devices used for 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 I 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). We have used these activities to support the analysis of the Exploratory Factor Analysis (explained in [Section 3.2.](#)). From a Capabilities’ Approach perspective, the internet has transformed various aspects of modern life, providing new opportunities for communication, information access, social interaction, and participation in economic, cultural, and political activities, enhancing overall people's well-being. The three top preferred online activities by Italian older people over 60 years old were: instant messaging for 75% of the participants in 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. Data analysis

All analyses were performed using the statistical software Stata 16 and proper methods were adopted for each research question. [Figure 1](#) illustrates the steps of the methodology followed. First, we used descriptive statistics to investigate the overall 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), based on principal components method of extraction and varimax rotation ([Samuels, 2016](#)) was employed to explore potential similarities between 40 online activities (RQ.2) and, as a result, the activities were reduced to 29. Five composite indices were created for every participant by adding up the values of the binary variables of Internet activities and dividing them by the number of activities included in the resulting index. The created indexes receive values that range from zero to maximum 0.80, 0.88 or one. The range of values is not equal among them

because, on the one hand, the number of the contained online activities differs and, on the other hand, not all the individuals have performed all the activities included in some indexes, i.e. Economic and Daily Practical Activities. Then, a few tests using the value of Cronbach's alpha ([Cronbach, 1951](#)) measured the inter-item consistency reliability of the 29 activities and of the resulting factors².

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 indices of online activities created by the EFA analysis. LCA methodology requires four basic steps: (a) identification of LCA indicators, (b) identification and estimation of the latent class models, (c) evaluation of the latent class models and d) interpretation of the results ([Li, 2017](#)). As regards the identification of LCA indicators, this phase refers to the variables that need to be included in the LCA analysis. However, the most important stage of LCA concerns the identification of the number of latent classes. Various statistical criteria have been proposed by the researchers to identify the number of classes. For instance, AIC (Akaike Information Criterion), BIC (Bayesian Information Criterion), Lo–Mendell–Rubin (LMR), Bootstrap Likelihood Ratio Test (BLRT) etc. are descriptive fit indexes in which the model with the smallest value is preferred (see [Nylund-Gibson and Choi, 2018](#) for a complete presentation). Remarkably, there is no consensus between the researchers about the best statistical tool and a combination of tools is frequently used, such as the AIC ([Akaike, 1987](#)) and BIC ([Schwarz, 1978](#)) ([Nylund et al., 2007](#)). We have separately added several model specifications and estimated both AIC and BIC criteria. In general, BIC is recognised to be a reliable measure for the identification of the number of classes which favour parsimonious specifications ([Weller et al., 2020](#)) and the most frequently estimated and supported indicator for class selection by the researchers ([Nylund et al., 2007](#); [Nylund-Gibson and Choi, 2018](#), [Ulbricht et al., 2018](#)). As a consequence, we have used the BIC criterion for the final model 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](#)). These range from 0 to 1 but it is rare to find the extreme values in LCA models ([Ulbricht et al., 2018](#)). Conditional item probabilities higher than 0.70 and lower than 0.30 indicate high homogeneity ([Nylund-Gibson and Choi, 2018](#)). The names assigned to each latent class were determined by the index indicators with the highest values of item-response probabilities. Finally, a multinomial logistic

² Factors containing an eigenvalue of 1 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 indices ([Samuels, 2016](#)), as shown in [Table 3](#).

regression model was used to control for the role of socio-demographic characteristics of the class membership.

Figure 1. Roadmap between data analysis methods and research questions

4. Results

4.1. Time spent on the Internet and access devices: the role of age and gender

Regarding RQ.1, the younger older people (60-64 years old) in our sample are more intense users compared to the other age classes ([Figure 2](#)). Furthermore, considering gender differences, males used the Internet more than females in the last 3 months ([Figure 2](#)).

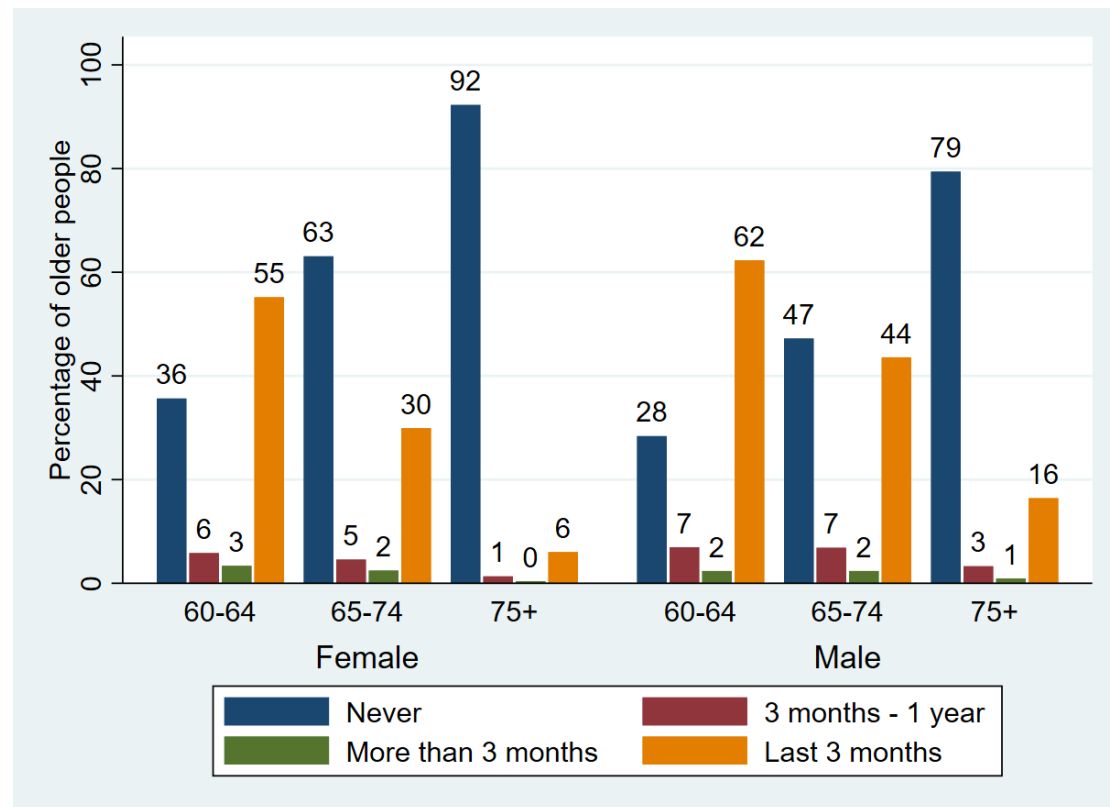


Figure 2. Internet use by age and gender of individuals over 60 years old (Data: Multipurpose survey “Aspects of Daily Life” 2018, Authors’ elaborations)

[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 gender, males again seem to present a slightly higher time allocation for the Internet than females.

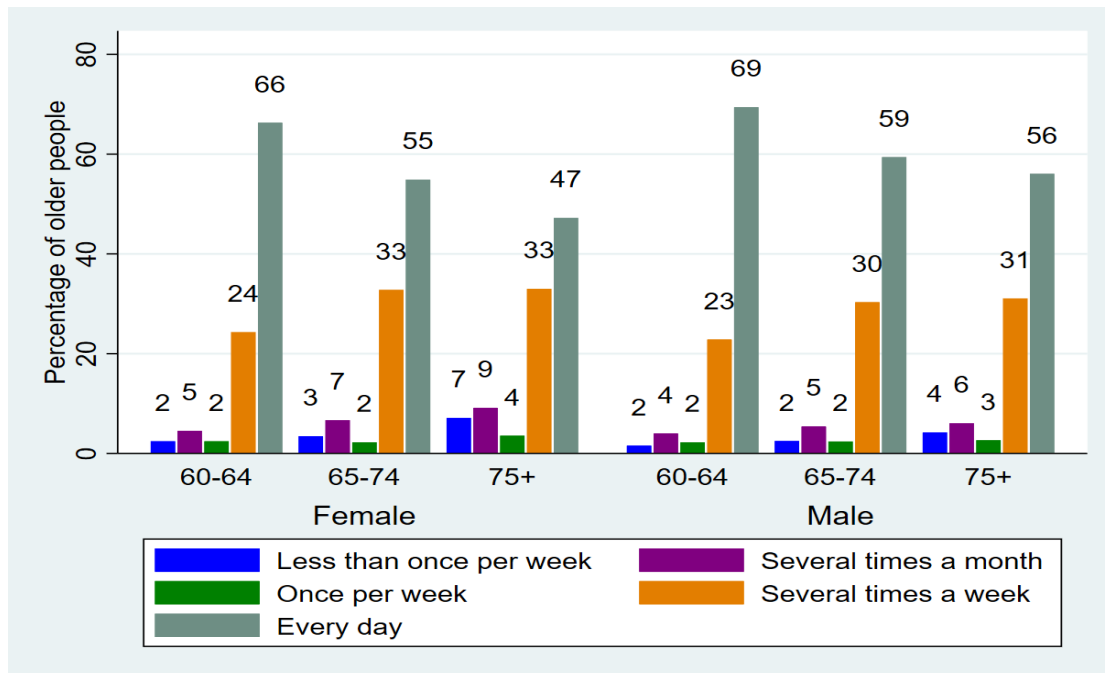


Figure 3. Frequency of Internet use among users aged over 60, by age and gender (Data: Multipurpose survey “Aspects of Daily Life” 2018, Authors’ elaborations)

Lastly, [Figure 4](#) shows the devices preferred by Italian older people to perform Internet activities. Differences are observed both in terms of age and gender: women aged 60-64 widely use mobile phones, while men of the same age prefer tablets. Women between 65 and 74 years old prefer other devices (a media or games player, e-book reader or smart watch) and men still prefer 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 mobile phones or tablets.

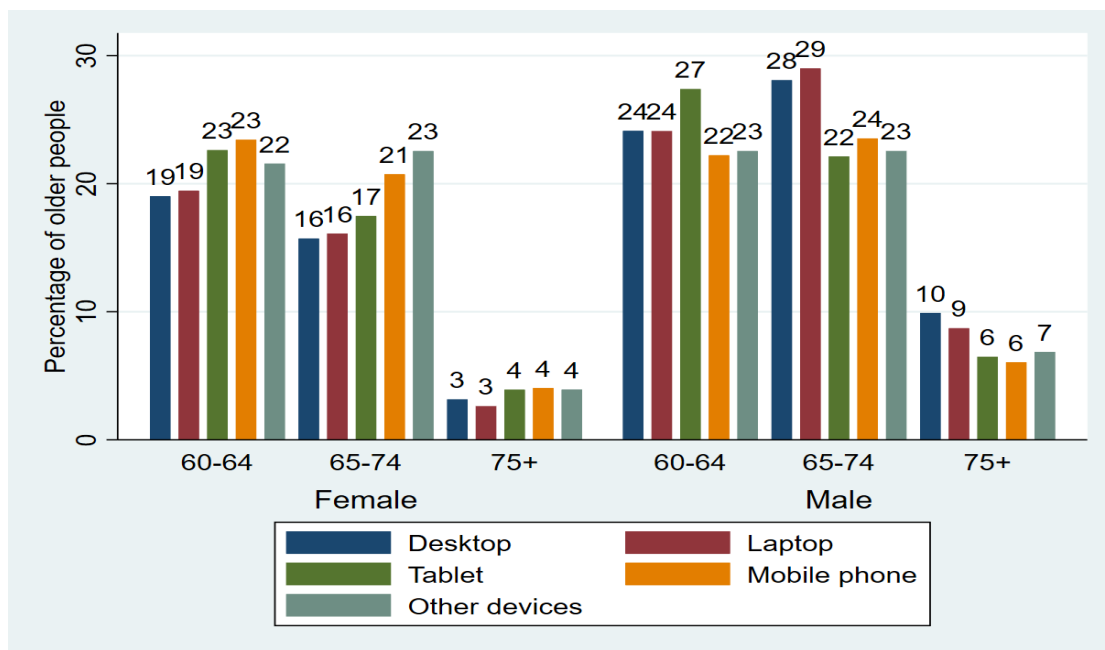


Figure 4. Devices used to connect to the Internet among users aged over 60, by age and gender
(Data: Multipurpose survey “Aspects of Daily Life” 2018, Authors’ elaborations)

4.2. Exploratory Factor Analysis: online activities and digital behaviour of the over 60s

As regards RQ.2, we divided the 29 online activities under consideration into five indices to create synthetical activity groups, namely *Daily Practical*, *Leisure*, *Transport & Accommodation*, *Communication* and *Economic* activities indices (see [Table 5](#)). The over 75s’ age group scores lower in all the indices compared to the older people under 75 years old ([Figures 5-9](#)) and, as fairly expected, this group in turn seems to be less digitally active than the others. Clear-cut similarities are observed across the indices. More specifically, we have two polarised results concerning the *Leisure Activities Index* ([Figure 5](#)) and the *Transport & Accommodation Activities Index* ([Figure 6](#)). The first category of activities, i.e. leisure, is primarily executed by all categories of older people; 40.11% aged 60-64, 31.24% aged 65-74 and 23.80% over 75 years perform at least three leisure activities (index equal or more than 0.60). On the other side, the second group of activities, transport and accommodation, are less frequently seeking for digital satisfaction by the older Internet users: only 5.04% of older people aged 60-64, 4.15% aged 65-74 and 1.89% over 75 years perform at least three activities (index value between 0.60 and 1.00). For this last one, as the index includes activities such as accommodation services or transport means booking, it is quite normal to find low values of the indices. With age increase, the choices of accommodation are almost stable, and the mobility is restricted either to smaller geographical ranges or decreased. Thus, the need to search for these specific kinds of information is more rarely desired. The *Communication* ([Figure 6](#)), *Economic* ([Figure 7](#)) and *Daily Practical Activities indices* ([Figure 8](#)) are placed between the above two extremes in terms of use heterogeneity.

Table 5. Factor loadings for the online activities reported

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 data	0.54				
Download software (other than games)	0.51				
Use special websites or apps to take advantage of a transport service by contacting a private individual (e.g., UBER)		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, HomeAway, 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 in professional networks			0.57		
Make phone calls/video calls			0.47		
Listen to music				0.69	
Get informed about political issues				0.67	
Watch streaming television				0.66	
Read newspapers, information, online magazines				0.66	
Watch video content from sharing services (e.g., YouTube)				0.59	
Use a website/app to get a paid job (e.g., Freelancer, Upwork, etc.)					0.95
Send completed online forms for private use to public administration or public service operators					0.63
Find information from public administration or public service operator websites					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.

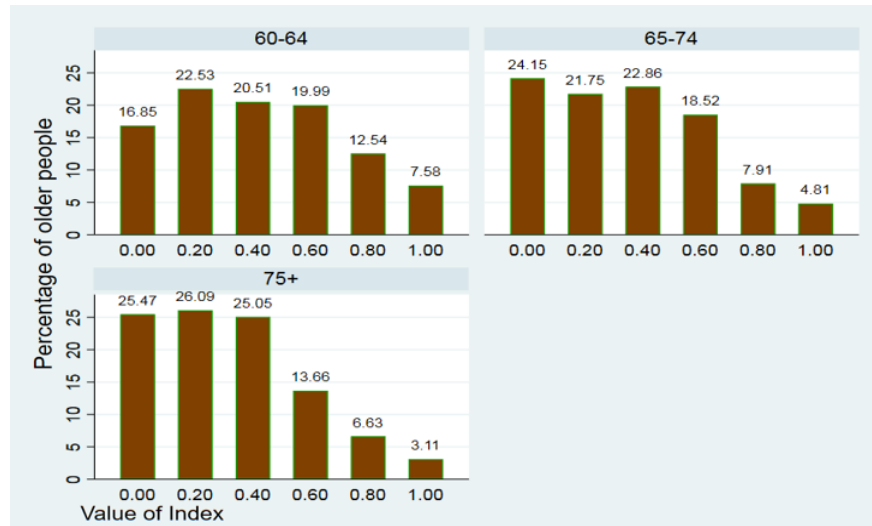


Figure 5. Index of Leisure Activities

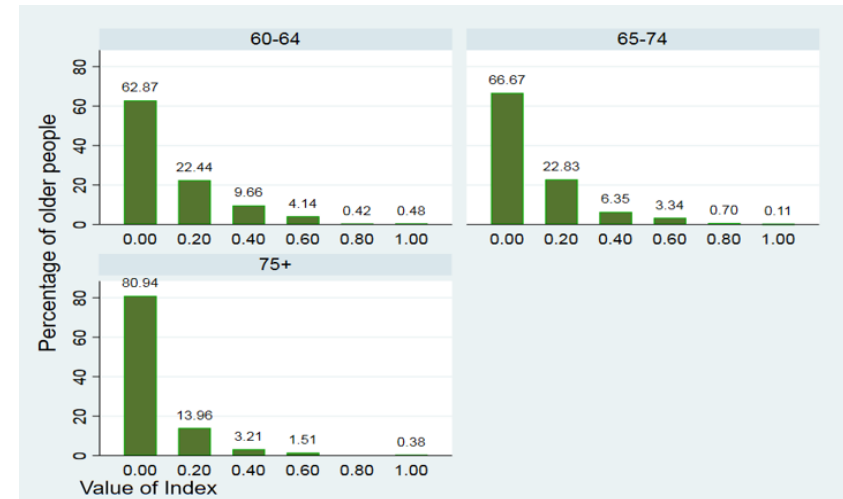


Figure 6. Index of Transport & Accommodation Activities

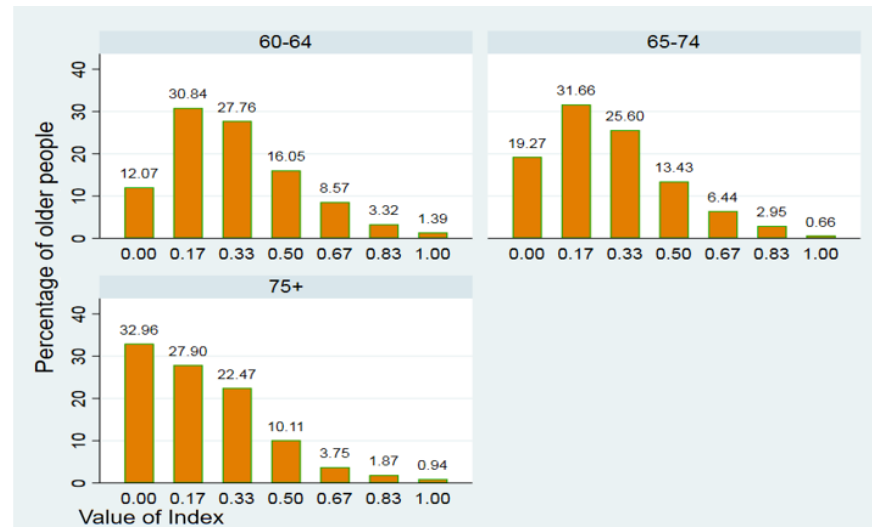


Figure 7. Index of Communication Activities

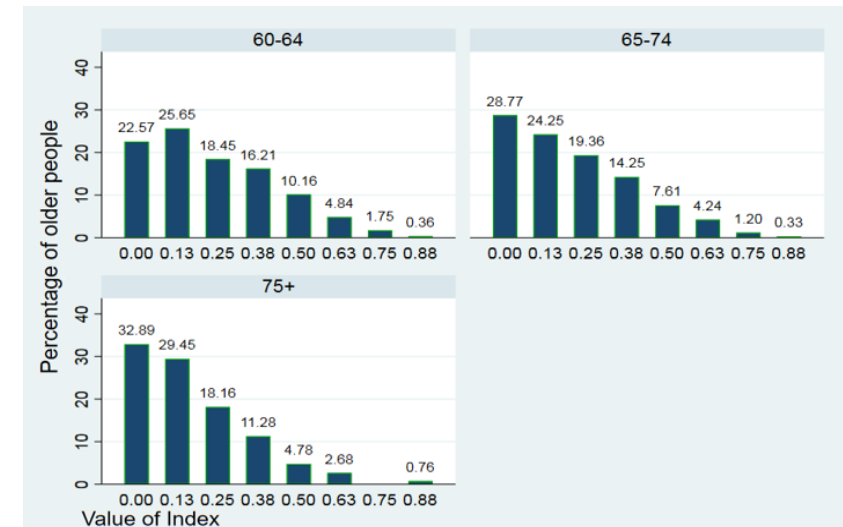


Figure 8. Index of Economic Activities



Figure 9. Index of Daily Practical Activities

4.3. Latent Class Analysis

4.3.1. Description of the latent classes

To assess RQ.3, we 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 BIC criterion is preferable, we chose the 3-class specification. The summary of the model fit statistics is shown in [Table 6](#).

Table 6. 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 indices to be assigned to each latent class. This measure indicates the average probability of this observation belonging to a given class ([Muthén and Muthén, 2000](#)). In [Table 7](#), Class 1 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 indices: *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 in this group seem to perform low in all the other activities, they are referred to as *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 8](#) 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%), are the younger older people (i.e., 60-64 years old) (49%), of male gender (61%), married (72%), with a high school (51%) or university degree (30%), are pensioners (56%) or (self) employed (36%). As for physical capabilities, 68% do not have any limitations. The prevailing type of Internet connection is fixed broadband (87%) while mobile (34%), SIM/USB key (12%) and narrowband (3%) are less

common. It seems that this group of older people consists of younger older individuals who have most probably retired recently or are about to retire soon and still maintain their digital skills. Also, the prevalence of individuals living in the North of Italy (which is the wealthiest area of the country) could be explained in terms of higher willingness to buy any electronic devices and pay the Internet connection.

On the other hand, considering the *Enjoyment users* class (28%), most individuals come from the middle-aged group (i.e., 65-74 years old) (50%), are female (67%) and residents in Northern Italy (West and East, 40%), followed by the Southern area (29%). Furthermore, *Enjoyment users* have mostly attended middle school (52%) and earn their living from their retirement pension (60%). Similar to the *Familiar users*, older people in the *Enjoyment users* class do not suffer from physical access limitations (62%). On the contrary, they prefer, almost equally, to get connected to the Internet either through fixed broadband (55%) or mobile networks (54%).

Finally, the lowest levels of individuals present were observed in the *Utilitarian users*' class (19%). Most of them are in the 65-74 years old group (47%) and are male (72%). Notably, the over 75s are mostly represented in the *Utilitarian* class with respect to the other ones. The same is true about their physical limitations (11%). As observed in other classes, married people (76%) and pensioners (75%) prevail here as well. A fixed broadband connection (76%) is the top method of getting online and the majority lives in the North of Italy (North-West: 29%, North-East: 26%). The results show that in this group we find the older category of old people and also with physical limitations and, as we have already said, this makes us think that the Internet serves to them to basic needs.

Table 7. Class membership and item response probabilities of online activity indices after controlling for covariates

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

Table 8. Baseline characteristics of people assigned to the 3 classes (with covariates)

<i>Variable</i>	<i>Responses</i>	<i>Familiar users</i>		<i>Enjoyment users</i>		<i>Utilitarian users</i>		<i>Total</i>	
		N=2,029	(52.16%)	N=1,108	(28.48%)	N=753	(19.36%)	N=3,890	(100%)
<i>Age</i>	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)
<i>Gender</i>	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)
<i>Civil status</i>	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)
	Elementary school/no qualifications	41	(2.02)	268	(24.19)	74	(9.83)	383	(9.85)
<i>Level of education</i>	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)
<i>Source of income</i>	(Self) employed	729	(35.93)	171	(15.43)	148	(19.65)	1,048	(26.94)
	Family maintenance	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)
<i>Physical limitations</i>	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)
<i>Internet connection: fixed broadband</i>	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)
<i>Internet connection: broadband mobile phone network via mobile phone or smartphone</i>	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)
<i>Internet connection: broadband mobile phone network via SIM card or USB key</i>	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)
<i>Internet connection: fixed or mobile narrowband connection</i>	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)
<i>Residential location</i>	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)
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4.3.2. The association of sociodemographic factors with class membership

To better answer RQ.3, we 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 9](#). The less likely latent class (Class 3: *Utilitarian users*) was used as the reference category.

From the pairwise comparison with *Familiar users*, note that the difference is statistically significant for age (all subgroups), education level (only for high school and university degrees), civil status (only being divorced), having severe physical limitations and all types of Internet connection. When comparing *Familiar* and *Utilitarian users*, the presence of physical health limitations emerges as significant.

These results mean that *Familiar users* are more likely to have completed higher education, be divorced, have fewer physical health issues and have better Internet accessibility. Regarding the assessment of *health status* (physical limitations).

Similarly, when comparing *Utilitarian* with *Enjoyment users*, significant differences were detected 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 to the Internet via a mobile network and living in the Centre, South/Islands.

Table 9. 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				
	Coef.		S.E.	95% CI Low-r - Upper		Coef.		S.E.	95% CI Low-r - Upper	
Reference group: <i>Group 3 Utilitarian users</i>										
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-employed)										
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 via mobile 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
Residential 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. Discussion and policy implications

To the best of our knowledge, this is the first study to analyse Internet use by Italian older adults in depth, also associating it with sociodemographic parameters. Remarkably, from a methodological point of view, two contributions are highlighted. Firstly, the inclusion of a wider range of online activities in the analysis compared to other studies provides a thorough understanding of Internet use by older people, making an innovative contribution to the literature. Secondly, an additional strength derives from the use of a representative sample of the Italian population, making the results generalisable to the whole population of Italian older people.

Considering RQ1, in line with [Facchini and Sala \(2019\)](#) the older people (60-64 years old) use the Internet more. We assume that this might happen because as people age, their health condition deteriorates and encumbers their ability to use computers. Finding that males use the Internet more compared to female is in good agreement not only with evidence from the Italian studies ([Colombo et al., 2014](#); [Carlo and Vergani, 2016](#)) but also with additional literature ([Selwyn et al., 2003](#); [Gell et al., 2013](#); [König et al., 2018](#)). However, on the contrary, [Yu et al. \(2015\)](#) argue that women use more the Internet and explain the contrast either as driven by the dominance of younger participants in their dataset or because the tendency of Internet dominance by men have been smoothened in favour of women since the 2000's.

The findings are in line with other Italian studies ([Carlo and Vergani, 2016](#)), where, among the older Internet users, women preferred laptops and men preferred desktops. Furthermore, our results cannot be compared directly with other existing studies, as we didn't find literature about gender-based information for the digital tools used by the older people. More generally speaking, [Nimrod \(2018\)](#) reported that older people (regardless of gender) principally use Internet through desktop computer (86.77%), followed by smartphone (82.87%), laptop computer (62.01%), and tablet (53.82%). Nevertheless, it could be argued that cultural and sample size differences are definitely present in the studies, and, as a consequence, our conclusions could not be interpreted as contradictory or odd with this respect.

As regards RQ2, 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 5](#)). As emphasised by [Olsson et al. \(2019\)](#), digital ways of communication spread among the younger generations, so older adults are trying to keep up with these 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 the age classes 60-64 and 65-74. Quite similar results were identified for the *Economic Activities Index*, which includes online purchases, the use of banking services and communication with banking institutions, mainly exploited by the under 75s. Remarkably, the activities 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 in performing their online activities with respect to the other age classes, the *Daily Practical Activities Index* does indeed show converging behaviour, probably because most of the activities included satisfy priority needs of daily life, pushing all the older people to become more involved with technology.

While the *Leisure Activities Index* involve almost all the age classes, *Accommodation Activities Index*, instead, display very high levels of inactivity in terms of online access, probably because, as people age, their accommodation (and related travel) choices rely on routine habits and mobility is often restricted to smaller geographical ranges (also accessible by walking/cycling). We found that Familiar users have higher education. These results are in line with the literature. As pointed out by other researchers, the higher the *education level* of the older people, the more likely the Internet use (Kämpfen and Maurer, 2018; König et al., 2018; Leukel et al., 2020).

Compared to the other two groups (*Familiar* and *Utilitarian users*), notably, most of the older adults classified in *Enjoyment users'* group live in the South. Unlike Chiu (2019), who found that the most educated selected leisure activities and the less educated did not spend time on the Internet at all, Italian older people with an education level of middle or primary school seem to opt for online enjoyment activities. The highest presence of married persons (66%) is also in this class. Similarly, other studies found that married older adults (or those living with a partner) are most likely to use the Internet for e-mail/texting messages (Gell et al., 2013). Similarly, Leukel et al. (2020) correlated 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 older people living with other people tend to use the Internet more often for entertainment purposes. Notably, we observe that *Enjoyment users'* group mainly consists of women and interestingly, as in another study, widowed and older housewives who aim to use the Internet for socialising (Yu et al., 2015).

With respect to RQ3, our study partially confirms what has already been found by the available literature Gell et al. (2013) found strong relations between increased health status levels and time allocated to the Internet or sending emails/text messages. Our findings about the significant factors that are related to *Familiar users* shape the profile of the old Internet user as having not only physical but also mental capabilities.

Our findings confirm some existing literature but differ from some others. Notably, Chiu (2019) confirms that women are more actively involved with enjoyment activities than men, as women form the majority of the *Enjoyment users'* group. On the contrary, Schehl et al. (2019) found that gender did not have a bearing on whether German older people were involved

with social activities online. However, when searching for *Utilitarian* with *Enjoyment users* the effects are not statistically significant. Other studies demonstrated that those with a better health evaluation are most likely to use the Internet ([Wan et al., 2022](#)) and others more specifically for social purposes ([Yu et al., 2015](#)). Overall speaking, the *Enjoyment users* is dominated from the one hand by women, who seek more often to connect with people and not only to communicate as might happen with men, and from the other hand by older people living in the South of Italy where family connections are appreciated more with respect to the Northern Italian areas.

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

Policy implications

The findings of this study can be interpreted into insightful practical recommendations for the policy makers. Remarkably, scientific evidence has shown that using the Internet was consistently positively associated with a better health performance of the older people, i.e., lower incidence of chronic conditions ([Duplaga, 2020](#)) and higher cognition ([Yu and Fiebig, 2020](#)). This implies, therefore, a reduction of visits to health care facilities and, as a result, lower burden on healthcare systems. Having said that, policymakers are called to design ad hoc measures to improve digital capabilities in later life and provide guidance on how to do that. The paper's findings suggest, however, that very different Internet users exist within the population group of the older people. The identification of classes, grouping together users with similar characteristics, has underlined the influence of socio-demographic characteristics on older people's digital habits in allocating their time to very different Internet activities. Especially the disadvantaged groups of the older population, such as women, those widowed, poorly educated, living alone, with limited direct economic resources and those with existing comorbidities, the internet access is still hindered. Nevertheless, learning and training programmes, although common interventions, are not enough for digital inclusion in later life, unless properly implemented to promote psychological confidence and feelings of achievement ([Lam and Lee, 2016](#); [Gallistl et al., 2020](#)). In addition, it has been found that the type of Internet connection, i.e., fixed broadband or mobile Internet connection, is strongly associated with the

activities individuals pursue online (Quaglione et al., 2020). It seems clear that effective policies require both ICT infrastructure and investment in specific training policies. Such a mixture of policies could support older people in approaching and improving their use of the Internet for different operations and stay independent and better connected to evolving modern societies. This should, consequently, improve their overall well-being (Lam and Lee, 2016).

6. Conclusions and limitations

The recent COVID-19 pandemic underlined the fact that older people who are not familiar with ICT use run a high risk of being not only socially but also digitally excluded (Seifert et al., 2020; Zheng and Walsham 2021). According to the capability approach framework, Internet services can enable older adults to achieve social inclusiveness and independence, only if the variety of digital activities includes a large number of active ageing parameters. The findings of our study could be useful in giving suggestions to the policymakers on the design of appropriate measures to increase the digital capabilities of different older people categories, considering their different features, needs and capabilities.

Although we have tried to do our best to guarantee the robustness of our results, there are still some limitations that should be mentioned here. As regards the quality of our data, despite the range of the included online activities, the frequency of performance of each activity was missing from the dataset. Also, all the variables about the many online activities were self-reported by the older people, which means that there might be some underestimation or overestimation of the real online activity. Moreover, additional variables, such as traditional literacy (Van Deursen and Helsper, 2015), previous experience with computers (König et al., 2018) and basic common age-related chronic diseases and 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), researchers have principally used cross-sectional data in their research, as in our case. As there are some controversies in the literature with respect to the influence of some sociodemographic characteristics, e.g., devices for Internet use, gender differences, etc. and a full description of the online activities, future research studies need to shed further light on the ambiguous aspects of older people's digital behaviour. The application of a similar methodology to ours in other geographical contexts, as well, could enrich the analysis, making the results comparable and underlining the similarities and differences in older people's digital behaviour according to specific cultural features.

Abbreviations

AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion

CA	Capability Approach
EFA	Exploratory Factor Analysis
ICT	Information and Communication Technology
ISTAT	Italian National Institute of Statistics
LCA	Latent Class Analysis

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