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Abstract

In recent years, there has been a growing interest among scholars on Information and Communication Technologies (ICTs) and their beneficial effects on elderly wellbeing; almost all contributions support the positive impact of ICTs among older population because their use has been demonstrated to enhance social participation and psychosocial wellbeing. This paper contributes to the extant literature by using a specific and comprehensive measure of quality of life, the WHOQol-Bref, on a sample of 341 individuals attending the University of Third Age in an Italian town. Through different model specifications, we are able to demonstrate the positive impact of ICTs' use on elderly quality of life. Results corroborate the findings of existing literature and provide insight on possible policy measures framed in an active aging approach.

Keywords

ICT, active ageing policies, quality of life, WHOQol-Bref, OLS.

JEL codes

I12, I26, J14

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1. Introduction

During the past decades the phenomenon of population aging has risen healthcare and economic issues within western countries. In order to warrant older people an adequate Quality of Life (QoL), the Governments of several industrialized countries have been adopting active aging policies: the challenge consists in identifying strategies that could effectively promote and sustain activity, independence and health during older ages (European Commission, 2018).

Demographic changes characterizing western countries impact on the burden that societies have to sustain. Ageing is associated with a progressive deterioration of individual's health: as age increases, the probability of being exposed to chronic and degenerative diseases rises, limiting the individual's autonomy and augmenting his need of care (Brenna and Di Novi, 2016).

In 2016, people aged 65 or older accounted for more than 20% of the total population in three European countries: Italy (22%), Germany (21.3%) and Greece (21.1%). This figure is 19.2% at the European level and it is expected to rise to 28% by 2060 (Eurostat, 2016).

In order to reduce the burden of the increasingly ageing population, promoting conditions for the elderly people in what concerns an active participation to society, volunteering in the community, family caregiving and daily activities, represents a crucial strategy for well-being (Huxhold, Fiori and Windsor, 2013). A successful active aging addresses three main factors: it decreases the probability of disease and disease-related disability, it helps in developing cognitive and physical functional capacity, and it finally promotes an active engagement with life.

During old age, the strategy that sees the adaptation to aging is associated to higher levels of involvement in social and leisure activities (Adams et al. 2011, Janke et al., 2008). Through participation in leisure activities, people can build social relationships, feel positive emotions, acquire additional skills and knowledge (Brajša-Žganec, Merkaš and Šverko, 2010; Escuder-Mollon and Cabedo, 2013). In particular, undertaking educational tasks is seen as a way of staying young, because learning in later life helps developing social contacts and postpones mental problems associated with ageing (Phillipson and Ogg, 2010). While for young people learning is interpreted as an investment for the future, the scenario is modified in adult age and educational tasks may help retired people in adapting to old age (Adams, Leibbrandt and Moon, 2011; Santos *et al.*, 2014).

In this perspective, in the last 30-40 years several Universities of the Third Age (UTAs) have grown in many industrialized countries (Formosa, 2014), among which Italy. The literature on the topic often refers to single case studies (Gitto, 2017; Lardies-Bosque1 *et al*., 2015; Escuder-Mollon and Cabedo, 2013; Zielinska-Wieczkowska *et al*., 2011) and outlines the direct health benefits, both physical and cognitive, produced by mental stimulation in later life (Sonati *et al.*, 2011; Cohen, 2006). In Italy,

aging population has the possibility to follow informal courses and educational activities delivered by the UTAs. Some UTAs are organized on a national scale and associated with specific networks, as, for example, *Federuni* (that counts about 250 Universities for the elderly in Italy) or the *Associazione per l'AUtogestione dei SERvizi e la solidarietà* (AUSER), the National Organization for older people, promoting active ageing.

Among informal courses, the ones addressing information and communications technologies (ICT) have quite a noticeable success among the elderly (Mayhorn et al, 2004) because, up to now, people over 65 is not very familiar with the use of information technologies. Through the use of ICT people can surf on the internet, use electronic mail and keep in touch with their relatives, log in institutional websites in order to get access to public services, buy electronic tickets for leisure time. All these activities support the integration of aging people within society and increase their active participation to social life.

The use of ICT also reduces the burden of many administrative tasks: elderly can manage their bank accounts, bill payments, etc., directly from home, without the need of external help. This is crucial for older people with physical activity limitations because it both implies resource saving and improves their self-esteem (Heyn Billips, 2001).

The paper focuses on a sample of 341 elderly people attending UTA's courses in Milazzo, an Italian town situated in Southern Italy; the specific name of the University is *Libera Università della Terza Età* (LUTE). Through the application of different model specifications, we analyzed the impact of ICT use on elderly quality of life. Literature reports evidence of a positive effect of ICT use on elderly wellbeing, which is often measured in terms of social relations, increased autonomy and life enhancement (Phillipson and Ogg, 2010, Gonzalez, Ramirez and Viadel, 2012), but very few studies apply specific parameters to assess the elderly quality of life.

Our paper contributes to the extant literature by using a specific and comprehensive measure of QoL, the WHOQol-Bref, which is a parameter validated by the World Health Organization aimed at assessing individuals' quality of life through a questionnaire representing different aspects of everyday life. Results corroborate the findings of existing literature on the importance of using ICT by aging population in order to maintain a suitable quality of life, and this evidence addresses valuable policy considerations.

The remain of the work is structured as follows: Section 2 carries out a brief literature review on the beneficial effects of ICTs among aging population, Section 3 provides descriptive statistics, Section 4 presents the empirical strategy and Section 5 discusses the results. Concluding remarks are reported in Section 6.

2. Elderly and ICT use

In recent years, there has been a growing interest among scholars on ICT use and its beneficial effects on elderly wellbeing. Almost all contributions support the positive impact of ICTs among older population: the use of digital tools has been demonstrated to enhance social participation and psychosocial wellbeing (Heart and Kalderon, 2013; Hernández-Encuentra, Pousada and Gómez-Zúñiga, 2009; Carpenter and Bunday, 2007; Selwyn, Gorard and Furlong, 2003).

Earlier empirical works suggest that the use of ICT by ageing population favors life enhancement and social participation, because it promotes adult learning and supports both health information access and communication with family and friends. Several sources noted that the primary benefit of older people's use of ICT was the ability to maintain relationships with friends and family, and thereby gain social support (Age UK, 2010). There was considerable evidence of the positive effects of a range of ICT on social involvement with friends and family.

A scoping review of the academic and grey literature, covering the period between January 2007 and August 2014 has been carried out by Damant *et al.* (2017), who employ WHOQOL models to classify and analyze the relevant literature. The findings from the review were mixed, because older people's use of ICT has been shown to have both positive and negative impacts, looking at several aspects of QoL.

As it has been noted, using computers and surfing on the internet gives older people a greater sense of independence and control over their daily lives (Morris, Goodman and Brading, 2007), especially for people aged over 65, who are housebound and may therefore feel isolated. People who are constant internet users tended to report a higher autonomy in various aspects of their lives (Mason, Sinclair and Berry, 2012). Further, Martinez-Pecino et al. (2012) reported that older people who own a mobile phone experienced a sense of freedom and independence.

It is unquestionable that technology pervades every aspect of modern life and ICT tools have the potential of assisting the elderly in many tasks of their daily activities, especially if applied to areas which are strategic for elderly wellbeing, such as housing, health and social services (Heart and Kalderon, 2013; Bernard and Philips, 2000). With reference to healthcare services, the improvement of telemedicine has increasingly allowed older people to stay home and be monitored via ICT applications by a doctor or a medical center (Vimarlund and Olve, 2015).

However, even in industrialized countries, ICT access by older population is not as straightforward as it may be for younger adults. A growing strand of literature suggests that elderly are physically and psychologically disadvantaged when using new technologies: they are less self-confident and more selective than younger people when using ICT (Broady, Chan and Caputi, 2010; Rosseau and

Rogers, 1998) and physical limitations such as sight decrement, hand-eye coordination, motor functioning represent an obstacle to ICT approach (Selwyn, Gorard and Furlong, 2003).

Factors such as previous computer experience, computer anxiety, and perceived usefulness may influence the development of older adults' attitudes towards computers. Reduction of initial computer anxiety through specific training courses might enhance the effectiveness of computer use for older adults (Czaja and Sharit, 2012; Charness, Bosman and Elliott, 1995). Thus, training programs should be developed to demonstrate the practical uses of computers for older adults and reduce initial anxiety by introducing positive experiences through practical exercise.

There are, of course, specific variables that impact on the familiarity with ICT use by older people, and these are mostly related to individual socioeconomic status. A study based on Canadian population and internet use in older adulthood shows that socioeconomic variables in the childhood (*i.e.* parents' education and family income) impact positively on internet use by older adults and the same positive relationship emerges if an individual experienced at least one period of high socioeconomic status during his life course (Pannor Silver, 2013). Previous research corroborates these findings (Lenhart et al, 2003). There are also material factors related to the socioeconomic divide in using internet and ICT. Most of the elderly people do not have their own computers, because they cannot afford them. Health, as well, is a determinant in the use of computers, with healthier elderly more prone to making use of ICT with respect to unhealthy coevals (Heart and Kalderon 2013).

Given these premises, the paper tries to shed some light on the impact of ICT use on elderly Qol.

3. Materials and methods

The study has been carried out within a wider project aimed at evaluating QoL in the population of individuals enrolled at the LUTE in Milazzo, Sicily (Italy).

The LUTE was established in Milazzo in 2011 and adheres to the AUSER, the Italian association that promotes active aging. It operates in the field of lifelong learning and organizes its activities exclusively on the basis of volunteers' work. The term "*Libera*" (free), referring to the UTA, signifies that, although mainly directed to the elderly, adult people, with no age limits, may enroll.

In 2016, people involved in LUTE activities in Milazzo, attending the courses, teaching or working as volunteers reached 900 units. Available courses are more than one hundred and they cover different thematic areas; together with classes based on traditional learning, there are interactive classes aimed at making individuals familiar with the use of ICTs as personal computer, tablet, smartphone, etc. LUTE's attendants were asked to fill a questionnaire providing information on: individual

socioeconomic characteristics (9 items); educational initiatives and courses followed (19 items); knowledge and current use of ICTs (5 items); Quality of Life (QoL), which was assessed through the use of WHOQoL Bref, composed by 24 items, relating to specific dimensions of everyday life, plus 2 separate items aimed at asking the respondents to directly rate, on a 0-5 Likert scale, respectively their health status and QoL.

Table 1 summarizes the contents of the survey.

Table 1 – the survey

Dimensions surveyed	**No. items**
Individuals' personal information	9 items
Information on LUTE attendance	19 items
Information on the use of ICT technologies	5 items
Quality of Life assessment	WHOQoL Bref – 26 items

Overall, 341 people answered the items of the questionnaire, although only 250 respondents completed the whole form. Since the final calculation of the WHOQoL Bref requires each of the items to be fulfilled, the ultimate sample included 250 observations.

The variables used in the model specifications refer mainly to ICT's use and QoL. With reference to the former, queries on the ***frequency*** of use, the number and ***typology*** of devices used (PC, tablet, smartphone) and the ***place*** where individuals mainly use their ICT tools, were employed in the model. As for QoL, the WHOQoL Bref (which represents a short form of the more common tool WHOQoL 100), was implemented in order to capture different domains of everyday life. The WHOQoL Bref consists of 24 items related to different aspects of well-being, respectively Physical health (7 items), Psychological health (6 items), Environmental health (8 items) and Social relationships (3 items), plus two separate items which provide further information about an individual's overall perception of QoL (answer to the question "How would you rate your Quality of Life?") and the perception of his/her own health (answer to the question "How satisfied are you with your health?"). Each of the 26 items is rated on a 5-point Likert scale, such that higher scores denote a higher QoL (WHOQoL Group, 1998; Skevington, Lotfy and O'Connell, 2004). The presence of two separate items addressing respectively the perception of either QoL or health status, allows the identification of two final scores: the *overall* WHOQoL Bref score, which includes information on the whole 26 items, and the *partial* WHOQoL Bref score, which includes data on the 24 items addressing the four domains of everyday

life. Details on the algorithms employed to obtain the final score, which is comparable to the more widespread WHOQoL100 score, are addressed by specific bibliographic sources (WHO, 1996). Within this paper, QoL in its different declinations (the overall WHOQoL Bref score and the single score obtained for either health status and QoL), has been employed as dependent variable in different model specifications, aimed at assessing the impact of ICT use on the QoL of LUTE's attendants.

3.1 Descriptive statistics

Table 2 reports the characteristics of the sample of people who answered the survey and the the scores reported in the WHOQoL Bref questionnaire.

Table 2 – characteristics of the sample

Variable	No. respondents	%	Std. dev.	Min	Max
Age	244	62.42 (mean)	10.769	27	95
Over 65	119	0.487	0.500	0	1
Gender (male)	84	0.336	0.474	0	1
Marital status:	**250**				
Single	25	0.10	0.300	0	1
Married	179	0.716	0.452	0	1
Divorced	17	0.068	0.252	0	1
Widowed	29	0.116	0.321	0	1
Living arrangements:	**250**				
Alone	37	0.148	0.356	0	1
Partner	118	0.464	0.500	0	1
Family	100	0.400	0.491	0	1
Education:	**250**				
Compulsory ed.	52	0.208	0.407	0	1
High school	100	0.604	0.490	0	1
Academic	48	0.192	0.394	0	1
Activity:	**250**				
Pensioner	136	0.544	0.499	0	1
Self-employee	8	0.032	0.176	0	1
Teacher	13	0.052	0.222	0	1
Salesman	4	0.016	0.126	0	1
Employee	23	0.092	0.290	0	1
Housewife	63	0.252	0.435	0	1
Unemployed	17	0.068	0.252	0	1
Income:	**233**				1
< 15,000 €	78	0.281	0.450	0	1
15,000-28,000 €	79	0.290	0.454	0	1
28,001-55,000 €	26	0.097	0.296	0	1
55,001-75,000 €	5	0.015	0.120	0	1
> 75,000 €	1	0.003	0.054	0	1
No answer	44	0.183	0.386	0	1
ICT availability (possible mult. choice)	**250**				
Personal computer	172	0.688	0.464	0	1
Tablet	58	0.232	0.423	0	1
Smartphone	118	0.472	0.500	0	1
None	20	0.08	0.271	0	1
Ability in using ICT (possible mult. choice)	**250**				

I cannot do anything	30	0.120	0.326	0	1
Text messages	119	0.476	0.500	0	1
Surfing the net	182	0.728	0.446	0	1
Social network	116	0.464	0.500	0	1
How often do you use ICT?	**243**				
Never	31	0.124	0.245	0	1
Sometimes	19	0.076	0.266	0	1
Frequently	43	0.172	0.378	0	1
Very frequently	150	0.600	0.491	0	1
Where do you use ICT?	**250**				
Wherever	15	0.064	0.245	0	1
At friends'	6	0.024	0.153	0	1
At home	199	0.796	0.404	0	1
When travelling/moving	82	0.328	0.470	0	1
Access to internet	**250**				
Internet yes	220	0.880	.326	0	1
Internet no	23	0.09	.290	0	1
Internet do not know	7	0.03	.090	0	1
Separate-item – Health (score)	250	3.436 (mean)	0.849	1	5
Separate -item – Quality of Life (score)	248	3.714 (mean)	0.693	1	5
Partial WHOQoL Bref (score)	250	83.334 (mean)	11.401	47	111
WHOQoL Bref (score)	248	90.454 (mean)	12.487	51	120
WHOQoL single items					
Pain	250	4.352	0.697	2	5
Drugs	250	3.796	0.870	1	5
Sleep	250	3.468	1.037	1	5
Physical activities	250	3.840	0.775	1	5
Working skills	250	3.880	0.701	1	5
Energy	250	3.496	0.751	1	5
Mobility	250	4.028	0.963	1	5
Physical dimension – total	250	26.860	3.931	14	35
Negative feelings	250	3.948	0.756	2	5
Physical aspect	250	3.388	0.805	1	5
Enjoying life	250	2.776	0.863	1	5
Meaning	249	3.377	0.947	1	5
Concentration	249	3.201	0.818	1	5
Self esteem	250	3.856	0.773	1	5
Psychological dimension – total	250	20.52	3.634	11	29
Personal relationship	250	3.868	0.870	1	5
Sex	250	3.348	0.954	1	5
Social support	250	3.620	0.898	1	5
Social dimension – total	250	10.836	2.077	4	15
Safety	250	3.256	0.721	1	5
Environment	250	3.264	0.746	1	5
Place	250	3.572	1.020	1	5
Health services	250	2.620	0.946	1	5
Money	250	2.792	0.674	1	4
Information	250	3.420	0.823	1	5
Recreation	250	3.056	0.881	1	5
Transports	250	3.128	0.627	1	5
Environmental dimension – total	250	25.108	25.108	11	37

The participants to the survey were 62 years old on average: the age in the sample ranged from 27 to 95 years, although the distribution is skipped to the right (almost 50% of the people in the sample were over 65 years old). It has been said earlier, in fact, that there is no age limit for enrolling to the LUTE, although the courses are mainly directed to the elderly.

Two thirds of the respondents were female; 71.6% were married and 86.4% lived with the family or with the partner; only 14.8% declared to live alone.

More than sixty per cent of the participants completed the high school, 19.2% of the people in the sample had an academic education. This educational framework suggests that there might be self-selection in the decision of attending LUTE's courses and this evidence should be considered when addressing policy measures.

Most of respondents are retired (n=136) and 25% of the sample is represented by housewife; professional figures, such as salesmen or employees are almost not (or very few) represented.

There are two levels of income more represented, respectively less than € 15000 (28%) and between 15000 and 28000 Euro (29%); to be noticed that 18% of respondents gave no answer to this topic.

The majority of respondents (88%) have an internet connection at home and use, therefore, ICTs frequently/very frequently (77.2%). Home is the preferred site to connect and use ICT (79.6% of the respondents); almost one third of the respondents, however, use digital devices when travelling/moving. Tablet is the device less popular (23.2%, comparing to smartphone - 47.2% - and personal computer - 68.8%). Most people in the sample use ICTs to surf on the internet (72.8%), 46.4% use social networks, while 12% declare they cannot use ICTs.

4. Empirical model

The analysis aims at identifying the impact of ICT's use on the QoL of LUTE's attendants.

We first employed OLS regressions, with different model specifications, each addressing a distinctive aspect of ICT's use, namely the ***frequency*** of use, the ***place*** where individuals mostly use their ICT and the ***kind*** of ICT mostly used.

Since we were especially interested in observing the use of ICT among the elderly, we also tested each regression on both the whole sample (n=250) and a restricted sample including only people *over 65* (n =119).

The relatively low number of observations in the sample, and especially in the subsample, was the main reason for choosing to keep separate the regressors related to the three different features. The second reason relates to multicollinearity: after building a covariance matrix between regressors addressing the three different aspects of ICT use, we found out that some items were highly correlated (correlation index = 0.5) and it was henceforth preferable to use them in separate models. Finally, keeping the three aspects separate, allows a clearer analysis of policy implications.

As for controls, we created a vector containing the most common socioeconomic variables (age, education, marital status, income, living arrangements) and we named it SOCIOEC (Jones, 2007). The

variables referred to different occupational categories were not included among the covariates addressing the socioeconomic status because they were very scarcely represented. For the same reason, with reference to income classes, we merged in a single category all the observations showing an income bigger than 28,000 euro. This value represents the threshold under which is concentrated the majority (n = 157) of the survey participants.

The "reference individual" is woman, 60 years old, married, she holds a high school degree, with an income ranging from € 15,000 to € 28,000, and lives with her partner.

With the exception of age, all the other regressors are dummy variables (DV). The dependent variable is a continuous variable which represents the QoL of respondents. After running some tests, we chose the variable including the score of the whole 26 items (WHQOL-Bref). As it has been explained, this variable includes the WHQOL total score for each of the four domains, plus the two separate items' score, each addressing the individual specific perception of either health or quality of life.

The value of the WHQOL-Bref, referred to the whole sample, ranges from 51 to 120, with a mean of 90.4 (see table 2). Since domain scores are scaled in a positive direction, higher values of WHQOL-Bref denote a higher QoL.

The first model specification is an OLS regression aimed at testing the impact of ICT's frequency of use on the attenders' QoL. Respondents were asked ***how often*** a month they used an ICT tool (which can be either a personal computer, a tablet or a smartphone). Answers could be: i) less than one hour a month (NEVERTIME); ii) once a week (SOMETIMES); iii) more than one hour a week (FREQUENT TIME); iv) every day (VERY FREQUENT TIME).

Each item is represented by a DV, which was employed as a regressor. To avoid multicollinearity, beside controls, only three DV representing the frequency of use were employed as regressor in the equation. Some strategies to avoid multicollinearity have been suggested in applied works (Sinan and Alkan, 2014; Zuur and Ieno, 2016).

Since we wanted to test the impact of the two edges variables (i.e. NEVERTIME *versus* VERY FREQUENT TIME), we built two different model specifications, each excluding one of the selected variables.

Given the standard OLS equation: $y_i = \alpha + \beta x_i + \varepsilon$,

the two model specifications are the following:

A1) WHQOL-Bref = $\alpha + \beta_1$ NEVERTIME + β_2 SOMETIMES + β_3 FREQUENTIME + β_i SOCIOEC + ε

A2) WHQOL-Bref = $\alpha + \beta_1$ SOMETIMES + β_2 FREQUENTIME + β_3 VERYFREQUENTIME+β_i SOCIOEC + ε

As it can be observed, the two equations differ for the substitution of one regressor in each, specifically VERY FREQUENT TIME *vs* NEVERTIME. The two regressions were run on both the full sample and the sample including only people *over 65*.

Results are reported in tables 3.1 and 3.2.

Table 3.1. – Equation A1 – Frequency of use and QoL

Variables	1st model – whole sample (std. errors in brackets):	2nd model – over 65 (std. errors in brackets):
When using ICT:		
Nevertime	-6.700***	-8.502***
	(2.499)	(2.844)
Sometime	-4.192	-12.487***
	(2.832)	(3.755)
Frequentime	-2.506	-2.148
	(2.097)	(2.583)
Gender (male)	-0.046	1.980
	(1.675)	(2.338)
Living:		
Alone	4.547	4.356
	(3.097)	(3.982)
Family	-1.533	-3.198
	(1.751)	(2.474)
Education:		
Compulsory	-4.752**	-7.250***
	(1.997)	(2.551)
Graduate	-0.202	2.690
	(2.001)	(2.802)
Marital status:		
Single	-6.703**	-5.281
	(3.060)	(4.899)
Divorced	-2.563	-3.603
	(3.259)	(4.272)
Widowed	-6.845**	-6.653*
	(3.195)	(3.968)
Income:		
Less 15,000 €	-4.880***	-3.975*
	(1.810)	(2.380)
More 28,000 €	6.432***	4.236
	(2.452)	(2.823)
No answer	-1.679	1.992
	(2.260)	(3.273)
Constant	105.245***	116.893***
	(5.798)	(14.880)
	R^2 = 0.237 Adj. R^2 = 0.187 F (15, 228) = 4.73 Prob > F = 0.000 Number obs. = 244	R^2 = 0.417 Adj. R^2 = 0.332 F (15, 103) = 4.91 Prob > F = 0.000 Number obs. = 119
*** significant at 99%; ** significant at 95*; * significant at 90%		

Table 3.2. - Equation A2 – Frequency of use and QoL

Variables	1st model – whole sample (std. errors in brackets):	2nd model – over 65 (std. errors in brackets):
When using ICT:		
Sometime	1.806	-5.050
	(3.091)	(3.782)
Frequentime	3.583	5.451*
	(2.588)	(3.000)

Very Frequentime	6.893*** (2.191)	8.666*** (2.592)
Gender (male)	0.166 (1.663)	1.641 (2.294)
Living: Alone Family	 3.882 (3.081) -1.425 (1.741)	 3.547 (3.948) -3.411 (2.439)
Education: Compulsory Graduate	 -4.608** (1.981) -0.379 (1.984)	 -7.403*** (2.504) 2.681 (2.760)
Marital status: Single Divorced Widowed	 -5.861* (3.080) -1.571 (3.259) -6.391** (3.161)	 -4.297 (4.882) -2.890 (4.243) -5.897 (3.921)
Income: Less 15,000 € More 28,000 € No answer	 -4.476** (1.804) 6.344** (2.435) -1.682 (2.243)	 -2.820 (2.411) 4.505 (2.778) 2.612* (3.267)
Constant	96.270*** (6.996)	100.631*** (16.215)
	R^2 = 0.246 Adj. R^2 = 0.196 F (15, 228) = 4.96 Prob > F = 0.000 Number obs. = 244	R^2 = 0.428 Adj. R^2 = 0.345 F (15, 103) = 5.15 Prob > F = 0.000 Number obs. = 119
*** significant at 99%; ** significant at 95*; * significant at 90%		

As a further step, we wanted to test if the place ***where*** the attendants prevalently use their ICT tools could affect their QoL. The questionnaire is provided by specific items related to this topic, whose answers are: i) almost never and wherever (NEVER); ii) not at home, which includes at friends'/ relatives'/community centers (OTHER HOME); iii) at home (MY HOME); iv) even in mobility (EVEN TRAVELLING).

The last answer denotes a high attachment to these tools, because it requires a good ability in handling either a PC, a tablet or a smartphone and a high motivation of using them even when travelling. From a correlation analysis, between EVENTRAVELLING and the DVs representing the possess of each ITC tools, the highest correlation index (0.46) is detected for the use of a smartphone, which makes sense because people use prevalently smartphones when travelling.

The OLS specification, which includes regressors addressing where people use prevalently their ICT is:

B) WHQOL-Bref = $\alpha + \beta_1$ OTHERHOME + β_2 MYHOME + β_3 EVENTRAVELLING + β_i SOCIOEC + ε

The omitted DV is the one related to the answer "almost never and wherever"; results from the regressions, run on both the whole sample and the subsample, are reported in Table 4.

Table 4: equation (B) – Place of use and QoL

Variables	**1st model – whole sample (std. errors in brackets):**	**2nd model – over 65 (std. errors in brackets):**
Where using ICT:		
Otherhome	5.358	-0.013
	(4.787)	(7.915)
Myhome	3.940**	5.588**
	(1.969)	(2.407)
Eventravelling	5.052***	9.245***
	(1.812)	(2.560)
Gender (male)	-0.716	-0.334
	(1.652)	(2.257)
Living:		
Alone	5.115*	5.341
	(3.095)	(3.994)
Family	-1.479	-2.204
	(1.737)	(2.411)
Education:		
Compulsory	-4.648**	-8.116***
	(1.993)	(2.493)
Graduate	-1.396	-0.877
	(1.997)	(2.730)
Marital status:		
Single	-6.925**	-5.490
	(3.031)	(4.866)
Divorced	-2.506	-4.984
	(3.342)	(4.295)
Widowed	-6.666**	-7.688*
	(3.094)	(3.926)
Income:		
Less 15,000 €	-3.832**	-1.830
	(1.841)	(2.524)
More 28,000 €	7,185***	6.380**
	(2.418)	(2.744)
No answer	-1.556	0.903
	(2.251)	(3.191)
Constant	96.555***	104.094***
	(6.866)	(15.859)
	$R^2 = 0.245$ Adj. $R^2 = 0.196$ F (15, 228) = 4.94 Prob > F = 0.000 Number obs. = 244	$R^2 = 0.423$ Adj. $R^2 = 0.339$ F (15, 103) = 5.04 Prob > F = 0.000 Number obs. = 119

*** significant at 99%; ** significant at 95*; * significant at 90%

Finally, we tested on the possible impact of using a specific ICT on the attendants' QoL. The questionnaire provided four items related to this point, each aimed at identifying the kind of devices mostly used (multiple choice was possible). The answers were: i) personal computer (PC); ii) tablet (TABLET); iii) smartphone (SMARTPH), iv) none (NO). We employed as regressors the three former DVs and dropped the one indicating no use of ICT.

The final specification is the following:

C) $\text{WHQOL-Bref} = \alpha_i + \beta_1 \text{PC} + \beta_2 \text{TABLET} + \beta_3 \text{SMARTPH} + \beta_i \text{SOCIOEC} + \varepsilon$

Two regressions were run on both the whole sample and the restricted sample, and results are reported in table 5.

Table 5: Equation (C) – ICT device and QoL

Variables	**1st model – whole sample (std. errors in brackets):**	**2nd model – over 65 (std. errors in brackets):**
Which ICT device:		
PC	5.041***	6.451***
	(1.683)	(2.203)
Tablet	0.044	3.645
	(1.740)	(2.341)
Smartph	-0.620	-2.501
	(1.580)	(2.152)
Age	-0.231***	-0.390*
	(0.088)	(0.224)
Gender (male)	-1.003	-1.191
	(1.679)	(2.328)
Living:		
Alone	4.856	6.904*
	(3.093)	(4.109)
Family	-1.951	-2.047
	(1.744)	(2.461)
Education:		
Compulsory	-4.876**	-6.823**
	(2.002)	(2.634)
Graduate	-1.370	-0.839
	(2.010)	(2.779)
Marital status:		
Single	-8.059	-7.107
	(3.066)	(4.972)
Divorced	-1.390	-4.297
	(3.292)	(4.337)
Widowed	-5.998**	-7.842*
	(3.105)	(4.036)
Income:		
Less 15,000 €	-4.541**	-4.219*

	(1.806)	(2.425)
More 28,000 €	7.335***	6.650**
	(2.431)	(2.814)
No answer	-2.108	-2.206
	(2.243)	(3.223)
Constant	105.641***	115.651***
	(6.308)	(16.280)
	$R^2 = 0.240$ Adj. $R^2 = 0.190$ F (15, 228) = 4.79 Prob > F = 0.000 Number obs. = 244	$R^2 = 0.398$ Adj. $R^2 = 0.310$ F (15, 103) = 4.54 Prob > F = 0.000 Number obs. = 119
*** significant at 99%; ** significant at 95*; * significant at 90%		

5. Discussion of Results

Results from all the regressions clearly address a positive impact of ICT use on the respondents' QoL. Equation A, in its two different declinations, deals with the frequency of ICT's use by LUTE's attendants. Starting with equation A1 (table 3.1) the DV addressing a very scarce use of ICT (less than one hour a month) is both negative and highly significant ($p<0.01$). Using an ICT tool very few times compared to using it every day has a negative impact on the quality of life. This evidence is corroborated by the results of equation A2 (table 3.2). In this regression, the variables related to ICT's frequency of use are scaled from once a week (SOMETIMES) to everyday (VERYFREQUENTIME): it is possible to observe that a LUTE's attendant that uses ICT every day has a positive and highly significant ($p<0.01$) impact on QoL, if compared to a LUTE's attendant that uses it once a month, when controlling for a number of socioeconomic factors.

If we look at both A1 and A2 regressions on the restricted sample (people over 65), results are even stronger. With reference to equation A1, both the variables addressing *less than one hour a month* and *once a week* are negative and highly significant, which means that an elderly who uses a smartphone, a tablet and/or a PC once a week or even less, has a greater probability of experimenting a lower QoL with respect to an *over 65* individual using ICT very often. Scaling the regressors from SOMETIMES to VERYFREQUENTIME inverts the sign of the results, since the reference individual uses ICT almost never (less than one hour a month). Both regressors related to higher use of ICT show a positive and significant impact on QoL, suggesting that incentivising the use of ICT by the elderly could represent a suitable measure for active ageing. Controls confirm evidence from literature: for education, having just compulsory education impacts negatively on QoL with respect to holding high school education (Grossman, 2000) and the significance of this regressor is kept through the four regressions; for marital status, being single compared to being married impacts negatively on the QoL

(Averett et al. 2013), but this result is significant only for the regressions run on the whole sample ($p<0.1$), possibly because this figure is almost not represented in the subsample (n = 8). The same negative impact is due to the circumstance of being widow, with the level of significance varying according to the model specification. Less than €15,000 income has a negative impact on QoL, whilst more than 28,000 impacts positively on QoL, the reference income being between 15,000 and 28,000. In order to corroborate the positive impact of using ICT on respondents QoL, a second regression (B) was run, employing regressors related to the place of use. The idea is to test whether people use ICT in places different from home and whether this circumstance impacts on their QoL. Using ICT at home, as might be expected, impacts positively on QoL ($p<0.5$ in both regressions, run on the whole and restricted sample). It is though surprising to find out that using these tools when travelling has a positive and significant impact on elderly's Qol. In fact, using ICT even when travelling is a practice very diffuse and enjoyable among young people, who like surfing on the internet and/or chatting with friends (Konrad & Wittowsky, 2017). Further, this habit is surely positive for workers who employ their travel time in functional activities, but it is quite surprising to find out that LUTE's attendants aged 65 and over have a positive return from the use of ICT when traveling. Controls maintain almost all the sign and level of significance reported in regression (A), corroborating the empirical exercise. Finally, with equation (C) we tested whether the use of a specific ICT (either a PC, a tablet or a smartphone) could impact on respondents QoL. In both equations, run respectively on the whole and the restricted sample, a positive impact on QoL due to the use of a PC is detected ($p<0.01$), whilst no significant effects are identified for the use of either a tablet or a smartphone. This aspect is rather uninvestigated by literature and deserves a deeper insight.

6. Robustness check

The robustness check was carried out through the specification of a probit model testing for the probability of experimenting good health, given a set of regressors on the frequency of ICT's use.
As might be recalled, the WHQOL-Bref includes two separate items addressing respectively the individual perception of his own health and QoL. With reference to the former, possible answers to the question "How satisfied are you with your health?" are rated in an ascendant 5 points Likert scale from *very unsatisfied* to *very satisfied*.[1] Table 6 reports the distribution of this categorical variable. Since only one respondent chose "very unsatisfied", we dropped this observation in order to create a balanced dependent binary variable named GOODHEALTH, which takes value of 1 if the individual is

[1] The answers, are: 1) very unsatisfied, 2) unsatisfied, 3) neither unsatisfied nor satisfied, 4) satisfied, 5) very satisfied.

either *very satisfied* or *satisfied* with his health status and equals 0 if the individual is *unsatisfied* or *neither unsatisfied nor satisfied* with his health status (Jones, 2007).

So, in our specification, the distribution of the dependent variable Y is the following:

$$y_i = \begin{cases} 1 & \text{if people are } \textit{very satisfied} \text{ or } \textit{satisfied} \text{ with their health status} \\ 0 & \text{if people are } \textit{unsatisfied} \text{ or } \textit{neither unsatisfied nor satisfied} \text{ with their health status.} \end{cases}$$

In the final specification, P (Y = 1|X) is the probability of scoring GOODHEALTH and the three regressors chosen for the frequency of use are: NEVERTIME SOMETIME, FREQUENTIME, (the omitted variable is VERYFREQUENTIME). We tested the probability of scoring GOODHEALTH, given ICTs' frequency of use and controlling for a set of socioeconomic variables.

The estimated equation is:

$Y=\beta X+\varepsilon$

Results are reported in table 7 and support the previous findings. Specifically, using ICT less than one hour a month compared to the circumstance of using it every day decreases the probability of scoring GOODHEALTH ($p<0.1$) for both the whole and the restricted sample. Moreover, several controls that were significant in the OLS regressions, are significant in the probit model too and maintain the same sign, which proves the robustness of the model and the validity of the WHOQoL Bref as a parameter to assess the QoL.

Table 6 – Scoring health status

Score	***Definition***	***N (250)***
1	Very unsatisfied	1
2	Unsatisfied	38
3	Neither unsatisfied nor satisfied	80
4	Satisfied	113
5	Very satisfied	18

Table 7: results of the Probit

Highhealth	1st model – whole sample (std. errors in brackets):	2nd model – over 65 (std. errors in brackets):
When using ICT:		
Nevertime	-0.588*	-0.751*
	(0.311)	(0.441)
Sometime	-0.535	-0.395
	(0.351)	(0.576)
Frequentime	-0.344	-0.130
	(0.244)	(0.346)
Age	-0.036***	-0.058
	(0.011)	(0.036)
Gender (male)	-0.142	-0.285
	(0.203)	(0.336)
Living:		
Alone	0.190	0.559
	(0.381)	(0.645)
Family	-0.334	-0.209
	(0.211)	(0.645)
Education:		
Compulsory	-0.164	-0.190
	(0.242)	(0.366)
Graduate	-0.192	0.419
	(0.242)	(0.401)
Marital status:		
Single	-0.958**	-0.961
	(0.383)	(0.829)
Divorced	0.357	-0.278
	(0.397)	(0.621)
Widowed	-0.277**	-0.688
	(3.195)	(0.656)
Income:		
Less 15,000 €	-0.330	-0.430*
	(0.217)	(0.345)
More 28,000 €	0.974***	1.146***
	(0.316)	(0.411)
No answer	0.012	-0.193
	(0.270)	(0.476)
Constant	2.739***	4.346**
	(0.727)	(2.487)
	Number obs. = 244 LR chi2(15) = 53.94 Prob > chi2 = 0.0000 pseudo R^2 = 0.1596	Number obs. = 119 LR chi2(15) = 35.70 Prob > chi2 = 0.0020 pseudo R^2 = 0.2224
*** significant at 99%; ** significant at 95*; * significant at 90%		

7. Concluding remarks

Aging imposes to Governments of developed countries one of the biggest economic and social challenge of this century. In order to contrast cognitive and physical impairment, the use of ICT among the elderly has been proven to exert a positive impact on their wellbeing. Our model focuses on a sample of 341 people attending the LUTE, which is an educational organization addressing active aging measures, and suggests that the use of ICTs among them, and especially among people aged 65 and over, has a positive impact on their QoL.

Results hold through different model specifications aimed at observing the frequency of use, the place of use and the kind of ICT used. The positive impact of ICTs' use is also confirmed by the robustness check, which tests the probability that a respondent would score his own health as either good or very good, given different levels of ICTs' frequency of use.

It may be observed that the sample we employed suffers from self-selection, since people attending LUTE are on average more educated and/or more skilled than general population. Notwithstanding this condition, our empirical exercise provides a suitable case study that may apply to broader contexts. From a technical standpoint, our sample represented a rather homogeneous group of people, from which we were able to distinguish a subsample of old individuals that confirmed, sometimes with stronger significance, the positive impact of ICT's use on elderly QoL.

Given this evidence, policy implications are twofold: first of all, any measure aimed at enabling aging population in the use of ICT, as for example implementing courses that increase ICT skills, applying fiscal detractions in order to favour the purchase of a PC by people in low socioeconomic conditions, and/or expanding free Wi-Fi zones, would increase the probability of favouring an active aging process.

The second point, although not specifically addressed by our model, deals with the positive effect of adult learning: given the evidence provided by literature on the importance of adult learning as a possible measure to keep psychological and social autonomy in older age, our paper indirectly confirms this position and suggests to promote UTAs activities in Italy and in other developed countries.

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