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ORIGINAL ARTICLE

Digital divide in elderly: Self-rated computer skills are associated with higher education, better cognitive abilities and increased mental health

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Abstract
Background and objectives: Recent evidence indicates a positive relationship of computer and internet use with mental health and life quality of elderly. However, the role of computer skills is unclear. This study evaluates self-rated computer skills of elderly and their relationship with mental health, cognitive abilities and related variables.
Methods: We used data recently collected by Survey of Health, Ageing and Retirement in Europe (SHARE) and included individuals across Europe aged 65 and above. The sample consisted of N=26,525, 55.6% were female. Mean age of the sample was 74.57 (SD=7.12).
Results: We observed significant relationships between self-rated computer skills level and mental health, cognitive abilities and physical health. Having a partner, education level and self-rated writing skills turned out to be the best predictors for self-rated computer skills level in elderly.
Conclusions: The findings underscore the importance of computer skills in the elderly. Programs designed to enhance the ability to engage in computer and internet activities may be useful to counteract the digital divide.

Introduction

The rise of information and communications technology (ICT) and its incredible benefits are accompanied by increasing concerns of negative effects on mental health and psychological well-being. Recent evidence deals with problematic smartphone use and internet addiction.[1-3]

However, for older people, ICT use research agenda postulates rather positive associations with mental health. The focus of evidence is on depression and loneliness. Social technology use in older adults is related to better mental health, fewer chronic diseases, better self-rated health, and reduced loneliness.[4]

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However, there are two sides of every coin. If elderly use ICT to escape the real world and avoid negative feelings resulting from direct interactions, it may increase loneliness.[5] Conversely, ICT usage can reduce loneliness by enhancing existing relationships and making new friendships. Recent evidence supports the association between online activity of elderly and reduced loneliness.[6]

Furthermore, recent studies found that internet use of elderly reduces the risk for depression.[7,8] A literature review concluded, that technology use among seniors reduces social isolation.[9]

However, computer and internet use may be dependent on individual computer and internet skills. Previous research indicates that lack of skills may be a barrier from using new technologies. Results of a study with a sample of 65- to 70-year-old people show that higher education is associated with higher ICT use. Non-users reported to be anxious with technology.[10] Hill et al. report, that while more and more activities are online, older people lack the skills to participate, what leads to a digital divide in society.[11] Technological experience and personality characteristics (e.g., agreeableness and openness to experience) were the strongest predictors of perceived usefulness of a computer system designed for seniors.[12]

Unfortunately, there is very little evidence about the relationship of computer skills and (mental) health. It is plausible that, e.g., cognitive abilities in elderly are associated with computer and internet skills. This, in turn, could limit or enhance computer and internet use.[13,14] Furthermore, subjective conviction of having good computer skills may influence computer self-efficacy of elderly and (mental) health outcomes.

Thus, the objective of this study was to assess, if older people with different self-rated computer skills levels also differ in internet use, cognitive abilities, mental health parameters and further life quality-related variables.

Methods

Sample

We used data from the Survey of Health, Ageing and Retirement in Europe (SHARE) Wave 6 (10.6103/SHARE.w6.611, http://www.share-project.org/home0.html).[15] The SHARE study is a consortium survey supplied to households in the European Union member States, Israel, and Switzerland. The SHARE target population includes all individuals aged 50 years and above, who live in the respective country. Data are collected via computer-assisted personal interviewing (CAPI), i.e., SHARE-interviewers ask participants on a face-to-face-basis using a laptop computer[16] (SHARE, 2017). For further methodological details, see Börsch-Supan et al.[17]

In this study, we included participants of the SHARE study aged 65 or above. Our final sample consisted of N=26,525 persons, 55.6% were female. Mean age of the sample was 74.57 (SD=7.12).

Measures

Self-rated computer skills

SHARE questionnaire provides two important questions regarding computer skills and use of internet. The question "How would you rate your computer skills? Would you say they are..." offers six response categories from "excellent" to "I never used a computer". We transformed data into three groups "never used a computer", "poor, fair skills", "good, very good, excellent skills". Further, we included the item "During the past 7 days, have you used the Internet, for e-mailing, searching for information, making purchases, or for any other purpose at least once?" with response categories "yes" and "no".

Mental health, psychosocial situation and education

We used generated variables of the mental health section provided by SHARE, i.e., depression scale EURO-D and depression caseness, formed by depression, pessimism, suicidality, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment, tearfulness.

For loneliness, we used the data from the short version of the R-UCLA Loneliness Scale,[18] with response categories ranging from "not lonely" to "very lonely". Relationship status was assessed with one item (partner yes vs. partner no).

Furthermore, we used ISCED-97 levels to classify the highest education achievements of participants (ranging from "0=pre-primary education" to "6=second stage of tertiary education; we transformed data into 0 to 2 vs. >2).

Cognitive abilities

We selected self-rated reading and writing skills (response categories: 1=Excellent to 5=Poor, respectively), verbal fluency score ("Now I would like you to name as many different animals as you can think of. You have one minute to do this."), and memory ("How would you rate your memory at the present time? Would you say it is excellent, very good, good, fair or poor?", response categories: 1=Excellent to 5=Poor) as parameters for cognitive abilities.

Physical health

To describe physical health, we selected self-perceived health ("Would you say your health is...?" Response categories range from 1=Excellent to 5=Poor), and chronic diseases (number of chronic diseases).

Statistical analysis

For statistical analysis, we used IBM SPSS Statistics 24 and Excel 2016. We calculated numbers and percentages of all parameters.

For variables on nominal measurement level, we performed χ^2 tests to compare different levels of computer skills. For continuous parameters, we performed Kolmogorov-Smirnov-Test for testing normality. Since we had to reject the normality assumption for most parameters, we chose to use Welch-Test for the one-way analysis of variance. Research indicates, that Welch-Test is relatively robust and can significantly reduce the probability for Type I error, if assumptions of parametric testing are not fully met.[19]

Further, we calculated an ordinal regression model in order to identify (mental) health predictors of computer skills level. We excluded age and gender from the analysis due to non-significant result in χ^2 tests, internet use last 7 days, and EURO-D Depression scale (instead we used Depression caseness) in model 1. We selected variables with a $\Delta OR > .30$ in relation to "never used a computer" for model 2.

Results

The analysis of self-rated computer skills level shows that 32.8% of the sample "never used a computer", 36.3% rated "poor or fair skills", and 30.8% "good, very good, or excellent skills".

Our results indicate significant differences between groups of self-rated computer skills level. Mental health, cognitive abilities and physical health were significantly better in persons with higher computer skills level. Age and gender revealed no significant relationship with computer skills level (Table 1).

Regression model 1 indicated, that having a partner, higher education, better self-rated reading- and writing skills, higher verbally fluency score, better memory, better self-perceived health, decreased loneliness and fewer chronic diseases significantly predict higher self-rated computer skills level. However, regression model 2 showed, that having a partner, higher education and better self-rated writing skills predict computer skills level with only a slightly decreased Nagelkerke's Pseudo R^2 compared to model 1 (Table 2).

Discussion

This study examined the relationship between self-rated computer skills level and internet use, cognitive abilities, mental health parameters and other life quality-related variables in Europeans aged 65 and older. We found clear associations between self-rated computer skills and all parameters, independent of age and gender. Findings indicate that better computer skills correspond to better mental and physical health, decreased loneliness, and better cognitive abilities.

Interestingly, our regression model 2 shows, that having a partner, better self-rated writing skills, and a higher education account for a large share of the variance of computer skills in our sample. There is some support for our results in research literature.

First, having never used a computer is associated with significantly increased odds ratio of not having a partner compared to individuals with at least poor or fair computer skills. Having a partner could be a trigger to be open and less anxious about technology. Moreover, elderly in a relationship may be socially less isolated than singles in the same age. Evidence suggests that older people engaging in ICT activities may have a more social, active lifestyle. Further, individuals aged 65 and older that engage in technology have closer family ties and greater overall connection to society.[20,21]

Second, self-rated writing skills are significantly related to computer skills. Recent research showed that language and memory skills improved after participating in a computer workshop designed for the elderly.[22] Moreover, writing skills can facilitate the access to technology.

Table 1 Relationship of self-rated computer skills with variables of internet use, education, cognitive abilities and mental health.

	Never used a computer (%)	Poor, fair skills (%)	Good, very good, excellent skills (%)	χ^2
Internet used last 7 days (yes)	0.0	56.4	93.5	14903.14**
Male	44.6	44.5	44.2	0.27n.s.
EURO-D Depression Caseness	39.6	26.1	17.6	986.06**
Partner yes (vs. no)	62.6	79.5	83.5	1137.69**
ISCED >2 Education	31.1	64.8	85.0	5161.13**
	Never used a computer M (SD)	**Poor, fair skills M (SD)**	**Good, very good, excellent skills M (SD)**	**F[1]**
Age	74.68 (7.15)	74.56 (7.10)	74.45 (7.10)	2.13n.s.
Self-rated reading skills[2]	2.88 (1.09)	2.22 (0.99)	1.71 (0.83)	586.23**
Self-rated writing skills[2]	3.03 (1.11)	2.37 (1.02)	1.78 (0.85)	647.88**
Verbal fluency score	15.80 (6.88)	20.66 (7.47)	23.77 (7.69)	2472.70**
Memory[2]	3.06 (1.02)	2.75 (0.93)	2.28 (0.91)	271.85**
EURO-D Depression	3.19 (2.58)	2.35 (2.16)	1.83 (1.89)	726.13**
Self-perceived Health[2]	3.67 (0.98)	3.18 (1.00)	2.68 (1.02)	2062.98**
Loneliness	4.32 (1.66)	3.92 (1.34)	3.64 (1.12)	467.90**
Chronic Diseases	2.35 (1.78)	1.74 (1.55)	1.29 (1.34)	964.54**

Note. M mean, SD standard deviation; N=26,525, we used listwise deletion of cases resulting in different n across tests (N>25,000 for all, except self-rated reading skills, n=4704; self-rated writing skills, n=4703; memory, n=4702).

[1] Univariate ANOVA Welch-Test.

[2] *High* values indicate *lower* cognitive skills and self-perceived health.

* p<0.01.

** p<0.001.

n.s. = not significant (p>0.05).

Table 2 Multinomial regression models with self-rated computer skills as dependent variable.

	Model 1 OR [95%CI]	Model 2 OR [95%CI]
EURO-D Depression (no case vs. case) [Never]+	1.00	
EURO-D Depression (no case vs. case) [Poor] +	1.09 [0.89; 1.32]n.s.	
EURO-D Depression (no case vs. case) [Good] +	0.97 [0.78; 1.22]n.s.	
Partner (no vs. yes) [Never]+	1.00	1.00
Partner (no vs. yes) [Poor]+	0.56 [0.46; 0.69]**	0.48 [0.39; 0.58]**
Partner (no vs. yes) [Good]+	0.59 [0.46; 0.76]**	0.43 [0.35; 0.54]**
ISCED Education (low vs. high) [Never]+	1.00	1.00
ISCED Education (low vs. high) [Poor]+	0.25 [0.21; 0.30]**	0.22 [0.18; 0.25]**
ISCED Education (low vs. high) [Good]+	0.10 [0.08; 0.12]**	0.08 [0.07; 0.10]**
Self-rated reading skills [Never]+ 1	1.00	
Self-rated reading skills [Poor]+ 1	0.80 [0.69; 0.92]*	
Self-rated reading skills [Good]+ 1	0.82 [0.68; 0.97]	
Self-rated writing skills [Never]+ 1	1.00	1.00
Self-rated writing skills [Poor]+ 1	0.94 [0.82; 1.09]n.s.	0.69 [0.64; 0.75]**
Self-rated writing skills [Good]+ 1	0.64 [0.53; 0.76]**	0.40 [0.36; 0.44]**
Verbal fluency score [Never]+ 1	1.00	
Verbal fluency score [Poor]+ 1	1.07 [1.06; 1.09]**	
Verbal fluency score [Good]+ 1	1.10 [1.09; 1.12]**	
Memory [Never]+ 1	1.00	
Memory [Poor]+ 1	1.03 [0.93; 1.14]n.s	
Memory [Good]+ 1	0.78 [0.70; 0.87]**	
Self-perceived health [Never]+ 1	1.00	
Self-perceived health [Poor]+ 1	0.83 [0.76; 0.92]**	
Self-perceived health [Good]+ 1	0.74 [0.66; 0.82]**	
Loneliness [Never]+	1.00	
Loneliness [Poor]+	1.04 [0.98; 1.10]n.s	
Loneliness [Good]+	0.92 [0.86; 0.99]*	
Chronic diseases [Never]+		
Chronic diseases [Poor]+	0.89 [0.83; 0.94]**	
Chronic diseases [Good]+	0.83 [0.77; 0.90]**	
Pseudo R^{2++}	.46	.39

Note. OR=odds ratio, CI=confidence interval.
We included ordinal and nominal variables as factors, and continuous variables as covariates in both models; n=4571 for model 1, and n=4642 for model 2.
+ Never=never used a computer; Poor=poor, fair; Good=good, very good, excellent.
++ Pseudo R^2 Nagelkerke Test.
1 *High* values indicate *lower* cognitive skills and self-perceived health.
* $p<0.01$.
** $p<0.001$.
n.s. = not significant ($p>0.05$).

Third, our results are in line with evidence that found higher education level is associated with higher ICT use.[10]

Our results also show that self-rated computer skills and internet use are strongly related. Unfortunately, older people are commonly supposed to lack the skills to participate in online activities, despite their potential positive effects on well-being of older people.[11]

Self-rated computer skills are associated with (mental) health and quality of life outcomes, as our data from across Europe indicate. Furthermore, computer skills are related to education level. Fang et al.[23] defined education as one among others factor that contribute to a digital divide, i.e., individuals with higher education will have facilitated access towards modern technologies and thus further improve their competence. Furthermore, health literacy is associated with education, which may explain the relationship between computer skills and health. One study group found that individuals with low health literacy were less likely to use the internet.[24]

Moreover, computer skills may have positive effects on computer self-efficacy. Self-efficacy is linked to a wide range of positive health and life quality outcomes.[25] Recent indicate that computer related self-efficacy and computer anxiety predict use of internet tools in older people.[26] However, consistent computer use has positive effect on computer related self-efficacy and anxiety.[27]

Since internet and smartphone addiction is an emerging public health issues in younger people,[2] we found no indication of possible adverse effects of excessive or problematic computer or internet use in our sample of elderly.

Limitations

However, this study has some limitations. We based the analysis on self-evaluations and questionnaire data. Self-rated computer skills was only one question in the survey. The cross-sectional character of this study limits interpretations of causal relationships. Thus, our results should be considered as preliminary.

Nevertheless, if further research supports our results, this can have practical implications. Computer and internet training programs for elderly[12,22] can be a promising direction to support mental, social and physical health of older people.

Ethical considerations

The author analyzed data provided by SHARE consortium. Different ethic committees have continuously reviewed SHARE study (For details see: The Survey of Health, Ageing and Retirement in Europe (SHARE): 3. Methodology (share-project.org).

Most recently, the Ethics Council of the Max Planck Society Munich has reviewed and approved, with decision on May 29, 2020. All necessary consents of participants were obtained (For details, see http://www.share-project.org/organisation/dates-facts.html).

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Conflict of interest

The author declares no conflict of interest.

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