


Prevalence of Computer Use among Geriatric In- and Outpatients

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Abstract

Objective: Despite its many benefits, tele-rehabilitation is not widely used by the older generations. This study aimed to investigate the opportunity to offer tele-rehabilitation in a geriatric population by determining the prevalence of computer use and to examine whether the patients' characteristics affect computer use. **Design:** Cross-sectional study. **Patients:** Cognitive well-functioning in- and outpatients aged 65 years or older. **Methods:** Patients were consecutively included and surveyed. **Results:** A total of 249 patients participated in the survey. Among them, 124 were computer users. Four of these never went online. Compared to non-users, computer users were younger OR: 0.91 (95% CI: 0.87; 0.94) $p = 0.001$, less frail OR: 0.37 (95% CI: 0.25; 0.55) $p = 0.001$, had a higher functional capacity OR: 1.02 (95% CI 1.01; 1.03) $p = 0.001$ and more often had an education at high school level or higher OR: 1.7 (95% CI: 1.41; 2.40). **Conclusion:** Only half of the geriatric patients are computer users. If tele-rehabilitation is to be adopted by a wider geriatric population challenged by reduced mobility, long transportation times, or frailty, computer training, user friendly devices and computer support should be considered beforehand.

Keywords

geriatrics, frailty, technology, aging

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Introduction

Physical training is important for minimising functional impairments resulting in activity limitations and participation restrictions in older patients (Brovold et al., 2013). However, frequent training sessions are resource-demanding. Tele-rehabilitation (TR) might be a solution, as it can help frail patients avoid exhausting transportation (Hansen et al., 2020). During the ongoing Covid-19 pandemic, TR is in higher demand than ever, as the need for social distancing has caused older people to avoid attending training sessions. The consequence might be more immobilisation and, by extension, greater functional impairment (Goethals et al., 2020).

Information and communications technologies (ICT) are already used in healthcare—for example, in online video conferencing or physical exercise sessions (Peel et al., 2011; Tsai et al., 2017; Zhou et al., 2020). Vestibular TR has been shown to be feasible for geriatric falls clinic patients (Smaerup et al.,

2015). However, a study by Jørgensen et al. (2021) found TR to be almost impossible for geriatric inpatients (Jørgensen et al., 2021). Exhaustion, and insufficient digital literacy were some of the reasons cited by the patients (Jørgensen et al., 2021). Therefore, we wanted to uncover the reasons for this disappointing outcome, hoping to minimise the reduction in physical function in acutely admitted geriatric patients without resource-demanding training interventions.

In 2019, half of the global population used the internet (Statista, 2020). In the Nordic countries, the proportion

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ranges from 94% to 98% (Eurostat, 2017) but the percentages are considerably lower among older people where 60% of Danish people aged 64–74 years and 35% of people aged 75–89 years used computers and the internet more times a day in 2020 (Statistic Denmark, 2020). In 2017, computers were used by 77% of the entire population in Lithuania, where Lesauskaitė et al. (2019) reported a rate of 20% among geriatric inpatients. Older age was a predictor of low usage, but education level and gender were not significant predictors (Lesauskaitė et al., 2019). That study did not include factors such as functional capacity, frailty, living alone versus living with someone, or dwelling status.

Several factors explain older generations' low adoption of technological solutions, including a lack of computer support, living alone, and a low education level (Arcury et al., 2020; Berner et al., 2015; van Deursen & Helsper, 2015). Traditional literacy is positively associated with e-mailing and searching for information online (van Deursen & Helsper, 2015). Previous studies have investigated gender-related differences in computer use among older people. Berner et al. (2015) found that males used the internet more frequently than females (Berner et al., 2015), whereas in other studies, gender was not an influencing factor (Arcury et al., 2020; van Deursen & Helsper, 2015). Keränen et al. (2017) found lower ICT use among frail home-dwelling senior citizens with no hospital contact than among those assessed to be non-frail (Keränen et al., 2017). However, none of these studies included acutely admitted geriatric patients, although almost half of these patients present with severe frailty (Gregersen et al., 2020).

Moreover, to our knowledge, no previous studies have investigated factors that influence the adoption of TR by a broad population of geriatric falls clinic outpatients or inpatients discharged after acute illness. To fill this gap, we investigated the prevalence of computer use in a Danish geriatric population. We further examined whether there were any associations between computer use and age, gender, education level, living alone versus living with somebody, dwelling status, functional capacity, and frailty level.

Research Design and Methods

Sample

This cross-sectional study included geriatric inpatients transferred from the emergency department to the geriatric ward and outpatients presenting to a geriatric falls clinic. Patients who were under the age of 65 years, were cognitively impaired/diagnosed with dementia or were otherwise unable to respond to the questionnaire, had terminal illnesses, or were referred to another specialty were excluded.

Data Sources

Two data sets were used: (1) data obtained from the electronic health record (EHR), including information on age, gender,

education level, living alone/with someone, dwelling status, frailty level, functional capacity level, and cognitive status, and (2) data collected through a questionnaire-based survey on computer use.

Patient Characteristics

Age was categorised into three groups: 65–74 years, 75–84 years, and ≥ 85 years. Education level was categorised into patients who finished the 7th grade, patients who finished the 8th–10th grades, patients who were trained workers, and patients who finished high school or had higher education. Living status was categorised into living alone and living with somebody (spouse, partner, or next of kin). Dwelling status was categorised into living in one's own home, in a sheltered home, and in an institution.

Functional capacity was measured using the Functional Recovery Score (FRS) (Zuckerman et al., 2000). The FRS is an 11-item questionnaire covering *basic activities of daily living*, such as bathing, dressing, feeding, and using the toilet, *instrumental activities of daily living*, such as shopping, doing the laundry, doing light housework, preparing food, banking, and transportation, and *mobility*, referring to whether the patient is ambulatory indoors or outdoors or is non-ambulatory. The score ranges from 0 to 100 points, with higher scores indicating greater functional capacity.

Frailty was measured using the Multidimensional Prognostic Index (MPI). The MPI is based on the Comprehensive Geriatric Assessment and is a cumulative deficit model (Gregersen et al., 2020; Pilotto et al., 2008) consisting of the following 8 domains: social aspects, number of drugs used, basic activities of daily living, instrumental activities of daily living, cognitive status, severity of morbidities, (including an assessment of cardiac, vascular, respiratory, eye-ear-nose-throat, and upper and lower gastroenteric diseases, hepatic, renal, genitourinary, musculoskeletal, and skin disorders, nervous system, endocrine-metabolic system, and psychiatric behavioural problems), risk of developing pressure sores, nutritional status. The patient is assigned to one of three levels: MPI-1, non-frail; MPI-2, moderately frail; and MPI-3, severely frail (Gregersen et al., 2020).

Cognitive impairment was measured using the Short Portable Mental Status Questionnaire (SPMSQ) (Erkinjuntti et al., 1987). The SPMSQ is a 10-item questionnaire that assesses memory, attention, orientation, calculation, and language. Four or more errors indicate that the patient is cognitively impaired before hospitalisation or is suspected of dementia.

Computer Use

The patients were asked, 'Do you use computer?' referring to occasional device use and 'Do you use the internet?', was also a question regarding occasional internet use. The number of

desktop computers, laptops, and tablets was categorised as none, 1, and 2 or more. Desktop computers, laptops, and tablets are hereinafter collectively referred to as ‘computers’.

Most comparative studies used in this article are based on internet use. In our study, the questionnaires included questions on both computer use, and internet use, and we included both computer and internet users ($N = 124$) in all the analyses. In this article they are referred to as computer users. Our aim in doing so was to investigate how many geriatric patients could potentially be included in a TR intervention based on their ability to use a computer.

Questionnaire Data Collection

Two assistants were trained in conducting the survey. At the beginning of the study, there was a phase-in period during which the two assistants administered the questionnaire together to ensure agreement. This was done because the questionnaires were administered orally to avoid a low response rate—for example, among the frailest patients. (Keränen et al., 2017) previously reported that the response rate among the frailest older adults might have been lower than among the less frail respondents, which may have biased their results (Keränen et al., 2017). To avoid this issue, in this study, all items were read aloud one by one, and the interviewers ensured that they were as neutral to the questions and answers as possible. For inpatients, the questionnaires were administered as close to the time of discharge as possible. All inpatients stayed in single-bed rooms in the geriatric ward and were surveyed there, while the outpatients were surveyed in screened rooms in the falls clinic’s facilities. It took approximately 15 minutes to administer the questionnaire.

Sample Size

To calculate the sample size, we performed a power analysis based on numbers from the central authority on statistics where 92% of people aged 65–74 and 71% of people aged 75–89 years used the internet in 2019 (Statistic Denmark, 2019). Based on these percentages, the power analysis indicated that 158 respondents were needed for this study. To obtain a sufficient number of respondents for an adjusted analysis, we added 10% per variable, resulting in another 90 respondents corresponding to the six variables used in the analysis for adjustment (Kirkwood & Sterne, 2003). For a valid sample size for two-sample comparisons of proportions, a minimum of 248 patients was required for a significance level of 0.05 and a power of 90%.

Statistical Analysis

A descriptive analysis was performed to summarise the respondents’ baseline characteristic. The data were expressed as means and standard deviations (SD) or numbers and percentages. To evaluate differences between computer users

and non-users, Student’s t -test was used for normally distributed data, expressed as means and SDs, and the Wilcoxon rank-sum test was used for non-normally distributed data, expressed as medians and interquartile ranges (IQRs). Categorical variables, including dichotomous variables were analysed using the chi-square test and were expressed as numbers and percentages.

A logistic regression model was used to evaluate associations between baseline characteristics and computer use. The model was mutually adjusted for explanatory variables that, based on the literature, were considered confounders: age, gender, level of education, living status, frailty, and dwelling status. No interactions were found between any variables. The results were expressed as odds ratios (OR) with 95% confidence intervals. The logistic regression model’s goodness of fit was assessed using the Hosmer–Lemeshow test. All tests were two-sided and were performed at a significance level of 0.05 and a power of 0.90 using Stata version 17.

Approvals

This study was approved by the Danish Data Protection Agency (1-16-02-201-17) and was conducted in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The questionnaire responses were anonymised. In accordance with the Danish Ethics Committee, Health science questionnaire surveys and interview surveys that do not include human biological material, written informed consent is not required. The patients provided verbal consent and were informed of their right to withdraw their participation at any time.

Results

Respondents

A total of 361 patients were assessed for eligibility. Of those, 103 patients were excluded, resulting in 258 eligible patients. Nine patients refused to participate, resulting in a final sample of 249 patients (Figure 1). Their mean age (SD) was 83.2 (8.0) years, and almost 60% were female. (Figure 1 can be placed here)

As shown in Table 1, most participants were inpatients and were living alone in their own homes. Most had received 7 years of schooling, and the next most education level were respondents who had finished high school or had a higher education level. Almost three quarters of the respondents received home help. (Table 1 can be placed here)

Prevalence of Computer Use and Associated Factors

Among the patients, 124 were computer users, and 125 were non-users as seen in Figure 1. Four of the computer users never attended the internet.

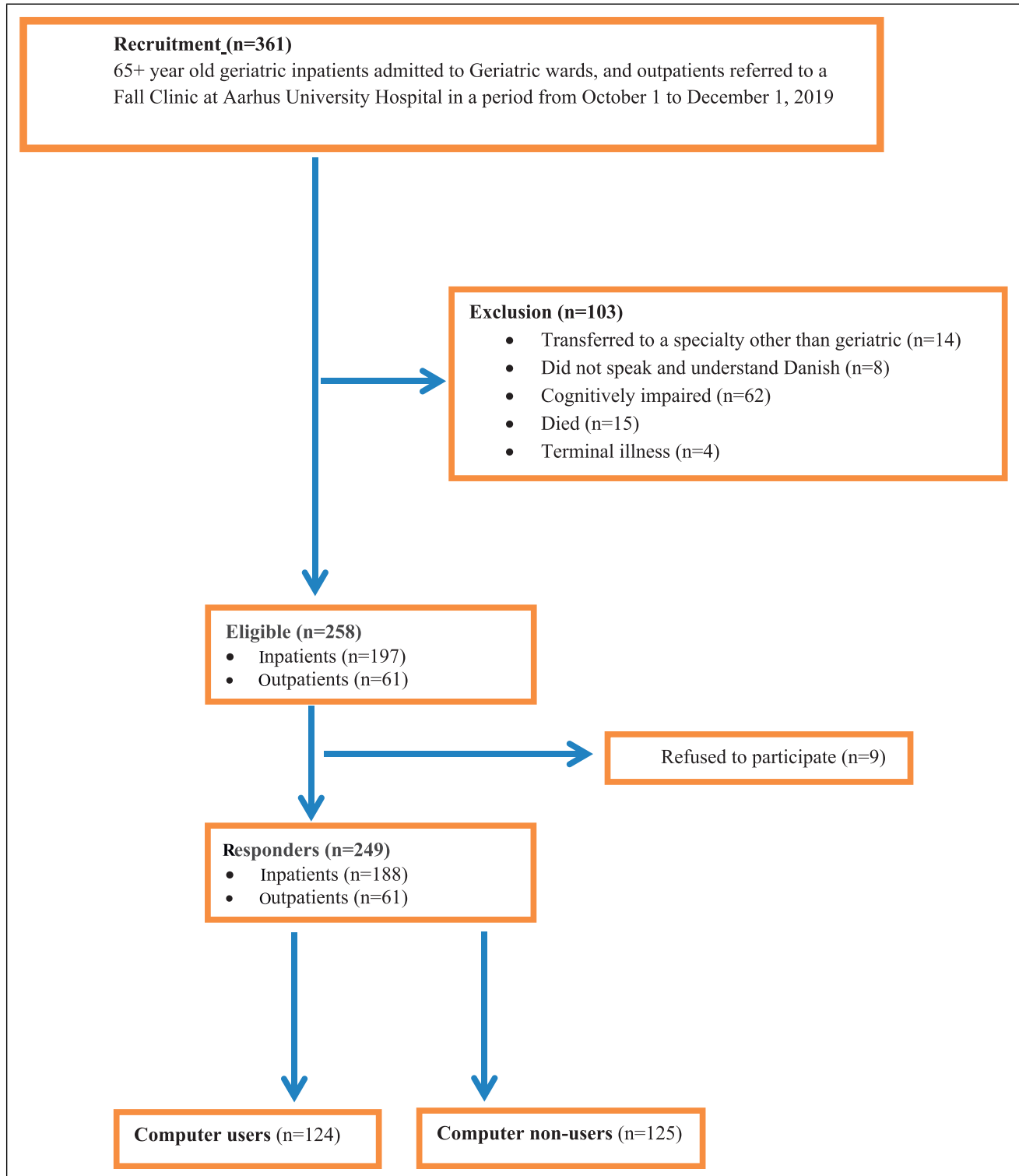


Figure 1. Flow-chart of patient recruitment for the survey.

A logistic regression analysis of age as a continuous variable showed that each additional year of age correlated with a lower likelihood of using a computer after

adjustment for gender, level of education, dwelling status, living alone/with someone, and frailty level the OR was 0.9 (95% CI: 0.87;0.94 $p < 0.001$). An analysis of age

Table 1. Baseline Characteristics.

Baseline characteristics	N = 249
Age, mean (\pm SD)	83.2 (8)
Gender, n (%)	
Male	102 (41)
Female	147 (59)
Patient groups, n (%)	
Inpatients	188 (75)
Outpatients	61 (25)
Dwelling status, n (%)	
Own home	207 (83)
Sheltered housing	28 (11)
Nursing home	14 (6)
Living status, n (%)	
Living with someone	85 (34)
Living alone	164 (66)
Education, n (%)	
\leq 7 years	83 (33)
8-10 years	48 (19)
Trained worker	48 (19)
High school/Further education	68 (28)
Missing	2 (1)
Prescribed medication, n (%)	
0-3	16 (7)
4-7	79 (32)
8 or more	151 (61)
Home help, n (%)	
No home help	44 (18)
Receive home help	181 (73)
Receive help from relatives or friends	23 (9)
Missing	1 (0)
Use of walking aid: n (%)	
No walking aid	59 (24)
Walking stick	16 (6)
Walking frame	13 (5)
Walker	114 (46)
Wheel chair	47 (19)
Frailty, n (%)	
Non-frail	65 (25)
Moderately frail	120 (49)
Severely frail	61 (25)
Missing	3 (1)
Use of electronic devices: n (%) ^a	
Computer	114 (46)
Tablet	50 (21)
Fixed net phone	141 (58)
Mobile phone	124 (50)
Smart phone	82 (33)

^aMore devices can be chosen.

stratified into 3 age groups showed that patients aged 75–84 years were less likely to use a computer than those aged 65–74 years. However, as shown in Table 2, after adjusting for potential confounders, there was no longer a significant difference between the two youngest age groups. In the

oldest age group (85 years or older), the odds of computer non-use were still significant when this group was compared to those aged 65 to 74 years and after adjustment for the explanatory variables (Table 2).

Table 2 reveals that the education level was associated with computer use. Participants with 10 years of schooling or less were less likely to be computer users than those with the highest level of education.

Severely frail patients were less likely to use computer than non-frail patients (Table 2). However, also shown in Table 2 this significant result was not found among moderately frail- and non-frail patients after adjustment for the potential confounders. (Table 2 can be placed here)

Computer Use and Functional Capacity

As shown in Figure 2, the computer users had a significantly higher median FRS than the non-users. (The mean FRS of the users and non-users were 69.59 and 51.39, respectively). (Figure 2 can be placed here).

We found frailty level significant associated with functional capacity where those who were scored as moderately or severely frail had a significant lower score in FRS compared to the group of non-frail $p < 0.001$.

Discussion

Demographics and Computer Use

Half the responders were computer users, and they were characterised by younger age, higher functional capacity, less frailty, and a higher education level than the non-users. We excluded cognitively impaired patients, who accounted for 17% of the initial 361 geriatric patients assessed, as such patients may have difficulty using a computer. Face-to-face guided exercises may be more suitable for this group.

Age

We found a decrease in computer use with each additional year of age. This result is in line with Lesauskaitė et al. (2019) who found the same association in geriatric inpatients (Lesauskaitė et al., 2019). However, when dividing age into three groups we found that patients aged 85 years or older had a significant lower likelihood of using computers than the youngest patients. No significant difference was found among those aged 75 to 84 years compared to the youngest age groups.

Gender and Age Related Differences in Computer Use

We found no association between gender and computer use. This finding suggests that older females may be as likely as

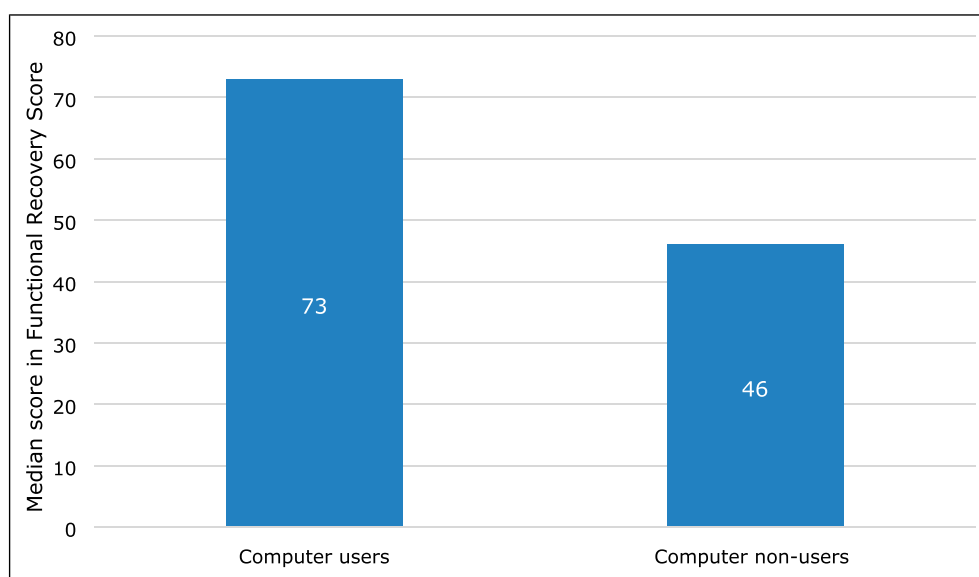
Table 2. Associations between computer use and age, gender, level of education, living status and dwelling status (N = 249).

Characteristics	Computer use		Crude OR 95% (CI)	p-value	Adjusted OR ^a 95% (CI)	p-value
	Users n = 124	Non-users n = 125				
Age groups, n (%)						
• 65-74	30 (24)	10 (8)	1.00 (ref)		1.00 (ref)	
• 75-84	57 (46)	39 (31)	0.49 (0.21-1.11)	.09	0.48 (0.19-1.26)	.14
• ≥85	37 (30)	76 (61)	0.16 (0.07-0.37)	.001	0.17 (0.07-0.43)	.001
Gender, n (%)						
• Male	52 (42)	50 (40)	1.00 (ref)		1.00 (ref)	
• Female	72 (58)	75 (60)	0.92 (0.56-1.53)	.76	1.10 (0.58-2.10)	.76
Level of education, n (%) ^b						
• High school, further-higher edu.	48 (39)	20 (16)	1.00 (ref)		1.00 (ref)	
• Trained worker	30 (24)	18 (15)	0.69 (0.32-1.52)	.36	0.69 (0.28-1.70)	.42
• Finished 8 to 10 grade	24 (19)	24 (19)	0.42 (0.19-0.90)	.03	0.34 (0.14-0.86)	.02
• Finish seven grade	22 (18)	61 (50)	0.15 (0.07-0.31)	.001	0.14 (0.06-0.32)	.001
Living status, n (%)						
• Living with partner/relatives	51 (41)	34 (27)	1.00 (ref)		1.00 (ref)	
• Living alone	73 (59)	91 (73)	0.53 (0.31-0.91)	.02	0.98 (0.49-1.90)	.96
State of frailty, n (%) ^c						
• Non-frail	47 (38)	18 (15)	1.00 (ref)		1.00 (ref)	
• Moderately frail	60 (49)	60 (49)	0.38 (0.20-0.73)	.004	0.53 (0.25-1.12)	.10
• Severely frail	16 (13)	45 (36)	0.14 (0.06-0.30)	.001	0.19 (0.08-0.49)	.001
Dwelling status, n (%)						
• Own home	113 (91)	94 (75)	1.00 (ref)		1.00 (ref)	
• Sheltered home	10 (8)	18 (15)	0.46 (0.2-1.05)	.07	0.79 (0.30-2.06)	.63
• Institution	1 (1)	13 (10)	0.06 (0.008-0.50)	.009	0.09 (0.01-0.81)	.03

^aAdjustments are made for age, gender, level of education, living status, frailty, and dwelling status.

^bTwo missings.

^cThree missings.

**Figure 2.** Title: “ Functional Capacity among users and non-users of computer”.

older males are to participate in a TR intervention. Similar results were obtained in another study that examined internet use among adults aged 55 years and older (Arcury et al., 2020). Conversely, van Deursen and Helsper (2015) found that older females were less likely than older males were to use the internet, even when there was a home internet connection (used by others), suggesting that older males may be more likely than older females are to use the internet (van Deursen & Helsper, 2015). Berner et al. (2013) investigated change in internet use focused on the period from 2004 to 2010 and found that older females (i.e. aged 60–96 years) were less likely than older males were to start using the internet (Berner et al., 2013). However, this was not the case in the 60 to 80-year-old age group, where male gender was not associated with internet use. Furthermore, education level was not an influencing factor in this study (Berner et al., 2013). A difference in the education levels of the participants in the study by Berner et al. (2013) versus those of the participants in recent studies, including ours, may explain the discord in the findings (Berner et al., 2013). According to Statistic Denmark (2015), in terms of education levels, those of females tended to be higher than those of males in 2015, when compared with statistics for the 1960s and 70s (Statistic Denmark, 2015).

Living Status and Computer Use

In our study, computer use was not associated with living status (i.e. living alone, co-habiting or living with family members). In contrast, Arcury et al. (2020) found an association between internet use by older males and females and married status, which the authors linked to computer support by their spouse (Arcury et al., 2020).

Likewise, Berner et al. (2015) reported that not living alone (e.g. living with a partner or family member) was associated with increased internet use. They attributed this finding to the possibility of receiving help with computer problems from someone living in the same dwelling (Berner et al., 2015).

The older age of the responders in our study versus that of the participants in the earlier studies may explain the lack of any association between computer use and living status in our study. In our study, in terms of the age distribution and living status of the participants, 33% of those in the youngest age group (65–74 years) and 25% of those in the oldest age group (85 years or older) were living with someone, in contrast to 46% of those in the middle age group (75–84 years). In our study, 33% of the participants aged 65 to 74 years were living with someone. This figure is lower than that reported for the general population in Denmark in 2019, where more than 70% of this group were living with someone (Statistic Denmark, 2019). As reported previously, in the general population, younger age is associated with a higher rate of computer use (Statista, 2019). It is conceivable that computer

help may be more readily available to older adults living with someone of a younger age than older adults living with someone of a similarly old age. Explained by, that younger individuals are more likely than older individuals are to be familiar with computers. Unfortunately, in our study, we did not collect information on the age of the respondent's spouse, partner or next of kin. Such information could have shed light on the role of living status. Our results point to a difference in living status between the youngest geriatric responders and Statistic Denmark's participants.

Education Level and Computer Use

In our study, 34% of the participants had solely primary school education. Among them, 18% were computer users, as opposed to 39% of the participants with a higher education level. Berner et al. (2015) also found an association between education level and internet use among older adults in Sweden (Berner et al., 2015). Similarly, van Deursen and Helsper (2015), reported that a lower education level correlated with a lower likelihood of internet use. They also suggested that 'traditional literacy' (i.e., the ability to read, write, and understand a text) might be an influencing factor for e-mail use and reading information online because the internet is primarily text-based, thus requiring literacy and a certain degree of cognitive skills (van Deursen & Helsper, 2015). On the other hand, Lesauskaitė et al. (2019) found no association between education and computer use among geriatric inpatients. This may be because they categorised education status into only two levels: university and below university (Lesauskaitė et al., 2019). In this study, we divided education into more levels, which allowed a more precise identification of the groups that may need support or education to increase the feasibility of TR interventions (Fields et al., 2021). Since the education level plays a major role in computer use, digital training as part of a TR offer is crucial if TR is to be adopted by a broader geriatric population.

Frailty, Functional Capacity and Computer Use

Almost 74% of the responders in our study were moderately or severely frail. In our study group, severe frailty was associated with low computer use. To our knowledge, no previous study has assessed the association between frailty levels and computer use in the geriatric population. Keränen et al. (2017) studied physically frail, pre-frail and non-frail home-dwelling seniors and found that individuals with higher levels of frailty were less likely to have a home internet connection than individuals with lower levels of frailty (Keränen et al., 2017). The level of frailty of the responders in our study differed from that of the study population in the study by Keränen et al. In the study by Keränen et al. (2017), only 7.1% of the participants were frail (Keränen et al., 2017).

In contrast, in our study, 25% of the responders were considered severely frail. Our finding of low computer use in the frailest patients was not surprising. In addition, in our study, the scores of the computer non-users on the FRS were significantly lower than those of the computer users. FRS reflects functional capacity. This suggests that those who have the greatest need of rehabilitation, for instance, during a lockdown, might be those who are least equipped to avail of a TR intervention.

Dwelling Status and Computer Use

In this study, we included only cognitively well-functioning geriatric patients, as we wished to investigate the prevalence of geriatric patients who would potentially be able to participate in a TR intervention. The good cognitive status of our study population may explain why only 14 of our respondents were nursing home residents. Among these nursing home residents, one was computer user. Most of the other respondents lived in their own homes. Several studies carried out TR in older people under the auspices of a hospital or rehabilitation centre (Chan et al., 2012; Laver et al., 2012; van den Berg et al., 2015). We may expect that inpatients or those attending rehabilitation centres have access to enhanced computer support from technical staff or the health professionals. However, when older home-dwellers have to attend rehabilitation outside their homes, they might be challenged due to issues surrounding transportation or for instance a need for social distancing? When they conduct TR as home exercises, they are challenged in relation to the IT solutions used where no staff or professional support is present.

If telehealth shall address the issues raised above for individuals able to access specific healthcare services only at home via telehealth, do technological devices need to be made more intuitive and user friendly.

Has the COVID-19 Pandemic Influenced the Use of Telehealth Solutions?

This survey was conducted immediately before a lockdown initiated in response to the COVID-19 pandemic. It is highly likely that stay-at-home orders included as part of this lockdown motivated older people to seek telehealth solutions. A U.S. study involving 3257 older individuals found that the use of telehealth solutions increased from 4.6% before the pandemic in 2019 to 21% during the pandemic in 2020 (Choi et al., 2022). Nevertheless, unless new interventions are introduced such as made the technology more user friendly and hereby more attractive, the gap in the uptake of telehealth such as TR between younger and older telehealth users will remain wide.

Limitations and Strengths

A limitation of our study may be the inclusion of the outpatients and inpatients as a single group in the analysis. This may have obscured differences in frailty levels between them.

In our study 31% of the inpatients were severely frail compared to only 5% of the outpatients. In considering these individuals as one group, our aim was to increase the generalisability of our results to other European countries (Joosten et al., 2014; Santos-Eggimann et al., 2009; Volpato et al., 2015).

Another limitation of the study was that the questionnaires did not contain any questions about vision quality/acuity. Impaired vision has been shown to be significantly associated with not using a computer (Keränen et al., 2017). It was a limitation that we did not ask the patients whether they had used computers at work before retiring. Previous research showed that a work history of computer/internet use was associated with continued computer/internet use post-retirement (König et al., 2018). An additional limitation of this study was the use of the SPSMQ as a screening tool for cognitive impairment. Age-related impairment in several components of cognition (Czaja & Lee, 2007) (e.g. learning ability and information retention) poses a challenge when faced with complex tasks, such as those involving new technologies. It is possible that use of a more in-depth cognitive instrument other than the SPSMQ would have revealed more cognitive disorders.

Due to the patients' conditions, we expected that many of them would not have the necessary energy to fill in the questionnaires themselves. Therefore, a strength was that we completed the questionnaire along with the patients. Although this was aimed at avoiding a low response rate it also gave us the possibility to elaborate on questions they did not find entirely clear. To reduce the possibility of survey bias, the interviewers were as neutral to the questions as possible. Furthermore, we avoided asking certain questions, such as questions regarding household income, as the presence of the interviewer may have caused the respondents to give less honest answers to sensitive questions. Finally, another strength was that we collected data on age, gender, education level, living alone/with someone, dwelling status, frailty level, functional capacity level, and cognitive status from the Electronic Health Record.

Surveys involving older populations are often characterised by low response rates (Ellis & Allaire, 1999; Holt et al., 2019). A strength of this study was the high response rate (97%). The high response rate strengthens the generalisability of our results to the general geriatric population. Another strength was that the survey included all consecutive patients referred to the geriatric department during the study period.

Conclusion

In our study, only 50% of the geriatric patients were capable of participating in TR interventions. Furthermore, we found computer users younger than non-users. These computer users had an education level higher than grade 10, they were not institutionalized, they had high functional capacity, and

they were not severely frail. Before suggesting telehealth solutions such as TR, it is necessary to assess patients' computer skills. Furthermore, technological support during such interventions may be necessary. Finally, if TR interventions are to be expanded to include older individuals with no knowledge of computers/computer use, computer education prior to the intervention will be necessary. Although this might not be feasible for geriatric patients immediately after hospital discharge, it may be feasible for healthier community-dwelling older people.

In the future, to reduce the digital divide between young and old, development of telehealth solutions there should beforehand be a careful assessment of needs that take account of the cognitive challenges and other causes for computer non-use that are frequently found in the older population. This will allow more people to access tele-health solutions and take part in TR programmes.

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Authors' note

This study was approved by the Danish Data Protection Agency (no. 1-16-02-201-17) and was conducted in accordance with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. The questionnaire responses were anonymised. In accordance with the Danish Ethics Committee, Health science questionnaire surveys and interview surveys that do not include human biological material, written informed consent is not required. The patients provided verbal consent and were informed of their right to withdraw their participation at any time.

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References

- Arcury, T. A., Sandberg, J. C., Melius, K. P., Quandt, S. A., Leng, X., Latulipe, C., Miller, D. P., Jr., Smith, D. A., & Bertoni, A. G. (2020). Older adult internet use and ehealth literacy. *Journal of Applied Gerontology, 39*(2), 141–150. <https://doi.org/10.1177/0733464818807468>
- Berner, J., Rennemark, M., Jørgéus, C., Anderberg, P., Sköldunger, A., Wahlberg, M., Elmståhl, S., & Berglund, J. (2015). Factors influencing Internet usage in older adults (65 years and above) living in rural and urban Sweden. *Health Informatics Journal, 21*(3), 237–249. <https://doi.org/10.1177/1460458214521226>
- Berner, Jessica S, Rennemark, Mikael, Jøgréus, Claes, & Berglund, Johan. (2013). Factors associated with change in Internet usage of Swedish older adults (2004-2010). *Health Informatics J, 17*(4), 1741-281119(2), 152-62. DOI:10.1177/1460458212462151
- Brovold, T., Skelton, D. A., & Bergland, A. (2013). Older adults recently discharged from the hospital: effect of aerobic interval exercise on health-related quality of life, physical fitness, and physical activity. *Journal of American Geriatrics Society, 61*(9), 1580–1585. <https://doi.org/10.1111/jgs.12400>
- Chan, T. C., Chan, F., Shea, Y. F., Lin, O. Y., Luk, J. K. H., & Chan, F. H. W. (2012). Interactive virtual reality Wii in geriatric day hospital: A study to assess its feasibility, acceptability and efficacy: Interactive virtual reality Wii in GDH. *Geriatrics & Gerontology International, 12*(4), 714–721. <https://doi.org/10.1111/j.1447-0594.2012.00848.x>
- Choi, N. G., DiNitto, D. M., Marti, C. N., & Choi, B. Y. (2022). Telehealth use among older adults during COVID-19: Associations with sociodemographic and health characteristics, technology device ownership, and technology learning. *Journal of Applied Gerontology, 41*(3), 600–609. <https://doi.org/10.1177/07334648211047347>
- Czaja, S. J., & Lee, C. C. (2007). The impact of aging on access to technology. *Universal Access in the Information Society, 5*(4), 341–349. <https://doi.org/10.1007/s10209-006-0060-x>
- Ellis, D., & Allaire, J. C. (1999). Modeling computer interest in older adults: The role of age, education, computer knowledge, and computer anxiety. *Hum Factors, 41*(3), 345–355. <https://doi.org/10.1518/001872099779610996>
- Erkinjuntti, T., Sulkava, R., Wikstrom, J., & Autio, L. (1987). Short portable mental status questionnaire as a screening test for dementia and delirium among the elderly. *Journal of the American Geriatrics Society, 35*(5), 412–416. <https://doi.org/10.1111/j.1532-5415.1987.tb04662.x>
- Eurostat, t. s. o. o. t. E. U. (2017, 07-09-2020). *Individuals - computer use*. https://ec.europa.eu/eurostat/databrowser/view/isoc_ci_cfp_cu/default/table?lang=en
- Fields, J., Cemballi, A. G., Michalec, C., Uchida, D., Griffiths, K., Cardes, H., Cuellar, J., Chodos, A. H., & Lyles, C. R. (2021). In-home technology training among socially isolated older adults: Findings from the tech allies program. *Journal of Applied Gerontology, 40*(5), 489–499. <https://doi.org/10.1177/0733464820910028>
- Goethals, L., Barth, N., Guyot, J., Hupin, D., Celarier, T., & Bongue, B. (2020). Impact of home quarantine on physical activity among older adults living at home during the COVID-19 pandemic: Qualitative interview study. *JMIR Aging, 3*(1), Article e19007. <https://doi.org/10.2196/19007>
- Gregersen, M., Hansen, T. K., Jørgensen, B. B., & Damsgaard, E. M. (2020). Frailty is associated with hospital readmission in geriatric patients: A prognostic study. *European Geriatric Medicine, 11*(5), 783–792. <https://doi.org/10.1007/s41999-020-00335-w>

- Hansen, H., Bieler, T., Beyer, N., Kalleose, T., Wilcke, J. T., Østergaard, L. M., Frost Andeassen, H., Martinez, G., Lavesen, M., Frølich, A., & Godtfredsen, N. S. (2020). Supervised pulmonary tele-rehabilitation versus pulmonary rehabilitation in severe COPD: A randomised multicentre trial. *Thorax*, 75(5), 413–421. <https://doi.org/10.1136/thoraxjnl-2019-214246>
- Holt, K. A., Karnoe, A., Overgaard, D., Nielsen, S. E., Kayser, L., Røder, M. E., & From, G. (2019). Differences in the level of electronic health literacy between users and nonusers of digital health Services: An exploratory survey of a group of medical outpatients. *Interactive Journal of Medical Research*, 8(2), Article e8423. <https://doi.org/10.2196/ijmr.8423>
- Joosten, E., Demuynck, M., Detroyer, E., & Milisen, K. (2014). Prevalence of frailty and its ability to predict in hospital delirium, falls, and 6-month mortality in hospitalized older patients. *BMC Geriatrics*, 14(1), 1. <https://doi.org/10.1186/1471-2318-14-1>
- Jørgensen, B. B., Gregersen, M., Pallesen, S. H., & Damsgaard, E. M. (2021). A group-based real-time videoconferencing telerehabilitation programme in recently discharged geriatric patients: A feasibility study. *European Geriatric Medicine*, 1–8(4), 801–808. <https://doi.org/10.1007/s41999-020-00444-6>
- Keränen, N. S., Kangas, M., Immonen, M., Similä, H., Enwald, H., Korpelainen, R., & Jämsä, T. (2017). Use of information and communication technologies among older people with and without frailty: A population-based survey. *Journal of Medical Internet Research*, 19(2), Article e29. <https://doi.org/10.2196/jmir.5507>
- Kirkwood, B. R., & Sterne, J. A. C. (2003). *Essential medical statistics*. John Wiley & Sons, Incorporated. <http://ebookcentral.proquest.com/lib/asb/detail.action?docID=624728>
- König, R., Seifert, A., & Doh, M. (2018). Internet use among older Europeans: An analysis based on SHARE data. *Universal Access in the Information Society*, 17(3), 621–633. <https://doi.org/10.1007/s10209-018-0609-5>
- Laver, K., George, S., Ratcliffe, J., Quinn, S., Whitehead, C., Davies, O., & Crotty, M. (2012). Use of an interactive video gaming program compared with conventional physiotherapy for hospitalised older adults: A feasibility trial. *Disability and Rehabilitation*, 34(21), 1802–1808. <https://doi.org/10.3109/09638288.2012.662570>
- Lesauskaitė, V., Damulevičienė, G., Knašienė, J., Kazanavičius, E., Liutkevičius, A., & Janavičiūtė, A. (2019). Older adults-potential users of technologies. *Medicina (Kaunas, Lithuania)*, 55(6), 253. <https://doi.org/10.3390/medicina55060253>
- Peel, N. M., Russell, T. G., & Gray, L. C. (2011). Feasibility of using an in-home video conferencing system in geriatric rehabilitation. *Journal of Rehabilitation Medicine*, 43(4), 364–366. <https://doi.org/10.2340/16501977-0675>
- Pilotto, A., Ferrucci, L., Franceschi, M., D'Ambrosio, L. P., Scarcelli, C., Cascavilla, L., Paris, F., Placentino, G., Seripa, D., Dallapiccola, B., & Leandro, G. (2008). Development and validation of a multidimensional prognostic index for one-year mortality from comprehensive geriatric assessment in hospitalized older patients. *Rejuvenation Research*, 11(1), 151–161. <https://doi.org/10.1089/rej.2007.0569>
- Santos-Eggimann, B., Cuénoud, P., Spagnoli, J., & Junod, J. (2009). Prevalence of frailty in middle-aged and older community-dwelling Europeans Living in 10 Countries. *The Journals of Gerontology: Series A*, 64A(6), 675–681. <https://doi.org/10.1093/gerona/glp012>
- Smaerup, M., Grönvall, E., Larsen, S. B., Laessoe, U., Henriksen, J. J., & Damsgaard, E. M. (2015). Computer-assisted training as a complement in rehabilitation of patients with chronic vestibular dizziness—a randomized controlled trial. *Archives of Physical Medicine and Rehabilitation*, 96(3), 395–401. <https://doi.org/10.1016/j.apmr.2014.10.005>
- Statista, J., Clement. (2019, 03 -11-20). *Internet user by age worldwide*. <https://www.statista.com/statistics/272365/age-distribution-of-internet-users-worldwide/>
- Statista, J., Clement. (2020, 07-01-20). *Internet usage worldwide - statistics & facts*. <https://www.statista.com/statistics/273018/number-of-internet-users-worldwide/>
- Statistic Denmark. (2015, 01-07-2015). *Kvinder og mænd i 100 år - fra ligeret mod ligestilling*. <https://www.dst.dk/Site/Dst/Udgifter/GetPubFile.aspx?id=22699&sid=kvind>
- Statistic Denmark. (2019, 02-01-2020). *Andelen af danskere på mindst 65 år, der bor alene, er historisk lav [The proportion of Danes aged 65 or more who live alone is historically low]*. <https://www.dst.dk/da/Statistik/nyheder-analyser-publ/bagtal/2019/2019-23-12-aeldre-der-bor-alene>
- Statistic Denmark. (2020). *IT anvendelse i befolkningen 2020 [ICT use in house hold and by individual 2020]*. Statistic Denmark. <https://www.dst.dk/Site/Dst/Udgifter/GetPubFile.aspx?id=29450&sid=itbef2020>
- Tsai, L. L., McNamara, R. J., Moddel, C., Alison, J. A., McKenzie, D. K., & McKeough, Z. J. (2017). Home-based telerehabilitation via real-time videoconferencing improves endurance exercise capacity in patients with COPD: The randomized controlled TeleR Study. *Respirology (Carlton, Vic.)*, 22(4), 699–707. <https://doi.org/10.1111/resp.12966>
- van den Berg, M., Sherrington, C., Killington, M., Smith, S., Bongers, B., Hassett, L., & Crotty, M. (2015). Video and computer-based interactive exercises are safe and improve task-specific balance in geriatric and neurological rehabilitation: A randomised trial. *Journal of Physiotherapy*, 62(1), 20–28. <https://doi.org/10.1016/j.jphys.2015.11.005>
- van Deursen, A. J. A. M., & Helsper, E. J. (2015). A nuanced understanding of Internet use and non-use among the elderly. *European Journal of Communication*, 30(2), 171–187. <https://doi.org/10.1177/0267323115578059>
- Volpato, S., Bazzano, S., Fontana, A., Ferrucci, L., & Pilotto, A. (2015). Multidimensional Prognostic Index predicts mortality and length of stay during hospitalization in the older patients: A multicenter prospective study. *The Journals of Gerontology: Series A, Biological Sciences and Medical Sciences*, 70(3), 325–331. <https://doi.org/10.1093/gerona/glu167>

- Zhou, F., Wang, Z., Mai, X., Liu, X., Reid, C., Sandover, S., Zhang, K., & Xu, D. (2020). Online clinical consultation as a utility tool for managing medical crisis during a pandemic: Retrospective analysis on the characteristics of online clinical consultations during the COVID-19 pandemic. *Journal of Primary Care & Community Health*, 11(11), 2150132720975517. <https://doi.org/10.1177/2150132720975517>
- Zuckerman, J. D., Koval, K. J., Aharonoff, G. B., Hiebert, R., & Skovron, M. L. (2000). A functional recovery score for elderly hip fracture patients: I. Development. *Journal of Orthopaedic Trauma*, 14(1), 20–25. <https://doi.org/10.1097/00005131-200001000-00005>