A cross-national and longitudinal study on predictors in starting and stopping Internet use (2001-2013) by Swedish and Dutch older adults 66 years and above

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Background The Internet and information communication technology is today considered as a means to sustain active and healthy aging, and to provide better care for the aging population. There is an increase in prevalence in older adults using the Internet, however many are still not using the Internet. This study therefore, investigated predictors in starting and stopping Internet use by older adults between 2001-2013 in Sweden and the Netherlands. These represent currently two of the highest older adult Internet users in Europe. The aim of this study was to examine, first, if there was a different starting and stopping rate in Sweden and the Netherlands; second, if the predictors age, gender, education, rural/urban living, living alone/not, cognition and functional limitations have different effects in either country. **Methods** A cross-national and longitudinal design was chosen. Data was used from the Longitudinal Aging study Amsterdam (LASA) and the Swedish National Study on Aging and Care (SNAC). Cox regression analyses were done to test the predictors over time with starting or stopping Internet use. An interaction term 'variable*country' was then considered for each variable, if significant, leading to a stratification into a multivariate model per country. **Results** More older adults started use in the Netherlands (19%); lower in age, normal cognitive functioning, living alone, fewer functional limitations and lower education were predictive of starting. In Sweden fewer started (10.3%), where being female was the only significant predictor of starting use. Both countries did not have many people stopping use; in the Netherlands (3%) they were younger in age and living urban, whereas in Sweden (1.7%), they had lower cognitive functioning. **Conclusion** Results indicate that there are differences between countries in starting use. These differences can possibly be explained by the early adoption of the Internet in Sweden. The new findings that the older adults living alone and lower educated are now going online, are positive regarding the theme of active aging. For those stopping use, the differences are more country-specific. More research is needed in order to understand better what an older adult was using the Internet for and why they stop.

Keywords: older adults, internet starting stopping, longitudinal cross-national design

The Internet and information communication technology (ICT) are currently being explored as a means to sustain, provide better health care costs and living for older adults. Enhancing an older adults' quality of life and social engagement through ICT is considered today a part of active aging[1], the process of optimising opportunities for health, security and well-being for older people[2].

Europe is already focusing on addressing the needs of older adults through ICT. They have launched a partnership for healthy and active aging so as to increase the number of healthy life years by 2020[1]. ICT is a prerequisite for this especially to increase health literacy so as to help prevent chronic illnesses[3], to create sustainable health care systems[4] and for the older adult to be able to live independently as long as possible[5].

Data from 2013-2014, indicated that there was 44% Internet usage in Europe by older adults aged 65-74; yet only 37% older adults in Europe have Internet access at home[6]. There are still differences in the number of older users per country, and compared to younger users. Previous research posits it is a generational problem[7], where it is considered that the diffusion of the Internet in the older adults' social and daily lives is still taking its time but will eventually even out. However, it has been noted that there are still a large number of older adults that are not getting online[8].

Still there seems to be a gap in research explaining the reasons for starting and stopping to use the Internet by older adults. Understanding which factors influence the starting of Internet use, and barriers of this uptake would be useful for the older adults themselves, but also for the policy makers and regulators as well as the technology developers[9].

Therefore, this study chose to focus on two of the oldest populations and with the highest proportions of older adult Internet users in Europe for this purpose. Sweden and the Netherlands are currently the highest number of older adults Internet users between 65-74 years of age, in Sweden 79% and in the Netherlands 78% respectively. There has also been an increase in prevalence in Internet access at home from 2000/2002, where the Netherlands only had two out of ten 65 and over with home Internet access[9]; in Sweden, very few even had computers at home[11]. But in 2013 75% of users between 65-74 had access at home[6]. This increase will allow for an investigation of predictors affecting starting Internet use and stopping Internet use cross-nationally, establishing possible trends and hopefully new insights into older adults' Internet use.

Sweden and the Netherlands

These countries were selected for their similarities and some relevant differences[12], which could affect starting or stopping Internet use.

Some similarities are that Sweden and the Netherlands are two highly industrialised societies, which today have good Internet access due to high fibre networks. There is a strive to follow the European initiative 2020 for higher broadband access per household by both countries[13]. Both countries have their most active older users between the ages of 65-75 years of age and, they both have a lower usage percentage in the ages 75 and over. As of 2013, only half of the Swedish 75-85 year olds are using the Internet[14]. In the Netherlands, one third of those aged 75 years and above are using the Internet[15].

Sweden has had one of the oldest populations in Europe for many years. Since the 1950's they already had a higher percentage of older adults compared to the Netherlands[16]. Today, respectively 19% of the population are 65 years and above for Sweden and 16.5% for the Netherlands[16]. This means that within healthcare there may be a greater need to implement ICT tools in order to meet the demands of the number of older patients in Sweden. The ratio of health workers to number of older adults is on the decline. This poses a problem when the oldest older adults are large consumers of health care. Predictions state that there will be a lack of personnel for every older adult[17]; hence new applications, organisational structures and ways of working are necessary[18]. If the older adults are not easily adopting the new technologies especially the Internet, the barriers need to be further investigated.

Sweden has a total population of around 9.7 million[14], whereas the Netherlands has a population of close to 16.9 million[19]. The population density of Sweden is much thinner than the Netherlands. Sweden has on average 24 persons/km^2 of land compared to the Netherlands with on average 498 people/km^2 [20]. This suggests that in Sweden there may be a need to have more medical consultations at a distance via online tools, or develop online shopping geared towards older people. The problem however, as noted previously is that there is still a geographic digital divide with those living rurally having less technology adoption, especially in the oldest older adults[21]. The data from that study however came from 2001-2004. Thus it seems of interest to investigate this further, using data from 2001 through to 2013. It could be that more recently, the Swedish older adults have been starting to use the Internet more due to the need to connect and have contact with family, for example; and because of the increasing presence of the Internet in daily life.

Reported barriers and facilitators

Many barriers to using ICT have been noted by previous research. These fall into the categories of socio-demographic characteristics, physical and mental health status, social and geographic environment. The two most prominent socio-demographic factors that lead to a decrease in

Internet usage are being higher in age and lower educated[22]. On average from the age of 75 onwards[23], there is consistently much less Internet use; many oldest-older adults do not engage with new technology, primarily as they have little interest in it[24] and because of the technological interaction they had in their generation[25]. Being lower educated and not starting to use the Internet may suggest a lack of intention to use the Internet[26], or not having had any previous contact with ICT possibly due to the type of work that the older adult engaged in before retirement.

Gender has also been a predictor affecting Internet use; older males were until recently more frequent Internet users than females[21]. However, a recent study investigating drivers and barriers to online shopping by older adults indicated no gender differences[27]. Similarly a study on older adults using Internet over time, indicated that gender was no longer an influencing predictor[28].

Functional and cognitive decline are more common with increasing age, and previous research has indicated that this also leads to less Internet and ICT use[22]. Being frail, has been indicative of both wanting to go online and finding release but also not physically being able to learn or take on new tasks[29]. Learning a new task also requires fluid intelligence, which has to do with inductive reasoning, short-term memory, speed processing information and problem solving. These elements tend to peak in late middle adulthood and slightly diminish as a person grows older[30], particularly when cognitive illness is present. This is a problem when considering that ICT solutions are being built especially for older adults as they are often not taken into account.

Studies have indicated that websites for older adults should be built to optimise present capabilities and compensate for weaknesses[31] ; yet a study measuring Internet usability indicated that adhering to guidelines for older adults does not necessarily lead to efficient usage[32]. Other studies have shown that ICT can be a way to train the brain and even improve cognitive functioning[33]. This may motivate a person to start using the Internet, especially if it is presented by a health care professional as a tool to enhance cognitive functioning.

Studies have indicated that the environment one lives in is important in uptake of new technology[34]. Many older adults living in groups or communities can be motivated by discussions by their peers, or in a group setting it can also be easier to learn a new task. An obstacle in the social environment such as living alone[21], lack of support or assistance and also a lack of a training programme[35] can lead to less use and older adults disassociating themselves from the Internet and computer mediated devices.

Living in either a rural or urban area, has been indicative to impact Internet use in older adults[21]. Rural living, usually suggests less technology use overall by older adults. Studies point to worse Internet connections in rural areas[36], others have indicated that older adults that live rurally have worse health[37], which can lead to stopping or less Internet usage.

Predictors in starting to use the Internet may be the same as in stopping. For example, if one is higher in age and has functional limitations, these can be reasons to go online so as to look up health information, or to have contact with family socially or to receive support and care. Conversely, these same factors can lead to stopping Internet use. As mentioned, those higher in age are using the Internet less; a decline in health such as loss of vision and mounting cognitive deficits, may lead to difficulties in and a decline in use of technology[38].

When considering the above-mentioned predictors cross-nationally and longitudinally between Sweden and the Netherlands, the authors are expecting that there are differences per country in age-related changes with starting or stopping Internet use. The first hypothesis is, therefore, that there are differences between Sweden and the Netherlands in Internet use of older adults. The fact that Sweden has had a much older population for a longer time[39], could mean that because of more age-peers as role models, the prevalence in starting Internet use is higher.

The second hypothesis is that due to the density differences in both countries, living rural or urban will impact Internet usage, where there will be less older adults starting Internet use in the rural areas overall but especially noticeable in Sweden.

A longitudinal design was used to examine, firstly if starting and stopping has a different rate in Sweden and the Netherlands. Secondly if the predictors (age, gender, education, rural/urban, living alone/with someone, cognitive functioning and functional limitations) have different effects in Sweden and the Netherlands.

Methods

Sample

The samples in this study are taken from the Swedish National Study on Aging and Care (SNAC) and from the Longitudinal Aging Study of Amsterdam (LASA). They are both ongoing studies, nationally representative of their older adult populations.

LASA
LASA began in 1992. It is a population-based, multi-disciplinary study, with overall aim to explore, study and understand the physical, emotional, cognitive and social functioning of older adults[41]. The participants are recruited from the registries of 11 municipalities of three geographic regions in the Netherlands; the protestant north, the catholic south and the secular west. Each region includes both rural and urban areas.

The first cohort that entered was between the ages of 55-85 years old (n=3,107; response rate 62%) where face-to-face interviews were held at baseline with a follow-up every three years. More details on the LASA study itself can be found elsewhere[40].

SNAC
SNAC began in 2001, with four participating regions in Sweden: Kungsholmen, Skåne, Nordanstig and Blekinge. The study's overall aim is to increase the knowledge and understanding of the older adults' needs for social and medical services, as well as their medical and functional statuses. Several questionnaires and interviews are used, which were first asked at baseline (2001/2003) (response rate 66.4%), with six year follow-ups after that. For people 81 years and above, there is a follow-up every three years due to the rapid physical and mental changes that begin around that age. A more detailed outline of the SNAC study can be found in Lagergren et al.[41]. Three of the Swedish sites are participating in this study: Kungsholmen, Skåne and Blekinge.

This study combines LASA and SNAC participants into one sample. Older adults 66 years of age and above were followed and four periods were investigated based upon the SNAC waves: baseline (T1) 2001/2003, follow-up (T2) 2004/2006, follow-up (T3) 2007/2010, follow-up (T4) 2010/2013.

Harmonisation of the data was needed before being able to combine the data sets. A number of merging steps were performed before all variables were available with the same name and measuring the same constructs. Many variables needed recoding or creating to properly match between the data sets; these are described below individually.

The predictors
Internet use: starting and stopping
At each wave, Internet use was a question with a yes or no as the possible answer.

Studying whether and when an event occurs, must use a well-defined point in time through to the occurrence of a particular event[42]. This 'time to event', is what is being investigated. In this study, the dependent variable (or event) was based on the new Internet starters between the years 2001-2013, and the new Internet stoppers.

Starting to use the Internet, was constructed based on the sample of non-Internet users at T1 (2001/2003) for both Sweden and the Netherlands. Each new person who started to use the Internet was taken into account for every subsequent wave T2, T3 and T4. Because no exact timing data were available, a person was considered to start using the Internet, half way into each time period, so at 2.0, 5.5 or 8.5 years. The new dependent variable was 'time to start'.

Stopping to use the Internet was constructed based on the number of Internet users at T1 (2001/2003) for both the Dutch and the Swedish data. The procedure was the same as mentioned above. A new variable was created, for every wave T2, T3 and T4, where halfway each time period was considered the time of stopping. This dependent variable was 'time to stop'. Those who did not start or stop were considered as censored observations.

Independent variables
The descriptive data for each of the variables are provided in *Table 1*.
Age was used as a continuous variable in the predictor models and per country. Age was calculated from date of birth to the date that the interviews were conducted.

Gender was coded as a binary variable with 1 for males and 2 for females. It was used as a categorical variable throughout the analyses.

Table 1. Descriptive statistics of the predictors for starting or stopping with Internet use of older adults (age >65 years) at baseline (T1) in the Netherlands (2001/2002; n=1236) and Sweden (2001/2003; n=5106)

Parameter		Netherlands	Sweden
Internet use, n (%)		133 (10.8)	971 (19.0)
no Internet use, n (%)		1,103 (89.2)	4,135 (81.0)
Age, mean (range)		76.4 (66-94)	77.0 (66-100)
Gender	Female, n (%)	692 (56.0)	3,079 (60.3)
	Male, n (%)	544 (44.0)	2,027 (39.7)
Education	Lower, n (%)	1,039 (84.1)	2,685 (53.0)
	Higher, n (%)	196 (15.9)	2,376 (46.9)
Living	Rural, n (%)	701 (56.8)	726 (14.7)
	Urban, n (%)	533 (43.2)	4,217 (85.3)
Household	Live alone, n (%)	537 (43.7)	2,560 (50.3)
	Living+1, n (%)	693 (56.3)	2,534 (49.7)
Cognition score	Mean	27.0	27
	Median	28	28
Functionality	No limitations, n (%)	859 (71.1)	2,926 (62.6)
	Limited, n (%)	349 (28.9)	1,746 (37.4)

Education level was dichotomised into lower and higher educated (secondary school and above). We categorised education into two, so as to facilitate comparison and presentation. Education level was used as a categorical variable in the descriptive analysis and in the predictor model.

Rural or urban living was based on the number of addresses per km^2. This variable already existed in LASA[43], representing participants living in three possible regions in the Netherlands. Thus a similar variable had to be created for SNAC so as to be able to use and compare the data. Addresses were analysed per postal code provided from the participants, which were then matched to the provided categories of names of city, town or village, from statistic databases in Sweden[44], and then the provided level of urbanisation. Scores ranging from 1 to 5 were possible, where 1: less than 500 addresses per km^2; 2: between 500-1000 addresses/km^2; 3: 1000-1500 addresses/km^2; 4: 1500-2500 addresses/km^2; 5: more than 2500 addresses/km^2. The authors dichotomised this variable into those living up to 1500 addresses/ km^2 as living rural, and those who were living 1500 addresses/ km^2 and more as urban, for the descriptive analysis. It was used as a continuous variable in the predictor models.

Living alone or with someone was a binary variable. It was created based on whether an older adult was living with at least with one person (partner, friend, in a facility with other members or other), or living alone. It was used as a categorical variable in the analyses.

Cognitive functioning was measured using the Mini mental state examination (MMSE), which intends to measure the presence of normal cognitive functioning versus the presence of cognitive difficulty. Scores vary between 0-30, where normal to good cognitive functioning ranges between scores from 26-30 (maximum) and scores under 26 suggests cognitive difficulty[45]. In this study it was entered as a continuous variable for the prediction models.

Functional limitations was based on a combination of questions, from a selection of the functional limitations Organisation for Economic Co-operation and Development (OECD) scale[46], and from some questions of the activities of daily living (ADL)[47]. They are self-reports based on the difficulty level of the following activities: walking up and down 15 steps of a staircase, cutting one's own toenails, being able to use public transportation, being able to walk around for five minutes without stopping, being able to sit and rise from a chair and being able to dress/undress oneself. There are five response categories (1: no I cannot; 2: only with help; 3: yes with much difficulty; 4: yes with some difficulty; 5: yes without difficulty), where disability is measured by the total sum of the items; the higher the score the more limitations the older adult has in performing the daily tasks. The variable was dichotomised for the descriptive table as either a person had none or at least one (up to six) functional limitations. For the predictor models, it was used as a continuous variable.

Statistical Tests

IBM SPSS version 23 was used for all statistical analyses.

Baseline difference in potential predictors between countries are reported from the first wave T1 (2001/2002) (*Table 1*). The rates in starting and stopping Internet use were calculated based on those who were not using the Internet in T1 and started in T2, T3 or T4; similarly those who were using the Internet in T1, T2 or T3 and then stopped in the following measurement wave were then counted as stopping (*Table 2*).

In order to test the multicollinearity of the predictors, two tests were conducted. Firstly, one overall Pearson correlation matrix was calculated to verify the correlations between all variables. Secondly a Variance Inflation factor (VIF) and tolerance statistic were conducted on each predictor with Internet use. They indicate as to whether there is a strong linear relationship between the predictors, where a VIF higher than 10 and a tolerance statistic less than 0.1 are both indicators of multicollinearity[48].

Cox regression was the method selected to test the predictive value of potential predictors. The method is based on a conditional prob-

Table 2. Percentage of non-users, users, starters and stoppers of Internet use in the Netherlands (n=1236) and Sweden (n=5106) between 2001-2013

Time frame	Initial non-use	Initial use	Started	Stopped
	THE NETHERLANDS			
T1: 2001/2002	89.2	10.8		
T2: 2005/2006			6.2	0.8
T3: 2008/2009			2.8	1.5
T4: 2011/2012			1.9	0.7
	SWEDEN			
T1: 2001/2003	81.0	19.0		
T2: 2004/2006			0.8	0.9
T3: 2007/2009			0.4	0.4
T4: 2010/2013			0.2	0.4

ability of the event happening (here being either starting or stopping Internet use) within a time interval. It tests the hazard ratio of a predictor influencing an event to happen or not over time.

The Cox regression has a proportional hazard (PH) assumption, which claims that the baseline hazard is a function of t but does not involve the predictors, where the predictors do not change over time. The PH assumption was verified for both the Swedish and Dutch older adult starters and stoppers of Internet use.

The Swedish and Dutch data were pooled together in order to control for, and test the differences between countries. A variable 'country' was created, where Sweden was coded as 0 and the Netherlands was coded as 1. This variable was firstly entered as the independent variable into a simple Cox regression to test for country differences. Thereafter a multivariate model was used for starting and stopping use with all the predictors including country.

To examine the strength of the associations between all independent variables with the outcome variable, starting or stopping use, between countries, the authors created an interaction term: variable*country, which was included one by one into a multivariate pooled model. As it is recommended, a significance level of ($p<0.10$)[49], is applied for interaction terms. If there is at least one significant interaction, it was then necessary to stratify in a multivariate model per country.

Stratifying meant that the variables were investigated separately per country so as to study the individual predictors per country. Eight regressions per country were conducted for starting and stopping to use the Internet. First each predictor was investigated separately for its predictive ability on Internet use. For this preliminary exploration, a liberal significance level of ($p<0.20$) was used so as not to miss important predictors[50]. These significant variables were then be entered into one final regression analysis per country, and tested at ($p<0.05$).

Results

Baseline data of the study samples in both countries (*Table 1*) showed, first, a greater Internet use in Sweden than in the Netherlands as of 2001/2002. Furthermore, the Swedish participants included slightly more women, many were higher educated, were more often living in urban areas, were somewhat more often living alone, and were more often functionally limited than the Netherlands participants. The averages of age and of the cognitive test score were very similar.

There were significant correlations between some variables, but there was no sign of collinearity with the coefficients ranging between -0.346 through to +0.371. These indicated only medium effects. Similarly the VIF (all less than 10) and tolerance statistic (all higher than 0.1) confirmed this, with no cause for concern of multicollinearity.

The frequency of starting and stopping Internet use can be found in the *Table 2*. The Netherlands has a stronger increase in use of the Internet over the period with (10.9%) compared to Sweden with only (1.4%) new users. There was however about the same proportion of the older people stopping Internet use in the Netherlands as in Sweden (3.0% and 1.7% respectively).

This was also verified in the Cox regression by country in *Table 3*. It first indicates country with starting use of Internet followed by all the predictors with country. This same procedure was done for the stoppers. There is a significant difference per country in those starting Internet use (HR:2.323;1.505-3.587). However for those stopping use (HR:0.640;0.360-1.138), there is no significant difference, suggesting individual differences in predictors in stopping use per country.

Table 3. Cox regression enter method of pooled data for starters and stoppers (n=6342) with predictors and country (Sweden=0, Netherlands=1); b=coefficient; SE=Standard error; HR=Hazard ratio; CI=Confidence Interval 95%; W=Wald statistics; Confidence limit 0.05, significant values in bold

Parameter	**b±SE**	**HR**	**CI**	**W**	**p**
		Starters			
Age	-0.060±0.016	0.942	0.913-0.971	14.317	**0.001**
Gender	0.537±0.150	1.711	1.274-2.299	9.773	**0.001**
Education	-0.503±0.161	0.605	0.441-0.829	9.773	**0.002**
Rural / urban	0.088±0.058	1.092	0.976-1.223	2.357	0.125
Living +1 / no	-0.333±0.168	0.717	0.516-0.995	3.954	**0.047**
Cognition	0.118±0.043	1.125	1.034-1.225	7.519	**0.010**
Functional limitation	-0.131±0.113	0.877	0.703-1.096	1.332	0.248
Country	-0.843±0.222	2.323	1.505-3.587	14.476	**0.001**
		Stoppers			
Age	0.042±0.026	1.043	0.991-1.098	2.640	0.104
Gender	-0.364±0.203	0.695	0.467-1.035	3.208	0.073
Education	0.190±0.199	1.209	0.818-1.786	0.906	0.341
Rural / urban	-0.093±0.083	0.911	0.774-1.072	1.252	0.263
Living +1 / no	-0.442±0.229	0.643	0.410-1.007	3.718	0.054
Cognition	-0.142±0.047	0.868	0.792-0.951	9.203	**0.010**
Functional limitation	0.184±0.112	1.201	0.965-1.496	2.701	0.100
Country	0.446±0.294	0.640	0.360-1.138	2.309	**0.129**

In *Table 4*, each 'country*variable' interaction is presented in the pooled data. There is one significant interaction for the starters, which is with functional limitation and country (p<0.05). For those stopping use, the interaction with rural or urban living was significant (p<0.05). This necessitated stratification per country (*Table 5* for Sweden and *Table 6* for the Netherlands).

In Sweden (*Table 5*), the results display all seven variables in separate models with starting to use the Internet. Four variables are significantly predictive in starting use at (p<0.20); namely being female (HR:2.470;CI95%:1.546-3.946), lower educated (HR:0.592;CI95%:0.370-0.947), having normal to good cognitive functioning (HR:1.100;CI95%:0.985-1.229), and living alone (HR:0.644;CI95%:0.404-1.026). Putting these variables into one final Cox regression model, being female was then the only significant predictor of starting use (HR:2.380;CI95%:1.442-3.982).

The lower part of *Table 5*, illustrates the seven predictors separately with stopping use in Sweden. Six variables were significantly predictive in stopping use: those higher educated (HR:1.602;CI95%:1.040-2.468), higher in age (HR:1.090;CI95%:1.020-1.166), lower cognitive functioning (HR:0.837;CI95%:0.766-0.916), living alone (HR:0.737;CI95%:0.464-1.168), with more functional limitations (HR:1.298;CI95%: 1.045-1.611) and living rural (HR: 0.715;CI95%:0.595-0.860). When these were added into one model using a Cox regression, being lower in cognitive functioning (HR:0.884;CI95%:0.797-0.980) proved significantly predictive of stopping to use the Internet.

In *Table 6*, Dutch females (HR:1.509;CI95%: 1.087-2.095), lower educated (HR:0.436; CI95%: 0.300-0.634), lower in age (HR:0.868; CI95%: 0.840-0.897), having good cognitive functioning (HR:1.388;CI95%:1.252-1.540), living alone (HR:0.316;CI95%:0.214-0.469) and having fewer functional limitations (HR:0.360;CI95%:0.240-0.540) were more likely to start using the Internet. When all these variables were entered into one final model (a Cox regression enter method), being lower in age (HR:0.904;CI95%:0.873-0.937), having good cognitive functioning (HR:1.183;CI95%:1.065-1.314), living alone (HR:0.606;CI95%:0.398-0.921), having fewer functional limitations (HR:0.576; CI95%:0.383-0.853) and being lower educated

Table 4. Seven interaction effects (p values) of 'Country' on predictors and starting or stopping Internet use, based on pooled data (n=6342) with 17.4% Internet users and 82.6% non-users; confidence limit 0.05; significant p values in bold

Parameter		**Hazard ratio, (Confidence interval 95%)**	
		Starters	**Stoppers**
Age	Country	0.008 (0.000-1.902)	0.042 (0.000-54.091)
	Age	0.965 (0.909-1.024)	1.092 (1.021-1.168)
	Country*age	0.948 (0.885-1.015)	0.956 (0.871-1.050)
	p	0.123	0.348
Gender	Country	0.499 (0.209-1.192)	1.978 (0.617-6.344)
	Gender	0.406 (0.254-0.648)	0.758 (0.494-1.162)
	Country*gender	1.388 (0.783-2.458)	0.963 (0.449-2.066)
	p	0.262	0.923
Education	Country	0.391 (0.157-0.974)	2.234 (0.688-7.250)
	Education	0.589 (0.368-0.943)	0.621 (0.403-0.956)
	Country*education	1.419 (0.778-2.589)	0.928 (0.416-2.070)
	p	0.254	0.855
Rural / urban	Country	0.352 (0.118-1.055)	8.548 (2.631-27.775)
	Rural / urban	1.030 (0.817-1.297)	0.711 (0.592-0.855)
	Country*rural /urban	1.058 (0.816-1.372)	1.369 (1.016-1.843)
	p	0.671	**<0.05**
Living +1 / no	Country	0.441 (0.270-0.720)	2.022 (0.947-4.317)
	Living +1 / no	0.640 (0.402-1.020)	0.740 (0.467-1.174)
	country*living +1	1.497 (0.814-2.753)	0.882 (0.368-2.115)
	p	0.194	0.779
Cognition	Country	0.143 (0.002-11.408)	2.640 (0.008-866.84)
	Cognition	1.103 (0.988-1.232)	0.831 (0.760-0.909)
	Country*cognition	1.115 (0.955-1.304)	1.012 (0.823-1.243)
	P	0.169	0.913
Functional limitation	Country	0.294 (0.213-0.406)	2.096 (1.392-3.156)
	Functional limitation	0.896 (0.710-1.132)	1.300 (1.046-1.615)
	country*functional limitation	0.599 (0.379-0.947)	1.250 (0.683-2.285)
	p	**<0.05**	0.469

(HR:0.579;CI95%:0.392-0.853) were predictive of starting to use the Internet.

There were few who stopped using the Internet in the Netherlands over the period (3%). All the predictors were separately influencing whether an older adult would stop using the Internet. So, being female was predictive (HR:1.946;CI95%:1.034-3.665); being lower educated (HR:0.416;CI95%:0.211-0.817); lower in age (HR:0.899; CI95%:0.852-0.949); having normal to good cognitive functioning (HR:1.326;CI95%:1.108-1.587); living alone (HR:0.319,CI95%:0.152-0.671); having fewer functional limitations (HR:0.501;CI95%:0.288-0.870); living urban (HR:1.234;CI95%:0.981-1.552). When entered into one final model using a Cox regression enter method, only being younger in age (HR:0.936;CI95%:0.883-0.992) and living urban (HR:1.287;CI95%:1.013-1.635) were predictive of whether a Dutch older adult would stop using the Internet.

Discussion

The present paper provides a report on possible differences between Dutch and Swedish older adults regarding Internet starting and stopping, and predictors of these behaviours. The main findings indicated that, there are indeed differences between the two countries, but only in the rate of those starting to use the Internet. Sweden and the Netherlands had about the same number of older adults stopping use during 2001-2013. There were individual differences found with living rural or urban yet this predictor was not influencing stopping use in Sweden but only in the Netherlands.

The rates of Internet use are different between countries can probably be attributed to practical differences. The authors believe that this can be noticed firstly in 2001, where there were more companies and organisations in Sweden using the Internet compared to the Netherlands[51], which suggests an already larger spread of the Internet in Swedish society. Furthermore, the Internet was cheaper in Sweden in 2001 as compared to the Netherlands[52]. This can probably partly explain why there were twice as many older adult users in Sweden in 2001. As of 2007, the Swedish showed a stagnation of new users, where no new groups such are starting to use the Internet however, those who were already using the Internet are using the Internet more[53]. Dutch data, on the other hand, indicated as of 2005 quicker access to the Internet showed an increase in usage overall but also by older adults between the years 2005-2013[54].

Table 5. Cox regression models with predictors of starting or stopping Internet use in Sweden; b=coefficient; SE=Standard error; HR=Hazard ratio; CI=Confidence Interval 95%; W=Wald statistics; Confidence limit 0.20 for one-predictor models 1-7, and 0.05 for models with significant predictors (Model 8), significant p values in bold

Model		b±SE	HR	CI	W	p
	Starting					
1	Age	-0.033±0.031	0.967	0.911-1.027	1.171	0.279
2	Gender	0.904±0.239	2.470	1.546-3.946	14.298	**0.001**
3	Education	-0.525±0.240	0.592	0.370-0.947	4.772	**0.029**
4	Rural / urban	0.028±0.118	1.028	0.816-1.295	0.056	0.813
5	Living +1 / no	-0.440±0.238	0.644	0.404-1.026	3.424	**0.064**
6	Cognition	0.095±0.056	1.100	0.985-1.229	2.853	**0.091**
7	Functional limitation	-0.100±0.119	0.905	0.716-1.143	0.706	0.401
8	Gender	0.867±0.263	2.380	1.422-3.982	10.899	**0.001**
	Education	-0.384±0.248	0.681	0.419-1.107	2.399	0.121
	Cognition	0.102±0.061	1.107	0.938-1.246	2.805	0.094
	Living +1 / no	-0.080±0.261	0.923	0.554-1.539	0.923	0.759
	Stopping					
1	Age	0.087±0.034	1.090	1.020-1.166	6.368	**0.012**
2	Gender	0.269±0.218	0.764	0.498-1.172	1.517	0.218
3	Education	0.471±0.221	1.602	1.040-2.468	4.567	**0.033**
4	Rural / urban	-0.335±0.094	0.715	0.595-0.860	12.662	**0.001**
5	Living +1 / no	-0.306±0.235	0.737	0.464-1.168	1.687	**0.194**
6	Cognition	-0.178±0.046	0.837	0.766-0.916	15.153	**0.001**
7	Functional limitation	0.261±0.110	1.298	1.045-1.611	5.569	**0.018**
8	Cognition	-0.123±0.053	0.884	0.797-0.980	2.968	**0.020**
	Rural / urban	-0.194±0.113	0.823	0.660-1.027	2.968	0.085
	Age	0.056±0.039	1.057	0.980-1.141	2.092	0.148
	Functional limitation	0.170±0.126	1.185	0.926-1.517	1.822	0.177
	Education	0.128±0.248	1.137	0.700-1.847	0.267	0.605
	Living +1 / no	-0.357±0.257	0.700	0.423-1.157	1.934	0.164

Significant differences between countries were found for older adults starting to use the Internet. In Sweden, it was the females who would start using the Internet. In the Netherlands, it was those younger in age, with good normal cognitive functioning, living alone, with less functional limitations and lower educated. These differences can be indicative of first of all that there were more older adults using the Internet already in Sweden in 2001/2003 compared to the Netherlands (*Table 2*). Secondly, the number of starting individuals is higher in the Netherlands during this time period so more factors are likely to influence usage.

Older Swedish females are now catching up in Internet usage, possibly having become more used to the Internet's frequency in daily life and more aware of its' benefits. A recent study indicated that older women were more likely than men to benefit and comply with online interventions in health promotion[55]; this suggests that there may be different reasons for females and males to go online.

Lower educated older adults and those living alone were the ones starting. Many earlier studies have indicated that these are predictors, which often are linked to non-use[21,22]. Our findings, therefore, could suggest a change in time periods with those who are starting to use the Internet today having other characteristics than early adopters. Those who were lagging behind, such as people living alone and lower educated are now catching up. Thus, the digital divide may be changing, where the gaps are closing regarding certain characteristics. The gaps specifically between lower and middle educated older adults have, in a previous study, been dissipating as noticed in their Internet skills between the years 2010-2013[56]. One reason could be that getting an Internet subscription has become cheaper, which for the lower educated who often have a lower income, would make a difference. Living alone seems to have become a reason to go online, which could be social, to be able to handle independent living or having a need to understand what it means to be online and feeling part of society[29]. It could also be that the children's impact on technology use of older adults has become more important[57]. A younger person will agree that if an older adult lives alone being able to use the Internet to communicate, do banking or get health or governmental information is necessary, so might teach and help their older parents or grandparents to use the Internet. The next of kin can thus contribute to active aging. These tentative explanations need further research.

There were no significant differences in older adults stopping Internet use per country. Older adults who were lower in cognitive functioning would stop using the Internet in Sweden. This confirms other research as good cognitive functioning has often been reported to be needed in order to use and continue using new technology[58]. Many devices and tools need to accommodate more for cognitive decline. For the Netherlands, lower in age and living urban were significant predictors in stopping. These results could give insight into the Internet user profiles. Previous research has indicated that stopping use is due to being older in age and is also a generational problem[23]. According to the results here, younger older adults are also stopping. It has been mentioned in previous research, if an older adult does not see the point in using the Internet or new ICT

Table 6. Cox regression models with predictors of starting or stopping Internet use in the Netherlands; b=coefficient; SE=Standard error; HR=Hazard ratio; CI=Confidence Interval 95%; W=Wald statistics; Confidence limit 0.20 for one-predictor models 1-7, and 0.05 for models with significant predictors (Model 8), significant p values in bold

Model		b±SE	HR	CI	W	p
	STARTERS					
1	Age	-0.141±0.017	0.868	0.840-0.897	72.584	0.001
2	Gender	0.411±0.167	1.509	1.087-2.095	6.042	**0.014**
3	Education	-0.829±0.191	0.436	0.300-0.634	18.854	**0.001**
4	Rural / urban	0.021±0.060	1.021	0.908-1.149	1.122	0.727
5	Living +1 / no	-1.150±0.201	0.316	0.214-0.469	32.864	**0.001**
6	Cognition	0.328±0.053	1.388	1.252-1.540	38.769	**0.001**
7	Functional limitation	-1.023±0.207	0.360	0.240-0.540	24.340	**0.001**
8	Age	-0.101±0.018	0.904	0.873-0.937	31.258	**0.001**
	Cognition	0.168±0.054	1.183	1.065-1.314	9.845	**0.01**
	Living +1 / no	-0.501±0.214	0.606	0.398-0.921	5.504	**0.05**
	Functional limitation	-0.552±0.209	0.576	0.383-0.867	6.995	**0.01**
	Education	-0.547±0.198	0.579	0.392-0.853	7.620	**0.01**
	Gender	0.115±0.181	1.122	0.787-1.598	0.403	0.525
	STOPPERS					
1	Age	-0.106±0.027	0.899	0.852-0.949	15.014	**0.000**
2	Gender	0.666±0.323	1.946	1.034-3.665	4.252	**0.039**
3	Education	-0.878±0.345	0.416	0.211-0.817	6.472	**0.011**
4	Rural / urban	0.210±0.117	1.234	0.981-1.552	3.211	**0.073**
5	Living +1 / no	-1.141±0.379	0.319	0.152-0.671	9.079	**0.003**
6	Cognition	0.282±0.092	1.326	1.108-1.587	9.494	**0.002**
7	Functional limitation	-0.691±0.282	0.501	0.288-0.870	6.025	**0.014**
8	Age	-0.066±0.030	0.936	0.883-0.992	4.999	**0.050**
	Cognition	0.140±0.094	1.150	0.957-1.383	2.225	0.136
	Living +1 / no	-0.637±0.408	0.529	0.238-1.176	2.441	0.118
	Education	-0.406±0.361	0.666	0.328-1.352	1.265	0.261
	Functional limitation	-0.289±0.288	0.749	0.426-1.316	1.013	0.314
	Gender	0.264±0.345	1.303	0.662-2.561	0.587	0.444
	Rural / urban	0.252±0.122	1.287	1.013-1.635	4.278	**0.05**

tools there will be less usage. Further research should address what the older adults were using the Internet for to understand why they stop. Age may be a much more intricate predictor with Internet use as older adults are such a heterogeneous group. For example, with any cohort, there are many differences according to background, upbringing and life events. These reasons backing age itself, may also be worth exploring as they could give indication why someone would start or stop using the Internet.

Living urban was not influencing whether any older adult would start using the Internet. This was different to what the authors expected. In the Netherlands living urban was affecting whether someone would stop using the Internet. This is contrary to Sweden where those who live rural are the ones more likely to stop. When the significant predictors per country were combined into one model, only in the Netherlands did urban living still influence stopping use, along with being younger in age. Older adults who live urban have usually already been computer users[59] for a while so it may not come as a surprise that some are stopping.

Strengths and limitations

A strength in this study is that it is a longitudinal design, where older adults have been followed over four waves. The time aspect is taken into account to explore modifications in behaviour, and it is possible to arrive closer to causal inferences. There are a few limitations, namely that only a small number of older adults stopped. This means that the results are difficult to generalise. It is also not known what the older adults were using the Internet for, which could give more indication as to why someone would stop. There were also some methodological challenges within the harmonisation process, where an attempt to combine questions so as to be as close as possible, they still varied slightly between Sweden and the Netherlands. Within functional limitations for example, there is the question of taking a 'brisk 5 minute walk' (Swedish data) and 'taking a 5 minute walk outside' (Dutch data). These slight differences may have small impacts on the answers provided by the older adults in each country.

Conclusion

In this study the authors investigated possible predictors in starting and stopping Internet use between the years 2001-2013. There were significant differences found between countries in predictors in starting use. There were much fewer older adults starting to use the Internet in Sweden compared to the Netherlands. On average the same amount of people were stopping in Sweden as in the Netherlands. The predictor urban or rural living was not impacting Sweden to a higher degree, even though Sweden is much less densely populated than the Netherlands.

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