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Maintaining health-related quality of life from 85 to 93 years of age despite decreased functional ability

Short title: Maintained HRQoL at age 93

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Abstract

Purpose: The oldest-old is the most rapidly growing age group in Sweden and in the western world. This group is known to be at great risk of increased functional dependency and the need for help in their daily lives. The aim was to examine how the oldest-old change over time regarding health-related quality of life (HRQoL), cognition, depression and ability to perform activities of daily living and investigate what factors explain HRQoL at age 85 and 93 years.

Methods: In this study, 60 individuals from the Swedish ELSA 85 study were followed from age 85 to 93 years. Measurements used were EQ-5D, Geriatric Depression Scale, Mini Mental State Examination and ability to perform activities of daily living. Nonparametric statistics and regression analyses were used.

Results: Although the individuals had increased mobility problems, decreased ability to manage activities of daily living, and thus had increased need of assistance, they scored their HRQoL at age 93 years at almost the same level as at age 85 years. No depression and low dependence in activities of daily living speaks in favour for higher HRQoL.

Conclusions: HRQoL can be maintained during aging despite decreased functional ability and increased need of assistance in daily life.

Keywords: Health-related quality of life, Daily living, Elderly

Introduction

The very old (80+) is the most rapidly growing age group in Sweden and in the western world (WHO, 2002). This group is also known to be at high risk of increased functional dependency and the need for help in their daily lives (Dahlin-Ivanoff et al., 2010; Larsson and Thorslund, 2006). The very old might have problems with functional ability for different reasons, symptoms and diseases. The group is heterogeneous and even though many elderly people stay healthy and active, the average disability increases gradually among the very old (Verbrugge, 2016). It is important for occupational therapists to help people to stay as active as possible and promote participation in daily activities throughout the life course. Health-related quality of Life (HRQoL) of the elderly population is of interest to all health care professionals, including occupational therapists. Earlier studies have examined the factors influencing HRQoL in elderly people. Decreased perceived HRQoL seems to be influenced by reduced physical capacity, especially regarding mobility tasks related to activities of daily living (ADL) in frail elderly people (Langlois et al., 2012). Maintaining mobility in older people has also been shown to be related to physical and mental HRQoL (Fagerström and Borglin, 2010). Thus, focusing on restricted mobility may be helpful in identifying older people at risk for decreasing HRQoL. However, physical impairment is not the only symptom related to low HRQoL. Burström et al. (2014) found that anxiety/depression had the strongest relationship with HRQoL measured by the EQ-5D index value and EQ-5D visual analogue scale (VAS) in a Swedish study estimating experienced-based data in a general population. Both cognition and physical function correlate with HRQoL in old age (Kim, 2016). In one study examining, what factors were important for life satisfaction among individuals aged 78–93 years, physical symptoms and impaired ADL predicted a decline in life satisfaction for a 3-year period (Enkvist et al., 2012). However, there is a lack of studies exploring change over time concerning quality of life, cognition,

depression and ability to perform ADL among oldest-old (85+) individuals. There is also a lack of studies that examines what factors predicts well-being in very old age and longevity. Therefore, the aims of this study was to follow individuals from age 85 years to 93 years and investigate the following:

1. Changes over time regarding HRQoL, cognition, depression and ability to perform ADLs.
2. What variables predict HRQoL at the age of 85 and 93 years?
3. What variables at age 85 years predict longevity and taking part in follow-up at age 93 years?

Methods

Design

This study is part of the Elderly in Linköping Screening Assessment (ELSA 85), a population study of 85-year-old people in the south of Sweden (Nägga et al., 2011) with longitudinal follow-ups at the age of 86, 90 and 93 years. Linköping is the fifth largest municipality in Sweden and has 150,000 inhabitants. At baseline (T1, i.e. test occasion 1) and first follow-up (T2), the study included three phases: a postal questionnaire, a home visit by an occupational therapist and a reception visit at a geriatric clinic. At the age of 90 years (T3) and 93 years (T4), the study was shortened to a home visit. The individuals had to participate in each phase to be included in the next phase (Figure 1). The major aim of ELSA 85 was to characterize and define evidence-based knowledge on how best to plan, design and provide health care for the oldest-old. The study focused on physical, cognitive and environmental factors and ability to perform activities of daily living.

Sample

All individuals born in 1922 ($n = 650$) were invited to participate in the study at baseline (Nägga et al., 2011). Those 650 individuals received written information about the study together with an invitation to take part in the first three phases at the age of 85 years. At each follow-up, a new invitation was sent out to those who took part in the previous phase. Of the 650 individuals, 496 (76%) answered the postal questionnaire in the first phase and 380 (77%) took part in the second phase, a home visit by an occupational therapist. Eight years later at the age of 93 years, 60 (16%) took part in the last follow-up (T4). A flowchart describing the data collection from aged 85 to 93 years is shown in Figure 1. The present study only include data from T1 and T4. An analysis of dropouts at T1 and T2 has been described elsewhere (Dong et al., 2015). The dropouts from the first phase to the second phase at T1 consisted of more individuals living in sheltered accommodations or nursing homes, they had more difficulties in mobility and self-care measured by the EQ-5D 3 level version (EQ-5D-3L) (Dong et al., 2015).

Procedures and measurements

The postal questionnaire (sent out in the first phase at the age of 85 years) included 10 items about demographics, education, socioeconomic status (SES), use of assistive technology and physical exercise habits (walking once a week; walking several times a week; walking every day; other regular exercise; or no exercise). SES, referring to previous occupation, was classified into the following categories according to Dutton and Levine (1989): low (blue collar); intermediate (white collar); and high (self-employed or academic profession).

The questionnaire also included a self-reported measure for HRQoL, EQ-5D-3L (EuroQoL Group, 1990). This generic instrument assesses HRQoL in terms of mobility, self-

care, usual activities, pain/discomfort, and anxiety/depression. The EQ-5D-3L response alternatives are no problems, moderate problems, or severe problems. The scores on the five EQ-5D-3L items were converted into a single summary index value generated by means of the Time-Trade-Off method (Dolan, 1997). The EQ-5D-3L index value ranges from +1 to -0.594 , where +1 represents perfect health, 0 a state equivalent to death, and -0.594 worse than death (Dolan, 1997). The EQ-5D-3L also include a VAS recording the individuals self-rated valuation of health, ranging from 0 (worst imaginable health state) to 100 (best imaginable health state). The EQ-5D is considered to be a practical and easy to administer tool for assessing the elderly population (Johnson and Pickard, 2000), valid in a general population (Holland et al., 2004), and effective in persons with cognitive impairments (Wolfs et al., 2007).

At the follow-up at age 93 years, a structured interview took place in the person's home using the 10 items from the questionnaire and the EQ-5D-3L was administered. The total time of the home-visit was approximately two hours.

At home visits (age 85 and 93 years), questions about the ability to perform personal activities of daily living (PADL) were asked with four questions that addressed the participant's ability to perform dressing, bathing, toileting and eating. Answer alternatives were: 1, independent, 2, need of some help, or 3, need of much help. A single summary score was calculated (range 4–12) and used in the regression analyses. A higher score indicates greater dependency in PADLs.

The Instrumental Activity Measure (IAM) (Andrén et al., 1997) was used to assess perceived difficulty in instrumental activities of daily living (IADL). IAM include eight activities: locomotion outdoors, preparing a simple meal, cooking, using public transport,

small-scale shopping, large-scale shopping, cleaning, and washing with the following scoring alternatives: 4, no difficulties; 3, some difficulties; 2, great difficulties; and 1, too difficult. A single summary score was calculated (range 8–32) and used in the regression analyses. A lower score indicates greater difficulties in IADLs. The IAM take approximately 10 minutes to perform through interview. It has been proved to have good interrater agreement (Daving et al., 2000)

An assessment of cognitive function was also done during the home visit using the Mini Mental State Examination (MMSE) (Folstein et al., 1975). The MMSE assesses orientation in time and place, attention, memory, language and visual construction. The MMSE has a maximum of 30 points with higher scores indicating better cognition. It contains 20 items and takes about 8-10 minutes to complete. The following cut-off levels were used to grade cognitive impairment: ≥ 27 , no impairment; 21–26, mild; 11–20, moderate; and ≤ 10 , severe impairment (Folstein et al., 2001). The test is widely used and has proved to have a pooled sensitivity of 81.4% and a pooled specificity of 87.2 % in screening for cognitive impairment in non-specialist settings. The internal-consistency has been proved to be moderate and test-retest reliability is often described as good (Mitchell, 2013).

Depression was assessed using the Geriatric Depression Scale, GDS15 (Sheikh and Yesavage, 1986), which contains 15 items with the response alternatives “yes” or “no”. A score of six or above indicates possible depression (Wancata et al., 2006). It takes about 5-10 minutes to complete. The results of a meta-analysis by Mitchell et al. (2010) resulted in a recommendation to use the GDS15 in diagnosing late-life depression in primary care settings with a sensitivity of 81.3% and specificity of 78.4%.

Statistical analyses

Statistical analyses were performed using SPSS 22.0. The results for each of the EQ-5D-3L items were dichotomized into two categories: being independent/having no problems or being in need of help/having problems; no pain/discomfort or reporting pain/discomfort; and no anxiety/depression or reporting anxiety/depression. The PADL items were dichotomized into being independent or being in need of help. The IAM items were dichotomized into two categories: having problems or not having problems. Those dichotomizations were done in order to analyse change over time for each item (Tables 2 and 3) and analyse correlations between IADLs and EQ-5D-3L (Table 4).

Analysing change over time, non-parametric analyses were used for ordinal scales (Wilcoxon signed rank test) using all answer alternatives for PADL and IADL.

We used a paired t test for comparing the EQ-5D-3L index value and EQ-5D-L3 VAS over time and between genders and for comparing the summary score of PADL and IADL over time. A p value <0.05 was considered statistically significant.

Spearman's rank-order correlation was used for analyses of associations between IAM items and HRQoL as found in the EQ-5D-3L VAS and the EQ-5D-3L index value and also between MMSE and EQ-5D-3L VAS and the EQ-5D-3L index value.

Linear regression analyses were performed, using the enter method, for our second aim: to evaluate which variables predicted HRQoL at 85 and 93 years of age separately. In addition, a linear regression analysis was performed with variables at 85 years of age to study if they predicted HRQoL at 93. EQ-5D-3L VAS was dependent variable and gender, education, GDS15, MMSE, PADL and IAM were independent variables. The rule of thumb that 10 cases of data per predictor is sufficient was followed (Field, 2013). We also

performed a binary logistic regression analysis for the third aim, i.e. to find out what variables at baseline predicted longevity and study participation at the age of 93 years. The dependent variable was study participation at the age of 93 years. Independent variables were the same as above; gender, education, GDS15, MMSE, PADL and IAM. We used the enter method in all regression analysis.

Results

The sample consisted of 29 women (48%) and 31 men (52%), all of whom participated at 85 and 93 years of age. The average number of years in formal education was 9.27 (SD 3.7) with a range between 4 and 22 years. The socioeconomic status (SES) of our sample was low for 19 individuals (32%), intermediate for 32 individuals (53%) and high for nine individuals (15%), measured by the method described by Dutton and Levine (1989). At the age of 93 years, four participants had some help from a proxy during the interview. Those four were living in nursing homes and could not take part in the cognitive testing or the GDS. However, they could take part in the interviews regarding ADL and in two cases, they were able to finish the EQ-5D. In total, nine participants could not or would not complete the MMSE due to bad sight or hearing or not being able to write, or were too tired. Five participants did not complete the GDS and two did not complete the EQ-5D.

The characteristics of the individuals are presented in Table 1, including comparisons between their status at age 85 years and 8 years later at age 93 years. At the age of 93 years, a greater proportion of the individuals were living in sheltered housing, were using more community assistance and assistive technology than when they were at 85 years of age. Half of the individuals were living alone at age 85 years, whereas 75% were living alone at age 93 years. At age 85 years, 90% of the individuals reported doing exercise, while at age 93 years, the frequency was lower (80%); the difference was not significant. Cognition measured by

the MMSE showed a small but significant change in terms of lower mean score. At age 93 years, 41 individuals (68 %) had a MMSE score ≥ 27 (i.e. no cognitive impairment).

Measures with GDS15 showed a small increase over time, but only one individual scored ≥ 5 at age 85 years (2%) and five individuals at age 93 years (8%).

The EQ-5D-3L index value decreased significantly, but the analysis of EQ-5D-3L VAS did not show any significant change over time (Table 2). The participants reported mobility problems, need of help with self-care and usual activities to a higher extent than at 85 years of age. However, at the age of 93 years, a smaller proportion reported pain/discomfort although the change over time was not significant. The frequency of anxiety/depression did not change between the two data collection points. There was a gender difference regarding the EQ-5D-3L index value at 85 years of age; women had a lower index value than men but no significant difference for EQ-5D-3L VAS at age 85 years and no gender difference for index value or VAS at 93 years of age. Regarding PADL and IADL, we found significantly decreased ability for all items except toileting and eating (Table 3). The global sum for PADL and IADL showed significant decreased ability (Table 1).

Correlations between PADL/IADL items and EQ-5D-3L VAS were weaker at age 93 years compared with age 85 years except for locomotion (Table 4). Significant correlation was found between GDS15 and the EQ-5D-3L index value and EQ-5D-3L VAS, respectively, at age 85 years ($r = -0.58, p < 0.001$; and $r = -0.60, p < 0.001$) and at the age of 93 years ($r = -0.34, p = 0.012$; and $r = -0.46, p < 0.001$), although slightly weaker. The EQ-5D-3L index values and VAS were associated with MMSE scores ($r = 0.30, p = 0.021$; and $r = 0.34, p = 0.009$) at age 85 years but not at age 93 years.

In the linear regression analyses at the age of 85 years, the only significant independent variables associated with EQ-5D-3L VAS were IAM and GDS15 (Table 5) and at age 93 years, GDS15 was the only significant independent variable associated with EQ-5D-3L VAS (Table 6). When using the independent variables from 85 years to explain EQ-5D-3L VAS at 93 years of age, GDS15 was the only significant variable and the model summary (adjusted R^2) was 35%. We found two significant variables that predicted longevity and participation at 93 years: MMSE ($p = 0.001$) and IAM ($p = 0.021$).

Discussion

Our results show that even though the participants had increased mobility problems, decreased ability to manage PADL and IADL, and thus had increased need of assistance, they still scored their HRQoL measured by the EQ-5D-3L VAS at age 93 years at almost the same level as at age 85 years. In this study, increased mobility problems at age 93 years resulted in a larger proportion of participants being in need of mobility assistive technology (wheelchair, walkers and canes). The participants' physical exercise habits did not change significantly over this 8-year period. The use of walking aids may have helped them to continue with their exercise habits. It seems that most of the participants remained relatively cognitively intact over the years, and the frequency of signs of depression was low. The fact that our participants stayed cognitively healthy over the years and the frequency of signs of depression was low might also explain the unchanged HRQoL. According to earlier research, those are both important factors for HRQoL (George et al., 2014; Burström et al., 2014; Johansson et al., 2012). Despite low scores, GDS15 was the only significant independent variable that explained HRQoL at the age of 93 years.

The fact that preserved ADL/IADL function is of great importance for HRQoL and for mental health, it is important for occupational therapists to work on preventive activities

as well as enable leisure activities, social activities and promote a high level of functioning in elderly people. For example, interventions that promote mobility, including technical aids, and information about technical aids are important areas. Changes/interventions on a societal level are also important. Every intervention that makes it easier for an elderly person to be active and participate in society despite decreased functional ability is important.

High and stable self-ratings of HRQoL, despite increasing numbers of chronic diseases and decreasing functional ability, is well known in studies of aging (Jopp et al., 2016). This process might be seen as an adjustment of expectations related to age. Older participants tend to report declines when explicitly asked to rate how health has changed over time instead of rating their health at the moment (Jylhä, 2009). In a qualitative study, Ågren (1999) interviewed 41 individuals at the age of 85 and 93 years. Over the 7 years, the participants had generally experienced a number of changes, mainly regarding health and personal relationships. Although some were positive, they mentioned negative changes and most often they meant that health had deteriorated. However, their results showed how well people adapted to those changes. The way elderly people adapt to changes in life and health might also partly explain the findings in this study.

We also found that self-reported frequency of pain/discomfort and anxiety/depression had not changed significantly over time. The most commonly reported problems within the EQ-5D-3L were mobility and pain/discomfort, confirming the results from a study by Gerber et al. (2016), who showed that pain and mobility were the items most affected in an elderly South Africa population using the EQ-6D (EQ-5D questionnaire plus cognition). In contrast to a study (Hinz et al., 2014) in a general German population, we did not find any difference between men and women regarding EQ-5D-3L VAS at age 85 years or at age 93 years. The mean values in our study were lower, however their results were based on elderly people

defined as being 70 years or older and no range was presented. Feng et al. (2015) presented results for a general population in England aged ≥ 65 years who also showed gender differences, however, it is impossible to compare populations when the age categories differ so much.

Perhaps the continuity theory is relevant for our population, at least when considering their physical exercise habits and the EQ-5D-3L VAS scores. We might also link our results to the disability paradox, people reporting high quality of life despite disabilities, as analysed in a qualitative study by Albrecht and Devlieger (1999). They found that quality of life is dependent on establishing and maintaining a balance between body, mind, spirit of self and with the individual's social context and external environment. High quality of life could be due to secondary gains when individuals adapt to new conditions and reinterpret their lives. The model of selective optimization with compensation (Baltes and Baltes, 1990) might also be relevant when interpreting our results in terms of successful aging if related to high HRQoL.

Limitations

Limitations of this study include the small sample and the use of self-reported data. However, patient-reported outcome measures are useful in patient-centred health care to ensure that the individual's perspective is taken into account and we used the same method/protocol at every test occasion. We cannot generalize our results to other populations. This sample may not be representative of other individuals aged 93 years because the majority of our participants were cognitively relatively healthy and had few signs of depression. Four participants wanted to have a proxy as support during the interview at age 93, this was however not a limitation rather a strength that helped the participants to ensure

that their point of view was taken into count. The amount of participants for the regression analyses was in the lower limit and this has to be kept in mind.

However, the participants were followed over a period of 8 years and this seems to be unique. Another strength is that the scores were from a cohort of the same age, not diffused over a large age span. The use of the EQ-5D-3L questionnaire must be discussed as it is influenced by a range of psychological and cultural factors (Schneider et al., 2004), but also varies systematically with objective health measures (Leinonen et al., 2002). However, the EQ-5D-3L is considered to be a practical and easy to administer tool for assessing the elderly population (Holland et al., 2004), and valid in a general population (Johnson and Pickard, 2000).

Future research

Future studies might consider using the EQ-5D-3L together with a rating of perceived change in health (Jylhä, 2009). Also a qualitative approach to the study would have gained more insight into what people perceive as quality of life at the age of 85 and 93 years.

Conclusions

The main finding was that these oldest-old individuals maintained their HRQoL over an 8-year period despite decreased functional capacity, increased need of assistance, but continued habits of physical exercise. The GDS15 was the only significant variable explaining HRQoL at age 93 years, and MMSE and IADL predicted longevity and study participation at 93 years. In the oldest-old individuals, it is of great importance to pay attention to physical, physiological and cognitive functions as well as ADL. Occupational therapists can support the oldest-old to maintain daily life function and HRQoL with recommendation, information and/or prescription of assistive technology and by adapting

activities and the environment (for example home planning) in order to facilitate participation and independence in daily activities and social activities. There is a need for further research to explore oldest-old individuals' perspective of HRQoL; a qualitative or mixed method study might add new understanding and knowledge.

Key findings

- HRQoL can be maintained during aging despite decreased functional capacity and increased need of assistance in daily life.
- Good mental health is important for HRQoL of the oldest-old.

What the study has added

The study has given increased knowledge of how the HRQoL looks among the oldest-old and more insight into what happens over time for the oldest-old regarding HRQoL.

Research ethics

The Research Ethics Committee of Linköping University, Sweden, has approved the study (2006/141-06 and 2014/455-31).

Consent

Written informed consent was collected by all participants at each phase.

Declaration of conflicting interest

The authors declare that there is no conflict of interest.

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References

- Albrecht GL and Devlieger PJ (1999) The disability paradox: high quality of life against all odds. *Social Science and Medicine* 48(8): 977–988.
- Andrén E, Daving Y and Grimby G (1997) *Instrumental Activity Measure*. Göteborgs University.
- Baltes PB and Baltes MM (1990) Psychological perspectives on successful aging: the model of selective optimization with compensation. In: Baltes PB, Baltes MM (eds) *Successful Aging: Perspectives from the Behavioural Sciences*. Cambridge, UK: Cambridge University Press, pp. 1–34.
- Burström K, Sun S, Gerdtham U-G et al. (2014) Swedish experience-based value sets for EQ-5D-3L health states. *Quality of Life Research* 23(2): 431-42.
- Dahlin-Ivanoff S, Gosman-Hedström G, Edberg A-K, et al. (2010). Elderly persons in the risk zone. Design of a multidimensional, health-promoting, randomised three-armed controlled trial for "prefrail" people of 80+ years living at home. *BMC Geriatrics* 10(1): 27.

Dolan P (1997) Modeling valuations for EuroQol health states. *Medical Care* 35(11): 1095–1108.

Dutton DB and Levine S (1989) Socioeconomic status and health: overview, methodological critique, and reformulation. In: Bunker JP, Gomby DS and Kehrer BH (eds) *Pathways to Health: The Role of Social Factors*. 1st ed. Menlo Park, CA: Henry J Kaiser Family Foundation, pp. 29–69.

Enkvist A, Ekström H and Elmståhl S (2012) What factors affect life satisfaction (LS) among the oldest-old? *Archives of Gerontology and Geriatrics* 54(1): 140–145.

EuroQol Group (1990) EuroQol: a new facility for the measurement of health-related quality of life. *Health Policy* 16(3): 199–208.

Fagerström C and Borglin G (2010) Mobility, functional ability and health-related quality of life among people of 60 years and over. *Aging and Clinical Experimental Research* 22(5-6): 387–394.

Feng Y, Devlin N and Herdman M (2015) Assessing the health of the general population in England: how do the three- and five-level versions of EQ-5D-3L compare? *Health and Quality of Life Outcomes* 13(1): 171.

Field A (2013) *Discovering statistics using IBM SPSS statistics*. 4th ed. London: Sage Publication.

Folstein MF, Folstein SE and McHugh PR (1975) Mini-Mental State: a practical method for grading the cognitive state of patients for the clinician. *Journal of Psychiatric Research* 12(3): 189–198.

Folstein MF, Folstein SE, McHugh PR and Fanjiang G (2001) *Mini-Mental State Examination User's guide*. Odessa, FL: Psychological Assessment Resources.

- Gerber AM, Botes R, Mostert A, et al. (2016) A cohort study of elderly people in Bloemfontein, South Africa, to determine health-related quality of life and functional abilities. *South African Medical Journal* 106(3): 298–301.
- Hinz A, Kohlmann T, Stöbel-Richter Y, et al. (2014). The quality of life questionnaire EQ-5D-3L-5L: psychometric properties and normative values for the general German population. *Quality of Life Research* 23(2): 443–447.
- Holland R, Smith RD, Harvey I, et al. (2004) Assessing quality of life in the elderly: a direct comparison of the EQ-5D-3L and AQoL. *Health Economics* 13(8): 793–805.
- Daving Y, Andrén E, Grimby G. (2000) Inter-rater agreement using the Instrumental Activity Measure. *Scand J Occup Ther* 7(1): 33–8.
- Dong H-J, Wressle E, Marcusson J. (2015). Unaltered image of health maintenance: an observation of non-participants in a Swedish cohort study of 85 to 86 year olds. *Journal of Frailty & Aging* 4(2): 93–99.
- Johansson M, Marcusson J and Wressle E (2012) Cognition, daily living, and health-related quality of life in 85-year-olds in Sweden. *Aging, Neuropsychology and Cognition* 19(3): 421–432.
- Johnson JA and Pickard AS (2000) Comparison of the EQ-5D-3L and SF-12 health surveys in a general population survey in Alberta, Canada. *Medical Care* 38(1): 115–121.
- Jopp DS, Park MKS, Lehrfeld J, et al. (2016) Physical, cognitive, social and mental health in near-centenarians and centenarians living in New York City: findings from the Fordham Centenarian Study. *BMC Geriatrics* 16(1): 1.
- Jylhä M (2009) What is self-rated health and why does it predict mortality? Towards a unified conceptual model. *Social Science & Medicine* 69(3): 307–316.

- Kim D (2016) Correlation between physical function, cognitive function, and health-related quality of life in elderly persons. *Journal of Physical Therapy Science* 28(6): 1844–1848.
- Langlois F, Vu TT, Kergoat MJ, et al. (2012) The multiple dimensions of frailty: physical capacity, cognition, and quality of life. *International Psychogeriatric* 24(9): 1429–1436.
- Larsson K and Thorslund M (2006) Chapter 8: Old people's health." *Scandinavian Journal of Public Health Supplement* 67: 185–198.
- Leinonen R, Heikkinen E and Jylha M (2002) Changes in health, functional performance and activity predict changes in self-rated health: a 10-year follow-up study in older people. *Archives of Gerontology and Geriatric* 35(1): 79–92.
- Mitchell AJ (2013). The Mini-Mental State Examination (MMSE): An Update on Its Diagnostic Validity for Cognitive Disorders. In: Larner A (eds), *Cognitive Screening Instruments*. Springer, London. pp.15-46.
- Mitchell AJ, Bird V, Rizzo M and Meader N. (2010). Diagnostic validity and added value of the Geriatric Depression Scale for depression in primary care: a meta-analysis of GDS30 and GDS15. *Journal of Affective Disorders*, 125(1-3): 10-17.
- Nägga K, Dong HJ, Marcusson J, et al. (2012). Health-related factors associated with hospitalization for old people: comparisons of elderly aged 85 in a population cohort study. *Archives of Gerontology and Geriatrics* 54(2): 391–397.
- Schneider G, Driesch G, Kruse A, et al. (2004) What influences self-perception of health in the elderly? The role of objective health condition, subjective well-being and sense of coherence. *Archives of Gerontology and Geriatric* 39(3): 227–237.

- Sheikh JI and Yesavage JA (1986) Geriatric Depression Scale (GDS): recent evidence and development of a shorter version. In: Brink TL (ed) *Clinical Gerontology: A Guide to Assessment and Intervention*. New York: Howarth Press.
- Verbrugge LM, Brown DC and Zajacova A (2017) Disability rises gradually for a cohort of older Americans. *The Journals of Gerontology* 72(1): 151–161.
- Wancata J, Alexandrowicz R, Marquart B, et al. (2006) The criterion validity of the Geriatric Depression Scale: a systematic review. *Acta Psychiatrica Scandinavica* 114(6): 398–410.
- Wolfs, C.A.G., Dirksen, C.D., Kessels, A., Willems, D.C.M., Verhey, F.R.J., & Severens, J.L. (2007). Performance of the EQ-5D and the EQ-5D+C in elderly patients with cognitive impairments. *Health and Quality of Life Outcomes* 5(1): 33.
- World Health Organization (WHO) (2002) Active aging: a policy framework. Available at: <http://www.who.int> (accessed 17 November 2017).
- Ågren M (1999) ... en dag i taget. En rapport om livet vid 92 års ålder. Rapport no. 75. Jönköping: Institutionen för gerontologi (in Swedish). Available at: <https://www.diva-portal.org/smash/get/diva2:4485/FULLTEXT01.pdf> (accessed 20 February 2018).

Fig. 1 Flowchart of data collection from 85 years (T1) to 93 years (T4). Text in bold type shows the data collection points included in this study. Data from the postal questionnaire for those 380 participants was also included in the analyses.

Table 1 Characteristics of individuals at age 85 versus 93 years (n = 60)

	At age 85 years, n (%)	At age 93 years, n (%)	<i>p</i>
Housing,			<0.001
Ordinary housing	58 (97)	47 (78)	
Sheltered housing	2 (3)	13 (22)	
Community assistance			<0.001
Necessary, but not daily	17 (28)	16 (27)	
Necessary, daily ^a	2 (3)	21 (35)	
Transportation service	12 (20)	41 (68)	<0.001
Personal alarm	17 (28)	32 (53)	0.02
Mobility assistive technology			<0.001
Wheelchair	–	7 (12)	
Walker	12 (20)	36 (60)	
Cane	10 (17)	17 (28)	
Physical exercise habits			0.278 ^b
Walking daily (≥ 30 min)	7 (12)	6 (10)	
Walking several times/week	17 (29)	17 (28)	
Walking once a week	20 (34)	18 (30)	
Other regular exercise	9 (15)	7 (12)	
No exercise	6 (10)	12 (20)	
MMSE, mean (SD)	28.5 (1.6)	27.5 (2.3)	<0.001 ^a
Range	23–30	20–30	
GDS15, mean (SD)	1.7 (1.6)	2.7 (2.2)	0.000 ^b
Median	1.5	2	
Range	0–6	0–11	
PADL, mean (SD)	4.1 (0.5)	4.8 (1.9)	0.002
Range	4–7	4–12	
IAM, mean (SD)	28.9 (4.9)	21.4 (7.8)	0.000
Range	12–32	8–32	

^aIncluding individuals living in sheltered housing^bWilcoxon signed rank test

Table 2 Self-reported health-related quality of life, EQ-5D-3L, at age 85 versus 93 years (n = 58)

	At age 85 years, n (%)	At age 93 years, n (%)	<i>p</i>
EQ-5D items			
Mobility problems	19 (32)	35 (58)	<0.001 ^a
Need help with self-care	3 (5)	11 (18)	0.005 ^a
Need help with usual activities	9 (15)	34 (57)	<0.001 ^a
Reported pain/discomfort	46 (77)	37 (62)	0.117 ^a
Reported anxiety/depression	21 (35)	21 (35)	0.808 ^a
EQ-5D index value, mean (SD)	0.76 (0.18)	0.66 (0.31)	0.015 ^b
Range	0.02–1.00	– 0.36–1.00	
EQ-5D VAS, mean (SD)	72.2 (16.8)	68.9 (16.1)	0.139 ^b
Range	30–100	29–100	

^aWilcoxon signed rank test

^bPaired sample t-test

Table 3 Need of assistance with PADL and perceived difficulties in IADL at age 85 versus 93 years (n=60)

	At age 85 years, n (%)	At age 93 years, n (%)	<i>p</i>
<i>PADL items</i>			
Bath/take a shower	3 (5)	12 (20)	0.004
Dressing/undressing	1 (2)	10 (17)	0.004
Toileting	–	6 (10)	0.023
Eating	–	3 (5)	0.102
<i>IADL items</i>			
Locomotion outdoors	17 (28)	37 (62)	<0.001
Preparing a simple meal	3 (5)	19 (32)	<0.001
Cooking	11 (18)	33 (55)	<0.001
Using public transport	11 (18)	46 (77)	<0.001
Small-scale shopping	6 (10)	32 (53)	<0.001
Large-scale shopping	11 (18)	39 (65)	<0.001
Cleaning	20 (33)	46 (77)	<0.001
Washing	15 (25)	37 (62)	<0.001

Wilcoxon signed rank test

Table 4 Correlations between EQ-5D-3L VAS and IADL at age 85 versus at age 93, r , and level of significance

	EQ-5D VAS at age 85 years	EQ-5D VAS at age 93 years
Locomotion outdoors	0.463***	0.492***
Preparing a simple meal	0.347**	0.330*
Cooking	0.419**	0.368**
Using public transport	0.435**	0.276*
Small-scale shopping	0.454***	0.441**
Large-scale shopping	0.525***	0.382**
Cleaning	0.650***	0.335*
Washing	0.580***	0.252

Spearman's rank correlation test: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Table 5 Linear regression analysis at age 85 with dependent variable EQ-5D-3L (VAS)

Variables	β -coefficient	p	Adj R ²
	age 85	age 85	
Gender	- 0.100	0.317	
Education	0.163	0.096	
PADL	0.250	0.064	
IAM	0.660	0.000	
GDS-15	- 0.357	0.002	
MMSE	- 0.048	0.657	
Model summary			52 %

Table 6 Linear regression analysis at age 93 with dependent variable EQ-5D-3L (VAS)

Variables	β -coefficient	p	Adj R ²
	age 93	age 93	
Gender	0.051	0.717	
Education	0.175	0.214	
PADL	- 0.072	0.641	
IAM	0.202	0.229	
GDS-15	- 0.319	0.035	
MMSE	- 0.222	0.143	
Model summary			18%