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The rise in life expectancy – concomitant rise in subjective life expectancy? Changes over the period 1999-2016

Deeg, Dorly; van der Noordt, Maaike; Sant, Noëlle; Galenkamp, Henrike; Janssen, Fanny; Huisman, Martijn

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Document Version
Publisher's PDF, also known as Version of record

Publication date:
2019

Link to publication in University of Groningen/UMCG research database

Citation for published version (APA):
Deeg, D., van der Noordt, M., Sant, N., Galenkamp, H., Janssen, F., & Huisman, M. (2019). *The rise in life expectancy – concomitant rise in subjective life expectancy? Changes over the period 1999-2016*. Network for Studies on Pensions, Aging and Retirement (NETSPAR).

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The rise in life expectancy – corresponding rise in subjective life expectancy?

Changes over the period 1999–2016

Dorly Deeg, Maaike van der Noordt, Noëlle Sant, Henrike Galenkamp, Fanny Janssen and Martijn Huisman

DESIGN PAPER 122

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Abstract

The rise in life expectancy – corresponding rise in subjective life expectancy? Changes over the period 1999-2016

We test the hypothesis that subjective remaining life expectancy (SRLE) increased concomitantly with the rise in actuarial remaining life expectancy (ARLE) over the period 1999-2016. As earlier evidence shows the relevance of SRLE for the intention of older workers to continue working, we focus on people aged 64-67 years. We also examine the influence of personal characteristics on the trend in SRLE. We select data from six measurement waves (n=1,967 observations) of the Longitudinal Aging Study Amsterdam, which is representative for people aged 55 and over in the Netherlands. SRLE is derived from a 'lifeline' on which participants indicated where they stood in life at the moment of participation. We find no change over time in SRLE for men; for women, in contrast, we find a significant increase in SRLE, greater than the increase in ARLE. Among the personal characteristics, a poorer self-rated health (men), chronic diseases (women), and, unexpectedly, a higher level of education and better cognitive functioning (both genders) are associated with a shorter SRLE. For women, preference for a fixed retirement age of 65 or lower is associated with a longer SRLE. We discuss implications for the willingness of people aged 64-67 to extend working life.

Samenvatting

Gaat de stijging in levensverwachting samen met een stijging van de subjectieve levensverwachting? Veranderingen over de periode 1999-2016

Voor de periode 1999-2016 onderzoeken wij de hypothese dat subjectieve resterende levensverwachting (SRL) is toegenomen parallel aan de toename in de actuariële resterende levensverwachting (ARL). Omdat eerder onderzoek de relevantie laat zien van de SRL voor de intentie van oudere werkers om langer door te werken, richten wij ons op mensen in de leeftijdsgroep 64-67 jaar. Tevens onderzoeken wij de invloed van persoonlijke kenmerken op de trend in de SRL over de tijd. Wij gebruiken gegevens van zes meetronden (n=1,967 observaties) van de Longitudinal Aging Study Amsterdam, welk onderzoek representatief is voor inwoners van Nederland van 55 jaar en ouder. De SRL wordt afgeleid van een 'levenslijn' waarop deelnemers bij iedere meetronde hebben aangegeven op welk moment in hun leven zij zich bevonden ten tijde van het interview. Wij vinden voor mannen geen verandering in de SRL over de tijd; voor vrouwen vinden we daarentegen een significante toename in de SRL die groter is dan de toename in de ARL. Van de persoonlijke kenmerken blijken een slechte ervaren gezondheid (mannen), chronische ziekten (vrouwen) en, tegen de verwachting, een hoger opleidingsniveau en beter cognitief functioneren (zowel mannen als vrouwen) samen te hangen met een kortere SRL. Bij vrouwen hangt de voorkeur voor een vaste pensioenleeftijd van 65 jaar of lager samen met een langere SRL. Wij bespreken de implicaties voor de bereidheid van mensen van 64-67 jaar om langer door te werken.

Executive summary

Study aim
Older people's perceptions of their remaining lifespan, or 'subjective remaining life expectancy' (SRLE), are positively associated with a later intended age at retirement. There is little evidence on changes in SRLE in light of increases in actuarial remaining life expectancy (ARLE). We test the hypothesis that SRLE increased concomitantly with the rise in ARLE over the period 1999–2016. We do this for the age group of 64–67 years, because this is the age group that is affected by the rise in the statutory retirement age. First, in order to show the relevance of SRLE for the extension of working life, in a subsample of people doing paid work, we examine its prospective association with continuation of work. Subsequently, we examine whether people who were 64–67 years old in 2016 perceive their remaining life expectancy as longer than people aged 64–67 years in 1999. In addition, we assess the explanatory value of personal characteristics for the time trend in SRLE.

Summary of findings
We find no change over time in SRLE for men; for women, in contrast, we find a significant increase in SRLE, greater than the increase in ARLE. As to personal characteristics, a poorer self-rated health (men), chronic diseases (women), and, unexpectedly, a higher level of education and better cognitive functioning (both genders) are associated with a shorter SRLE. For women, preference for a fixed retirement age of 65 or lower is associated with a longer SRLE. These personal characteristics appear to suppress the time trend in SRLE for women. This means that if the number of people with chronic diseases had not increased and if the level of education and cognitive functioning had not improved, the rise in SRLE observed for women would have been steeper.

Implications
Our study showed that between 1999 and 2016, SRLE of men did not rise, which sharply contrasts with the rise by more than three years in their ARLE. As opposed to the stable trend for men, SRLE of women showed a substantial rise of four years, whereas their ARLE rose by only two years. We showed that a longer SRLE is associated with continuation of paid work, although this only applies for women. Conceivably, during the study period women were less restricted than men in their possibility to continue paid work or not, so that their subjective life expectancy could play a larger role in the decision to continue working. This needs further examination.

Meanwhile, the stability found for men should be taken as a warning sign. When men aged 64–67 years are required to continue to work longer, they may view this requirement as unfair, as they may perceive life in retirement as shortened. Such views may impair their willingness to continue working. This may have two possible consequences. First, if men decide to stop working before the statutory retirement age, they will contribute less to taxes, and will also have less money to spend after retirement. Second, if men do continue working, they may experience less well-being and motivation, and they may be more likely to drop out due to sick leave. Both situations may lead to lower productivity.

SRLE is only one of the factors that are associated with the decision to continue working. Nonetheless, it is worth investigating how this factor could be adjusted towards more realistic perceptions. Pension funds may be likely agents in educating people about their remaining life expectancy. However, messages that mainly involve numbers are difficult to get across and, thus, unlikely to lead to different perceptions. Moreover, individuals are more likely to base their perceptions on deaths among their family members and friends than on population-based statistics. The early death of a loved one will have an impact on one's personal sense of finitude, and this will not be easily counteracted by population-based statistics. Therefore, it would be worthwhile for pension funds to 'personalize' messages about remaining life expectancy by providing information that is based on level of education or gender of the target group.

1. Introduction

In most developed countries, the life expectancy of the overall population has been rising. In the Netherlands, an acceleration in this rise was observed from 2002 onwards (Mackenbach et al. 2011). This rise is increasingly due to a mortality decline at older ages (Statistics Netherlands 2017). Objectively, older people thus have the prospect of increasingly longer lives, with concomitant entitlements to state and work-derived pensions. In order to contain pension costs, many Western countries have designed policy measures to increase the statutory pension age beyond age 65, parallel with the rise in actuarial remaining life expectancy (ARLE, OECD 2015). Such measures are likely to work best if older people personally expect to live longer than previous generations. Prospective studies have shown that older people's perceptions of their remaining length of life – their subjective remaining life expectancy (SRLE) – are positively associated with a later intended ages of retirement (Hurd et al. 2004, Van Solinge & Henkens 2010). Thus, if people expect to live longer, they are likely to be more highly motivated to continue working and thus show better compliance with a higher statutory retirement age.

There is little evidence on how SRLE changes when ARLE increases (Perozek 2008). If older people keep track of actuarial estimates and projections, they may perceive that they have more years ahead of them than previous generations. This perception may in turn affect their expected retirement age. The 'fairness principle' implies that older workers would consider it fair to have as many years of 'post-retirement freedom' as the generations that preceded them (Fontijn & Deeg 2016). Thus, if the current generation of older workers expects to live longer than the generation that reached the statutory retirement age a decade ago, the current generation may count on retiring at a higher age. Vice versa, if the current generation does not take into account the rise of ARLE, it may prepare to retire at the same age as the previous generation.

Older people's SRLE is likely based on their personal experience rather than on actuarial estimates. On the one hand, older people may consider the age that their parents reached and project their own life expectancy correspondingly (Hurd & McGarry 2002, Zick et al. 2014). Thus, the current older generation may experience that the generation of their parents lived longer than expected. This may feed the expectation that it has more years ahead of them than their parents' generation had at the same age. This, in turn, may cause them to feel that they will reach the phase of life that is qualified as 'old' at a higher chronological age than their parents' generation, and may lead them to expect a higher retirement age. On the other hand, older people live longer with chronic diseases due to improvements in medical treatment (Deeg

et al. 2013). Thus, older people nowadays have more age peers with chronic diseases. Past experience may have taught them that someone with a chronic disease does not live very long, and this may temper their own expectation of a longer life (Zick et al. 2014). In turn, they may not be inclined to retire at a higher age than previous generations.

Earlier studies have shown that individual health status and other personal characteristics are important determinants of SRLE (Benitez-Silva & Ni 2008, Hurd & McGarry 1995, Mirowski & Ross 2000, Palgi et al. 2018, Zick et al. 2014). These characteristics may change across subsequent generations. One important characteristic is level of education, which has been rising steadily and which is associated with both a longer ARLE and a longer SRLE (Joung et al. 2000, Majer et al. 2011, Mirowski & Ross 2000). Furthermore, motivational factors such as self-confidence have been shown to be higher in recent generations and may be expected to be accompanied by a longer SRLE (Deeg & Huisman 2010, Mirowski & Ross 2000). In contrast, the prevalence of chronic diseases has been rising, although self-rated health has remained stable (Galenkamp et al. 2013). Finally, a new characteristic may be relevant in light of the pension debate: one's personal norm about the age up to which workforce participation is viewed as normal. This age norm has been rising (Kappelle & Deeg 2010), which may be associated with a higher SRLE (Teppa et al. 2015).

The current study provides evidence on changes in SRLE from a nationwide representative study in the Netherlands, across a period of accelerated rise in ARLE. Same-age cohorts are compared from 1999 to 2016. First, in order to show the relevance of SRLE for the extension of working life, in a subsample of people doing paid work, we examine its prospective association with continuation of work. Next, we examine whether people aged 64-67 years in 2016 perceived their remaining life expectancy as longer than people aged 64-67 years in 1999. A third question that we address is the explanatory value of health and other personal characteristics for the time trend in SRLE.

2. Methods

Sample

The data used come from the Longitudinal Aging Study Amsterdam (LASA), an ongoing longitudinal study with baseline measurement wave in 1992–93 and three-year follow-up waves (Huisman et al. 2011, Hoogendijk et al. 2016). LASA is based on a national representative cohort; the sample was recruited from the municipal registries of 11 municipalities in three geographic regions that together represent the socio-cultural variety in the Netherlands: the regions around Amsterdam (West), Zwolle (North-East), and Oss (South). The initial ages of sampled persons were 55–85 years. Men and older-old were oversampled. The baseline sample size was 3,107. In 2002 and 2012, new samples aged 55–64 years were recruited from the same sampling frames as in 1992, with sample sizes of 1,002 and 1,023, respectively. At subsequent follow-up measurements, these cohorts were merged with the earlier cohorts.

The dependent variable for this study, subjective life expectancy, was introduced into the LASA interview at the third wave in 1999, so that six waves between 1999 and 2016 are available. At each of these waves, subsamples aged 64–67 years were selected. These are the ages common to all six waves, and relevant in the context of retirement timing. Because the interval between waves was three years, participants aged 64 could be included in two subsequent waves. Therefore, some overlap in participants exists across waves. Pooled across all waves, 1,967 observations were available from 1,741 participants. The dependent variable was not available for n=214 (10.9%) of all observations. Furthermore, scores that were deemed invalid (see under Measures) were excluded, reducing the number of observations by a further 47 (2.4%). Compared to the remaining sample, the 261 excluded observations pertained more often to females (17.1 vs 8.9% males) and to participants with lower education (9.4 versus 10.5 years) and a lower score on the MMSE (27.0 versus 28.1), more chronic diseases (2.1 versus 1.7), a higher score on the disability scale (2.1 versus 1.2), more depressive symptoms (10.0 versus 6.9), and poorer self-rated health (2.5 versus 2.3). There were no differences regarding age and work participation. The final analytic sample included 845 observations from 754 male participants and 861 observations from 778 female participants.

Measures

Actuarial remaining life expectancy

For each wave, the number of actuarially expected remaining years of life (ARLE) was assigned to each participant, based on the remaining life expectancy at the age of

interview from period life tables for the Dutch male and female population in the same year (Statline.cbs.nl).

Dependent variable

Subjective remaining life expectancy (SRLE) was measured by a 'lifeline' (Thijssen et al. 2014). This line, 25 cm in length, was presented to the participant on a piece of paper, with at the far left the word 'beginning' and at the far right the word 'end'. Participants were asked to indicate with a cross at which point on this line they felt they stood at this moment in life. After completion of the interviews, a research assistant measured the place of the crosses on the lifelines and assigned a corresponding number between 0 (beginning of the line) and 1 (end of the line). Following Thijssen et al. (2014), values below 0.39 were not deemed valid for persons in the age group studied, and thus observations lower than 0.39 were excluded.

SRLE was calculated in two steps (Thijssen et al. 2014). First, the participant's age was divided by the value measured on the lifeline. This yielded the total life span as perceived by each participant. Subsequently, the participant's age was subtracted from the total perceived life span, yielding each participant's SRLE. Due to the exclusion of lifeline values lower than 0.39, the maximum SRLE was 103 years.

Independent variables

Health

Health was measured involving self-rated health, chronic diseases, disability, and cognitive impairment.

Self-rated health was measured using one question, with codes from (1) very good, to (5) poor (Van Sonsbeek 1991).

Seven major *chronic disease* categories were assessed in the interview: respiratory diseases, cardiac diseases, peripheral artery disease, stroke, diabetes, arthritis and cancer. In a validation study, respondents' self-reports of these diseases were compared to information obtained from their general practitioners, and proved to be reliable across the study period (Galenkamp et al. 2014). The number of chronic diseases reported by each participant was included in the analyses.

Disability was self-reported for six activities: climbing up and down a staircase, walking outside for 5 minutes, dressing and undressing, cutting own toenails, getting up from and sitting down in a chair, and using own or public transportation. Response categories were (0) yes, without difficulty, (1) yes, with difficulty, (2) not able without help, and (3) cannot (Van Sonsbeek, 1988; Kriegsman et al. 1997). The summed score ranged from 0 to 18.

Cognitive impairment was ascertained using the Dutch translation of the MiniMental State Exam (MMSE, Folstein et al. 1975, Launer et al. 1993). On 23 questions and tasks, respondents received one or more points when giving the correct answer or performing the task correctly. Scores ranged from 0 (all answers incorrect) to 30 (unimpaired).

Other personal characteristics

Other personal characteristics included demographics, depressive symptoms, sense of mastery, doing paid work, and age-norm about retirement.

Information on *age* and *sex* was derived from population registries.

Education was assessed in the interview, defined as the highest educational level attained. For the analyses, education was expressed in number of years.

Depressive symptoms were ascertained using the Dutch translation of the 20-item Center for Epidemiologic Studies Depression scale (CES-D, Radloff 1977; Beekman et al. 1994). Respondents were asked to indicate how often during the past week they had experienced each symptom, with response categories (0) (almost) never to (3) (almost) always. The score range is 0 (no symptoms) to 60 (maximum number of symptoms).

Sense of mastery, defined as the feeling that one has control over one's life and experiences rather than these being ruled by chance or others, was assessed using a five-item version of the Mastery scale (Pearlin & Schooler, 1978). The scale ranged from 5 to 25.

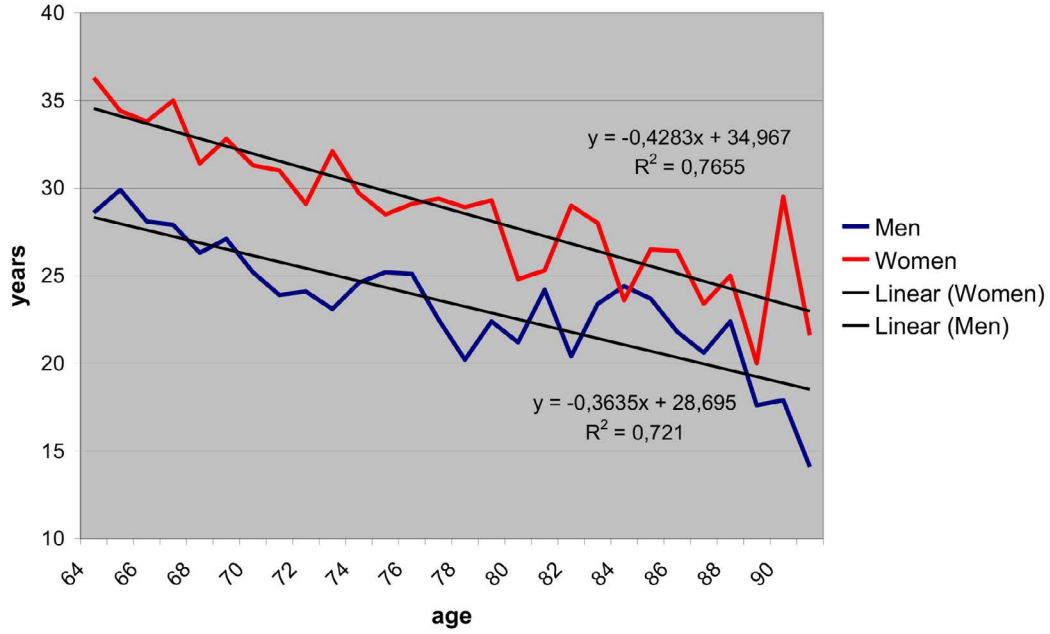
Age-norm, about the maximum age up to which workforce participation is viewed as normal, was defined as a response to the question: Do you think that people should not do paid work after a certain age? The initial response categories were 'no fixed age', and 'fixed age'. The latter response was followed by the question: After what age? (Kappelle & Deeg 2010). The responses to both questions were combined into categories: 'no fixed age', 'fixed age at 65 or lower', and 'fixed age higher than 65'.

Statistical analysis

Descriptive statistics for SRLE included the averages for men and women aged 64-67 and the bivariate correlations of SRLE with age and ARLE. The latter were calculated across all ages that were common to all waves in the dataset, i.e., 64-91 years, because the age range of 64-67 years has insufficient variation in age and ARLE.

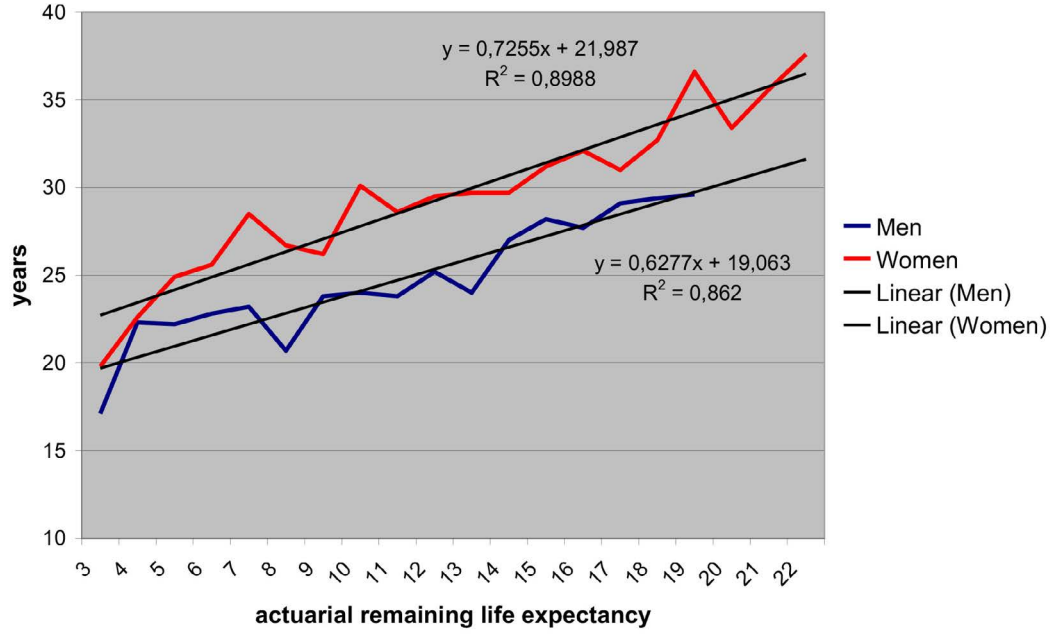
We addressed our first research question, the predictive value of SRLE for continuation of work, in a subsample of men and women aged 60-74 who do paid work (men: n=378, women: n=226); the wider age range was chosen in order to have a

Figure 1a. The association between subjective remaining life expectancy (SRLE) and age, based on generalized estimating equations on the sample pooled across six waves. Longitudinal Aging Study Amsterdam, 1999-2016.



Men: blue line; women: red line. The black lines are linear trend lines

Figure 1b. The association between subjective remaining life expectancy and remaining actuarial life expectancy, based on generalized estimating equations on the sample pooled across six waves. Longitudinal Aging Study Amsterdam, 1999-2016.



Men: blue line; women: red line. The black lines are linear trend lines

larger sample at our disposal. For our second research question, we tested sex-specific trends in SRLE using Generalized Estimating Equations adjusted for age, with time as the main determinant (basic model; Twisk 2003). Because there is some overlap in participants across subsequent waves, we accounted for the interdependence of the data by including a 2-dependent correlation matrix. Third, we examined the bivariate associations of personal characteristics with SRLE in the sample pooled across waves, by calculating the marginal means of SRLE for categorized personal characteristics (for categories, see Table 2). Fourth, in order to examine the explanatory value of personal characteristics for the time trend in SRLE, the sex-specific models were expanded with these variables. We then applied stepwise backward selection, omitting one by one the covariate with the highest p-value, until all covariates had p-values < 0.10.

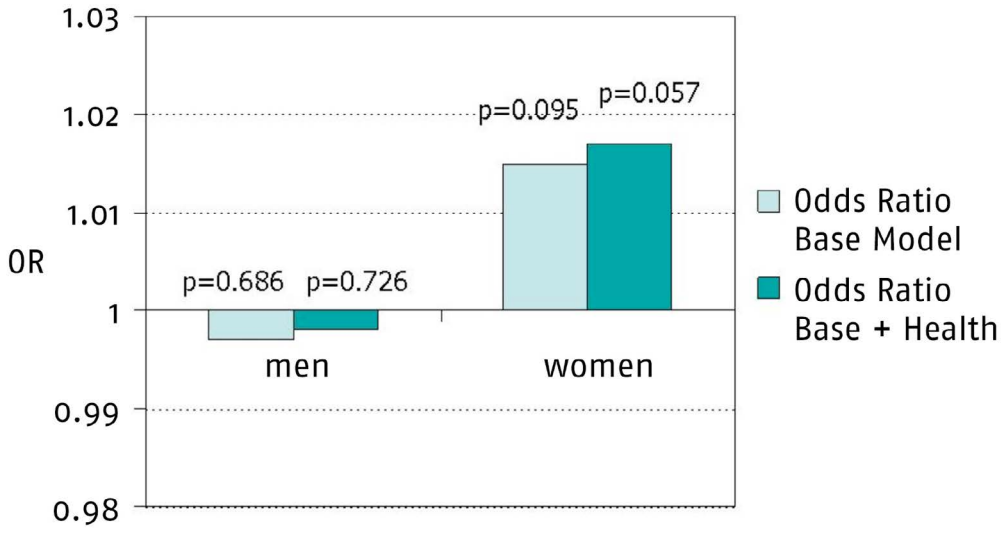
3. Results

Descriptive characteristics of subjective life expectancy

The mean SRLE was 28.6 (standard deviation [sd]: 15.1) for 64-67-year-old male participants and 34.6 (sd: 18.3) for 64-67-year-old female participants. Women thus feel that they have a comparatively longer life expectancy, but at the same time there is more variation among women than men.

The correlations of SRLE with age and ARLE are examined for all available ages from 64 to 91 years. In this wider age group, there was a significant correlation of SRLE with age: -0.16 and -0.17 for men and women, respectively, indicating that older participants perceived their life expectancy as shorter. The association of SRLE and age was approximately linear for both men and women (Figure 1a). In this wider age group there was also a significant correlation of SRLE with ARLE: 0.16 and 0.17 for men and women, respectively. These correlations indicate that, at a longer ARLE, the participants also perceived their life expectancy as longer. The association of SRLE and ARLE was approximately linear for both genders (Figure 1b). Note that the size of the correlations of SRLE with age and ARLE is only small to moderate.

Figure 2. The association between subjective remaining life expectancy (SRLE) and continuation of work after three years, for participants with paid work at baseline aged 60-74 years (men: n=378, women: n=226), based on generalized estimating equations on the sample pooled across five waves. Longitudinal Aging Study Amsterdam, 1999-2016.



Subjective life expectancy and continuation of paid work

Continuation of paid work is examined in the age group 60-74. Across the six waves, in this age group 378 men and 226 women were active on the labor market and had information on labor market status at follow-up. As Figure 2 shows, an earlier SRLE was marginally predictive of continuation of paid work only for women (p=0.057), but not for men (p=0.726).

Table 1. Actuarial remaining life expectancy (ARLE) at age 65 and subjective remaining life expectancy (SRLE) at age 64-67 years, by sex, for the period 1999-2016 (source: Longitudinal Aging Study Amsterdam)

	1999	2002	2006	2009	2012	2016	Test for trend (p-value)
Men (n)	*141*	*129*	*164*	*130*	*128*	*149*	
ARLE	15.1	15.6	16.7	17.4	17.8	18.3	<0.001
SRLE*	28.4	31.1	27.0	28.8	29.7	28.2	0.846
Women (n)	*147*	*121*	*162*	*136*	*141*	*145*	
ARLE	19.1	19.2	20.1	20.7	20.8	21.0	<0.001
SRLE*	32.3	34.6	32.9	36.0	35.7	36.3	0.041

* Estimated marginal means, for age 66. Trend over time is tested using generalized estimating equations for participants aged 64-67.

Trend over time in remaining actuarial life expectancy and subjective life expectancy

ARLE at ages 64-67 rose steadily from 1999 to 2016 (p<0.001). This rise was quite substantial in men, from 15.1 to 18.3 years, and a bit less substantial in women, from 19.1 to 21.0 years (Table 1).

Meanwhile, SRLE for men aged 64-67 showed a stable trend during the study period, i.e., when tested as a linear trend, no consistently rising or falling trend could be observed (regression coefficient: -0.019, p=0.846). For women, in contrast, there was a positive trend (regression coefficient: 0.236, p=0.041). Thus, our hypothesis of a rising trend is confirmed only for women.

Bivariate association of subjective life expectancy and personal characteristics

Table 2 presents the means of SRLE for categorized personal characteristics. Education showed a strong association, with higher levels of education linked to lower SRLE. Likewise, higher cognitive scores were strongly associated with a lower SRLE. The finding that people with a higher education and better cognitive function appeared to perceive a shorter life expectancy than their lower educated and poorer cognitively functioning age peers is contrary to what would be expected, as there is ample

Table 2. Subjective remaining life expectancy[1] by personal characteristics, for 64-67-year-old men and women pooled across the period 1999-2016 (Longitudinal Aging Study Amsterdam)

	Men		Women	
	N	Mean SRLE	N	Mean SRLE
Education				
- Low (elementary or less)	138	34.3	202	39.6
- Middle (secondary schooling)	444	29.0	515	34.2
- High (college or university)	258	25.3**	135	28.5**
Paid job				
- Yes	184	27.5	124	33.3
- No	656	29.1	728	34.8
Self-rated health				
- Good or very good	622	28.3	591	34.5
- Fair to poor	218	27.3	251	34.8
No. of chronic diseases				
- None	194	30.4	119	36.4
- One	252	27.4	262	35.0
- Two	219	28.7	245	33.4
- Three or more	175	29.9	226	34.4
Functional limitations				
- (Almost) none (scores 0-2)	740	28.8	692	34.7
- Mild (scores 3-7)	79	28.0	122	34.0
- Severe (scores >=8)	21	31.5	38	32.8
Cognitive functioning				
- Good (scores >= 26)	704	28.0	728	33.6
- Mild impairment (scores 21-25)	132	32.1	122	40.5
- Severe impairment (scores < 21)	4	39.9*	2	39.1*
Depressive symptomsa				
- No relevant symptoms (scores <16)	772	28.7	735	34.6
- Relevant symptoms (scores >=16)	68	29.0	117	34.4
Sense of mastery				
- Lowest tertile (scores <17)	188	28.5	249	34.6
- Middle tertile (scores 17-19)	275	27.7	260	33.5
- Highest tertile (scores >=20)	377	29.7	343	35.3
Fixed retirement age[a]				
- No fixed age	497	27.8	534	33.5
- Fixed age 65 or lower	84	30.9	55	44.6
- Fixed age 66 or higher	31	26.1	21	35.4*

1 Marginal means from generalized estimating equations adjusted for age and time, estimated at age 66.0 years and time 8.2 years

* p< 0.05

a Not available for 2002

evidence that these same people enjoy a longer ARLE. We will come back to this issue in the Discussion section.

Most other characteristics did not show any association with SRLE. The only exception is that, for women but not for men, agreeing with a fixed retirement age of 65 or lower was significantly associated with a higher SRLE.

Table 3. Multivariate model of subjective life expectancy[1] regressed on personal characteristics, for 64-67-year-old men and women, during the period 1999-2016 (Longitudinal Aging Study Amsterdam)

	Men		Women	
	B	CI	B	CI
Time in years	0.06	-0.14 – 0.25	0.51	0.25 – 0.77**
Education	-0.82	-1.13 – -0.50**	-0.92	-1.37 – -0.48**
Self-rated health	-2.24	-3.46 – -1.02**	-	-
No. of chronic diseases	-	-	-1.14	-2.25 – -0.03*
Cognitive functioning	-0.69	-1.44 – 0.07+	-1.29	-2.18 – -0.40*
Fixed retirement age[a]				
- No fixed age	-	-	Ref.	Ref.
- Age 65 or lower			8.43	1.54 – 15.32*
- Age 66 or higher			0.53	-6.38 – 7.46

1 Regression coefficients from generalized estimating equations

+ p< 0.10; * p< 0.05; ** p< 0.001

a Not available for 2002

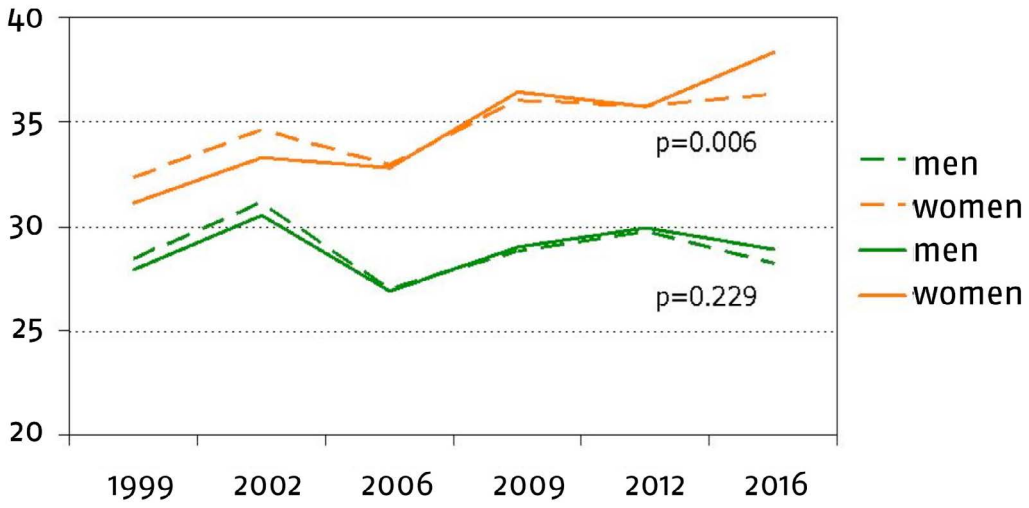
Subjective life expectancy and personal characteristics over time

In sex-specific multivariate models of SRLE with time as the main independent variable, all independent variables were included as continuous variables. In order to achieve a parsimonious model, only variables that showed a p-value <0.20 were retained (Table 3). Thus, for men, years of education, self-rated health, and cognitive functioning were retained. For women, years of education, number of chronic diseases, cognitive functioning, and preference for a fixed retirement age were retained.

Among the personal characteristics, higher levels of education and higher cognitive scores again had the strongest association with higher SRLE scores for both men and women. Other covariates showed differential associations between the genders. In men, poorer self-rated health was significantly associated with a lower SRLE. In women, a greater number of chronic diseases was associated with lower SRLE scores; agreeing with a fixed retirement age of 65 years or lower was also associated with a higher SRLE.

Figure 3 shows the SRLE trends for men and women based on marginal means, unadjusted and adjusted for personal characteristics. Time, the main independent variable, remained non-significant in men (regression coefficient: 0.058, p=0.557), but showed a strong association in women (regression coefficient: 0.507, p<0.001). The coefficient for women indicates that when personal characteristics are accounted for, women's SRLE increased by half a year for each calendar year.

Figure 3. Trend in subjective remaining life expectancy (SRLE) from 1999 to 2016 for men and women aged 64-67: marginal estimates in years based on generalized estimating equations. The intermitted lines are adjusted for age; the solid lines are adjusted for all significant personal characteristics. Longitudinal Aging Study Amsterdam.



4. Discussion

This study focused on changes over a period of 17 years in subjective remaining life expectancy (SRLE). In view of the steady rise of the actuarial remaining life expectancy (ARLE), we expected that people of the same age would perceive their life expectancy to be longer at the end than at the start of the study period. This expectation was confirmed for women; their SRLE rose even faster than their ARLE. However, we found no evidence of a longer SRLE for men. It must be concluded that men's perception of their remaining life expectancy is stable, despite the substantial rise in their ARLE during the study period. This finding for men does correspond with evidence from a study by Elder (2013) based on the U.S. Health and Retirement Study. Elder found no change in subjective survival forecasts from 1992 to 2006. In particular, people younger than 65 were pessimistic about their survival prospects, and this pessimism was observed to increase over time. Elder attributed this finding to 'a great deal of random error' (Elder 2013, p. 586) in the subjective forecasts. However, the author provided no substantive explanations.

Our null-finding in men also corresponds with an experimental study by Teppa and colleagues (2015), in which participants were asked about their expected survival probabilities before and after the research staff provided them with information about their cohort survival. The authors found that participants did not update their earlier expectations of survival after receiving the objective information. On the contrary, in the majority of cases they became more pessimistic. In our study, the information about the rise in ARLE was not provided personally but was assumed to be widely known. Indeed, news items on the continued rise in life expectancy appear in the media on a very regular basis in the Netherlands (e.g., Statistics Netherlands, 19 March 2018, 3 November 2017).

Teppa and colleagues (2015) suggest two possible mechanisms that would explain their finding. First, giving people information in terms of probabilities and percentages may cause confusion and result in lower accuracy. The authors support this explanation with evidence on low 'numeracy' by using three questions that test the study participants on their understanding of ratios, percentages, and probabilities. Only one-third of all study participants answered all three questions correctly. Thus, no matter how frequently the media report on rising life expectancy, their messages may not be understood correctly by a substantial number of citizens. A second explanation is that information about death primes a generally pessimistic psychological state, which is mirrored in the perception of one's own life expectancy. In our study, the word used at the right end of the 'lifeline' was 'end'. This word might have had

a similar connotation as 'death'. Robert Kastenbaum, a gerontologist who pioneered in the psychology of death, showed that most people are unwilling to contemplate their own death (Kastenbaum 2000). Burke and colleagues (2010) use the notion of 'terror management' to indicate that people, when confronted with the need to think of their own death, call up strategies that distance them from death. In relation to our measurement approach in which we use a lifeline, such distancing would make it unlikely that study participants place a cross very near the word 'end'.

The first of these mechanisms may explain the stability of the trend in SRLE that we found, as it posits that people are generally unresponsive to numeric information – also to numeric information that holds increasingly positive prospects about the duration of life. Likewise, the second mechanism may be at work regardless of available external information. Participants are deterred from placing a cross too close to the word 'end' on the lifeline. This mechanism may also explain why participants' SRLE appeared to be 10 to 15 years higher than the ARLE, while several (but not all) studies of SRLE show an underestimation of ARLE (Dormont et al 2014, Bago d'Uva et al 2017, Kutlu-Koc and Kalwij 2017).

The role of personal characteristics in SRLE

Turning to the correlates of SRLE, the negative associations of level of education and cognitive functioning with SRLE stand out. The notion of terror management may be helpful to explain these findings. People with poor cognitive functioning may distance themselves farther away from death on the lifeline than people with better cognitive abilities. Given that people are aware of their cognitive decline, the end of life may be more salient to them, especially in this day and age with frequent media attention to dementia. When confronted with the lifeline, their defense mechanism may lead them to place the cross at a greater distance from the word 'end'.

Regarding our finding of a shorter SRLE perceived by the higher educated, the first mechanism proposed by Teppa and colleagues does not seem helpful in explaining this. As we can assume that the higher educated are better at understanding numeric information than the lower educated, the former would be expected to pick up positive information on the expected duration of life and accordingly, perceive an increasingly longer life ahead of them in the course of the study period. In fact, we observed the opposite. Possibly, the second mechanism proposed by Teppa and colleagues applies: it is conceivable that the lower educated have stronger defenses against the idea of their own death because such defenses bring them more psychological benefit (Mirowski and Ross 2000; Burke et al. 2010).

There may, however, be other mechanisms that explain our finding. Older people with a higher education are likely to have had more success in life in terms of personal and societal achievements than lower educated people. This may have contributed to the feeling that they have achieved things that will outlive them, which makes their own death of less importance (Major et al. 2016). By consequence, terror management may not play as large a role for the highly educated. In contrast, for the lower educated the phenomenon of 'defensive positive illusion' may play a role (Mirowski and Ross 2000). Unrealistic positive expectations may help people to cope with their lives when they experience hardship such as poor health. An exaggerated youthful bias could be interpreted as a manifestation of an 'ageless self', a term coined by Kaufman (1987). Perceiving an ageless self serves to enhance the continuity and coherence of the self-image, which is negatively affected by the physical changes associated with age. It would be worth examining whether an ageless self is experienced more often by older persons with a lower education than by more highly educated older persons.

Physical health indicators showed no bivariate associations with SRLE, but in the multivariate model, self-rated health showed an association with SRLE for men and chronic diseases did the same for women. These findings are in line with earlier studies that focused in particular on self-rated health (Mirowski and Ross 2000; van Solinge and Henkens 2009).

Another personal characteristic that we examined was the preference for a fixed retirement age. We hypothesized that a higher age-norm would be associated with a longer SRLE. However, our findings show that women who favor a retirement age of 65 years or lower have a higher SRLE than those who favor 66 or higher or those who disagree with a fixed retirement age. This association persisted in the multivariate model. For men, a similar tendency was seen, but this did not reach significance. Meanwhile, the percentage of people who support a fixed age norm was as low as 12%, so that only few study participants stated a specific age. It is not entirely clear how this finding should be interpreted. Tentatively, people who favor a fixed retirement age of 65 or lower expect to spend many years on other things than paid work.

The role of personal characteristics in SRLE trends

Our study furthermore assessed how personal characteristics affected the trend in SRLE. Health status affected the trend in SRLE for women. In particular, the number of chronic diseases functioned as a suppressor of the trend for women. This means that if the number of chronic diseases had not increased during 1999-2016, the rise in SRLE would have been steeper for women.

For the factors level of education and cognitive functioning, there is ample evidence that these improved over time (e.g., Deeg et al. 2018). For women, we found a steeper increase in the SRLE after adjusting for these factors in the multivariate model. Thus, also education and cognition showed a suppressor effect, meaning that if level of education and cognitive functioning had remained the same over time, the rise in SRLE would have been steeper.

Summarizing, even after accounting for personal characteristics, we found no rise in SRLE for men, but a substantial rise for women. It is possible that the explanations forwarded for stability in SRLE over time apply to men but not to women. The studies cited that tested underlying mechanisms did not show separate findings for men and women or did not find gender differences. Our findings suggest that a distinction by gender is needed in future research into underlying mechanisms.

Comments on methodology

A strength of our study is the long study period of 17 years, and the availability of six measurement waves. Still, the SRLE showed rather substantial fluctuations (Figure 3). Possibly, within the narrow age range selected, the relatively low number per wave led to random fluctuations.

Some discussion should be devoted to the measure of SRLE used in our study, as it has rarely been used before (Thijssen et al. 2014). Our measure of SRLE appeared to correspond to chronological age and ARLE, although the correlations were only small to moderate. On the 'lifeline' from which our measure of SRLE was derived, study participants may have been equally likely to indicate their position based on their perceived distance to their life's beginning (i.e., subjective age) and on their perceived distance to their life's end (i.e. subjective remaining life expectancy). A specific position on the lifeline may thus also be interpreted as subjective age. The substantial increase in SRLE for women may then also be interpreted as evidence of an increasingly younger subjective age. A decrease in subjective age may be caused by quite different factors than an increase in SRLE. For example, for women, body image plays a larger role in their subjective age than for men (Harris 1994). Women aged 64–67 in 2016 may perceive their age as younger than women aged 64–67 in 1999 due to the recent advancements in cosmetic surgery that enables the maintenance of a young appearance (Gunn et al. 2009).

Another limitation of our SRLE measure is that the discrepancy between SRLE and ARLE is larger than in earlier studies, amounting to an overestimation by 10 years for men and by 15 years for women. While some studies also reported an overestimation (Mirowski 1999), other studies reported an underestimation. The overestimation

became larger with increasing age, and the underestimation became smaller with increasing age, in some cases turning into an overestimation (Elder 2013, Dormont et al. 2014). An explanation for this phenomenon is that people may become more optimistic as they have survived to an older age (Mirowski 1999). In our study as well, the discrepancy increases with age towards a greater overestimation (Figure 1b). Thus, although our operational definition is very different from the definitions applied in earlier studies, the change of the discrepancy between SRLE and ARLE with age is similar.

Regarding the ecological value of our measure, it should be noted that the highest SRLE in our study was 103 years, amounting to a total life span of 170 years. Such a life span is rather unrealistic when we compare it to the life span of the oldest person in the world, Jeanne Calment, who lived to the age of 122. However, current demographic projections assert that in the 21st century an average life expectancy of 100 will be realized, and that a much longer life span may be attainable for some individuals (De Beer et al. 2017). In view of the high media interest of such projections, it may well be that some of our respondents applied such optimistic expectations to their own life span.

Yet another limitation is the fact that valid scores on the lifeline were not available for 13.3% of the observations. We found this item-non-response more often for women and for participants with lower education and poorer scores on all health indicators. Thus, our findings pertain to a relatively healthy selection of 64-67-year-olds. It must be noted that in earlier studies, which used other operational definitions of SRLE than ours, the item-non-response was at least of the same order of magnitude. In the landmark study by Mirowski (1999) the item-non-response was over 20%. The non-responders were characterized by higher age (i.e., over 45), lower education, and lower sense of mastery. In a study by Dormont and colleagues (2014), the item-non-response was 15%, with lower education and poorer health as explanatory factors.

In view of these limitations, we note that our study focuses on trends. Thus, any bias in the measurement instrument cannot explain our findings, as long as this bias is the same across time points. There are several arguments for this being the case in our study. First, the data collection methods are exactly the same across all time points from 1998-1999 through 2015-2016. This applies to the way of approaching the respondents and the place of the lifeline in the interview. Also, regarding the recruitment of additional samples (in 2002 and 2012), the sampling frame and the response rates were the same (Hoogendijk et al. 2016). Second, the response at follow-up waves is very high, varying between 93% and 96% (of the surviving sample).

Third, the percentage of missing values on the lifeline shows non-significant variation across time points (on average 10.9%, with a minimum and maximum of 9,4% and 14.0%, respectively; p=0.446).

In all, despite the rather high levels of our measure of SRLE, our main findings concern trends in SRLE, and we are confident that any possible bias has not affected our main findings.

Implications

Our study shows that SRLE did not rise in line with ARLE for men, but it does show a strong rise for women. In other words, men aged 64-67 years do not feel that they have a higher life expectancy in 2016 than they did in 1999, but women aged 64-67 do. We showed that a longer SRLE is associated with continuation of paid work, albeit in women only. Conceivably, during the study period, women were less restricted than men in their possibility to continue paid work or not. As such, their SRLE could play a larger role in the decision to continue working. This needs further examination.

Meanwhile, the lack of an association found for men should be taken as a warning sign. When men in the age group of 64-67 years are required to continue to work longer, they may view this requirement as unfair, as they perceive life in retirement as being shortened. Such a view may negatively impact their willingness to continue working. This may have two possible consequences. First, if men decide to stop working before the statutory retirement age, they will have contributed less to taxes, and will also have less money to spend after retirement. Second, if men do continue working, they may experience less well-being and motivation to work, and they may be more likely to drop out due to sick leave. Neither of these is conducive to productivity.

SRLE is only one of the factors that play a role in a person's decision to continue working. However, it makes sense to consider how this factor could be changed towards more realistic perceptions. Can we educate people about their life expectancy? Teppa and colleagues (2015) conclude from their study that this is unlikely. One reason is that numeric information is difficult to get across. Another reason is that individuals are more likely to base their life expectancy perceptions on deaths among their family members and friends than on population-based statistics. The early death of a love one will have an impact on one's sense of finitude, which will not be easily counteracted by population-based statistics. Therefore, it would be worthwhile to 'personalize' messages about remaining life expectancy by providing the information in the context of the personal experiences of the target group. This could be done, for example, by placing the survival of one's parents or one's own

cohort in a context: "Compared with other women (or men) born at the same time, your mother (or father, grandmother, grandfather) lived x years longer (or shorter) than the average." This has been attempted by Teppa et al. (2015), but it did not result in improvements in SRLE. However, it might be that personalizing messages on the basis of level of education or gender has more impact on perceptions of one's own longevity.

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Network for Studies on Pensions, Aging and Retirement

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Netspar
Phone +31 13 466 2109
E-mail info@netspar.nl
www.netspar.nl

May 2019