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Employability after age 65?

Trends over 23 years in life expectancy in good and in poor physical and cognitive health of 65-74-year-olds in the Netherlands

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Abstract

In light of population aging and the need to contain pension costs, many Western countries are increasing the statutory pension age in parallel with the rise in life expectancy (LE) from age 65. An as yet unanswered question is whether LE from age 65 in good health increases at the same rate as overall LE. The current study provides evidence on 23-year trends in physically and cognitively (un)healthy LE for ages that are relevant for future rises in the statutory pension age, i.e. 65-74 years, for the Netherlands. More precisely, because it is restricted to this age interval, this study concerns the partial LE between ages 65 and 74.

Data were obtained from eight waves of the Longitudinal Aging Study Amsterdam (LASA), a representative study for the Netherlands, from 1993 to 2016.

Partial LE between ages 65 and 74 rose from 8.7 to 9.3 years for men and from 9.3 to 9.5 years for women. Partial LE with mild physical health problems increased for men from 3.3 to 5.4 years and for women from 4.0 to 5.5 years. Partial LE with severe physical health problems remained stable for men at 0.6 years and for women at 1.3 years. Meanwhile, partial LE with good cognitive health rose for men from 7.3 to 8.4 years and for women from 7.8 to 8.7 years. The latter rise appeared to be largely attributable to the rise in educational level.

A decrease in physically healthy years is accompanied by an increase in cognitively healthy years. Implications for the feasibility of extending working lives are discussed in this paper.

Samenvatting

In verband met de veroudering van de bevolking en de noodzaak om de pensioenkosten te beperken, laten veel westerse landen de officiële pensioenleeftijd even snel stijgen als de levensverwachting (LVW) vanaf de leeftijd van 65 jaar. Een onbeantwoorde vraag is of de LVW vanaf 65 jaar in goede gezondheid even snel stijgt als de totale LVW. Dit rapport laat Nederlandse trends in lichamelijk en cognitief (on)gezonde LVW zien over een periode van 23 jaar, voor een leeftijdsgroep die relevant is voor de toekomstige stijging van de officiële pensioenleeftijd, d.w.z. 65-74 jaar. Preciezer gezegd, door de beperking tot dit leeftijdsinterval betreft dit onderzoek de partiële LVW tussen de leeftijden 65 en 74 jaar.

De gebruikte gegevens zijn ontleend aan acht meetcycli van de nationaal representatieve Longitudinal Aging Study Amsterdam (LASA), van 1993 tot 2016.

De partiële LVW tussen de leeftijden 65 en 74 steeg voor mannen van 8,7 naar 9,3 jaar en voor vrouwen van 9,3 naar 9,5 jaar. De partiële LVW met lichte lichamelijke gezondheidsproblemen nam toe: voor mannen van 3,3 naar 5,4 jaar en voor vrouwen van 4,0 naar 5,5 jaar. De partiële LVW met ernstige lichamelijke gezondheidsproblemen bleef stabiel, voor mannen op 0,6 jaar en voor vrouwen op 1,3 jaar. Intussen steeg de partiële LVW in goede cognitieve gezondheid voor mannen van 7,3 naar 8,4 jaar en voor vrouwen van 7,8 naar 8,7 jaar. Deze toename was voor het merendeel toe te schrijven aan de toename in het opleidingsniveau.

Een afname in lichamelijk gezonde levensjaren gaat dus vergezeld van een toename in cognitieve gezonde levensjaren. Omdat kan worden verwacht dat zowel werknemers in goede als in slechte gezondheid langer zullen doorwerken wanneer de AOW-leeftijd verder stijgt, zullen aanpassingen op de werkvloer nodig zijn om werknemers met lichamelijke gezondheidsproblemen in staat te stellen door te werken. Ook zullen grotere flexibiliteit van pensioenregelingen en gradueel deeltijdpensioen in beschouwing moeten worden genomen.

Executive summary with focus on implications

Study aims

It is Dutch government policy to raise the statutory retirement age parallel with the rise in life expectancy (LE) from age 65 onwards as from 2021. It remains a fact that at population level, health decreases with each increasing year of age. An unanswered question is whether LE from age 65 in good health increases at the same rate as total LE. The current study provides evidence on trends over the 23-year period from 1993 to 2016 in physically and cognitively healthy LE for ages relevant for future rises in the statutory pension age, i.e. from 65 to 74 years. More precisely, because it is confined to this age interval, this study concerns the partial LE between ages 65 and 74.

We use the Longitudinal Aging Study Amsterdam, a representative study for the Netherlands, which provides measures of physical and cognitive health. A study of both physically and cognitively healthy LE provides the necessary combination of insights to assess the full potential of extending working lives.

Summary of findings

Between 1993 and 2016, partial LE from age 65 to age 74 rose from 8.7 to 9.3 years for men and from 9.3 to 9.5 years for women.

For partial *LE in physical health*, not an improvement but a non-negligible deterioration was found. Specifically, partial LE in good physical health decreased substantially for men from 4.8 to 3.3 years and for women from 4.0 to 2.7 years. In contrast, partial LE with mild physical health problems increased for men from 3.3 to 5.4 years and for women from 4.0 to 5.5 years. Partial LE with severe physical health problems remained stable for men at 0.6 years and for women at 1.3 years.

Depending on the specific health measure, study design, time period and country, earlier studies showed a slightly more favourable trend, with increases in LE with mild health problems that are offset by decreases in LE in poor health. Some studies showed an increase in LE in good physical health, but this never exceeded the increase in total LE. Most previous studies on LE in good physical health were based on disability only. In our study, 'good physical health' is defined as the presence of at most one chronic disease and absence of disability. We included diseases in our definition, because having two or more chronic diseases ('multimorbidity') is a complex condition with serious consequences for functioning, well-being, and sickness absence. Thus, multimorbidity is expected to better reflect the issues that older workers are confronted with. The decrease in LE in good physical health that was found in our study is partly driven by the increase in the prevalence of multimorbidity. Such increase, which has been shown by several studies in various countries, is attributable to the improvements in diagnosis and treatment of several major chronic conditions, such as heart disease, diabetes, and cancer, enabling people to live longer with their diseases, even though they cannot be cured. Living longer with chronic diseases leads, in turn, to limitations in functioning, such as difficulty in performing daily activities.

For partial *LE in cognitive health*, a clear improvement was observed: for men from 7.3 to 8.4 years and for women from 7.8 to 8.7 years. This amounts to a 15% increase for men and 12% for women. These increases exceed those in partial LE, but, because of limitations in the data used, the increases in LE in cognitive health may be smaller. However, sensitivity analyses showed that the conclusion that the trend is positive is warranted.

Policy relevance

Increasing the statutory retirement age will mean that a growing number of older workers will have developed chronic conditions and/or mild disability before they have reached the statutory retirement age. If their effective retirement age is lower than the statutory retirement age, this has consequences for their contribution to their work-related pension. Moreover, if they leave the workforce through a disability pension, this will increase rather than decrease the public costs. On the other hand, if workers continue working until the statutory retirement age despite compromised health, their post-retirement health status may be impacted negatively. As a worse post-retirement health status is likely to imply fewer consumptive expenses and higher health care costs, this may nullify the decrease in pension costs.

The implications of the findings from this study for the employability of older workers are threefold. First, to the extent that the labor market will be less oriented towards physical and more towards cognitive skills, the opposing developments in physically and cognitively healthy life expectancy may not greatly affect the employability of persons beyond age 65. However, age-related decline in cognitive ability does still occur and may increase work stress.

- This points to the need to adjust tasks by lowering the cognitive demands, for example by eliminating distractions from the work environment, or allowing more time for rest to cater to an increased need for recovery.
- Alternatively, cognitive training may improve the performance of older workers on the job.

Second, a certain measure of physical health is required for work, even if the work requires predominantly cognitive skills. Furthermore, part of the labor market continues to involve jobs that require physical skills.

- Adaptations may be needed for older workers with physical health problems to enable them to continue working in these jobs.
- Depending on the specific impairment of a worker, adjustments may pertain to tasks, tools, furniture, or the number of working hours per week.

Third, stricter pension schemes clearly affect workers' decisions to extend their workforce participation, both in good and poor health. However, regardless of the prevailing schemes, workers in poor health leave the workforce earlier than workers in good health. Because 'one size does not fit all', the concept of a fixed retirement age may need to be reconsidered. In this context, it must be noted that the number of hours worked weekly in the age group 55–65 is rather low.

- Greater flexibility in pension schemes, including a gradual reduction of working hours, needs to be considered.

1. Introduction

In view of the aging of the population and in order to contain pension costs, many Western countries have designed policy measures to increase the statutory pension age beyond age 65 and thus extend the working lives of older workers. Several countries, including the Netherlands, have adopted a policy to increase the statutory pension age parallel with the increase in life expectancy. Accumulated evidence from developed countries on trends in healthy and unhealthy life years from the age of 65 suggests, however, that the rise in life expectancy beyond age 65 is not accompanied by a similar rise in the number of years in good health (EHLEIS 2015). In particular, years with chronic diseases and mild physical disability have been shown to increase, while years with severe physical disability remain more or less constant (for a summary of evidence, see Jagger et al. 2016). If these trends continue in the coming years, this will mean that a growing number of older workers will have developed chronic conditions and/or mild disability before they have reached the statutory retirement age, and that their employability will be at stake. If their effective retirement age is lower than the statutory retirement age, this has consequences for their contribution to work-related pensions. On the other hand, if they continue working up to the statutory retirement age despite compromised health, their post-retirement health status may be impacted negatively. As a worse post-retirement health status is likely to imply fewer consumptive expenses and higher health care costs, this may nullify the decrease in pension costs.

In view of the shift in the labor market towards fewer jobs requiring physical skills and more jobs requiring cognitive skills (den Butter & Mihaylov 2013, Romeu Gordo & Skirbekk 2013), not only physical but also cognitive health is increasing in importance. Cognitive aging may manifest itself at older working ages, in particular in cognitive functions such as information processing speed and 'multitasking'. Notably, studies on specific cognitive functions show improved functioning in subsequent cohorts (Brailean et al. 2016, Gerstorf et al. 2015, Dodge et al. 2016), although these findings are not uncontested (Hülür et al. 2013). Recent studies on trends in cognitive impairment or dementia show consistent decreases in prevalence and incidence (Matthews et al. 2013, Karlsson et al. 2015, Langa et al. 2016, Satizabal et al. 2016, Wu et al. 2015). Regarding life years spent in good or poor cognitive health, there is less evidence than for physical health, but several recent studies have provided evidence pointing to an increase in years in good cognitive health that comes close to or even exceeds the increase in life expectancy from age 65 (Crimmins et al. 2016, Jagger et al. 2016). This evidence suggests a delay the onset of years spent in poor cognitive health. Thus, it seems that the prospects for life years beyond age 65 in good cognitive health are more favorable than for those in good physical health.

Evidence on trends in cognitively healthy life years is only sparse and recent, whereas evidence on trends in physically healthy life years has built up over several decades (Robine & Michel 2004). The latter body of research has taught us to be cautious about generalizing across periods and geographic regions (Deeg 2004). In terms of life expectancy in good physical health, recent trends in the Netherlands are very close to those for the fifteen western EU countries combined (EHLEIS 2015). So far, no evidence exists on trends in life expectancy in good cognitive health for the Netherlands.

The current study contributes evidence from a nationwide representative study in the Netherlands across the relatively long period of 1993–2016. Specifically, this study examines trends over 23 years in partial life expectancy (LE) from age 65 to age 74, as this is the relevant age group for future rises in the statutory retirement age. More precisely, because of the confinement to this age interval, this study pertains to the partial LE between ages 65 and 74. Partial LE in good and poor physical health and partial LE in good and poor cognitive health are considered. Joint studies of years in physically and cognitively healthy life years are rare, but they nonetheless provide the necessary combination of insights to assess the full potential to extend working lives (Jagger et al. 2016, Stafford et al. 2016).

During the period covered by this study, various measures were taken to extend working lives beyond the retirement age of 60 years, which prevailed in the 1990s. Most conspicuously, in 2006 the early retirement schemes were abolished, after which the actual retirement age quickly rose to over 64 years. In addition, from 2012 the statutory retirement age started to rise gradually, so that it will be 67 years in 2021. In 2016, the last year of the period under examination here, the statutory retirement age was 65.5 years. In view of the recent rise in actual retirement age after the early retirement schemes were abolished, it can be expected that the rise in statutory retirement age will lead to a further rise in the actual retirement age. However, it is not clear whether a similar rise can be expected for workers in poor health. In order to clarify the link between healthy life expectancy and employability, health differences in workforce participation by age are examined for two years: before the abolishment of early retirement schemes and after the onset of the rise in statutory retirement age.

2. Methods

Sample

Data were used from the Longitudinal Aging Study Amsterdam (LASA), which is representative for the Netherlands. The first cohort of this study included 3,107 participants aged 55-85 years, who had been recruited in 1992-1993, the second cohort included 1,002 participants aged 55-64 years who were recruited in 2002-2003, and the third cohort included 1,023 participants aged 55-64 years who were recruited in 2012-2013. The samples for these cohorts were derived from the population registers of eleven municipalities in three culturally distinct geographic areas in the Netherlands (west, north-east and south). The samples were weighted so that together they represented the distribution of population density in the Netherlands. Participants are followed with three-yearly waves of face-to-face interviews and tests. From the 1995-96 wave onwards, participants who refuse a face-to-face interview are offered a 15-minute telephone interview, in which either the participant or a proxy can respond. Details on the sampling and data collection methods have been published elsewhere (Huisman et al. 2011, Hoogendijk et al. 2016).

For the current study, subsamples aged 65-74 years were selected from participants at measurement waves between 1993 and 2016[1]. The number of participants in each wave varied from 966 to 664 for physical health and from 936 to 618 for cognitive health.

Measures

Physical health

Physical health was defined considering both multimorbidity and disability. First, multimorbidity is defined as the presence of at least two chronic diseases in one person. It is a complex condition that may have serious consequences for personal functioning and well-being (Marengoni et al. 2011). Second, disability has been repeatedly found to be associated with early exit from the labor market (Van Rijn et al. 2014). Although subjective measures such as self-rated health have been shown to be more closely linked to retirement decisions than disease status (Nilsson et al. 2016), multimorbidity has the advantage of being more objective and at the same time highly predictive of self-rated health (Galenkamp et al. 2013a). Thus, multimorbidity and disability may be considered to reflect the health states that are relevant to older

1 For brevity purposes, measurement waves are indicated by the second year, as two-thirds of participants were interviewed in this year.

workers. Moreover, both aspects are predictive of the health care costs incurred at ages over 65 years (Pot et al. 2009, Wouterse et al. 2013).

Multimorbidity was measured by self-reports of the following major chronic diseases: lung diseases (including COPD, emphysema, bronchitis, and asthma), coronary heart diseases, peripheral arterial disease, stroke, diabetes, cancer, and arthritis (including osteoarthritis and rheumatoid arthritis). In addition, participants could indicate if they had other chronic diseases, with a maximum of two. The comparability of these self-reports with general practitioner records was satisfactory and remained the same across the period 1993-2009 (Galenkamp et al. 2014).

Disability was measured by self-reports of the degree of difficulty or need of help with the following six activities: climbing stairs, dressing, getting up from a chair, cutting one's toenails, walking 400 meters, and using own or public transportation. Mild disability was defined as difficulty with at least one activity, and severe disability as needing help with at least one activity (Galenkamp et al. 2013b).

Chronic diseases and disability were inquired about in both the face-to-face and telephone interviews. From these measures, three physical health states are calculated:

1. Good physical health: no multimorbidity or (mild) disability;
2. Mild physical health problems: multimorbidity and/or disability, but not both multimorbidity and severe disability;
3. Poor physical health: both multimorbidity and severe disability.

Cognitive health

Cognitive functioning consists of a range of components, many of which have been shown to be associated with the ability to work (Ihle et al. 2015). A widely used test that combines several cognitive functions is the MiniMental State Examination (MMSE), which was therefore selected for inclusion in this study. The cognitive functions addressed are memory, attention, orientation, and language and praxis (Jones & Gallo 2000).

The MMSE includes 23 items, with a maximum score of 30 when all responses are correct (Folstein et al. 1995). Good cognitive health is defined as a score of 26 or higher (following Jagger, et al. 2016). The MMSE was included in the face-to-face interview only. Two cognitive health states are distinguished:

1. Good cognitive health: score of 26 or higher on the MMSE;
2. Poor cognitive health: score of 25 or lower on the MMSE.

Covariates
Age (based on date of birth) and gender were obtained from the municipal registers. Level of education was defined as the highest educational level achieved, and coded in nine categories. These categories were expressed in years of schooling as follows: elementary school not completed (5 years), elementary education (6 years), lower vocational education (9 years), general intermediate education (10 years), intermediate vocational education (11 years), general secondary education (12 years), higher vocational education (15 years), college education (16 years), and university education (18 years).

Data analysis
Life expectancies in good and poor health were calculated using the life table method of Sullivan, based on age and gender (Mathers & Robine 1997). Period life tables provide survival probabilities for the population from a certain age onwards, in this study age 65. Note that the capping of the pertinent age group at age 75 implies that partial life expectancies are calculated, which have a logical maximum of 10 years. At the age of 65, the survival probability is set to 1. At age 66, the probability to survive is 1 minus the proportion of deaths at age 65; at age 67 the probability to survive is the survival probability at age 66 minus the proportion of deaths at age 66, and so on. If a person dies at a certain age, such person is assumed to have lived half a year, for which reason the survival probabilities for two subsequent ages are averaged (Van der Meulen and Janssen 2007). The resulting probabilities for ages up to 74 add up to the partial life expectancy from age 65 to age 74. For each age year from 65 onwards the survival probability is then multiplied by the prevalence of good or poor health in that particular age year. These age-specific probabilities are summed to the partial life expectancy in good or poor health.

Statistics Netherlands publishes national life tables based on single years of age for each calendar year. We used those for 1993, 1996, 1999, 2002, 2006, 2009, 2012, and 2016. The prevalences of good and poor health were derived from the corresponding LASA waves. As health problems are still relatively scarce up to age 75, we refrained from using age-specific prevalence rates that were directly derived from the data, because these would yield results that are too unstable. Instead, we fitted a polynomial of the association of health with age and derived age-specific prevalence rates from this.

A statistical test for trends in life expectancy (in good health) is not available, but trends in the prevalence of good and poor health can be tested using Generalized Estimating Equations (GEE) adjusted for age and gender, with calendar year as the main determinant (Twisk 2003). Here, calendar year is counted from 0 for 1993 to 23 for 2016. GEE takes account of the interdependence of the data in subsequent waves, which is needed because there is an overlap in participants across the waves.

A series of sensitivity analyses was performed. First, as the MMSE is known for its educational bias (Kittner et al. 1986), the trend in good and poor cognitive health was examined in a second GEE model that adjusted for educational level at each wave. Second, because a substantial number of participants was tested more than once, a trend in cognitive health may be the manifestation of a practice effect (Dodge et al. 2016). Therefore, GEE analyses were repeated, accounting for the number of times tested. Third, as attrition in longitudinal studies has been shown to be linked to poor cognitive functioning (Chatfield et al. 2005), it is possible that our data provide an underestimation of poor cognitive health. However, as this study examines trends over time, and not levels of cognitive health at a specific point in time, attrition will not affect the trend if it is similar over time. Therefore, using GEE, the stability of the trend in two types of attrition was examined based on the associations of the MMSE at time t with 1) non-participation for reasons other than mortality at time t+1, and 2) participation but non-response on the MMSE at time t+1. Subsequently, in the model that tests the effect of year on cognitive health, both types of attrition were included to determine to what extent they affected the effect of year.

In order to clarify the link between life expectancy in good health and employability, health differences in workforce participation by age are examined for the years 2002 and 2016. Using univariate analysis of variance, health differences in participation are tested for each year. Differences in the age-decline in participation are tested by considering the interaction term of health and age.

3. Results

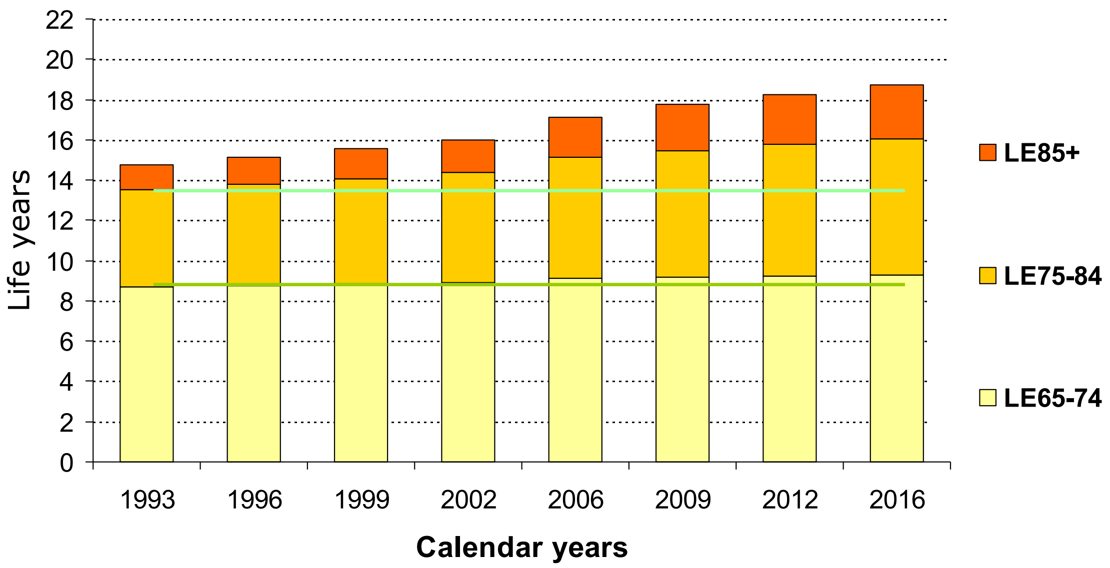
Partial life expectancy

During the period 1993-2016, partial life expectancy between ages 65 and 74 rose from 8.7 to 9.3 years for men from the 1995-96 cycle onwards and from 9.3 to 9.5 years for women (Table 1). To put these changes in perspective, Figures 1a and 1b show the changes in total life expectancy for men and women, respectively. Total life expectancy at age 65 rose from 15.0 to 18.8 years in men and from 19.5 to 21.4 years in women. It should be noted that the contribution of the 64-74-partial life expectancy to the rise in total life expectancy at age 65 is very small. In men, the greatest contribution is from the partial life expectancy between ages 75 and 84, and in women it is from the partial life expectancy at age 85.

Physical health

Taking all LASA measurement waves between 1993 and 2016 into account, we first tested trends in the prevalence of good and poor health using GEE models adjusted for age. The prevalence of good physical health showed decreases both in men, with an Odds Ratio for year (OR(year)) of 0.965 and a Confidence Interval (CI) of 0.954-0.976 ($p<0.001$), and in women with OR(year) of 0.971 and CI of 0.960-0.982 ($p<0.001$).

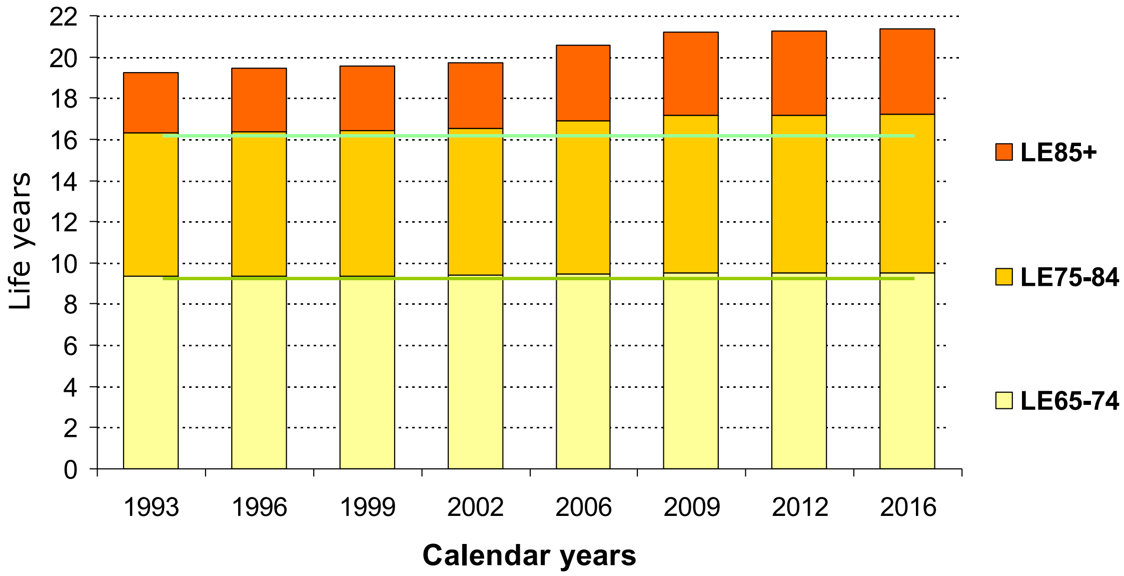
Figure 1a. Life expectancy from age 65: contribution of partial life expectancies over time, for men.*



The green lines allow better visibility of the change over time.

* LE65-74: partial life expectancy between 65-74 years;
LE75-84: partial life expectancy between 75-84 years;
LE85+: life expectancy from 85 years

Figure 1b. Life expectancy from age 65: contribution of partial life expectancies over time, for women.*



The green lines allow better visibility of the change over time.

* LE65-74: partial life expectancy between 65-74 years
LE75-84: partial life expectancy between 75-84 years
LE85+: life expectancy from 85 years

An OR of 0.965 means that, for each year between 1993 and 2016, the prevalence of good health declines by (1-0.965)*100=3.5%. For example, when the prevalence of good health is 50% in 1993, it is estimated to have declined to (50-0.035*50)=48.2% by 1994. The prevalence of poor physical health showed no change in both men (OR(year)=0.997, CI: 0.978-1.017, p=0.793) and women (OR(year)=0.999, CI: 0.984-1.013, p=0.848). Adding years of education to the GEE models had a lowering effect on the OR for the trend in good health: in men the OR was 16.3% lower and in women it was even 31.0% lower. This implies that the level of education appeared to be a suppressor of the downward trend in good health, meaning that the trend in good health would have decreased more steeply if the level of education had not increased over time. Years of education did not have any effect on the trend in poor health in either .

Now turning to partial healthy life expectancy (Table 1 and Figures 2a and 2b), the number of physically healthy life years in men decreased from 4.8 years to 3.3 years, with no decrease occurring in the 2000s, but a further decrease in the 2010s. In women, partial life expectancy in good physical health decreased as well, from 4.0 to 2.7 years. This decrease showed the same non-linear pattern over time as for men. Partial life expectancy in poor physical health in men fluctuated around 0.6 years, with no sign of increase or decrease over time. Also in women, partial life expectancy in poor health stayed practically stable, but at 1.3 years.

Table 1. Partial life expectancy and partial life expectancy in good and poor physical health between the ages of 65 and 74, by gender, for the period 1993–2016
(source: Longitudinal Aging Study Amsterdam)

	1993	1996	1999	2002	2006	2009	2012	2016	Difference 2016–1993
Men									
Partial life expectancy	8.7	8.8	8.8	8.9	9.1	9.2	9.2	9.3	0.6
Partial life expectancy in good physical health *	4.8	4.1	3.8	3.8	4.0	4.0	3.0	3.3	−1.5
Proportion of partial life expectancy in good physical health	55.4%	41.7%	43.5%	42.4%	44.2%	43.8%	32.1%	35.3%	−20.1%
Partial life expectancy in poor physical health**	0.6	0.7	0.7	0.9	0.7	0.9	0.5	0.6	0.0
Proportion of partial life expectancy in poor physical health	7.4%	8.2%	7.4%	10.0%	7.4%	10.0%	5.9%	6.6%	−0.8%
Women									
Partial life expectancy	9.3	9.3	9.4	9.4	9.5	9.5	9.5	9.5	0.2
Partial life expectancy in good physical health *	4.0	3.6	3.3	3.0	3.2	3.2	2.2	2.7	−1.3
Proportion of partial life expectancy in good physical health	42.6%	38.9%	35.3%	32.1%	33.6%	33.1%	23.2%	28.5%	−14.1%
Partial life expectancy in poor physical health **	1.3	1.4	1.1	1.3	1.3	1.1	1.4	1.3	0.0
Proportion of partial life expectancy in poor physical health	14.2%	15.2%	12.2%	13.4%	13.8%	11.8%	14.3%	13.6%	−0.6%

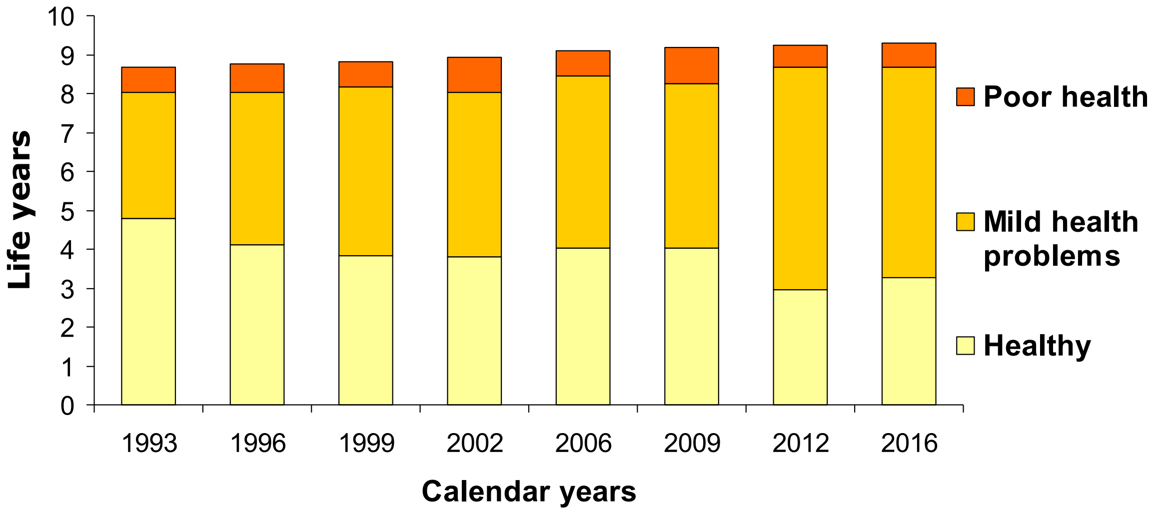
* = The expected number of years without multimorbidity and without (mild) disability
** = The expected number of years with multimorbidity and with severe disability

As total partial life expectancy increased during the study period, the proportion of remaining life without and with health problems was calculated in addition to the absolute number of years (Table 1). The proportional decrease of years in good physical health was seen to continue throughout the study period, with for both men and women a flattening during the 2000s and a further decrease in the 2010s. The proportion in years in poor health showed more fluctuation, with in men a general rise up to 2009 and a decrease after that, and in women general stability throughout the study period.

Cognitive health

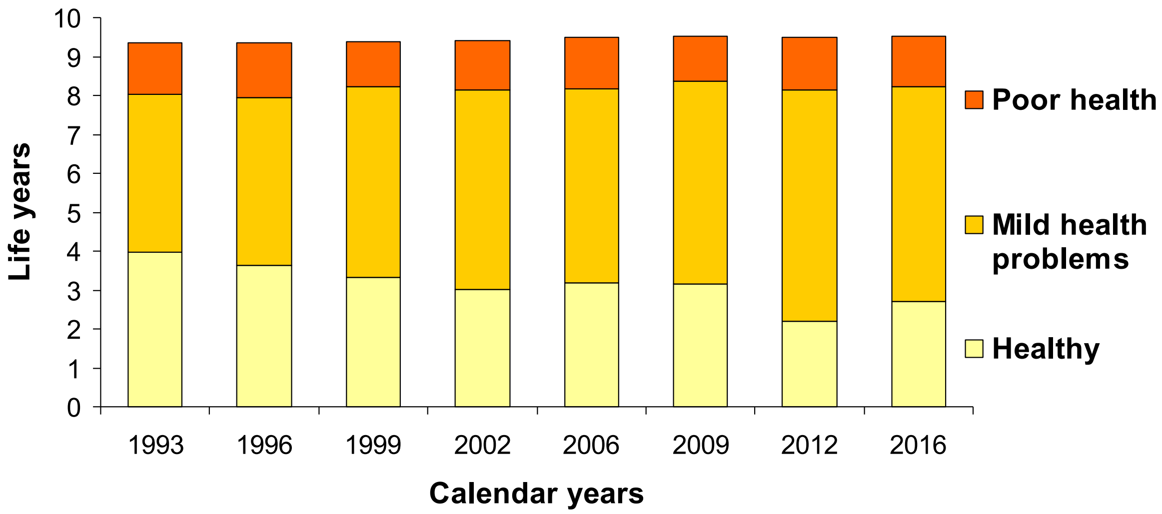
Taking all measurement waves between 1993 and 2016 into account, GEE models adjusted for age showed decreases in the prevalence of poor cognitive health in both

Figure 2a. Partial life expectancy between ages 65 and 74: physically healthy, mildly unhealthy, and severely unhealthy years, for men*



* Healthy = no multimorbidity + no mild disability
Mild physical health problems = multimorbidity and/or disability
Poor physical health = multimorbidity + severe disability

Figure 2b. Partial life expectancy between ages 65 and 74: physically healthy, mildly unhealthy, and severely unhealthy years, for women*



* Healthy = no multimorbidity + no mild disability
Mild physical health problems = multimorbidity and/or disability
Poor physical health = multimorbidity + severe disability

Table 2. Partial life expectancy and partial life expectancy in good cognitive health between the age of 65 and 74 years, by gender, for the period 1993–2016 (source: Longitudinal Aging Study Amsterdam)

	1993	1996	1999	2002	2006	2009	2012	2016	Difference 2016–1993
Men									
Partial life expectancy	8.7	8.8	8.8	8.9	9.1	9.2	9.2	9.3	0.6
Partial life expectancy in good cognitive health*	7.3	7.7	8.0	8.0	8.1	8.4	8.5	8.4	1.1
Proportion of partial life expectancy in good cognitive health	84.6%	87.8%	90.4%	89.1%	88.7%	91.2%	92.2%	89.9%	5.3%
Women									
Partial life expectancy	9.3	9.3	9.4	9.4	9.5	9.5	9.5	9.5	0.2
Partial life expectancy in good cognitive health*	7.8	8.0	8.2	8.3	8.4	8.9	8.7	8.7	0.9
Proportion of partial life expectancy in good cognitive health	83.3%	85.3%	87.4%	88.8%	88.1%	93.3%	91.4%	91.9%	8.6%

* = The expected number of years in good cognitive health

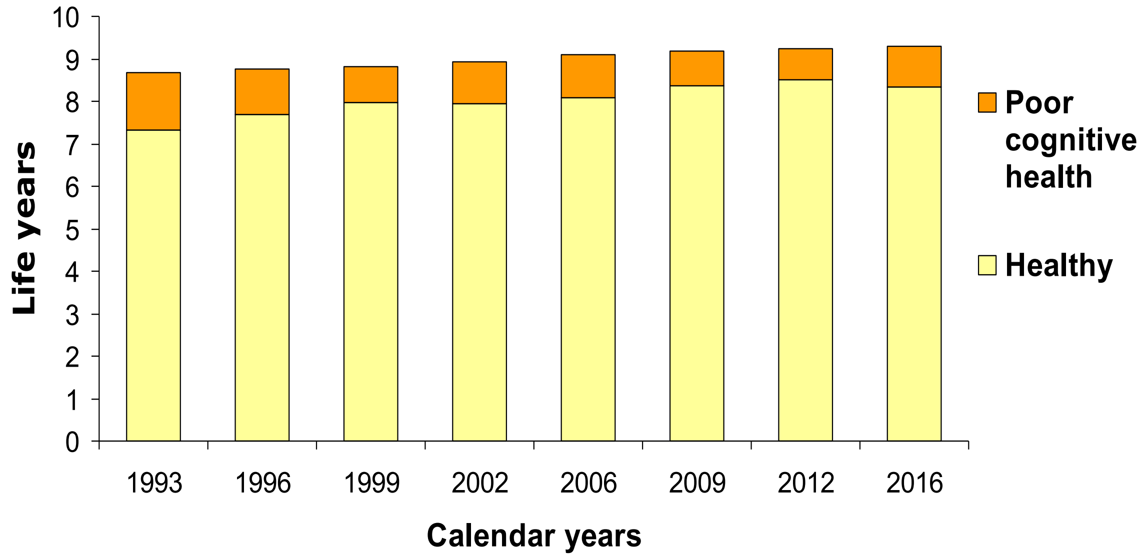
men (OR(year)=0.973, CI: 0.956–0.990, p=0.002) and women (OR(year)=0.963, CI: 0.947–0.979, p<0.001) over time. Adding years of education to these models attenuated the decreases substantially, by 55.6% in men and by even 73.7% in women, while the ORs were no longer statistically significant (p=0.204 for men and p=0.283 for women). This attenuation implies that 55.6% and 73.7% of the decrease in cognitively unhealthy life years in men and women, respectively, can be attributed to the rise in level of education.

Partial life expectancy between ages 65 and 74 in good cognitive health showed increases in men from 7.3 to 8.4 years, continuing up to 2012 (Table 2 and Figures 3a and 3b). In women, an increase was observed from 7.8 to 8.7 years, continuing throughout the study period. A proportional increase was seen to concentrate in the 1990s. Clearly, women showed a greater increase than men in the proportion of life years in good cognitive health. This can be attributed partly to the lesser rise in their life expectancy, and partly to their greater absolute increase in cognitively healthy life years. These increases exceed those for total life expectancy.

Practice effect

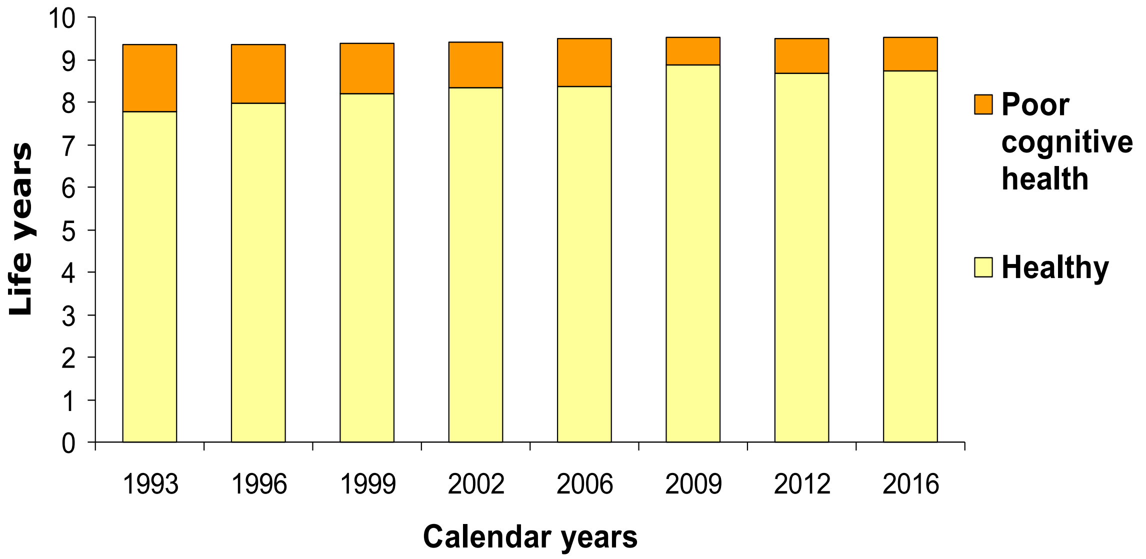
The number of times tested correlated highly with year (r=0.67). Testing both number of times tested and year within a single GEE model might introduce multicollinearity, so that the confounding effect of repeated testing cannot be evaluated directly.

Figure 3a. Partial life expectancy between ages 65 and 74: years in good cognitive health*, for men



* Healthy = MMSE >= 26
Poor cognitive health = MMSE < 26

Figure 3b. Partial life expectancy between ages 65 and 74: years in good cognitive health, for women



* Healthy = MMSE >= 26
Poor cognitive health = MMSE < 26

Therefore, an indirect approach is taken, which involves comparing the effects of year and number of times tested on cognitive health in separate models. Now, instead of year, wave number is used, because this variable has the same range as number of times tested (1 through 8), so that ORs can be compared. Number of times tested in a GEE model adjusted for age showed a significant decline of poor cognitive health with number of times tested: OR(ntimes)=0.818 (0.747–0.895) for men and 0.849 (0.778–0.925) for women. These estimates fell just within the confidence limits of those for wave number for women but not for men: OR(wave)=0.915 (CI: 0.865–0.968) for men and 0.887 (0.842–0.935) for women. Thus, the effects of number of times tested were a bit larger than those for wave number. Hence, it cannot be ruled out that the observed decline in poor cognitive health is attributable to a practice effect in the continuing participants.

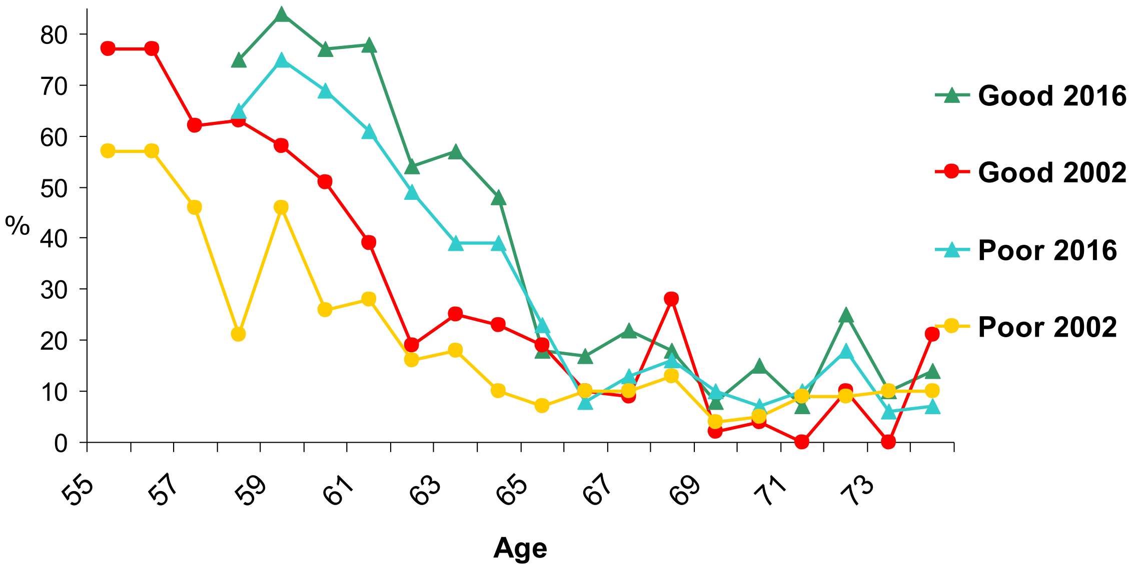
Adjusting for years of education could help clarify this confound. It was expected that the rise in the level of education would be an explanatory factor for the rise in good cognitive health. However, there is no reason to expect that the rise in level of education would explain the practice effect: the former is a population-based development, whereas the latter is an individual development. Testing a GEE model of the effect of number of times tested including years of education yielded smaller effects of number of times tested. The percentage attributable to education was 27.5% for men and 49.7% for women. Although substantial, these percentages were smaller than in the analyses of year (reported in the previous section). Based on this indirect evidence, we conclude that at least part of the improvement in cognitive health over time is not confounded by a practice effect.

Attrition

Across the study period, the average non-mortality attrition at time t+1 was 3.6% for participants in good cognitive health at time t (MMSE > 26) and 6.9% for participants in poor cognitive health (MMSE < 26). There was no systematic trend in non-mortality attrition, nor did the difference in non-mortality attrition between participants in good and poor cognitive health change over time (p(interaction wave*MMSE)=0.804). Again testing the trend in cognitive health, inclusion of non-mortality attrition into the model did not change the effect of year: the ORs for men and women were identical to those in the model without non-mortality attrition.

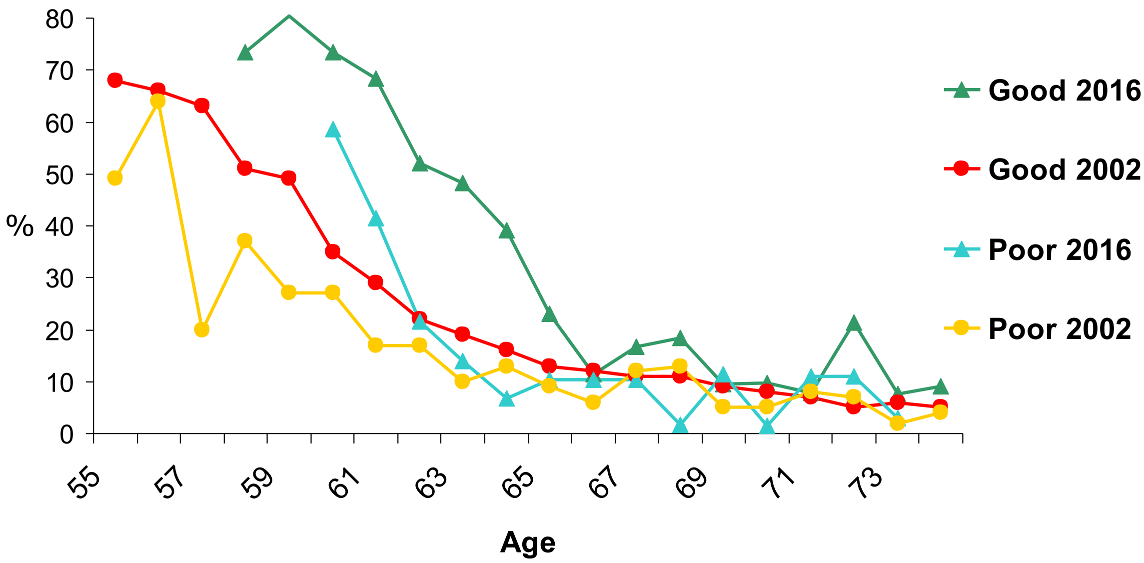
Considering non-response attrition on the MMSE among participants who did provide data on other measures at time t+1 (e.g., through proxies), this percentage averaged 5.4% for participants in good cognitive health and 12.1% for participants in poor cognitive health. There was no systematic trend in the proportion of

Figure 4a. Age-related decline in workforce participation in good and poor physical health: 2002 and 2016. Longitudinal Aging Study Amsterdam.



Note: Poor physical health = multimorbidity or difficulty with >=1 activity
Prevalences are adjusted for gender; in 2002 the minimum age is 55; in 2016 the minimum age is 58
Physical health difference in participation in 2002: F=20.92 (p<0.001); in 2016: F=6.55 (p=0.011)
Interaction health*age in 2002: F=2.03 (p=0.005); in 2016: F=0.23 (p=0.976)

Figure 4b. Age-related decline in workforce participation in good and poor cognitive health: 2002 and 2016. Longitudinal Aging Study Amsterdam.



Note: Poor cognitive health: MiniMental State Examination score < 26
Prevalences are adjusted for gender; in 2002 the minimum age is 55; in 2016 minimum age is 58; below age 60 there are not enough cases with poor cognitive health to obtain estimates of workforce participation.
Cognitive health difference in participation in 2002: F=20.92 (p<0.001); in 2016: F=8.60 (p=0.003)
Interaction health*age in 2002: F=2.03 (p=0.005); in 2016: F=1.53 (p=0.086)

non-response attrition over time (p=0.251). However, the difference between participants in good and poor cognitive health increased over the study period (p(interaction wave*MMSE)=0.029). The percentage of participants in good cognitive health with missing values at the next wave remained stable over time, but the percentage of participants in poor cognitive health who had missing values at the next wave increased over time. Testing the effect of year on cognitive health now including non-response attrition in the GEE model did not result in substantial differences in the ORs (ORs differed by 0.001 for both men and women).

Link with workforce participation

To estimate the extent to which age-related health decline affects workforce participation, we plotted in Figures 4a and 4b workforce participation by single age years and by level of health up to age 75. We did this for the calendar years 2002 and 2016, as these years represent the period before and after the drastic changes in early exit and disability pension schemes. As the number of workers older than 65 years is very small, we restricted our tests to the 55-66 years age range.

We first compare the dark red and dark green lines, representing the participation in good health. For both good physical and good cognitive health, we see an S-shaped pattern, showing a clear decline in participation around the actual retirement age prevailing in each year, i.e., around age 61 in 2002 and age 64 in 2016. Notably, this S-shape shifted to the right more or less in parallel. When we then compare the yellow and light blue lines, we see a similar shift to the right, again for both physical and cognitive poor health. This shift means that workers in poor health continued working longer after the early exit and disability pension scheme changes. However, even in 2016, participation by those in poor health remained substantially lower than by those in good health (in 2002: $p<0.001$ for physical and $p=0.007$ for cognitive health; in 2016: $p=0.018$ for physical and $p=0.004$ for cognitive health). Moreover, at all ages considered, workers in poor health worked fewer hours per week than workers in good health, although this difference did not reach significance (for 2016: good vs poor physical health: average 16.9 vs 14.2 hours, $p=0.119$; good vs poor cognitive health: average 15.4 vs 11.7 hours, $p=0.076$).

A further observation is that, for those in poor health, the age decline in participation occurred at an earlier age than the prevailing retirement age, while the age decline followed the same S-shaped pattern as for those in good health. Tests of the interaction effect of age and health on participation showed that the rate of decline was not significantly different for those in poor and good health, either in 2002 or in 2016.

4. Discussion

This study examined trends in partial life expectancy in good and poor physical and cognitive health for the age group 65-74 years over a period of 23 years. It provides the first national estimates of healthy life expectancy for this age group in the Netherlands. In light of the policy intention to raise the statutory retirement age parallel with life expectancy from age 65 onwards, the findings from this study are pertinent to the question whether life expectancy in good physical and cognitive health increases at the same rate as total life expectancy. The findings show an ongoing decline in physically healthy life years and a stable number of life years in poor physical health. In contrast, life years in good cognitive health showed increases that continued up to 2009, and even seemed to exceed the increase in total life expectancy for this age group.

Our findings fit in with those from other Western countries, in particular regarding the increase in life expectancy in good cognitive health (Jagger et al. 2016, Wu et al. 2016). Regarding life expectancy in good physical health, our findings are a bit more pessimistic, in that we observe stability of life years in poor health, whereas some other studies show a small decrease. Also, several – but not all – studies show evidence of an upward trend with mild physical health problems (Jagger et al. 2016). However, in most comparable studies a single measure of physical disability is used, not combined with multimorbidity as in this study. Considering that the prevalence of multimorbidity is expected to grow in the years to come (Crimmins & Beltrán-Sánchez 2010), and that multimorbidity represents a complex condition with serious consequences for functioning, well-being, and sickness absence (Marengoni et al. 2011, Verkooijen 2017), we believe that our health measure better reflects the issues that older workers are confronted with.

Because scores on the measure used for cognitive health are known to be affected by educational level, we ran also analyses adjusting our GEE analyses of trends in cognitive health for years of education. Education accounted for 56% and 74% in the trends for men and women, respectively. This finding corresponds with evidence of an improvement in intellectual ability in post-WWII generations (Flynn 1987). Various authors have attributed the improvement in cognitive functioning not only to access to education, but also to a shift from rote learning to more meaningful and active learning (Blair et al. 2005) and to an increase in highly complex work which stimulates cognitive functioning in midlife (Marioni et al. 2012). This improvement has also been attributed to non-educational factors, including better nutrition, smaller and more affluent families in which parents have more attention for their children, and greater information density in society (Hülür et al. 2013, Bordone et al. 2015). A further development, unrelated to educational level and particularly relevant to late life, is the recent improvement in the control of cardiovascular risk factors such as hypertension and cholesterol, which may help reduce cognitive decline (Crimmins et al. 2016, Dodge et al. 2016). Thus, both a rise in the level of education and other developments are likely to drive the observed improvement in cognitive health.

The rise in level of education did not account for trends in physical health. Instead, education proved to be a suppressor of the decreasing trend observed in good physical health, meaning that we would have observed a stronger decrease if the level of education had not increased over time. In the near future, further rises in the level of education of the older population may be expected, so that decreases in life expectancy in good health may continue to be counteracted by increases in the level of education (Joung et al. 2000).

Strengths and weaknesses

Our study has several strengths. First, it is based on a nationally representative sample of older people. Second, exactly the same measurement instruments have been used at each wave. Third, our calculations of healthy and unhealthy life years are performed for eight points in time, whereas most previous studies used only two time points (e.g., Jagger et al. 2016). With only two time points it cannot be determined whether trends accelerate or decelerate in specific periods, and measurement error may over- or underestimate trends.

Several weaknesses of this study should be mentioned. First, the MMSE has been designed as a screener for cognitive impairment and dementia and is probably less sensitive for cognitive health in general. Moreover, the cognitive functions that the MMSE measures (memory, attention, orientation, and language and praxis, cf. Jones and Gallo 2000) may not be the most relevant ones for employability in work involving complex tasks, where fluid intelligence and speed of information processing may be more important. Decline in these latter functions may start decades before the onset of cognitive impairment and dementia. However, in this study we chose the MMSE as our measure of cognitive health for reasons of comparability with earlier studies in other countries. Second, a substantial number of participants was tested more than once, raising the suspicion of a practice effect in the MMSE. We indeed found indirect evidence that the number of times tested accounted for part of the improvement observed. A further issue regarding longitudinal data is non-mortality attrition, which proved to be associated with the MMSE score in the previous measurement wave. Additional analyses showed that this association was of similar size across waves and that non-mortality attrition did not affect the trend in cognitive health. However, the proportion of participants with non-response on the MMSE increased among participants in poor cognitive health in the previous wave, whereas it did not increase among participants in good cognitive health in the previous wave. Additional analyses showed, however, no effect of non-response on MMSE on the trend in cognitive health. Combining the results from these various sensitivity analyses, we conclude that practice effects, but not non-mortality drop-out and non-response attrition, may have been partly responsible for the improving trends observed in cognitive health. Therefore, we cannot conclude with certainty that the rise in life expectancy in good cognitive health exceeds the rise in total life expectancy.

Conclusions and implications

A decrease in years in good physical health is accompanied by an increase in years in good cognitive health. Over time, workers with good as well as poor health continued to work up to higher ages due to changed early exit and disability pension schemes. However, regardless of the prevailing schemes, workers with poor health exited the workforce earlier than workers with good health and worked shorter hours. The implications of the findings from this study for the employability of older workers, and thus for the feasibility of increasing working lives, are threefold. First, to the extent that the labor market will be less oriented towards physical and more towards cognitive skills, the opposing developments in physically and cognitively healthy life expectancy may not greatly impact the employability of persons beyond age 65. However, a certain measure of physical health is required for all types of work, even if the work requires mainly cognitive skills. In addition, age-related decline in cognitive ability still occurs and may increase work stress and thus the need for recovery (Rijs et al. 2015, Jansen 2002). Second, as jobs requiring physical skills remain part of the labor market, adaptations may be needed for older workers with physical health problems so that they can continue working in these jobs (Boot et al. 2013). Third, pension schemes that allow a gradual reduction of the number of working hours may help older workers in poor health to extend their working lives.

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