Original article

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Educational differences in duration of working life and loss of paid employment: working life expectancy in The Netherlands

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Objectives This study aims to provide insight into educational differences in duration of working life by working life expectancy (WLE) and working years lost (WYL) through disability benefits and other non-employment states in the Netherlands.

Methods Monthly information on employment status of the Dutch population (N=4 999 947) between 16 and 66 years from 2001–2015 was used to estimate working life courses and loss of working years for specific non-employment states. Across educational groups, bi-directional transitions between paid employment and non-employment states were calculated. Using a multistate model, the WLE and WYL at age 16, 30, 50 and up to 66 years as statutory retirement age were estimated for each educational group, stratified by gender.

Results Low-educated men and women had a 7.3 (men) and 9.9 (women) years lower WLE at age 30 than high-educated men and women. Among low-educated men, 3.4 working years were lost due to disability benefit compared to 0.8 among high-educated men. Low-educated women lost 3.0 working years due to disability benefit compared to 1.4 among high-educated women.

Conclusions There are large educational inequalities over the course of working life. Among low-educated workers, more working years are lost due to unemployment, no income, and especially disability benefits. The latter reflects large educational inequalities in health and working conditions. The metrics of WLE and WYL provide useful insights into the life-course perspective on working careers.

Key terms education; educational inequality; ill health; inequalities; working life course; working years lost.

With increasing life expectancy and a rapidly ageing population, there is a need to increase the labor force participation until age 65 and beyond. The proportion of older workers in the workforce is growing and, hence, an increasing proportion of the workforce will face health problems during working life. A meta-analysis has illustrated that individuals with poor health are at increased risk for premature labor force exit due to disability benefits [risk ratio (RR) 3.61], unemployment (RR 1.44), and early retirement (RR 1.27) (1). Particularly workers with a low educational level are at risk for labor force exit and health-related labor force exit (2, 3). Educational inequalities in health-related exit from paid employment are substantial in all European countries (4), and it may be hypothesized that, with increasing retirement age, these disparities will increase, especially in the last years of working life (5). Although educational inequalities in labor force exit and re-employment are well-established, studies on the influence of socioeconomic position and poor health on displacement from the labor market do not present a clear insight into the cumulative loss of work capacity during working life. A life-course perspective is needed.

The metric of working life expectancy (WLE) as a measure of duration of working careers was first introduced in 1977 by Hoem (6), and revitalized by Nurminen and colleagues (7) and others (8). WLE expresses, in analogy to the concept of life expectancy,

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the number of years that a person is expected to spend in paid employment until he or she finally leaves the labor force for statutory retirement (7). It is important to note that WLE is a population measure, ie, it presents an estimate of duration of working careers based on the cumulative labor force attachment of all persons in a particular study population. With the increasing statutory retirement age in many countries, WLE has been acknowledge as an interesting measure to capture working life course (9). The gap measure working years lost (WYL) reflects the working time lost due to premature exit from paid employment (10). This life-course perspective of the workforce, captured in WLE and health-related WYL, can be used to evaluate long-term consequences of policy changes in labor legislation, and provides insight into socioeconomic inequalities during the working life course.

In the past decade several studies have estimated the expected duration of working life. In Finland, Nurminen et al (7) have estimated a WLE at age 16–64 years of 29.7 years for women and 31.4 years for men (7). They also reported that 50-year old Finnish persons with poor health may lose 13–16 months of their remaining working life. Recently, Pedersen & Bjorner (11) found that Danish workers with a poor self-perceived health have a 1.4 year lower WLE at age 55 than workers in good self-perceived health (11). In particular occupations, health-related WYL may be substantially higher, for example in the construction industry (10). Studies in specific populations of chronically diseased persons have shown that persons with mental disorders may lose up to 15 years of their total working life due to disability benefits (12) and workers with arthritis three (women) or four (men) years (13). Focusing on WYL at age 50, Dudel & Myrskylä (14) have shown an educational gradient with an 8-year difference in WLE between workers with higher education and those with less than high school diploma (14). Leinonen et al (15) reported that in Finland manual workers were expected to spend 3.6–3.7 years less in work than upper non-manual employees (15).

These studies have illustrated that a substantial part of working careers is lost due to poor health and strenuous working conditions. However, existing studies on WLE and WYL have some disadvantages that hamper interpretation and comparability. First, some studies have addressed only disability benefits as an exit route (12, 13) without taking into account the competing risks of other exit routes (16). Second, other studies have ignored that exit from paid employment may be temporary, even after receiving a disability benefit (12, 13, 17). Third, some studies have relied on small study populations (14) or cross-sectional data (18), which are sensitive to selection bias. Fourth, most studies have focused on WLE at age ≥50 (16, 19), while many working years might be lost earlier in working life.

This study aims to estimate the working life expectancy in different educational groups in The Netherlands, and to study the working years lost in these educational groups through disability benefits and other states of non-employment. The study is based on a large proportion of the workforce in the Netherlands over a period of 15 years. It uses a multistate model that takes into account all dynamic patterns of entering and quitting paid employment to get insight into educational inequalities in labor force participation with a longitudinal perspective over the working life course.

Methods

Data

For this study, Statistics Netherlands enriched the social statistical database with register information on gender, age, educational level, and vital status, in order to calculate transition probabilities for entering and exiting the labor force. In total, complete information was available for 4 999 947 Dutch individuals aged 16–66 years at January 2001, of which N=2 761 301 were between 30–66 years. A starting age of 16 was chosen since in The Netherlands it is obligatory to go to school until that age. Individuals of this cohort were followed-up for 15 years (until December 2014). The age of 66 years was chosen to capture the recent increase in retirement age. We focus the current presentation on individuals aged 30–66 years because at age 30 most individuals will have finished their education and entered the labor force.

(Non)employment states

The social statistical database stores monthly information on the main income components, ie, gross wages, social benefits, and pensions, derived from Dutch tax registers (20). This information distinguishes seven mutually exclusive states (i): paid employment, (ii) disability benefits, (iii) unemployment, (iv) no income through paid employment, (v) (early) retirement, (vi) being a student, and (vii) emigration. Death is based on mortality statistics.

Employed persons had their main source of income through paid employment or having their own business, defined by a monthly transaction on income.

Disability benefit is defined as receiving these benefits for ≥50% of the personal income. In The Netherlands, individuals may be granted a disability benefit when they are partially or fully incapable of working after two years of sickness absence. The degree of the disability is determined by the loss of earnings due to illness relative to the earnings before. Only when there

is a reduction in income of >35% will disability benefits be granted (21).

In The Netherlands, individuals receive unemployment benefits in case of loss of paid employment, with a maximum of 38 months in the study period – depending on length of contract of past paid employment. After this period, the corresponding household may receive a social security benefit in case the disposable (household) income is below the legislative threshold (21). The state "unemployment" contains both those with unemployment and social security benefits.

Individuals with no income did not have a personal income or receive any benefits. These individuals may have left paid employment voluntarily or may belong to a household whose disposable income is above the critical threshold for social security benefits. This category could also include persons who are unemployed but do not yet receive an unemployment benefit, and individuals not in education, employment, or training (NEET). Therefore, individuals who had <3 months with "no income" and received unemployment afterwards were considered to be in unemployment also in those first months with no income.

The state pension (AOW) is a base pension. Until 2013, the state pension age was 65 years, and it increased for both men and women with one month to 65 years and 3 months in 2015 (still increasing to 67 years and 3 months in 2023). In addition, pension benefits could be available in case of a pension agreement with the employer. During the study period (2001–2015), it was also possible to retire early. In 2005, arrangements for early retirement pensions became more stringent, which for most employees became effective from 2006 onwards. We defined an individual as (early-)retired when his or her main source of income was a retirement benefit. Since retirement before the age of 45 years is highly unlikely, individuals who were registered as having retired before the age of 45 were assigned their most recent non-employment state before the "retirement" state. Younger individuals may have retirement as most important income source due to, for example, survivor pension.

Students are individuals who are registered at an educational institution. Emigration concerns those individuals outside the population, and might therefore also include those individuals lost in the registrations.

Sociodemographics

Individual characteristics included gender, age, and educational level. Age at baseline was calculated based on month and year of birth. The highest level of education was coded according to the 1997 International Standard Classification of Education (ISCED-97) and categorized into low (pre-primary, primary, and lower secondary), intermediate (upper secondary) and high (post-secondary) education. The highest level of education, certified by officially acquired degrees and diplomas, in the period 2001–2014 was used.

Statistical analyses

Multistate model. The information on monthly transitions between states of (non-)employment was used to assess the transitions rates (intensities) between states of (non-)employment in order to calculate the WLE and WYL. Individuals may move between stages of (non-)employment over time. The multi-state model is composed of the previously mentioned seven states of (non-)employment and death as the absorbing state – since no further transitions are possible after death. All other transitions between states are possible (total 49 transition possibilities). A transition matrix was constructed to define the possible transitions between these states and with death. The calculations were censored at age of 66 years, and the estimated WLE is thus based on the transitions from ages 16, 30, and 50 until 66 years.

The R package mstate (version 0.2.11, in R studio version 1.0.153), developed by Putter et al (22–24), was used to estimate cumulative transition rates and transition probabilities and to fit the multistate models. Analyses were stratified by gender and educational level. Within each stratum, a semi-parametric cox proportional hazard model was fitted to estimate the transition rates between (non)employment states, using age as a time variable. Within each stratified analysis, a Markov assumption was made, meaning that the transition rates are only dependent on the current state. For each of the possible transitions in the multistate model, the baseline transition hazards were used to obtain transition probabilities.

WLE and WYL. Using the estimated transition probabilities in the multi-state model, we were able to calculate the expected length of stay (ELOS) in a state, given the current state (ELOS function in the mstate R package). This is estimated by integrating the transition probabilities from the starting time until a give horizon age, in this study set at age 66 years (25). WLE is defined as the number of years in the "employed" state, conditional on being in paid employment at the starting ages of respectively 16, 30, and 50 years. In addition, the weighted WLE is also calculated across all persons in the population, thus including those in paid employment as well as those in all possible non-employment states at the starting age of 30. Uncertainty around the expected length of stay was calculated using bootstrapping. Bootstrapping consists of resampling from the study population with replacement. On the bootstrapped population, the ELOS is calculated, and this is repeated 1000 times. The lower and upper bound of the ELOS were estimated as the 2.5^{th} and 97.5^{th} percentile of the bootstrapped

Table 1. Labor force status in the Dutch workforce of age 30–66 year at baseline (January 2001), stratified by educational level and gender (N=2 761 301)

	N	(Self-) employed %	Student %	Disability benefits %	Unemployment %	No income %	(Early) retirement %
Men							
Low	416 449	71.9	0.0	7.7	14.1	3.8	1.8
Intermediate	574 198	86.9	0.1	3.2	5.3	2.6	1.1
High	404 594	90.5	0.4	1.5	3.3	2.6	0.8
Women							
Low	499 206	47.0	0.0	6.5	16.9	26.1	3.5
Intermediate	537 372	69.9	0.2	4.4	6.5	17.6	1.4
High	329 482	81.5	1.6	3.0	3.7	9.3	0.9

Table 2. Educational differences in working life expectancy (WLE) between ages 30–66 and 50–66 among men and women in the Dutch workforce, given being in paid employment at the starting age. [CI=confidence interval.]

	WLE at age 30 (95% CI)	WLE at age 50 (95% CI)
Men		
Low	20.9 (20. 9–21.0)	8.4 (8.3–8.4)
Intermediate	26.0 (25.9–26.0)	9.8 (9.8–9.8)
High	28.2 (28.2–28.2)	10.9 (10.9–10.9)
Difference (high-low)	7.3	2.5
Women		
Low	16.9 (16.8–16.9)	7.0 (7.0–7.0)
Intermediate	23.7 (23.7–23.8)	9.1 (9.0–9.1)
High	26.8 (26.7–26.8)	10.4 (10.4–10.4)
Difference (high-low)	9.9	3.4

ELOS. The total WYL due to the specific exit pathways were calculated as the difference between the age of 66 years and the WLE at ages 16, 30, and 50 respectively. In this publication, the key findings are presented for WYL at age 30, as at this age most individuals will have entered the labor force. Results for ages 16 and 50 can be found in the appendix (www.sjweh.fi/show_abstract.php?abstract_id=3843), supplementary files 3 and 5. The scripts are included in supplementary file 1.

Results

In the 2001 Dutch workforce, disability benefits among men (5.0 times) and women (2.2 times) were more prevalent among individuals with a low compared to high educational level (table 1). Men (4.3 times) and women (4.6 times) with a low educational level were also more likely to be unemployed. Participation in (self-)employment between 30–66 years is the highest (men 90.5%, women 81.5%) among high-educated individuals. The mean age among men and women decreased by educational level, reflecting the increased educational level over time. The figure in supplementary file 2 graphically presents the proportion of individuals in the different states by age, stratified by education and gender.

Educational differences in working life expectancy

Table 2 shows the WLE at different ages, stratified by educational level and gender. At age 30, the WLE for men was 20.9 years among low-educated and 28.2 years among high-educated individuals with a gap of 7.3 years. For women, this gap was 9.9 years, primarily due to the low WLE of 16.86 years among low-educated women. For those working at age 50, there were still educational differences in WLE (men: 2.5 years, women: 3.4 years). At all ages, the educational inequalities were larger for men than women. The gap in WLE is relatively small between the intermediate and high educational levels and is particularly apparent for the low education level. Table 2 shows the WLE conditional of being in paid employment at ages 30 and 50 (age 16 in supplementary files 3). When other starting non-employment states are taken into account, the weighted WLE at age 30 was up to 1 year lower compared to WLE based on paid employment as starting state (supplementary table S5).

Educational differences in working years lost

Low-educated men at age 30 lost in total 15.1 years of paid employment during their working life of which 41.5% due to unemployment, 22.5% to disability, 10.5% to no income, and 13.1% to (early) retirement (see table 3, for working years lost at age 16 and 50 years, supplementary files S3 and S5). The other non-employment states (time spent in education: 0.2%, emigration: 5.9%, and mortality: 6.4%) accounted for 12.5% of the WYL. Absolute educational inequalities in WYL were largest for unemployment and disability benefits. Low-educated men lost 4.3 (unemployment) and 2.6 (disability benefits) working years more than high-educated individuals.

Low-educated women lost in total 19.1 years of paid employment during their working life of which 36.3% due to unemployment, 31.3% to no income, 15.7% to disability, and 10.7% to early retirement. The other non-employment states (time spent in education: 0.3%, emigration: 2.5%, and mortality: 3.2%) contributed 6.0% to the WYL. Absolute educational inequalities in WYL among women were largest for unemployment

Table 3. Total working years lost (WYL) in the Dutch workforce between ages 30–66 through several pathways assuming paid employment at age 30, stratified by gender and educational level. [CI=confidence interval.]

	Disability benefits	Unemployment	(Early) retirement	No income	Death	Student	Emigration
	WYL (95% CI)	WYL (95% CI)	WYL (95% CI)	WYL (95% CI)	WYL (95% CI)	WYL (95% CI)	WYL (95% CI)
Men							
Low	3.4 (3.4–3.4)	6.3 (6.2–6.3)	2.0 (2.0–2.0)	1.6 (1.6–1.6)	1.0 (0.9–1.0)	0.0 (0.0–0.0)	0.9 (0.9–0.9)
Intermediate	1.8 (1.8–1.8)	3.4 (3.4–3.5)	2.3 (2.3–2.3)	1.1 (1.1–1.1)	0.7 (0.7–0.7)	0.1 (0.1–0.1)	0.6 (0.7–0.7)
High	0.8 (0.8–0.8)	1.9 (1.9–1.2)	2.4 (2.4–2.5)	1.0 (1.0–1.0)	0.5 (0.5–0.5)	0.1 (0.1–0.1)	1.1 (1.1–1.1)
Absolute difference (low-high)	2.6	4.3	–0.5	0.6	0.5	–0.1	–0.2
Women							
Low	3.0 (3.0–3.0)	7.0 (6.9–7.0)	2.1 (2.0–2.1)	6.0 (6.0–6.0)	0.6 (0.6–0.6)	0.1 (0.1–0.1)	0.5 (0.5–0.5)
Intermediate	2.0 (2.0–2.1)	3.3 (3.3–3.3)	2.1 (2.1–2.1)	3.7 (3.7–3.8)	0.5 (0.5–0.5)	0.2 (0.2–0.2)	0.4 (0.4–0.4)
High	1.4 (1.3–1.4)	1.8 (1.7–1.8)	2.3 (2.2–2.3)	2.4 (2.4–2.4)	0.4 (0.4–0.4)	0.2 (0.2–0.2)	0.8 (0.8–0.8)
Absolute difference (low-high)	1.7	5.2	–0.2	3.6	0.2	–0.2	–0.3

(5.2 years), followed by no income (3.6 years), and disability benefits (1.7 years).

From age 30 onwards, educational inequalities were lowest for emigration, (early) retirement, death, and being a student. High-educated workers had slightly higher emigration and also spent slightly more years in (early) retirement than low-educated workers. Mortality was substantially higher among men than women and also showed the expected educational gradient. WYL at age 16 (supplementary file 3) shows that high educated workers spent >7 years (men: 7.8 years, women: 7.4 years) in education, whereas low educated workers lose a similar amount of working years due to unemployment. Educational inequalities concerning WYL at age 50 are largest for unemployment and disability benefits (men) and for unemployment and no income (women) (supplementary file 5)

Discussion

This study showed large educational inequalities in working life expectancy in the workforce in The Netherlands. At age 30, high-educated men are expected to work 7.3 years longer during their life course than low-educated men. Among women, this difference is 9.9 years. A considerable amount of the lost working time, up to 4.4 years among low-educated men, is health-related due to disability benefits and premature death. Educational inequalities in health-related working years lost were much larger among men than women. Both among men and women, absolute inequalities were largest for unemployment.

The WLE and WYL metrics provide information regarding labor force participation and premature loss of paid employment during the life course. As mentioned in the introduction, several models have been developed to estimate WLE and WYL. Our model improves these models by using bi-directionality of entering and quitting paid employment and different exit routes to non-participation. Our model also encompasses a broad age range instead of older workers only, and presents detailed estimates for gender and educational level. A previous study has shown a substantial return to paid employment after a period of non-employment, including non-employment due to disability (26). The presented model takes into account that individuals can re-enter paid employment after non-employment and disability benefit.

Recently, two studies estimating WLE in The Netherlands were published – both focusing on WLE of older workers. Van der Noordt et al (17) reported WLE at age 58 years varying from 4.1–5.1 among lower educated individuals to 5.0–5.9 among higher educated individuals (17). De Wind et al (19) reported, based on the same data, a WLE at age 55 years of 5.7–6.8 years. Our study adds to these publications a life-course perspective on labor force participation from young age onwards. Our results show an WLE at age 30 of 21–28 years among men and 17–27 years among women. Assuming the age of 66 as an absorbing state, men lose 8–15 working years over the working life course and women 9–19 years. Especially among lower educated workers, a substantial number of working years are already lost before the age of 50 years.

The WLE at age 16 among Dutch men (32.7 years) is higher than the WLE in Finland projected for 2006 (31.4 years), as reported by Nurminen et al (7). Among Dutch women, the WLE at age 16 (29.3 years) was marginally lower compared to the WLE of 29.7 years among Finnish women. Our model takes into account the main source of income, regardless the number of working hours that may differ between Finnish and Dutch women. This comparison of WLE between Finland and The Netherlands also captures other differences. Our study presents WLE to the age of 66, compared to an age of 64 in the Finnish study, which will result in

higher estimates in The Netherlands. In contrast, the higher labor force participation in Finland, especially among women, will have increased WLE compared to The Netherlands. In the more recent study period, in The Netherlands national policies to postpone early retirement have been enacted, which will have increased WLE in The Netherlands compared to Finland. It is of interest to note that in an international comparison of WLE across 26 European countries in 2009, the WLE at age 50 in the Netherlands was among the highest quartile for men, but only around the mean value for women (27).

The contribution of the different exit pathways to the number of working years lost is a unique feature of this study and shows large differences between sociodemographic groups. At age 30, when the majority of the individuals have finished their school or study, low-educated individuals have a 7 (men) to 10 (women) years lower WLE than high educated individuals. While individuals with a low educational level enter paid employment much earlier than individuals with a high educational level, our model indicates that over the total life course high-educated persons spent substantially more years in paid employment than low-educated persons. Among women, the educational inequalities are larger than among men, and this can particularly be attributed to lost WYL due to "no income".

Poor health is a prerequisite for receiving disability benefits and the educational differences in years with disability benefits reflect educational inequalities in health (28), as well as in strenuous working conditions and unhealthy behaviors. Our results concerning educational inequalities in working years lost due to disability benefits are in line with a recent Finnish study showing that the highest educated men lost 0.6 years due to disability retirement compared to 2.7 years among the lowest educated group. For women this was 0.7 and 2.6 years (29). The working years lost due to premature death also reflect the well-known educational inequalities in mortality. The health-related WYL are underestimated, since in The Netherlands a disability benefit is usually granted after a period of two years of (partial) sickness absence paid by the employer. In our study, these years in sickness absence are counted as paid employment, since information is lacking on time spent in full sickness absence or partial return to work. Two mechanisms might play a role in the educational inequalities in disability benefit. First, poor health is more prevalent among individuals with a low educational level (30) leading to a higher prevalence of disability benefits in this educational group. Second, individuals with a low educational level are more likely to carry out more strenuous work. With similar health problems, workers with strenuous work demands might be more likely to become work disabled (3). More insight is needed to disentangle these two mechanisms.

Health problems are also related to unemployment (1), which is also more common among low- compared to high-educated individuals. New old-age retirement regulations might further influence socioeconomic health inequalities, since particularly lower educated workers will have more problems to stay healthy at work until the increased statutory retirement age. An uniform retirement age completely disregards the large educational inequalities in life expectancy and, in particular, healthy life expectancy. It would be relevant to get insight into the influence of WYL on (healthy) life expectancy after retirement.

It is of interest to note that 2–2.5 working years are lost due to (early) retirement, and higher educated workers spent more time in retirement than lower educated workers. Workers with a low educational level might need to work longer because they lack financial resources. In The Netherlands, collective agreements to retire early have been abolished from 2006 onwards, leading to a steep rise in the actual retirement age in The Netherlands. At the same time eligibility criteria for disability benefits have become more stringent. In Finland, a decrease has been shown in the time spent on disability pension over time. Since 2013, the statutory retirement age has also risen to 67 years and 3 months for future generations. It is of interest to get insight on how this rising retirement age has influenced loss of paid employment through other exit pathways out of paid employment.

If we disregard WYL due to education, the results show that workers with a high educational level in particular lose working years after the age of 50. For those with a low educational level, a substantial number of working years is already lost between 16–50 years. This indicates that in order to increase participation in paid employment among individuals with a low educational level, it is important to target also those in the younger age groups, while for high-educated workers measures targeting those aged ≥50 years might be more effective.

The model presented can be expanded to evaluate the impact of policy changes on participation in paid employment and working years lost due to specific exit pathways. Therefore, the concepts of WLE and WYL could therefore also be highly relevant for policy-makers.

A strength of the study is the use of a large national dataset representing Dutch individuals with 15 years of follow-up with monthly information on tax registries to define the states of employment and non-employment, which provides a robust estimate of WLE. The large time span includes diverse economic situations, which makes the estimation less vulnerable to specific situations in a certain year. There are also limitations to be mentioned. First, in the Dutch system, the states of unemployment and no income cannot be distinguished optimally.

Unemployed persons may receive unemployment or social security benefits, but the latter benefit depends on the household income. Therefore, individuals with no income may have lost their job, and, therefore, the WYL due to unemployment may have been underestimated. Second, although the register contains a large number of individuals, for 6 725 061 individuals no information on educational level was present. The linkage of school diplomas with education level was implemented in the early 1970s, and, thus, for many older workers educational level is not available. However, the current study population still contains a large number of older workers and the measures of WLE and WYL are not sensitive to the age distribution. Furthermore, there is also missing information on education as a consequence of immigration and emigration. Third, the model is based on the Markov assumption that a future state only depends on the current state, and not on the events that occurred before. This might not always be the case. For example, Schuring et al (26) have shown that a transition from disability benefits to paid employment is more likely during the first two years of disability than after a longer period of disability. A linked limitation is that changes in transition rates over calendar time are disregarded. In our model, the estimated transitional probabilities reflect the mean transition in a given year, based on the underlying distribution of years in and out of paid employment, which will largely account for time-dependent events.

The study shows that there are large educational differences in WLE, both among men and women. A considerable amount of the lost working time is health-related due to disability benefits and premature mortality. In comparison to high-educated workers, those with a low educational level lose a much larger part of their working life due to disability benefit, unemployment, and no income. The metrics of WLE and WYL provide unique insights into the life-course perspective of how health will influence duration of working careers.

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