Introduction

Life expectancy (LE) has been increasing in most European countries and further increases have been predicted. Rising LE accelerates the growth of the elderly population which creates an additional burden on the health care and pension systems. To counter this burden, almost all western countries are seeking ways to bring retirement ages more in line with increases in LE. The success of such a policy depends crucially on to what extent the additional life years that make up the increased LE are spent in good health.

The empirical literature suggests that poor health reduces the capability to work which decreases labour force participation. Popular measures of health used in studies linking health to labour participation include self-rated health and disability. Most studies focused on the elderly, and the results suggest that health is the most important determinant of labour participation for older workers. Although many studies found a negative effect of health losses on labour participation, there is lack of consensus on the strength of the effect. Estimates of the causal effect of health on labour participation are sensitive to the choice of health measure, identification assumptions regarding the effect of health on labour status and on the institutional context, such as disability insurance schemes or early retirement policies.

Measures of health such as disability status can be used to calculate disability-free life expectancy (DFLE). DFLE is a measure of population health that might be more relevant than LE for the political debates regarding the ageing of the population as it captures not only information on length of life but also on how many years are spent in good health. Even though the strength of the estimated impact of health on labour market status varies between studies, all studies suggest that productivity and labour participation can be extended by preventing or postponing health problems. Furthermore, no matter how disability is defined, disabled people seem to have on average lower levels of employment and income than non-disabled people. Disabled people also have lower working life expectancies (WLEs).

This study was designed to answer a question not before directly addressed in the literature on the relation between health and employment: does living longer in good health lead to a longer working life? This question is important from a public health and a social economic perspective, considering the consequences for political decision making regarding the pension system. Specifically, we aim to answer the question to what extent a decline in disability incidence could influence DFLE, and from there WLE.

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Background: Improvements in life expectancy have fuelled debates about the statutory retirement age in many European countries. This article contributes to this debate by investigating how changes in disability may influence both employment outcomes and disability-free life expectancy. Methods: We used data from the European Community Household Panel to estimate the impact of disability incidence on labour supply by country using propensity score techniques. In a second step, we translated the estimated effects of disability incidence into effects on working life expectancy as well as disability-free life expectancy using multi-state life tables. Results: Results from the matching analysis show that individuals who become disabled are more likely to leave the labour market. However, the size of the effect is much weaker than a simple descriptive analysis suggests and varies by country. A 10% decrease in disability incidence results in increases in disability-free life expectancy and working life expectancy of respectively 0.6 and 0.07 years on average. Conclusion: A large part of the differences in employment between disabled and non-disabled individuals is not due to a causal effect of disability on employment. Policies that reduce disability incidence increase disability-free life expectancy but have only a limited impact on working life expectancy.


Does living longer in good health facilitate longer working lives? The relationship between disability and working lives

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Methods

To answer our research question, we proceeded in two steps. First, we used propensity score matching techniques to estimate a causal effect of disability incidence on employment. Then, we used these effect estimates in combination with multi-state life tables (MSLTs) to estimate the impact of changes in disability incidence on DFLE and WLE.

Data

We used data from the European Community Household Panel (ECHP), which is a longitudinal study with annual measurement rounds running from 1994 to 2001. The survey is based on interviews using standardized questionnaires with individuals from representative household panels in 12 European countries. Assessment of disability status is based on the question ‘Are you hampered in daily activities by any physical or mental health problem, illness or disability?’ From the three possible responses (‘Yes, severely’, ‘Yes, to some extent’, 'No’), we classified the first two positive responses as ‘being disabled’. Information regarding employment status comes from self-defined main activity status, and individuals are classified as employed when they work part time, full time or are self-employed. As most countries have a retirement age of 65, we concentrated on individuals aged 50–65. The group of people who stated they are retired (and below the age of retirement age of 65, we concentrated on individuals aged 50–65). For these reasons, people who were non-disabled at 65 were then excluded from the analysis. Our sample consisted of individuals who reported disability in wave t and remained disabled; (iv) the controls consisted of all individuals meeting selection criteria (ii) but who remain non-disabled (table 1).

To correct for confounders, we matched cases and controls using propensity scores. The propensity score is the probability of becoming a case (becoming disabled), estimated as a function of a number of relevant pre-treatment covariates. We used Classification and regression tree analyses (CART) to estimate propensity scores. Contrary to logistic regression propensity score models that assume specific functional forms and distributions of covariates, in CART the relationship between an outcome and a predictor is evaluated through a learning algorithm without an a priori model specification. Propensity scores were estimated as the probability of becoming disabled conditional on the following characteristics measured at t: age, gender, marital status, education, number of children in the household, logarithm of the household equivalent income, percentage of total household income that comes from the individual’s labour income, number of days lost because of illness in the last month, and indicators of health-care utilization (having been admitted as an inpatient in hospital and number of visits to a general practitioner).

As the distribution of confounders for the cases differed from the distribution of confounders in the total sample, we reweighted the data in order to calculate the average treatment effect (ATE). We did this by employing a weighted regression analysis. In this weighted regression analysis, we, again, adjusted for the same covariates as when modelling the propensity score to obtain a so-called ‘doubly robust’ estimate for the ATE.

Scenario analyses: from disability incidence and ATE to life expectancy and working life expectancy

A decline in the incidence of disability may increase LE and DFLE. Furthermore, if disability incidence has a negative effect on employment, then a decline in disability incidence may be expected to increase employment and, consequently, increase WLE. WLE is defined as the number of years lived before retirement age while employed. To investigate to what extent increases in LE and DFLE can be translated into changes in WLE, we used MSLTs published by Majer et al., using ECHP data, to calculate LE/DFLE/WLE in various scenarios. (NB: The Netherlands was excluded from the life table analysis because of missing data on mortality in the ECHP.) WLE was calculated using the Sullivan method which takes the prevalence of employment by age as input.

Table 1 Selection criteria for cases and controls, three-step selection procedure

<table>
<thead>
<tr>
<th>Cases</th>
<th>$t_1 = t$</th>
<th>Non-disabled and employed</th>
<th>$t_2 = t + 1$</th>
<th>Disabled and employed</th>
<th>$t_3 = t + 2$</th>
<th>Disabled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controls</td>
<td>$t_1 = t$</td>
<td>Non-disabled and employed</td>
<td>$t_2 = t + 1$</td>
<td>Non-disabled and employed</td>
<td>$t_3 = t + 2$</td>
<td>Non-disabled</td>
</tr>
</tbody>
</table>
Besides calculating LE/DFLE/WLE using the default values for the input parameters, we also calculated them in a scenario in which we assumed disability incidence rate to decrease with 10% at ages 50–75. Comparing the values of LE/DFLE/WLE in the scenario with those in the baseline case allows assessing to what extent changes in LE/DFLE translate into changes in WLE. A 10% decrease in disability incidence impacts LE, DFLE and also WLE through changes in the number of people remaining alive in the life table. In addition to these changes in WLE, the decrease in disability incidence would also have a direct impact on the probability of employment estimated as ‘ATE’. When the disability incidence decreases, the decreased proportion of disabled people would have employment decreases that are a factor of ATE times that of rates under the original disability incidence. After the age of 75, we assumed the effect of disability on employment to be zero in the scenario analysis.

**Results**

Table 2 shows the employment prevalence and the prevalence of being disabled for people aged 50–65 in the ECHP data. In each country, around 20–30% of people reported having a disability. In this age category, less than 50% (except in Portugal and Denmark) reported being employed. However, comparing with analyses using the SHARE data, the employment prevalence in the ECHP data might be underestimated.

We defined cases and controls using two different selection procedures. The sample size (Supplementary table S1) for the three-step selection adjustment was much smaller than for the two-step selection adjustment.

Table 3 shows the estimated effect of disability incidence on employment status for nine different countries. In the baseline case, we estimated the association of present disability with present employment with no adjustment for confounders. For all the countries, the magnitudes of the effects are ordered from high to low in the following manner: baseline case, two-step selection adjustment and then three-step selection adjustment. The decrease in the effect size is in line with the aim of the selection procedures and matching adjustments to eliminate any spurious correlation between disability and employment. Thus, it is likely that the estimated effect of the three-step selection procedure is smaller than the two-step selection procedure because it excludes persons who have become more seriously disabled and therefore became not employed immediately. With the three-step procedure, not all the countries showed a significant effect. However, the estimates for Denmark, Ireland, Portugal and Spain showed significant effects in both selection procedures.

**Scenario analyses**

Table 4 presents LE, DFLE and WLE at age 50 by country. The baseline life expectancies were calculated using the MSLTs with default input parameter values; then, we assumed a decline of 10% in disability incidence rate, and presented the changes in LE, DFLE and WLE. Based on the different estimated effect of disability on employment (table 3), we have three different changes for WLE: ∆WLE (unadjusted), ∆WLE (two-step adjustment) and ∆WLE (three-step adjustment). The decrease in disability incidence resulted in an increase in LE, DFLE and WLE. However, the increase in WLE is much smaller than the increase in LE and DFLE. This is because in the life table model the change in the prevalence of employment followed by a decrease in disability is quite small. Also note that even though the unadjusted effect is much higher than the two-step ATE or three-step ATE in table 3, the differences between the ∆WLE (unadjusted) and ∆WLE (two-step adjustment) or ∆WLE (three-step adjustment) are not proportional to the differences in the ATE. This can be explained by the fact that changes in WLE are not only influenced by the ATE but also by the mechanism that lower mortality rates (as a result of a lower disability incidence) increase WLE. This mechanism also explains why for countries with a positive ATE in the three-step selection procedure WLE still increases in the lower disability incidence scenario.

**Conclusion**

This study estimated the effect of disability on employment and then investigated how this effect translates into changes in WLE. Our results indicate that becoming disabled increases the probability of leaving the labour market. However, although decreases in disability incidence have a relatively big impact on LE and DFLE, WLE is affected to a much lesser degree. Our analysis showed that the effect of disability on employment differs strongly by country and depending on the methodology used to estimate the effect; the life table analysis showed consistently that increases in DFLE only lead to smaller increases in WLE.

Table 2 Proportion employed and proportion disabled for the different countries

<table>
<thead>
<tr>
<th>Country</th>
<th>Proportion disabled</th>
<th>Proportion employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>0.22</td>
<td>0.40</td>
</tr>
<tr>
<td>Denmark</td>
<td>0.27</td>
<td>0.62</td>
</tr>
<tr>
<td>France</td>
<td>0.28</td>
<td>0.45</td>
</tr>
<tr>
<td>Greece</td>
<td>0.21</td>
<td>0.45</td>
</tr>
<tr>
<td>Ireland</td>
<td>0.20</td>
<td>0.47</td>
</tr>
<tr>
<td>Italy</td>
<td>0.18</td>
<td>0.39</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>0.30</td>
<td>0.46</td>
</tr>
<tr>
<td>Portugal</td>
<td>0.33</td>
<td>0.52</td>
</tr>
<tr>
<td>Spain</td>
<td>0.26</td>
<td>0.38</td>
</tr>
</tbody>
</table>

Note: The prevalence is estimated from raw data of all individuals aged 50–65 years.

Table 3 ATE of disability on labour force outcome—being employed

<table>
<thead>
<tr>
<th>Country</th>
<th>Unadjusted</th>
<th>Adjusted two step</th>
<th>Adjusted three step</th>
</tr>
</thead>
<tbody>
<tr>
<td>Belgium</td>
<td>−0.60 (0.116)**</td>
<td>−0.15 (0.060)**</td>
<td>0.07 (0.053)</td>
</tr>
<tr>
<td>Denmark</td>
<td>−0.63 (0.094)**</td>
<td>−0.07 (0.029)**</td>
<td>−0.02 (0.010)*</td>
</tr>
<tr>
<td>France</td>
<td>−0.34 (0.063)**</td>
<td>−0.08 (0.046)*</td>
<td>0.04 (0.073)</td>
</tr>
<tr>
<td>Greece</td>
<td>−0.48 (0.061)**</td>
<td>−0.19 (0.021)**</td>
<td>−0.06 (0.039)</td>
</tr>
<tr>
<td>Ireland</td>
<td>−0.69 (0.084)**</td>
<td>−0.13 (0.027)**</td>
<td>−0.12 (0.042)**</td>
</tr>
<tr>
<td>Italy</td>
<td>−0.33 (0.075)**</td>
<td>−0.13 (0.026)**</td>
<td>0.06 (0.039)</td>
</tr>
<tr>
<td>The Netherlands</td>
<td>−0.20 (0.061)**</td>
<td>−0.05 (0.025)*</td>
<td>−0.01 (0.038)</td>
</tr>
<tr>
<td>Portugal</td>
<td>−0.65 (0.035)**</td>
<td>−0.23 (0.018)**</td>
<td>−0.06 (0.022)**</td>
</tr>
<tr>
<td>Spain</td>
<td>−0.50 (0.057)**</td>
<td>−0.21 (0.023)**</td>
<td>−0.12 (0.053)*</td>
</tr>
</tbody>
</table>

Standard errors are given in brackets.
*Significant at 10% level; **Significant at 5% level; ***Significant at 1% level.
There are several limitations to our analysis. First, the sample size was small for the exposed group using the three-step selection procedure. If the treated and controls are not perfectly balanced, this might have caused a biased estimate of causal effect in some cases. Furthermore, even though the ATE estimated with the three-step selection procedure ensured that the direction of the effect was from disability to outcome of employment, it ignored individuals who are seriously disabled and who may lose their jobs soon after becoming disabled. This could have led to an underestimation of the effects. Another limitation is that disability status in our study was measured by one single question, ‘Are you hampered in daily activities by any physical or mental health problem, illness or disability?’ However, a more comprehensive validated scale might have provided more precise information on which type of disability factor would have a higher impact on employment. Also, information was lacking on some determinants of disability, such as previous working conditions and personality characteristics. In this study, we focused on the elderly who are relatively close to retirement which may have biased our findings. These people are probably more prone to retire by a personal decision before the standard age for retirement. For instance, at these ages, some people might opt for retirement in order to take care of their grandchildren. However, we failed to correct for these types of life events as the ECHP data did not allow us to do so. Finally, there is the issue of response in the ECHP. Low response rates might have been a problem in our study if they had been highly related to disability. Analyses on attrition in the ECHP showed a positive relationship with worsening health in all countries.20 However, loss to follow-up for reasons other than death or institutionalization was hardly related to disability status. Previous studies suggested that directly estimating treatment effects using traditional regression analyses might give similar results as propensity score modelling.24 To investigate whether this would also be the case in our study, we have also estimated regression models using a similar model specification in terms of confounders as employed in our propensity score model. From Supplementary table S2, it can be seen that the results are rather similar. However, it should be noted that the model specification was developed using the CART with outcome variable: being disabled or not. We could never develop such a model if we would have refrained from the matching analysis.

Notwithstanding the limitations mentioned above, we have been able to arrive at some important conclusions. Compared with the raw differences in employment rates for disabled and non-disabled people, disability can only explain a small portion of the lower employment rate among disabled people. The ATEs after the adjustments were introduced are much smaller than the unadjusted association of disability and employment. The differences of the estimates across countries can be partially explained by the differences in the institutional features among countries. In Ireland, e.g., disability benefits are not compatible with any kind of work, therefore individuals with mild disabilities might be more willing to leave labour market to get any sort of social benefit. Furthermore, Portugal and Spain have ample compensation policies for the disabled in terms of benefit levels compared with other countries in our study.1,4 One can expect that individuals who might benefit from better compensation policies have more incentives to exit the labour market due to the social benefits, and vice versa. Our results are also consistent with this perception.

Notwithstanding the limitations of the data, our results indicate that an increase in years lived without disability does not translate 100% into an increase in working lives. This suggests that other factors besides health, such as the mentioned life events, play an important role in retirement decisions. These obviously need further investigation. An implication of these findings is that health policies aimed at reducing disability are not sufficient to increase WLE and that additional policy measures (also outside the domain of health) are required to achieve that goal. Furthermore, as many countries have increased statutory retirement age, it would be interesting to investigate whether the relation between health and employment has changed in light of these policies.

In conclusion, individuals who become disabled are more likely to leave the labour market. However, increases in DFLE as a result of decreases in disability incidence do not translate 100% into increases in WLE.

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Conflicts of interest: None declared.

Key points

- Poor health reduces the capability to work and decreases labour participation.
Individuals who become disabled are more likely to leave the labour market.
The effect of disability on employment is smaller than a simple descriptive analysis suggests and varies by country.
Decreases in disability incidence have a bigger impact on (disability free) life expectancy than on working life expectancy.

References