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Assessing factors associated with long-term work disability after cancer in Belgium: a population-based cohort study using competing risks analysis with a 7-year follow-up

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ABSTRACT

Objectives The number of workers with cancer has dramatically increasing worldwide. One of the main priorities is to preserve their quality of life and the sustainability of social security systems. We have carried out this study to assess factors associated with the ability to work after cancer. Such insight should help with the planning of rehabilitation needs and tailored programmes.
Participants We conducted this register-based cohort study using individual data from the Belgian Disability Insurance. Data on 15 543 socially insured Belgian people who entered into the long-term work disability between 2007 and 2011 due to cancer were used.
Primary and secondary outcome measures We estimated the duration of work disability using Kaplan-Meier and the cause-specific cumulative incidence of ability to work stratified by age, gender, occupational class and year of entering the work disability system for 11 cancer sites using the Fine and Gray model allowing for competing risks.
Results The overall median time of work disability was 1.59 years (95% CI 1.52 to 1.66), ranging from 0.75 to 4.98 years. By the end of follow-up, more than one-third of the disabled cancer survivors were able to work (35%). While a large proportion of the women were able to work at the end of follow-up, the men who were able to work could do so sooner. Being women, white collar, young and having haematological, male genital or breast cancers were factors with the bestlikelihood to be able to return to work.
Conclusion Good prognostic factors for the ability to work were youth, woman, white collar and having breast, male genital or haematological cancers. Reviewing our results together with the cancer incidence predictions up to 2025 offers a high value for social security and rehabilitation planning and for ascertaining patients' perspectives.

Strengths and limitations of this study

- ► (Good) External validity: we used a population-based dataset without loss of follow-up; the external validity is therefore largely not limited, and the study offers high value (when linked with cancer incidence predictions) for the planning of rehabilitation needs for patients with cancer up to year 2025.
- ► Use of competing risk analysis: competing risks were added to the traditional survival analysis to respect the complexity of the outcomes. This is still rarely done in disability studies.
- ► Incomplete model: the lack of information on treatments and job demands limited the capacity of our model to (1) support the identification of a precise risk profile and (2) to tailor return-to-work interventions.

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BACKGROUND

The direct and indirect effects of work disability represent a significant burden for people who are absent due to sickness and to their families and their employers.[1] Long-term work disability may lead to social exclusion, deprivation or economic insecurity,[2] as well as poor health.[3] The negative impact of work disability on both social and health status is of high importance for public health,[4] but studies identifying those cancer survivors who are at risk of experiencing long-term work disability and identifying the avoidable proportion of work disability are lagging behind.

Work disability imposes significant costs on society[5 6] with up to 5% of gross domestic product in Organisation for Economic Co-operation and Development (OECD) countries being spent on disability benefits.[5] In 2010, the OECD published a report describing the barriers to (re)integration in the labour market for people with disability (ie, greater competition, more demanding workload and work pressure).[5] The report also describes the

Table 1 Number of cause-specific disabled workers in Belgium (top five evolution 2007–2013)

Group of diseases	2007	2008	2009	2010	2011	2012	2013
Mental heath	74 054 (33%)	78 112 (34%)	83 247 (34%)	88 535 (34%)	92 899 (34%)	98 171 (35%)	104 291 (35%)
Musculoskeletal and connective	58 032 (26%)	60 595 (26%)	65 146 (27%)	69 583 (27%)	74 192 (28%)	79 643 (28%)	86 071 (29%)
Circulatory diseases	19 372 (9%)	19 216 (8%)	19 427 (8%)	19 571 (8%)	19 549 (7%)	19 772 (7%)	19 963 (7%)
Traumatic injuries and poisoning	15 302 (7%)	15 776 (7%)	16 538 (7%)	17 080 (7%)	17 635 (7%)	18 383 (6%)	18 955 (6%)
Tumours*	13 592 (6%)	14 266 (6%)	15 103 (6%)	16 083 (6%)	16 742 (6%)	17 591 (6%)	18 462 (6%)
Others (13 other conditions)	43 332 (19%)	44 188 (19%)	45 748 (19%)	47 083 (18%)	48 482 (18%)	49 981 (18%)	51 666 (17%)
Total	223 684 (100%)	232 153	245 209	257 935	269 499	283 541	299 408

Annual Report National Institute for Health and Disability Insurance, 2014.
*Including cancers and benign tumours.

underlying social and economic tragedies. As the results for Belgium were poor, with a decrease in the number of people with disabilities employed over the past decade, authorities and social security administrators have been looking for measures or interventions to reverse the trend. A number of studies have been performed to support the authorities, but these are mainly qualitative and are based on small samples of cancer survivors.[7–13]

Insurance medicine researchers and epidemiologists acknowledge differences between diagnoses in terms of the duration of work disability.[14 15] Overall, the leading causes of work disability are musculoskeletal disorders and mental health problems, which have been widely studied.[16]

In Belgium, cancer is the fifth greatest cause of work disability, with 18 462 people on work disability due to cancer in 2013 (6.2% of all workers on work disability in Belgium)[17] (table 1). Each year, more than 25 000 Belgian inhabitants of working age (20–64 years) are diagnosed with cancer.

Over the last decade, cancer treatments in middle and high-income countries have greatly improved, leading to increased rates of cancer survival.[18 19] Despite these improved survival rates, a cancer diagnosis still causes great distress among individuals and their relatives[20] and is associated with work disability or death by their colleagues and supervisors.[7 21–24]

This automatic association of cancer with death is becoming less and less accurate, however, as was notably demonstrated in the study by Dal Maso *et al*[25] that a quarter of Italian cancer survivors have reached a death rate similar to that of the general population.

Cancer survivors can experience physiological and/or psychosocial symptoms due to side effects or long-term effects of treatment[26] and are more likely to report fair or poor health overall in all age groups.[27] For these survivors, work can represent a return to health or normality; a safeguard of their financial security, self-esteem and social contacts.[28–33]

Many studies have highlighted social inequalities in relation to return to work (RTW) among cancer survivors[34] The well-established relationship between socioeconomic position (SEP) and long-term sickness absence predicts that returning to work will be more difficult for cancer survivors in manual occupations.[35 36] Previous research has shown that working conditions and psychosocial conditions in manual occupations act as additional barriers.[35 37 38] Alongside the impact of working conditions, the unequal use of cancer rehabilitation services[39] may also lead to social inequalities in terms of RTW. It has also been shown that cancer survivors with a low SEP more commonly become unemployed[40] or take early retirement, which can act as a substitute for sickness absence benefits or unemployment.[40–42]

The Belgian context

In Belgium, cessation of work due to sickness must be reported to the employer immediately. The employer pays the guaranteed salary for 14 working days for blue-collar workers (manual workers) and 28 working days for white-collar workers (intellectual workers). For self-employed or unemployed individuals, the social security system (SSS) covers salary replacement after 28 working days. The absence due to sickness must be confirmed by a general practitioner or a specialist doctor.

After the period of guaranteed income from the employer, the SSS takes over the provision of a replacement income. The benefits for sickness-related absences vary between 40% and 65% of the reference salary, depending on the family situation (figure 1).

The SSS distinguishes between short-term and long-term work disability. Short-term work disability lasts up to 1 year, while long-term work disability is for periods exceeding 1 year. The division reflects a different evaluation method for assessing the worker's eligibility for sickness absence benefits as well as the calculation of the level of sickness absence benefits.

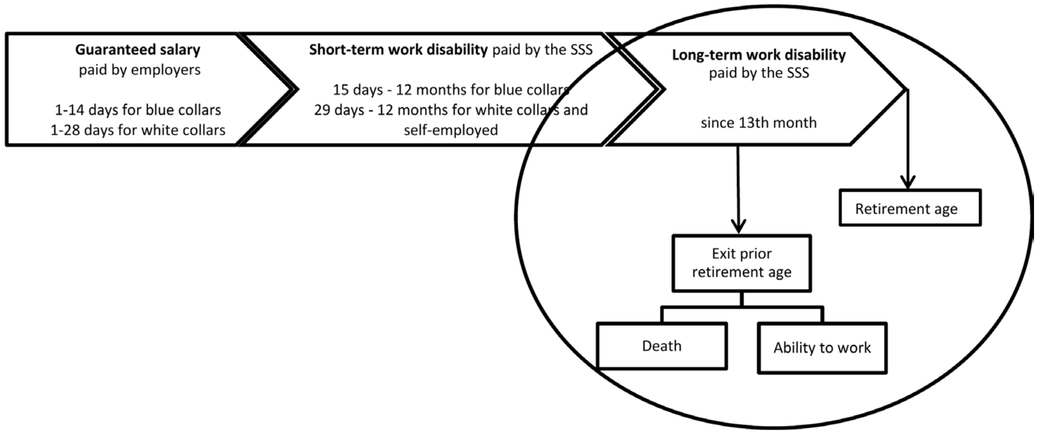

Figure 1 The Belgian social security scheme related to work disability. SSS, social security system.

Entitlement to long-term sickness absence benefits begins as of the second year after stopping work (13th month) and continues until the age of retirement, with no limit of duration. This applies to employees, self-employed and unemployed socially insured Belgian citizens. Civil servants (almost 20% of the Belgian workforce) benefit from a specific social security scheme. In Belgium, more than 90% of citizens are socially insured and covered by compulsory health insurance.[43]

There is an important knowledge gap in Belgium regarding a quantitative assessment of the impact of cancer on work disability. The following aspects need to be better understood: how long the work disability lasts, how the work disability ends, which workers are more at risk and so on. Our research helps to fill this gap. It is based on a recent model, developed in 2011 to study RTW after cancer,[22] which proposes a comprehensive list of influencing factors. Among these, we have been able to collect and analyse data on the following: age, gender, occupational class (OC), site of cancer and work-related outcomes (ability to work, retirement, death and disability).

This study is part of the scientific approach initiated in 2012 at the request of the Federal Ministry of Public Health and Social Security[44 45] to provide evidence and support for the decision-making process to improve and facilitate the professional reintegration of cancer survivors.

Our work reflects research on work disability due to cancer. Work disability is defined or measured as a legal status based on administrative definitions, that is, eligibility for benefit.

This article describes and discusses the results of a population-based cohort study of people with long-term cancer-related work disability, that is, receiving sickness absence benefits for more than 1 year. We will refer to this population below as 'disabled workers'. They have been followed for 3–7 years to measure the outflow from work disability to either retirement, ability to work or death.

METHODS

Study population

We presented the list of data required, the objectives and the format in which we planned to publish the results to the scientific board of the National Institute for Health and Disability Insurance (NIHDI). No ethical or privacy issues were identified by the Board, which allowed the extraction of the required data and the transfer of the coded dataset to the Cancer Centre of the Scientific Institute of Public Health (IPH). All data are administrative data automatically collected by the NIHDI. We therefore did not need informed consent from the workers. The coded data were transferred to the IPH through Outlook and are stored on the local server of the IPH that meets data safety and protection standards.

We included all socially insured Belgian people who entered into long-term work disability due to cancer between 1 January 2007 and 31 December 2011, excluding civil servants who are not included in the NIHDI database. From the total of 21 701 individuals, 6098 were excluded either due to their work disability starting before 1 January 2007 (and non-equivalent follow-up time) or due to inconsistent records (see figure 2). The last update of the data was on 31 December 2013, resulting in a maximum follow-up of 7 years.

Design and statistical analysis

We conducted a register-based cohort study, using data from the disability register of the NIHDI. Our research had three goals. Our first goal was to measure the duration of work disability by the year of entry in the work disability system. To achieve this first goal, we calculated the Kaplan-Meier estimate.

Second, following the taxonomy set out in theories of work disability,[46] our study aimed to build a prognostic model to estimate the subdistribution hazards of each event (death, ability to work and retirement) in the presence of competing risks using the Fine and Gray[47] model. For each event, the model was built separately for men and women, while adjusting for age, year of entry, cancer site and OC.

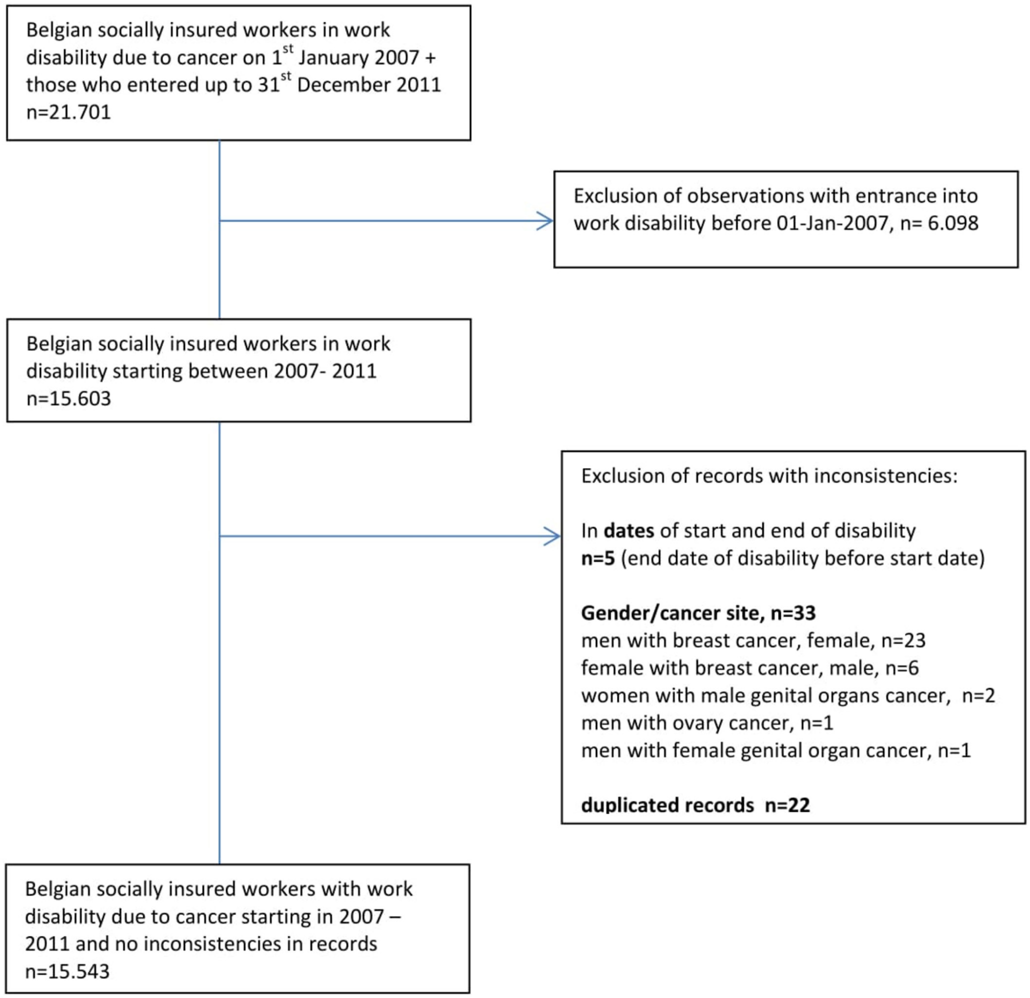

Figure 2 Flow chart of the number of workers disabled because of cancer between 2007 and 2011 in Belgium.

A third objective was to investigate social inequalities for ability to work among cancer survivors, paying attention to differences in age, gender and OC and adjusting for year of entry. For this, we also used the Fine and Gray model, replacing the cancer sites with four categories of cancer: those with low,[i] medium[ii] and high[iii] survival rates, according to the age-standardised 5-year relative survival (ASRS), calculated by the Belgian Cancer Registry.[48] The missing category includes those individuals with a cancer site for which the ASRS was not available.[iv] The two rationales behind this approach were as follows: first, it generates a parsimonious model (it avoids the lack of convergence due to the large size of the data set). Second, this approach makes it possible to account for the severity of the disease.

For the two first objectives, we used the 'cmprsk' package of the statistical software R which allows subdistribution analysis of competing risks. For the third objective, we used the Stata's V.14 stcrreg package.

Independent prognostic variables

Sociodemographic characteristics included in our study were age at entry into the work disability system, gender and OC. The age variable was based on the date of birth and was further categorised into four groups: 17–39; 40–49; 50–59 and 60+years. OCs were based on four categories: blue-collar workers, white-collar workers,

[i]Low survival rates: 'oesophagus', 'stomach', 'colon and rectum', 'pancreas', 'Other malignant neoplasm (Oth. Mal. Neop.) of digestive organs and peritoneum', 'mesothelioma', 'trachea and lung', 'myeloid and others', 'CNS', 'Oth. malignancies and undefined sites, invasive'.

[ii]Medium survival rates: 'lip and oral cavity, nasal cavities, middle ear and accessory sinuses, pharynx, larynx', 'non-Hodgkin's disease', 'uterus', 'cervix', 'ovary', 'Oth. mal. neop. women genitals', 'cervix', 'ovary', 'Oth. mal. neop. of women genitals', 'bladder', 'urinary system other than bladder', 'bone and connective tissue'.

[iii]High survival rates: 'Hodgkin disease', 'acute lymphoid leukaemia and lymphoid leukaemia, other', 'breast women', 'uterus', 'kidney', 'melanoma of the skin', 'thyroid and other endocrine glands'.

[iv]Missing survival rates: 'benign tumour', 'Mal. neop. of skin other than melanoma', 'Oth. malignancies and undefined sites, CIS', 'tumours of uncertain and unspecified behaviour'.

self-employed people and assisting spouses. They were recoded into a three-level variable: blue-collar workers, white-collar workers and self-employed people.

In total, 39 cancer sites have been identified using the ‘pathology codes’ transmitted by the NIHDI and registered by their International Classification of Diseases, Ninth Revision (ICD-9) codes (table 2). For the sake of comparability, we translated these into ICD-10 codes and gathered them into 11 cancer sites (table 2).

The year of entry in the work disability system was a continuous variable ranging from 2007 to 2011. We decided to recode the year of entry into a two-level variable: 2007–2010 and 2011. This decision is based on an exploratory analysis that showed significant difference in survival patterns between disability acquired before or after 2011 (log-rank test=502, df=1, P value<0.001) (figure 3).

Outcome variables: three competing events

The outcome variable is the event that causes the end of work disability. We defined three mutually exclusive events, that is, competing risks: death, retirement and ability to work.

The status retirement indicates that the worker is definitively out of the labour market due to age and will receive social benefits until death, while able to work indicates that the cancer-disabled worker was recognised by a health insurer's doctor as able to work. In practice, this might lead to an RTW, to unemployment or to a decision to be a stay-at-home spouse.

Those long-term workers with disability who had not experienced any event by the end of follow-up, on 31 December 2013, were administratively censored (38%, table 3).

RESULTS

Description of the study population

No observed workers were lost to follow-up. Table 3 describes the main characteristics of the work-disabled cancer survivors included in the study.

The majority (77%) of the cancer-disabled workers were aged 40–59 years.

Women were over-represented (62%), younger at entry (median age of 48 vs 53 years for men) and mostly white-collar workers (46% vs 21% for men) or blue-collar workers (43% vs 60%). After 3 years of follow-up, the outcome for the majority of cancer-disabled women (irrespectively from their year of entry) was disability (42.35%), while for most men the outcome was death (43.52%).

The most frequent cancer site was breast, representing 35% (n=5949) of disabled workers, followed by 15% (n=2400) of digestive tract cancers and 9% (n=1417) of respiratory tract cancers.

Regarding OC, half of the disabled workers were blue-collar workers, the majority of whom (41.34% of the total) were still disabled after 3 years of follow-up. White-collar workers (37%) had the shortest median time of work disability (1.30 years vs 1.79 years for the others), and the majority (40.74%) were able to work after 3 years of follow-up. Self-employed disabled workers represented 13% of the cohort, and the majority (38.82%) were still in disability after 3 years of follow-up.

After 3 years of follow-up, 62% of the cohort had experienced one of the three competing events (29% died, 1% retired and 32% were able to work). The other 38% remained disabled (table 3).

Figures 4–8 show the non-parametric cause-specific cumulative incidences of time to ability to work in the presence of competing risks. For all prognostic variables, the curves show a steep increase in ability to RTW within the first 2 years; later, the curves virtually level off.

Figures 9–12 show the box plots of time to any event (death, ability to work or retirement) stratified by each prognostic variable, respectively.

Younger workers (17–39 years) had the highest rates of ability to work at the end of follow-up (figure 5) and relatively short periods of work disability (figure 9), mainly due to the ability to work. Older workers presented the shortest work disability periods (figure 9), mainly due to death or retirement (59.14%, table 3).

Women had higher rates of ability to work compared with men (figure 6) but spent longer periods in work disability (figure 10). White-collar workers had higher rates of work disability and spent less time in it (figure 11). Regarding the cancer sites, workers with breast or haematological cancer had the highest rates of ability to work by the end of follow-up (figure 8) but the longest periods spent on work disability (figure 12). Those with respiratory tract, head and neck, digestive or central nervous system (CNS) cancers had the lowest rates of ability to work (figure 8) and shorter periods of work disability (figure 12), mainly due to death.

Prediction patterns of the end of work disability (model 1)

Results in table 4 suggest that good prognostic factors for the ability to work for both men and women are disability experienced after 2011 and white-collar OC. Regarding the 11 cancer sites, men with haematological or genital organ cancers are the most likely to be able to work. Among women, the cancer sites with the best chance for ability to work are haematological and breast.

Concerning deaths among men, disabled workers with respiratory tract, CNS, bone and connective tissue cancers are most at risk. Among women, those with respiratory tract, female genital organs, digestive tract and head and neck cancers are most at risk.

Social inequalities in the work disability of cancer survivors (model 2)

In the second model, we stratify by age and gender and allow interactions between both these variables and OC and survival categories (table 5). The absence of individuals in certain age categories entering retirement (17–49 years, table 2) leads to a convergence issue when

Table 2 The 11 cancer groups used for the analysis

Groups	The 11 cancer groups by anatomical location	5-year relative survival rate in men* (%)	5-year relative survival rate in women* (%)	Survival rate category	Frequency observed in the data
1	Other malignancies and undefined sites, CIS Benign tumours			NA	1247
2	Head and neck: lip, oral cavity, nasal cavities, middle-ear and accessory sinuses, pharynx, larynx	50.0	57.0	Medium	877
3	Digestive tract	22.8	22.7	Low	2400
	Oesophagus				257
	Stomach				218
	Colon and rectum				1479
	Pancreas				209
	Other malignant neoplasms of digestive organs and peritoneum				237
4	Respiratory tract	14.6	19.5	Low	1417
	Trachea and lung				1404
	Mesothelioma				13
5	Haematological				1660
	Hodgkin disease	86.1	85.0	High	263
	Non-Hodgkin disease	67.0	68.9	Medium	711
	Acute lymphoid leukaemia and lymphoid leukaemia and others	81.3	76.7	High	161
	Myeloid leukaemia and others	38.5	40.6	Low	307
6	Breast	78.2	88.0	High	5511
	Female breast				5494
	Male breast				17
7	Female genital organs				821
	Corpus uterus	-	Cervix uteri 69.8	Medium	273
	Cervix uteri		Corpus uterus 79.6	High	147
	Ovary		Ovary 54.1	Medium	362
	Others				
8	Male genital organs	95.3	—	High	486
	Prostate				377
	Testis				94
	Others				16
9	Urinary tract				388
	Kidney	71.0	0.7	High	147
	Bladder	56.6	49.2	Medium	178
	Others				63
10	CNS	22.7	25.8	Low	709
11	Bone and connective tissue (sarcomas)	61.9	59.7	Medium	
	Melanoma of the skin	86.2	91.0	High	
	Malignant neoplasms of skin other than melanoma			NA	
	Thyroid and other endocrine glands	89.3	94.1	High	

Continued

Table 2 Continued					
Groups	**The 11 cancer groups by anatomical location**	**5-year relative survival rate in men* (%)**	**5-year relative survival rate in women* (%)**	**Survival rate category**	**Frequency observed in the data**
	Other malignancies and undefined sites, invasive	51.5	39.1	Medium/low	
	Tumours of uncertain and unspecified behaviour			NA	
Total					15 543

*Reference: Belgian Cancer Registry. Cancer Survival in Belgium, 2004–2008.
CIS, carcinoma in situ; CNS, central nervous system; NA, not applicable.

modelling the cause-specific hazard for this type of event and this is therefore not reported.

Table 5 shows that, among men, blue-collar and self-employed workers aged 50–59 years were less likely to be able to work compared with white-collar workers. Similar results were found for blue-collar women aged 17–39, 40–49 and 50–59. These results translate into larger social inequalities in the 50–59 age group for both men and women.

Self-employed men were less likely to be able to work than white-collar workers when aged 17–39 or 50–59 and similarly for women aged 50–59.

DISCUSSION

In this study, we aimed to identify the factors that influence the reason for exiting the long-term work disability system and the length of work disability among cancer survivors.

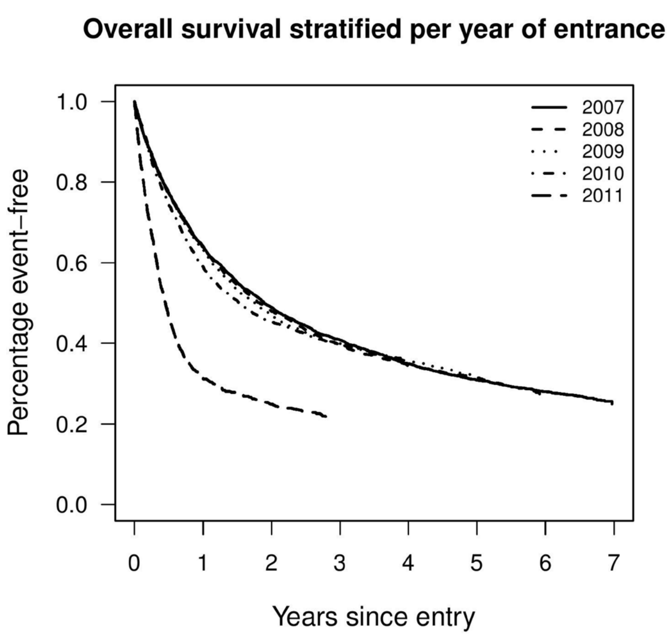

Figure 3 Kaplan-Meier estimator for the time in work disability, stratified by the year of entrance into work disability. Ending long-term work disability happens by death, retirement or ability to work, whichever occurs first.

To achieve this, we first measured the association between the duration of work disability and age, gender, OC, the year of entry into the work disability system and 11 cancer sites. Second, we estimated the distribution of three competing reasons for exiting the work disability system; and third, we investigated social inequalities in work disability among cancer survivors.

As not many of the population-based studies in this field include several cancer sites or use competing risk analysis, making comparisons is not easy. Moreover, our follow-up starts 1 year after the first day of sickness absence, that is, we only include long-term disabled workers. However, the impact of these determining factors on labour market participation has been tested in previous studies.[49] Results indicate that, overall, older age at entry into the work disability system and male gender are both factors that decrease the chance of being economically active. Our results show that an older age (>60 years) increase the risk of dying or retiring, and that workers aged 40–49 were the most likely to remain with disability for a long period (table 3). Men did indeed reduce the likelihood of being able to work but women experienced longer periods within the work disability system overall.

Regarding the cancer sites, we found a strong association between respiratory tract, head and neck and digestive tract cancers and death. The first two include smoking-related cancer sites,[50] which represent major sources of work disability and death in the working age population.

Other studies have compared different cancer sites to assess their association with employment status after cancer diagnosis. In line with our results, workers with respiratory and female genital cancers present smaller proportions of employment than workers with breast or haematological cancers, mainly due to poor self-reported health status.[26 27 51]

In line with previous research, blue-collar and self-employed workers are less likely to be able to work after cancer compared with white-collar workers, especially those aged 50–59 years.[26] According to other research, these social inequalities could be explained by more demanding working conditions,[52] later stage of cancer at diagnosis, differences in treatment[53] and lower participation in

Table 3 Description of the characteristics of the individuals included in the cohort, their median time spent in disability, the rate of those experiencing one of the three competing events and the rate of those remaining work disabled after 3 years of follow-up

n=15 543	Total individuals n (%)	Median time spent in work disability (years) (CI 95%)	3-year cumulative probability of ending work disability: Death	Retirement	Ability to work	Work disability (censored)
Year of entry						
2007	3454 (22.2)	1.89 (1.780 to 2.048)	29.04 (27.52–30.55)	1.51 (1.10–1.91)	28.69 (27.18–30.20)	40.76 (36.74–44.78)
2008	3760 (24.2)	1.83 (1.717 to 1.960)	28.64 (27.20–30.09)	1.65 (1.24–2.06)	30.13 (28.67–31.60)	39.57 (35.62–43.52)
2009	3630 (23.4)	1.76 (1.621 to 1.889)	28.76 (27.29–30.23)	0.74 (0.46–1.02)	30.61 (29.11–32.11)	39.89 (35.90–43.88)
2010	3388 (21.8)	1.54 (1.410 to 1.670)	27.54 (26.03–29.04)	0.56 (0.31–0.81)	32.29 (30.72–33.86)	39.61 (35.45–43.77)
2011	1311 (8.4)	0.45 (0.413 to 0.487)	31.59 (29.01–34.17)	0.54 (0.14–0.93)	46.76 (44.04–49.47)	21.12 (10.23–32.00)
Age at entry						
17–39	2421 (15.6)	1.51 (1.415 to 1.69)	18.46 (16.91–20.00)	–	45.53 (43.54–47.52)	36.01 (30.69–41.33)
40–49	5052 (32.5)	1.76 (1.637 to 1.88)	22.74 (21.59–23.90)	–	36.17 (34.84–37.49)	41.09 (37.78–44.39)
50–59	6946 (44.7)	1.70 (1.580 to 1.79)	34.21 (33.10–35.33)	–	25.51 (24.48–26.53)	40.28 (37.41–43.15)
≥60	1121 (7.2)	0.91 (0.797 to 1.06)	44.19 (41.28–47.10)	14.95 (12.86–17.04)	21.51 (19.10–23.92)	19.34 (7.36–31.33)
Gender						
Male	5874 (38)	1.18 (1.12 to 1.26)	43.52 (42.26–44.79)	1.5 (1.19–1.82)	23.15 (22.08–24.23)	31.82 (28.07–35.57)
Female	9669 (62)	1.94 (1.84 to 2.05)	19.78 (18.98–20.57)	0.82 (0.64–1.00)	37.06 (36.09–38.02)	42.35 (40.02–44.67)
Occupational class						
Blue collar	7715 (50)	1.79 (1.72 to 1.89)	31.43 (30.39–32.46)	0.59 (0.42–0.76)	26.65 (25.66–27.63)	41.34 (38.68–44.00)
White collar	5703 (37)	1.30 (1.23 to 1.37)	24.46 (23.34–25.57)	0.63 (0.43–0.84)	40.74 (39.47–42.02)	34.17 (30.56–37.78)
Assisting spouse and self-employed	2125 (13)	1.79 (1.63 to 1.97)	30.56 (28.60–32.53)	4.08 (3.24–4.92)	26.53 (24.66–28.41)	38.82 (33.47–44.18)
Cancer site						
CIS/Benign	614 (4)	4.98 (3.24 to 6.72)	10.76 (8.31–13.21)	1.14 (0.30–1.98)	33.07 (29.35–36.79)	55.03 (47.87–62.18)
Head and neck	877 (5.6)	1.69 (1.41 to 1.93)	44.43 (41.14–47.73)	0.35 (0.00–0.74)	17.69 (15.17–20.22)	37.53 (28.97–46.08)
Digestive tract	2400 (15.4)	1.31 (1.18 to 1.41)	42.15 (40.18–44.13)	1.76 (1.23–2.28)	23.98 (22.27–25.69)	32.11 (26.29–37.94)
Respiratory tract	1417 (9.1)	0.75 (0.69 to 0.83)	69.91 (67.52–72.30)	0.86 (0.37–1.34)	9.47 (7.94–10.99)	19.77 (9.26–30.28)
Haematological	1660 (10.7)	1.83 (1.66 to 2.08)	20.56 (18.62–22.51)	0.91 (0.45–1.36)	37.39 (35.06–39.72)	41.14 (35.38–46.90)
Breast	5511 (35.0)	2.10 (1.95 to 2.30)	10.29 (9.49–11.09)	0.78 (0.55–1.02)	44.80 (43.49–46.12)	44.13 (41.15–47.10)
Female genital organs	821 (5.3)	1.56 (1.37 to 1.82)	34.50 (31.25–37.76)	0.12 (0.00–0.36)	28.76 (25.67–31.86)	36.61 (27.60–45.62)
Male genital organs	486 (3.1)	1.73 (1.52 to 2.24)	17.93 (14.52–21.35)	6.21 (4.06–8.36)	36.25 (31.97–40.53)	39.60 (28.60–50.61)
Urinary tract	388 (2.5)	1.67 (1.32 to 2.16)	38.19 (33.35–43.03)	1.55 (0.32–2.78)	21.39 (17.31–25.47)	38.86 (26.37–51.36)
CNS	709 (4.6)	1.46 (1.18 to 1.89)	45.92 (42.25–49.60)	0.42 (0.00–0.90)	16.23 (13.52–18.95)	37.42 (27.88–46.96)

Continued

Table 3 Continued

n=15 543	Total individuals	Median time spent in work disability (years)	3-year cumulative probability of ending work disability			
	n (%)	(CI 95%)	Death	Retirement	Ability to work	Work disability (censored)
Bone and connective tissue (sarcomas)/skin/thyroid	660 (4.2)	1.24 (1.03 to 1.52)	39.13 (35.40–42.86)	0.76 (0.10–1.42)	26.55 (23.18–29.92)	33.56 (22.81–44.31)
Total, n (%)	15 543	1.59 (1.52 to 1.66)	4468 (29%)	167 (1%)	4943 (32%)	5964 (38%)

CIS, carcinoma in situ; CNS, central nervous system.

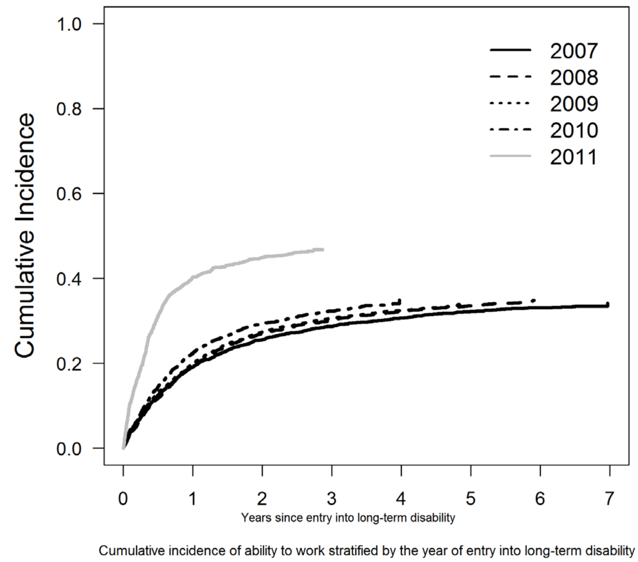

Figure 4 Cumulative incidence of ability to work stratified by the year of entrance into long-term disability.

rehabilitation services[39] among blue-collar workers. OC is also strongly associated with the income level, which may represent an incentive to RTW when it is significantly different (higher) than sickness absence benefits.[36]

A different impact of the OC on the risk of work disability according to age and gender has been shown in a Norwegian county, where young workers with blue-collar jobs are more at risk than older men.[54] The association between age and RTW has been reported with contradictory results in the literature, but the majority

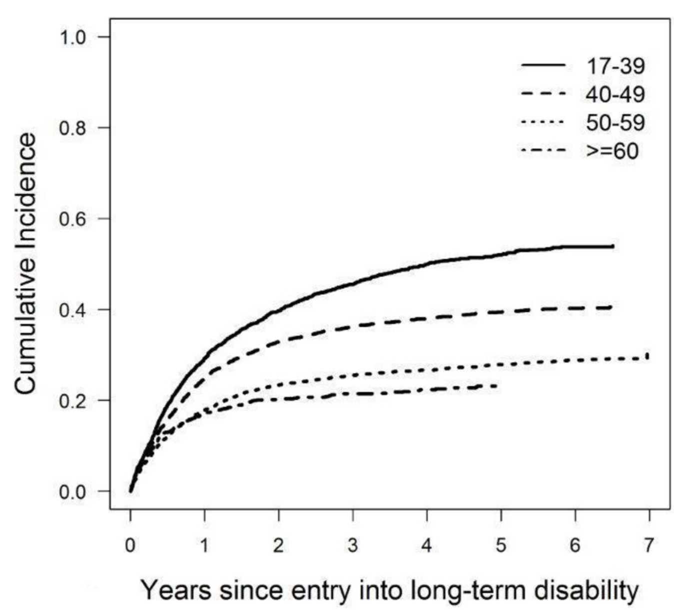

Figure 5 Cumulative incidence of ability to work stratified by the age at entry into long-term disability.

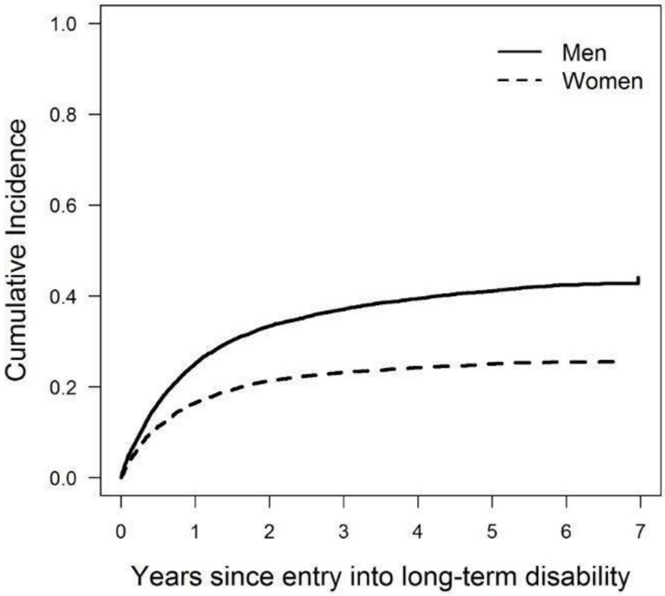

Figure 6 Cumulative incidence of ability to work stratified by gender.

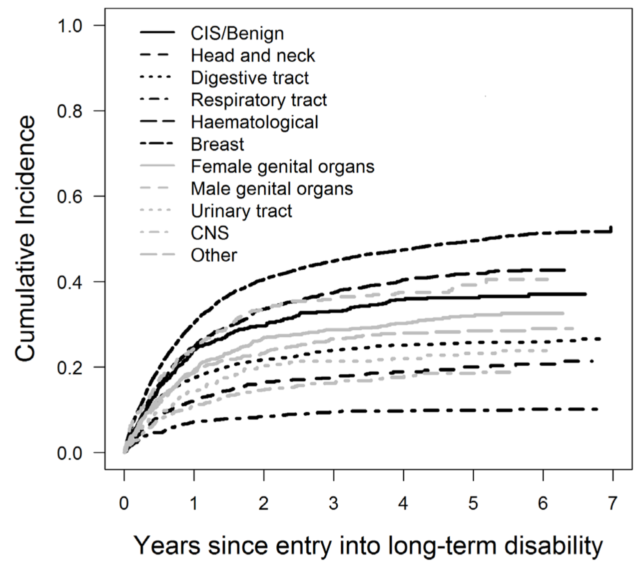

Figure 8 Cumulative incidence of ability to work stratified by cancer site. CIS, carcinoma in situ. CNS, central nervous system.

found higher age to be associated with later RTW or reduced chance of employment.[34] Our results show that, for Belgian cancer survivors, the opposite is found, with a larger impact of OC from the age of 40 years onwards compared with younger counterparts.

Demographic changes and the rising retirement age will increase the number of disabled workers and the length of work disability. Combined with the effects of the economic crisis (ie, greater competition and emphasis on maximum performance) this will worsen the situation if we do not implement measures, interventions and rehabilitation programmes to better (re)integrate disabled workers in the labour market.[5]

The measure introduced by the Belgian government by the end of 2010 seems to have had an impact already, as the workers who entered the work disability system in 2011 showed better outcomes than the others. In 2011, a new measure was implemented, allowing disabled workers to resume work without prior agreement of the health insurer's medical advisor.

Further studies need to be carried out in future to confirm this trend. However, at the end of follow-up, only

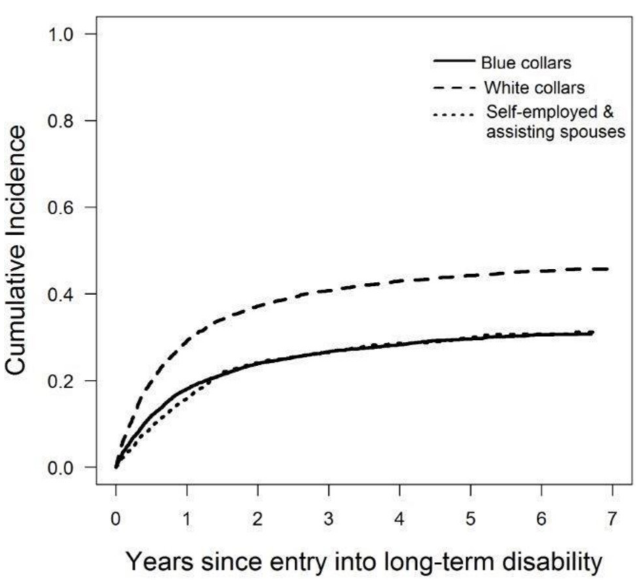

Figure 7 Cumulative incidence of ability to work stratified by occupational class.

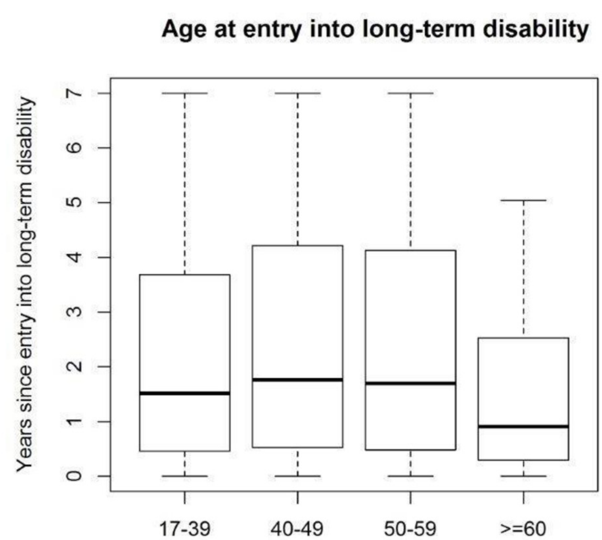

Figure 9 Box plot of time to any event (death, retirement or ability to work) stratified by the age at entry into long-term disability.

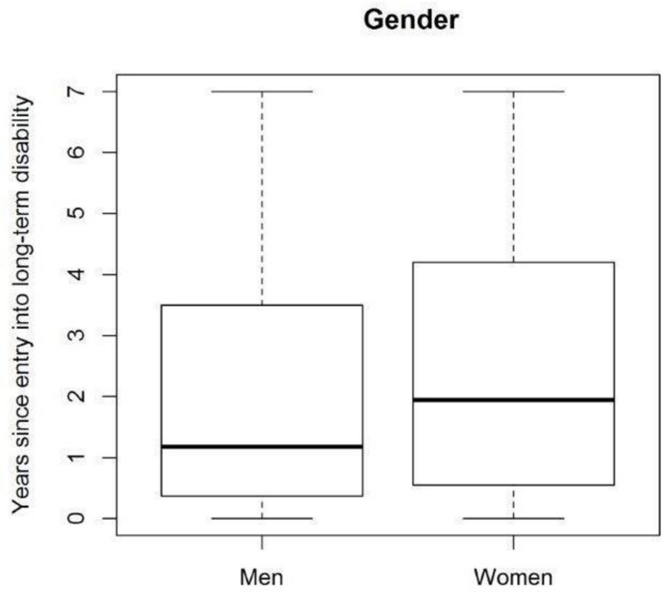

Figure 10 Box plot of time to any event (death, retirement or ability to work) stratified by gender.

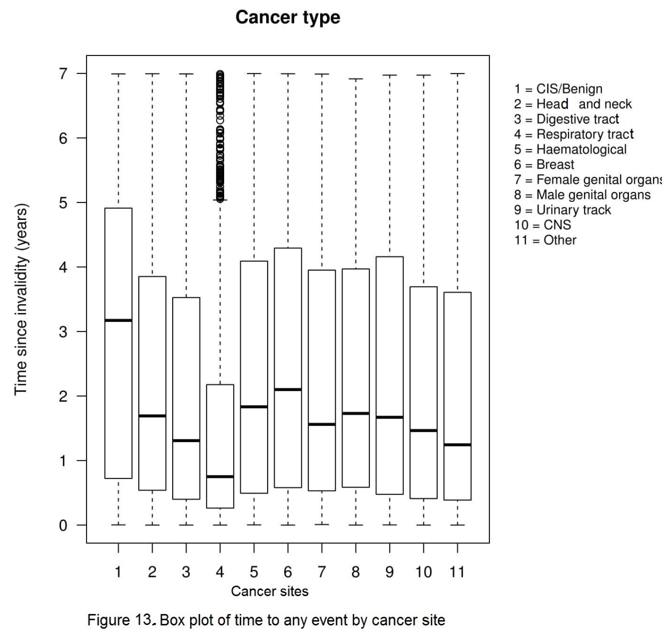

Figure 12 Box plot of time to any event (death, retirement or ability to work) stratified by cancer site. CIS, carcinoma in situ; CNS, central nervous system.

34.6% of the cancer survivors were able to work and 31% were administratively censored, remaining disabled.

Based on our results, key features of (work) rehabilitation programmes can be drawn. The non-parametric cause-specific cumulative incidence of time to ability to work (figure 4) suggests that interventions should be planned and implemented within the 2 years after the cancer diagnosis. Differences in age and gender imply tailoring of and specific attention to the needs of young workers and women. The association of the cancer site with the length of disability suggests that the awareness of oncologists who treat breast cancer, digestive track cancers and head and neck cancers, should be raised on the RTW and that they need to be involved in the assessment and management of symptoms.

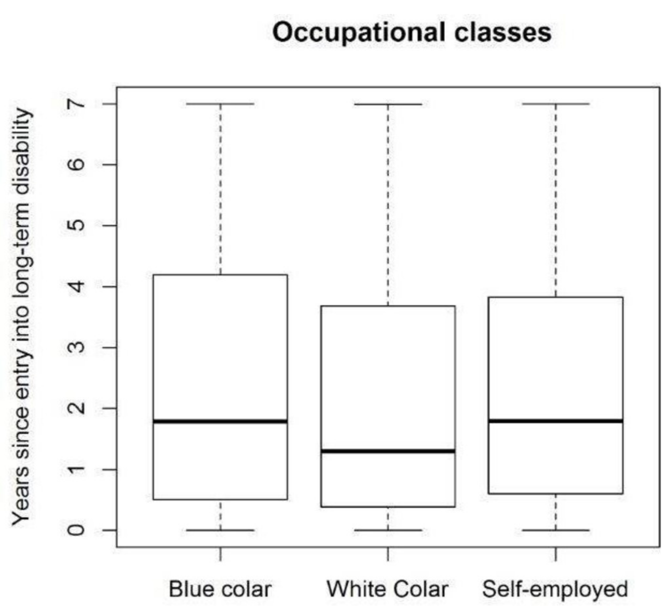

Figure 11 Box plot of time to any event (death, retirement or ability to work) stratified by occupational class.

The negative association of being blue collar or self-employed calls for the revision of employment policies for these high-risk groups, with for example, the creation of incentives for employers to adjust the working conditions of their sick-listed blue-collar workers.

Strengths, limitations and need for further research

The main strength of this study is the representativeness of the data and the generalisability of our results. We included in the analysis all Belgian workers disabled due to cancer between 2007 and 2011, excluding civil servants and individuals for whom we detected coding errors.

In most work disability studies, survival analyses are used to estimate the time to an event of interest. The end of work disability is, however, more complex than this, and may be caused by multiple factors. Therefore, the use of competing risks analysis becomes appropriate to avoid overestimating or underestimating the probability of experiencing each event.[55] This model is still rarely used in work disability studies and its use should be encouraged.

Regarding the objective of predicting disability, the two models showed their capacity to and effectiveness in predicting the length and the reasons for ending work disability among Belgian cancer survivors. Our second model presents original findings, using the survival rates to identify social inequalities.

Nevertheless, regarding the objective of providing insights on the content of work rehabilitation programmes, crucial information is lacking: the stage at diagnosis, the

Table 4 Model 1: SHR for the status at the end of follow-up

	Subdistribution HR at the end of follow-up (stratified by gender)											
	Men						Women					
	Death		Ability to work		Retirement		Death		Ability to work		Retirement	
	SHR	95% CI	SHR	95% CI	SHR	95% CI	SHR	95% CI	SHR	95% CI	SHR	95% CI
Year of entry												
2007–2010	1		1		1		1		1		1	
2011	1.26	(1.08 to 1.47)	1.55	(1.30 to 1.84)	0.21	0.07 to 0.69	1.14	(0.96 to 1.36)	2.03	(1.82 to 2.27)	0.41	(0.14 to 1.17)
Cancer site												
(1) CIS and benign	1		1		1		1		1		1	
(2) Head and neck	2.79	(1.97 to 3.94)	0.59	(0.43 to 0.82)	0.37	(0.12 to 1.17)	4.24	(2.66 to 6.77)	0.77	(0.54 to 1.11)	0.25	0.03 to 2.44
(3) Digestive track	2.73	(1.94 to 3.82)	0.85	(0.65 to 1.12)	0.50	(0.19 to 1.31)	4.84	(3.26 to 7.19)	0.69	(0.55 to 0.86)	0.57	0.16 to 2.05
(4) Respiratory track	5.81	(4.14 to 8.17)	0.34	(0.24 to 0.48)	0.18	(0.05 to 0.59)	10.0	(6.71 to 14.92)	0.27	(0.19 to 0.38)	0.18	0.03 to 0.93
(5) Haematological	1.47	(1.03 to 2.09)	1.14	(0.87 to 1.50)	0.52	(0.19 to 1.46)	2.15	(1.40 to 3.28)	1.11	(0.89 to 1.37)	0.84	0.21 to 3.34
(6) Breast	1.29	(0.45 to 3.67)	0.13	(0.02 to 0.97)	–	–	1.24	(0.85 to 1.83)	1.42	(1.19 to 1.71)	0.72	0.21 to 2.42
(7) Female genital organs	–	–	–	–	1.20	–	4.93	(3.33 to 7.32)	0.81	(0.65 to 1.02)	0.05	0.01 to 0.51
(8) Male genital organs	0.86	(0.58 to 1.27)	1.38	(1.04 to 1.85)	0.62	(0.46 to 3.09)	–	–	–	–	–	–
Urinary track	2.62	(1.78 to 3.85)	0.70	(0.48 to 0.67)		(0.21 to 1.87)	3.75	(2.20 to 6.38)	0.74	(0.48 to 1.13)	0.73	(0.15 to 3.49)
Central nervous system	3.87	(2.71 to 5.54)	0.47	(0.35 to 0.57)	0.14	(0.03 to 0.74)	6.48	(4.26 to 9.88)	0.41	(0.29 to 0.58)	0	–
Bone and connective tissue	2.93	(2.01 to 4.27)	0.76	(0.53 to 1.09)	0.46	(0.12 to 1.81)	5.32	(3.50 to 8.07)	0.75	(0.57 to 1.0)	0.20	(0.02 to 2.01)
Occupational class												
White collar	1		1		1		1		1		1	
Blue collar	1.02	(0.92 to 1.14)	1.49	(1.31 to 1.71)	1.46	(0.82 to 2.60)	1.06	(0.96 to 1.18)	1.43	(1.32 to 1.54)	0.75	0.45 to 1.24
Self-employed or assisting spouse	0.83	(0.73 to 0.93)	0.85	(0.72 to 1.01)	3.24	(2.02 to 5.21)	0.94	(0.80 to 1.12)	1.07	(0.95 to 1.22)	1.84	1.13 to 3.02
Age group												
19–39	1		1		–		1		1		–	
40–49	1.57	(1.29 to 1.91)	0.57	(0.48 to 0.67)	–	–	1.10	(0.93 to 1.30)	0.81	(0.74 to 0.89)	–	–
50–59	1.92	(1.60 to 2.31)	0.41	(0.35 to 0.48)	1	–	1.42	(1.22 to 1.67)	0.64	(0.58 to 0.71)	1	–
≥60	2.43	(1.96 to 3.02)	0.45	(0.36 to 0.57)	106.20	(39.73 to 284.06)	2.15	(1.70 to 2.71)	0.49	(0.39 to 0.62)	105.5	(54.3 to 204.8)

CIS, carcinoma in situ; SHR, subdistribution HR.

Table 5 Subdistribution HR based on the Fine and Gray model stratified by age and gender and adjusted for year of entry

Subdistribution HR at the end of follow-up					
		Men		Women	
		Death	Ability to work	Death	Ability to work
17–39					
Survival rate	High	1	1	1	1
	Medium	1.16 (0.48–2.82)	0.78 (0.47–1.29)	1.69 (1.08–2.65)	0.75 (0.57–0.99)
	Low	2.63 (1.21–5.72)	0.33 (0.19–0.60)	2.91 (1.99–4.26)	0.38 (0.27–0.53)
	Missing	2.17 (0.88–5.40)	0.50 (0.25–0.98)	1.33 (0.77–2.29)	0.58 (0.42–0.81)
Occupational class	White collar	1	1	1	1
	Blue collar	0.48 (0.20–1.15)	0.86 (0.58–1.27)	1.41 (1.02–1.93)	0.58 (0.48–0.69)
	Self-employed	1.43 (0.53–3.84)	0.48 (0.26–0.87)	1.13 (0.60–2.11)	1.05 (0.81–1.38)
40–49					
Survival rate	High	1	1	1	1
	Medium	1.53 (0.74–3.15)	1.22 (0.66–2.25)	3.19 (2.39–4.27)	0.58 (0.46–0.72)
	Low	3.32 (1.67–6.61)	0.63 (0.33–1.20)	5.84 (4.32–7.90)	0.24 (0.17–0.35)
	Missing	0.89 (0.32–2.47)	1.69 (0.82–3.50)	2.96 (2.08–4.22)	0.60 (0.46–0.78)
Occupational class	White collar	1	1	1	1
	Blue collar	1.12 (0.53–2.34)	0.79 (0.42–1.47)	1.42 (1.13–1.80)	0.59 (0.53–0.67)
	Self-employed	1.27 (0.47–3.42)	1.74 (0.88–3.43)	0.96 (0.62–1.49)	0.84 (0.70–1)
50–59					
Survival rate	High	1	1	1	1
	Medium	1.39 (0.93–2.10)	0.82 (0.53–1.24)	3.21 (2.53–4.07)	0.55 (0.44–0.70)
	Low	3.21 (2.15–4.77)	0.38 (0.24–0.61)	6.01 (4.73–7.64)	0.21 (0.14–0.31)
	Missing	1.47 (0.86–2.52)	0.76 (0.42–1.36)	2.22 (1.62–3.04)	0.75 (0.57–0.98)
Occupational class	White collar	1	1	1	1
	Blue collar	0.88 (0.57–1.34)	0.60 (0.39–0.92)	1.07 (0.86–1.34)	0.75 (0.65–0.86)
	Self-employed	0.75 (0.45–1.24)	0.57 (0.33–0.96)	1.34 (0.98–1.83)	0.69 (0.56–0.86)
≥60					
Survival rate	High	1	1	1	1
	Medium	1.13 (0.51–2.52)	2.26 (0.90–5.68)	2.85 (1.52–5.38)	0.91 (0.47–1.76)
	Low	3.16 (1.52–6.55)	0.72 (0.25–2.06)	3.92 (1.91–8.03)	0.29 (0.10–0.86)
	Missing	2.14 (0.69–6.66	1.21 (0.29–4.99)	2.68 (0.95–7.54)	0.41 (0.09–1.89)
Occupational class	White collar	1	1	1	1
	Blue collar	1.39 (0.61–3.13)	1.57 (0.60–4.08)	1.06 (0.54–2.09)	0.80 (0.46–1.39)
	Self-employed	0.55 (0.23–1.34)	1.19 (0.46–3.10)	1.09 (0.55–2.18)	0.60 (0.32–1.12)

type of treatment received and the side and long-term effects of the treatment[56]; the specific occupation and the working environment.[57] The inclusion of these variables in our models would allow a more complex but efficient model, explaining the remaining differences that still exist among workers of the same age, gender, OC and cancer site. This is feasible in the future, for example, by linking data from cancer registries to data on employment and socioeconomic status. Results could be used to develop rehabilitation programmes for cancer survivors similar to those that already exist in other countries.[58–61]

While our paper focuses on work disability among cancer survivors in Belgium, it is important to realise that the methods and principles used are generic and applicable for addressing work disability as a whole. Therefore, this report is also relevant for other conditions and SSS. This paper contributes towards closing the knowledge gap on the transition among cancer survivors from long-term work disability to ability to RTW. Linking these important results to predictions of cancer incidence should make it possible to plan cancer rehabilitation needs and related sickness absence benefits.

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