Short-term effect of colorectal cancer on income: analysis of an Italian cohort

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► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/jech-2022-220088).

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Received 16 November 2022
Accepted 17 January 2023
Published Online First
27 January 2023

To cite: Farina E, Rosso M, Dansero L, *et al*. *J Epidemiol Community Health* 2023;**77**:196–201.

ABSTRACT

Introduction The ability to return to work after a cancer diagnosis is a key aspect of cancer survivorship and quality of life. Studies have reported a significant risk of income loss for cancer survivors; however, there is limited evidence of the Italian context.

Methods The Work Histories Italian Panel (WHIP)-Salute database was used to select a cohort of incident cases of colorectal cancer (CRC) among workers in the private sector, based on hospital discharges. A propensity score matching was used to find a balanced control group for several confounders. Ordinary least square and logistic regressions were used to estimate the effect of a CRC diagnosis on annual income and the probability of switching from a full-time contract to a part-time one considering 3 years after the diagnosis.

Results Overall, we identified 925 CRC incident cases from 2006 until 2012. Our results confirm a statistically significant reduction in survivors' income compared with controls. This reduction was greater in the first year and then tend to decrease, with an average income loss over 3 years of about €12 000. Stratified analyses by sex and position confirmed the overall trend while indicating a strong effect modification. Regarding the switching from full-time to part-time employment, the results were never significant.

Conclusion Income loss does not seem to be related to an increase in part-time contracts, but rather to survivors' reduced work capacity following the invasive treatments. Further research is needed to investigate the complex dynamics behind this association.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Cancer survivors are more likely to report financial issues than the general population, including income reduction and unemployment.
⇒ The ability to return to work after cancer depends on cancer type, country-specific welfare benefits, job security, and labour laws.

WHAT THIS STUDY ADDS

⇒ This is the first study investigating the effect of receiving a diagnosis of colorectal cancer (CRC) on income and contract type in Italy.
⇒ The results show that a diagnosis of CRC can negatively impact the yearly income in the first 3 years after diagnosis and that gender and job position can influence this reduction.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The results of this study, which help to clarify the dynamics that affect patients with CRC and to identify more vulnerable groups in relation to income loss, are useful to redesign and target policies related to the return to work of survivors.

INTRODUCTION

Colorectal cancer (CRC) is estimated to have the second-highest incidence rate and the third mortality rate among cancers worldwide.[1] In the last decades, substantial improvements in cancer screening, management and therapies have increased diagnosis and survival rates in many countries. In Italy, the 5-year survival rate of CRC incident cases is estimated to be 77% for women and 76% for men in 2020. This rate increased by approximately 11% compared with the period 2010–2014.[2] Meanwhile, as early diagnosis became more common, the incidence of CRC among younger patients of working age significantly incremented.

Psychological, physical and social challenges could impact daily life. Treatments can leave long-lasting symptoms such as fatigue, pain and nutritional limitations.[3] Mental health is also a major complication affecting many survivors: anxiety-depressive syndrome is common even long after cancer diagnosis and is often misrecognised and untreated.[4 5] All these effects, both physical and psychological, can negatively affect daily life for a long time, including the ability to maintain a professional activity.

Studies have documented that cancer survivors are more likely to report financial issues than the general population, including income and working hours reduction, loss of productivity, or even unemployment.[6–11] The ability to fully return to work can be perceived as a key factor in cancer survivorship and better quality of life but has been reported to be challenging among many survivors.[12 13]

In Italy, more than 40 000 incident cases of CRC were estimated in 2020, with 40% of the diagnosis being among working-age individuals.[2] These figures are part of the reasons why understanding the actual impact of cancer on job careers and income is becoming essential.

Obtaining data integrating health information and job career is one of the major challenges as most of the available literature is based on survey

data which can only partly explain this association. The Work Histories Italian Panel (WHIP)-Salute database is so far the only available database integrating data on individual work careers and health information in Italy, offering a unique opportunity to study the relationship between cancer and work career.[14]

This study aims to investigate the impact of having a CRC diagnosis on annual income and the likelihood of moving from a full-time to a part-time contract, in the year of diagnosis and the following three, compared with the year before the diagnosis.

MATERIALS AND METHODS

Data sources

The WHIP database contains individual work histories extracted from the administrative archives of the National Institute for Social Welfare (INPS). The database was built from a systematic sample of workers selected every year based on 24 days of birth, and it represents 7% of the reference population. The career path was reconstructed for each subject considering work periods, retirement and unemployment benefits. Currently, the historical series covers the period from 1985 to 2012.

The WHIP sample is representative of the workers registered at the INPS; therefore, it represents the private sector (manufacturing, construction and services) and does not cover public employment and agriculture. It comprises employees, self-employed and para-subordinate, apart from some specific categories, for example, architects and lawyers, which are not registered at the INPS because they have their own pension funds. The most extensive and complete data regards employees, for whom demographic characteristics and various information on jobs and companies are available.

Data regarding health were extracted using the same sampling criteria: occupational injuries and diseases between 1994 and 2012 were retrieved from the archive of the National Insurance Institute for Occupational Injuries (INAIL); hospital discharges between 2001 and 2014 were retrieved from the archive of the Italian Ministry of Health; mortality between 1999 and 2012 was retrieved from the Italian National Institute of Statistics (ISTAT). Work and health information were linked via an encrypted unique identifier based on the worker's tax code. The whole integrated archive, called WHIP-Salute, covers the period from 2001 until 2012. For a more detailed description of the WHIP-Salute database, see Bena *et al*.[14]

Cohorts of workers

Starting from the WHIP-Salute database, a cohort of employee workers aged between 40 and 60, who worked for at least a period between 2006 and 2012, was initially selected. No restrictions were made on the type of contract (eg, permanent vs fixed term).

Based on hospital discharges, incident cases of CRC were identified for each year using the algorithm developed by Baldi *et al*.[15] All workers with an ICD-9-CM in the main diagnosis or the five secondary diagnoses associated with CRC (colon ICD-9-CM: 153.0–153.9, rectum ICD-9-CM: 154.0–154.1, 154.8), without hospitalisations in the previous 5 years (same ICD-9 codes as before), and without a history of CRC (ICD-9-CM V10.05–V10.06) were selected.

The cohort of exposed included all incident cases of CRC with a date of diagnosis within an active contract who were working the year before the diagnosis. The cohort of unexposed for each year included all employees who were working the year before and who were not prevalent nor incident cases of CRC of the selected year and the following three.

Propensity score matching

To balance the exposed and unexposed for several observed covariates, a propensity score matching (PSM) approach was used.[16] Initially, the first and the last percentile of income were eliminated to avoid possible measurement errors and exact matching of sex was performed. Then, within the sex strata, a 1:n PSM was done using the psmatch2 Stata command. The logit distribution was used to estimate the PS and multiple options were set up. To define a value for the maximum distance the width caliper was set at 0.02[17], and the common support option was used to drop exposed observations whose PS was higher than the maximum or less than the minimum of that of the unexposed, while the ties option was used to include all matched subject with identical PS. The procedure paired each exposed to all the possible unexposed within the caliper, thus the number of unexposed might vary. Weights have been given: the exposed counted 1, while each unexposed counted 1/n depending on the group size.

In the PSM, the following variables were included:

- Individual characteristics: year of cancer diagnosis, age in the year of diagnosis (continuous variable), nationality (born in high-income countries vs born in countries with strong migratory pressure as defined by the World Bank), annual income of the year preceding the diagnosis based on the deciles of the distribution.
- Job characteristics (primary contract of the year preceding the diagnosis): position (white collar vs blue collar), working hours (part time vs full time), type of contract (permanent vs fixed term), size of the firm (small: <50 employees, medium: 50–249 employees, big: ≥250 employees), geographical area of the firm (North of Italy, Centre, South and Islands), economic sector (Sector 1: ATECO 02 sections A, B, C, D, E, F; Sector 2: ATECO 02 sections G, H, I; Sector 3: ATECO 02 sections J, K; Sector 4: ATECO 02 L, M, N, O), job tenure (time elapsed from the beginning of the contract and the 31 December, ≤ 1 year vs >1 year). To select the job characteristics of the year preceding the diagnosis, we selected the primary employment contract. Specifically, if a worker had more than one work contract in the same year, as a rule, the end of employment date and the duration of the contract (in months) were used.

The method of standardised differences was used to assess the balance of covariates in the original and matched samples and to verify the success of propensity score modelling.[17 18] As a rule, more than 10% differences suggest an imbalance between the groups.[19] Moreover, to further examine the balance of covariates, we re-estimated the propensity score on the matched sample to compare the pseudo-R^2 before and after the matching.[20] Since pseudo-R^2 indicates how well the regressors explain the probability of being in the intervention group, after matching there should be no systematic differences in the distribution of covariates between the two groups and it should be fairly low.

Statistical analysis

To estimate the effect of a CRC diagnosis on income, ordinary least square regressions were applied. Four models were estimated separately using the income of the year of diagnosis (t_0) and of each of the following 3 years (t_1, t_2, t_3), respectively, as dependent variables, while exposure was the main independent variable of interest. The income of the year before the diagnosis and the fixed effects of the matched groups were included as control variables,

Table 1 Characteristics of the cohort of exposed

Variable	Year of diagnosis (t)							
	2006	2007	2008	2009	2010	2011	2012	Total
Sex								
Man	78 (67)	89 (68)	88 (71)	105 (71)	101 (74)	97 (69)	80 (62)	638 (69)
Woman	39 (33)	41 (32)	36 (29)	44 (29)	35 (26)	43 (31)	49 (38)	287 (31)
Age, mean (t-1)	50.7	50.9	50.3	50.4	50.8	51.2	51.1	
Position (t- 1)								
Blue collar	58 (50)	74 (57)	72 (58)	81 (54)	77 (57)	75 (54)	64 (50)	501 (54)
White collar	59 (50)	56 (43)	52 (42)	68 (46)	59 (43)	65 (46)	65 (50)	424 (46)
Working hours (t-1)								
Full time	101 (86)	113 (87)	110 (89)	126 (85)	120 (88)	117 (84)	97 (75)	784 (85)
Part time	16 (14)	17 (13)	14 (11)	23 (15)	16 (12)	23 (16)	32 (25)	141 (15)
Total	**117**	**130**	**124**	**149**	**136**	**140**	**129**	**925**

Results are expressed as n (%), unless otherwise indicated.

$$earnings\_t_i = \beta_0 + \beta_1 exposure + \beta_2 earnings\_t_{i-1} + \sum \beta_j * fixed\ effect_j$$

i=0, 1, 2, 3.

Moreover, to study the probability to switch from a full-time contract to a part-time one, logistic regression was used,

$$part\ time\_t_i = \beta_0 + \beta_1 exposure$$

i=0, 1, 2, 3.

Moving forward, over the years subjects who had already switched from full time to part time in the years before were excluded from the analyses.

Both models were performed overall and stratified by sex and position of the worker, while only the logit model was applied to a selection of workers who were working with a full-time contract in the year before the diagnosis.

In each year, if an employee became an autonomous or para-subordinate worker or started to receive a pension was excluded from the analysis of the current year, whereas if he died, he was excluded from the analysis of the following year. On the other hand, if a worker was no longer an employee but was not found in any of the other databases, he was considered unemployed and was given an income equal to zero.

To avoid unbalancing of the groups, if an exposed was excluded all his related unexposed were excluded too. Conversely, if an unexposed was excluded, the remaining observations were reweighted using the new count.

RESULTS

Overall, we selected 925 CRC incident cases during the period 2006–2012. Table 1 shows their demographic and job characteristics.

The balance between exposed and unexposed was achieved using the PSM procedure. Indeed, all the post-matching standardised differences are much less than 10%, almost all less than 2% (online supplemental figure S1). Furthermore, the mean bias was reduced from 11.6% to 0.9%, and the pseudo-R2 calculated on the matched sample was 0.001.

Workers exposed to CRC suffer a statistically significant reduction in income, starting from the cancer diagnosis (table 2).

The income reduction was greater in the first year after the diagnosis and then tend to decrease. During the observation period, on average, exposed earned about €12 000 less than their unexposed counterparts.

Stratified analyses confirmed the overall trend while indicating a strong effect modification. Both exposed men and women earn less than the unexposed but, considering the average of the whole sample, men have a greater reduction in income during the first 2 years, especially in the first year after the diagnosis (−€4800), and women suffer more from the third year onwards. Considering the position, blue-collar workers reduce their income by about €9000 during the first 2 years and by €4400 during the last two. On the other hand, white-collar workers start to significantly reduce their income from the second year (on average €3000 less each year).

All these results are confirmed by the analyses that consider only workers who have a full-time contract and who do not change their work schedule during the period (online supplemental table S1).

Figures 1 and 2 show the average annual income path by exposure, overall and stratified for sex and position. As expected, because of matching, the income trend before the year of diagnosis (t=0) is similar in exposed and unexposed and is growing. The results show that starting from the year of diagnosis, there is a general decrease in income. Even if reductions are more evident among the exposed, a slight decrease is present among the unexposed too. This reduction could be due to the specific period considered in our study which overlaps with the economic crisis.

Table 2 Linear regression on annual income, overall and stratified results for sex and position; results are expressed as a coefficient* (p value)

	Total	Man	Woman	Blue collar	White collar
t†	−2818.61 (0.000)	−3154.19 (0.000)	−2056.63 (0.000)	−3972.37 (0.000)	−1356.89 (0.059)
t+1	−4269.32 (0.000)	−4776.98 (0.000)	−3140.48 (0.000)	−5069.96 (0.000)	−3355.04 (0.007)
t+2	−2287.54 (0.011)	−2111.05 (0.076)	−2770.76 (0.016)	−1676.84 (0.057)	−2667.04 (0.111)
t+3	−3231.69 (0.004)	−3163.23 (0.029)	−3542.35 (0.030)	−2702.69 (0.026)	−2667.04 (0.067)

*Coefficients represent the average difference in annual income (in euros) between exposed and unexposed with respect to the year before the diagnosis.
†Where t is the year of diagnosis.

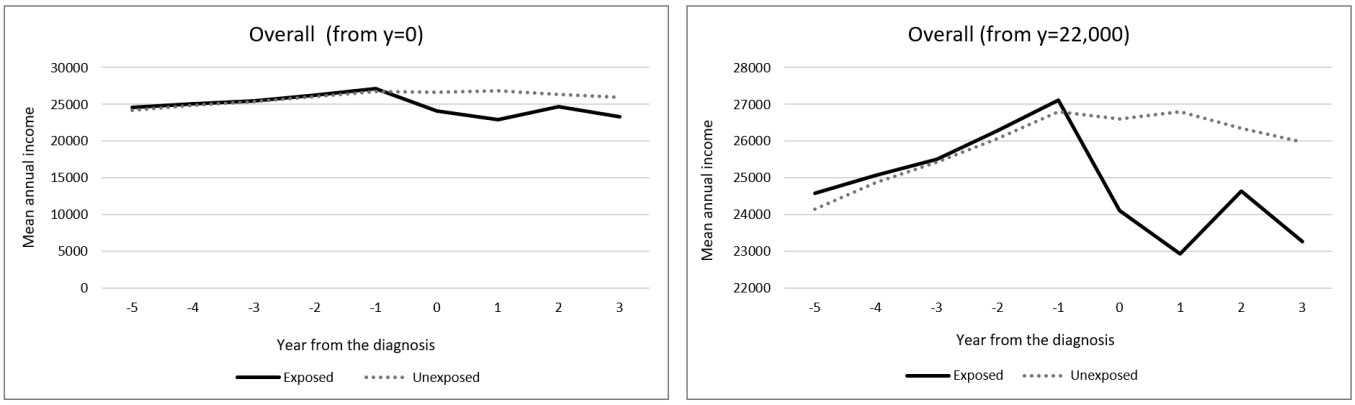

Figure 1 Average annual earnings path by exposure, where t=0 is the year of diagnosis.

Regarding the switching from full-time to part-time employment, results are never statistically significant (table 3).

However, it is possible to observe that, from the year after the diagnosis, the reduced work schedule was more widespread among those exposed to CRC than among the unexposed (ORs>1), both in the overall population and within subgroups. Even in this case, there seems to be an effect modification by gender and position. The rarity of the outcome may have influenced the results and the significance in the latest years and within subgroups.

DISCUSSION

This study on a nationwide systematic sample explores work career variations of CRC survivors, among middle-aged employees of the private sector, up to 3 years after diagnosis, focussing on income loss and changes in contract type.

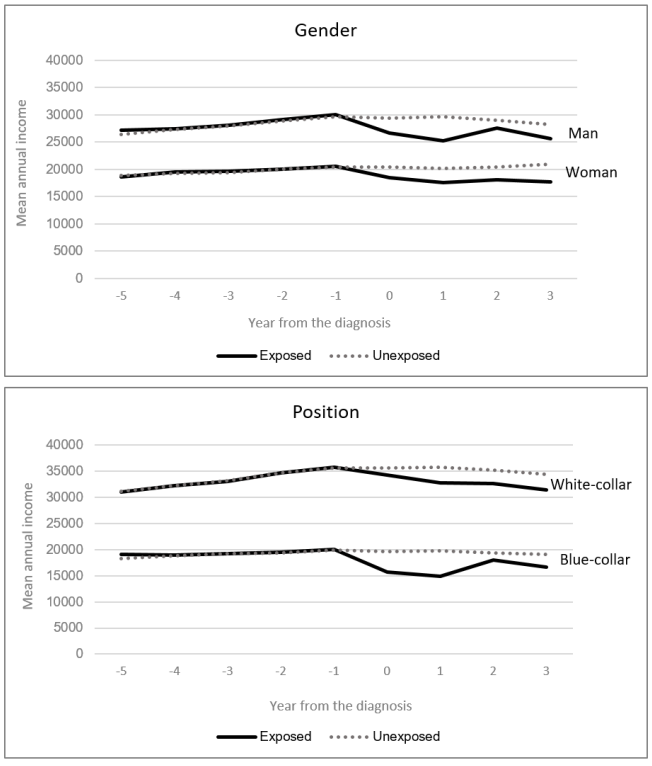

Figure 2 Average annual earnings path by exposure, stratified for gender and position, where t=0 is the year of diagnosis.

Our results show that a diagnosis of CRC can strongly impact the yearly income. Overall, we calculated a significant income loss 3 years after diagnosis, especially plunging during the first year. This reduction seems to be influenced by gender and job position, showing different patterns among the categories.

The negative effect of a cancer diagnosis on income is already established in the literature,[21 22] with some evidence on specific cancers such as breast cancer.[23 24] Literature suggests that the increase in part-time contracts and the reduction of working hours as explanations for the loss in income.[22 25 26] However, in our case, the income reduction does not seem to be related to an increase in part-time contracts as the analyses performed on the subsample of full-time workers confirm the overall trend.

We found a higher probability of becoming part-time workers for cancer survivors with respect to healthy subjects over time. Nevertheless, our analyses on part-time contracts are unpowered and further research is needed to confirm these results.

Another possible explanation for the income loss is directly linked with the reduced work capacity of CRC survivors due to treatments, therapies or after an ostomy surgical procedure,[27–29] which could be very invasive.

Since our systematic sample mainly includes workers from the private sector, we should consider remuneration as consisting of two parts: a fixed part and a variable part. The variable part usually depends on factors that lie outside of the standard job such as overtime, night shifts, bonuses based on performance, etc.[30–32] The reduction we found in the very short term (year of diagnosis and the following year) could be due to the decrease of the variable part as individuals on sick leave only receive the fixed part of the salary. On the contrary, in the long term, the fixed part could also be indirectly affected. As there is no career progression, the fixed part remains stable instead of increasing over time.

A major issue for cancer survivors who have reduced work capacity is related to the poor ability of the labour market to reintegrate workers into less demanding occupations. To date, there is no evidence of an association between cancer and mobility in other occupations with different job characteristics.[33] This lack of flexibility leads to a mismatch between the worker's reduced abilities and the job demands (both physical and mental) and could eventually lead to unemployment.[30] This happens more frequently when the worker is highly skilled or in small firms, where sometimes it is just not possible to find alternative employment.

Some studies have also found differences in the level of education and job title,[10 34 35] with blue-collar workers having almost

Table 3 Logistic regression on part-time, overall and stratified results for sex and position

		Total	Man	Woman	Blue collar	White collar
t*	New part-time exp/unexp	11/13	6/5	5/8	5/8	6/5
	OR (CI)	0.85 (0.38 to 1.92)	1.15 (0.35 to 3.72)	0.65 (0.21 to 2.04)	0.69 (0.22 to 2.18)	1.08 (0.30 to 3.84)
t+1	New part-time exp/unexp	9/7	2/4	7/3	3/5	6/2
	OR (CI)	1.33 (0.49 to 3.62)	0.46 (0.09 to 2.49)	2.92 (0.67 to 12.65)	0.62 (0.15 to 2.67)	3.03 (0.61 to 15.07)
t+2	New part-time exp/unexp	7/5	4/4	3/1	5/3	2/2
	OR (CI)	1.53 (0.47 to 5.00)	1.19 (0.28 to 5.10)	2.52 (0.30 to 21.22)	1.99 (0.43 to 9.15)	1.29 (0.16 to 10.63)
t+3	New part-time exp/unexp	9/4	5/2	4/2	6/2	3/2
	OR (CI)	2.37 (0.71 to 7.89)	2.11 (0.45 to 9.97)	2.85 (0.41 to 19.67)	2.84 (0.59 to 13.69)	1.78 (0.27 to 11.86)

Results are expressed as OR (CI).
*Where t is the year of diagnosis.
†Unexposed counts are calculated using weights.

three times the pay reduction of white-collar workers.[36] This is undoubtedly related to the fact that the tasks performed by blue-collar workers require more physical exertion, leading them more often to unemployment than white-collar workers. In addition, income capacity could be strongly affected if the employer adopts a pay-for-performance mechanism. As blue-collar's duties are often linked to physical labour, they are at risk of failing the productivity targets and losing incentives.

Working is fundamental in the recovery after cancer, providing psychological and economical benefits and promoting a sense of stability. Supportive interventions for CRC survivors integrating health and economic factors are needed. Outplacement should be easy and flexible, with the possibility of changing to less demanding and more suited jobs in line with the worker's reduced skills. As this could be challenging for small firms, external financial aid and incentives to those firms could facilitate the outplacement of workers. Moreover, specific training programmes could increase their chances of having more opportunities for re-employment in other types of jobs. The pay-for-performance mechanisms should be disincentivised or adapted differently in the case of illness survivors.

To redesign and target health policies, it is relevant to study the complex dynamics and possible paths that affect cancer survivors in relation to economic and social challenges and to understand which workers are most at risk of unemployment or income loss. Some studies have investigated the challenges related to the return to work after cancer from an employer's perspective; however, more evidence is needed to provide targeted policies.[23 37 38] Moreover, it is fundamental to consider the labour market institutions as they could substantially shape the labour response to health shocks.[39]

Further evidence is needed to determine the factors which influence the reduction in pay and the relationship with career opportunities, as well as the presence of possible discrimination phenomena. The psychological side of recovery after cancer should not be left outside, as it is fundamental in full recovery and could also affect the economical and social side. Each cancer has its effects in the short and long term, for this reason, it is appropriate to implement cancer-specific approaches.

Strengths and limitations

To our knowledge, this is the first study investigating the effect of having CRC on income and contract type in Italy. The WHIP database represents the main strength of this study as it gave us the unique opportunity to obtain information on the work histories of a representative sample directly from the National Institute for Social Welfare over a wide period.

Nonetheless, our study has also some limitations. Extracting data on cancer diagnosis from hospital discharges did not allow us to have information on the cancer stage. Therefore, we could not investigate the effect of cancer stages on work careers, which could have an impact on workability.[40] Another limitation is related to working hours, as we did not have the information on the number of hours per week worked, not allowing us to investigate if a reduction was present. Furthermore, we were unable to study public and self-employed workers, thus limiting the results' generalisability to the private sector employees.

CONCLUSION

In conclusion, we found that CRC survivors among middle-aged employees of the private sector had significant income loss after cancer diagnosis with variations between gender, contract type and job type. Understanding who is the most at risk of income loss after cancer is fundamental to providing integrated policies. Several factors could influence this association and further evidence is needed to fully understand which are the best economical, social and health approaches.

Correction notice This article has been corrected since it first published. The article is now open access under a CC BY licence agreement.

Contributors Conceptualisation: EF, MR, RI, GN, FR. Methodology: EF, MR, FR. Formal analysis: EF, MR. Data curation: EF. Software: MR. Writing—original draft preparation: EF, LD. Writing—review and editing: EF, LD, MR, RI, GN, AM, AB, FR. Supervision: AB, FR. Resources: AB. Validation: FR. Guarantor: FR. All authors have read and agreed to the published version of the manuscript.

Funding This project was funded by Compagnia di San Paolo, call 'TRAPEZIO - Paving the way to research excellence and talent attraction'.

Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval This study does not entail ethical approval. All activities, regardless of their complexity or depth, were conducted in accordance with Italian regulations on privacy (D.Lgs. 101/2018) and with the approval of the national institutes involved. Since 2013, the WHIP-Salute database has been included, under the responsibility of the Ministry of Health, in the National Statistics Programme that establishes what are the statistical surveys of public interest.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data may be obtained from a third party and are not publicly available. The statistical products available for release are defined within the National Statistics Program. A specific procedure to download an anonymised database with no linkage to individuals is available upon request. For a more detailed description of the WHIP-Salute database, see Servizio di Epidemiologia - Whipsalute.

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REFERENCES

1 Sung H, Ferlay J, Siegel RL, *et al*. Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA Cancer J Clin* 2021;71:209–49.
2 Associazione Italiana Registri Tumori (AIRTUM). *I numeri del cancro in italia 2021*. Intermedia Editore, 2021.
3 Arndt V, Merx H, Stegmaier C, *et al*. Quality of life in patients with colorectal cancer 1 year after diagnosis compared with the general population: a population-based study. *J Clin Oncol* 2004;22:4829–36.
4 Lloyd S, Baraghoshi D, Tao R, *et al*. Mental health disorders are more common in colorectal cancer survivors and associated with decreased overall survival. *Am J Clin Oncol* 2019;42:355–62.
5 Peng Y-N, Huang M-L, Kao C-H. Prevalence of depression and anxiety in colorectal cancer patients: a literature review. *Int J Environ Res Public Health* 2019;16:411.
6 Gordon LG, Beesley VL, Mihala G, *et al*. Reduced employment and financial hardship among middle-aged individuals with colorectal cancer. *Eur J Cancer Care (Engl)* 2017;26:ecc.12744.
7 de Boer AGEM, Taskila T, Ojajärvi A, *et al*. Cancer survivors and unemployment: a meta-analysis and meta-regression. *JAMA* 2009;301:753–62.
8 de Wind A, Tamminga SJ, Bony CAG, *et al*. Loss of paid employment up to 4 years after colorectal cancer diagnosis-A nationwide register-based study with a population-based reference group. *Cancers (Basel)* 2021;13:2868.
9 Kent EE, Davidoff A, de Moor JS, *et al*. Impact of sociodemographic characteristics on underemployment in a longitudinal, nationally representative study of cancer survivors: evidence for the importance of gender and marital status. *J Psychosoc Oncol* 2018;36:287–303.
10 Alleaume C, Bendiane M-K, Peretti-Watel P, *et al*. Inequality in income change among cancer survivors five years after diagnosis: evidence from a French national survey. *PLoS ONE* 2019;14:e0222832.
11 Blinder VS, Gany FM. Impact of cancer on employment. *J Clin Oncol* 2020;38:302–9.
12 Schuring M, Mackenbach J, Voorham T, *et al*. The effect of re-employment on perceived health. *J Epidemiol Community Health* 2011;65:639–44.
13 Cocchiara RA, De Blasio A, Sestili C, *et al*. Il ritorno al lavoro nei pazienti con cancro del colon retto: una revisione sistematica. *E&P* 2019;43:171–6.
14 Bena A, Leombruni R, Giraudo M, *et al*. A new Italian surveillance system for occupational injuries: characteristics and initial results. *Am J Ind Med* 2012;55:584–92.
15 Baldi I, Vicari P, Di Cuonzo D, *et al*. A high positive predictive value algorithm using Hospital administrative data identified incident cancer cases. *J Clin Epidemiol* 2008;61:373–9.
16 Rosenbaum PR, Rubin DB. Constructing a control group using multivariate matched sampling methods that incorporate the propensity score. *The American Statistician* 1985;39:33–8.
17 Austin PC. Some methods of propensity-score matching had superior performance to others: results of an empirical investigation and Monte Carlo simulations. *Biom J* 2009;51:171–84.
18 Heinze G, Jüni P. An overview of the objectives of and the approaches to propensity score analyses. *Eur Heart J* 2011;32:1704–8.
19 Barnieh L, James MT, Zhang J, *et al*. Propensity score methods and their application in nephrology research. *J Nephrol* 2011;24:256–62.
20 Sianesi B. An evaluation of the Swedish system of active labor market programs in the 1990s. *Review of Economics and Statistics* 2004;86:133–55.
21 Jeon S-H. The long-term effects of cancer on employment and earnings: the long-term effects of cancer on employment and earnings. *Health Econ* 2017;26:671–84.
22 Hernandez D, Schlander M. Income loss after a cancer diagnosis in Germany: an analysis based on the socio-economic panel survey. *Cancer Med* 2021;10:3726–40.
23 Schmidt ME, Scherer S, Wiskemann J, *et al*. Return to work after breast cancer: the role of treatment-related side effects and potential impact on quality of life. *Eur J Cancer Care (Engl)* 2019;28:e13051.
24 Šaltytė Benth J, Dahl FA, Lurås H, *et al*. A controlled study of income development for breast cancer survivors in Norway. *J Cancer Surviv* 2014;8:239–47.
25 Zajacova A, Dowd JB, Schoeni RF, *et al*. Employment and income losses among cancer survivors: estimates from a national longitudinal survey of American families. *Cancer* 2015;121:4425–32.
26 Mehnert A. Employment and work-related issues in cancer survivors. *Crit Rev Oncol Hematol* 2011;77:109–30.
27 McMullen CK, Bulkley JE, Altschuler A, *et al*. Greatest challenges of rectal cancer survivors: results of a population-based survey. *Dis Colon Rectum* 2016;59:1019–27.
28 Ayaz-Alkaya S. Overview of psychosocial problems in individuals with stoma: a review of literature. *Int Wound J* 2019;16:243–9.
29 Bulkley JE, McMullen CK, Grant M, *et al*. Ongoing ostomy self-care challenges of long-term rectal cancer survivors. *Support Care Cancer* 2018;26:3933–9.
30 Mazzolini G. The economic consequences of accidents at work. *Oxf Bull Econ Stat* 2020;82:1068–93. 10.1111/obes.12358 Available: https://onlinelibrary.wiley.com/toc/14680084/82/5
31 Devicienti F, Maida A, Pacelli L. The resurrection of the Italian wage curve. *Economics Letters* 2008;98:335–41.
32 Ammermüller A, Lucifora C, Origo F, *et al*. Wage flexibility in regional labour markets: evidence from Italy and Germany. *Regional Studies* 2010;44:401–21.
33 Heinesen E, Imai S, Maruyama S. Employment, job skills and occupational mobility of cancer survivors. *J Health Econ* 2018;58:151–75.
34 Taskila-Brandt T, Martikainen R, Virtanen SV, *et al*. The impact of education and occupation on the employment status of cancer survivors. *Eur J Cancer* 2004;40:2488–93.
35 Mols F, Tomalin B, Pearce A, *et al*. Financial toxicity and employment status in cancer survivors. A systematic literature review. *Support Care Cancer* 2020;28:5693–708.
36 Syse A, Tretli S, Kravdal Ø. Cancer's impact on employment and earnings -- a population-based study from Norway. *J Cancer Surviv* 2008;2:149–58.
37 Greidanus MA, de Boer AGEM, de Rijk AE, *et al*. Perceived employer-related barriers and facilitators for work participation of cancer survivors: a systematic review of employers' and survivors' perspectives. *Psychooncology* 2018;27:725–33.
38 Gruß I, Bradley CJ, Banegas MP. Colorectal cancer and return to work: a pilot study of recruiting cancer survivors and their employers. *Perm J* 2021;25:20.198.
39 Simonetti I, Belloni M, Farina E, *et al*. Labour market institutions and long term adjustments to health shocks: evidence from Italian administrative records. *Labour Economics* 2022;79:102277.
40 Franken MD, Vink G, van Grevenstein WMU, *et al*. Work ability in patients with stage I to IV colon cancer: results of the Dutch prospective colorectal cancer cohort. *Dis Colon Rectum* 2023;66:50–8.

Correction: *Short-term effect of colorectal cancer on income: analysis of an italian cohort*

Farina E, Rosso M, Dansero L, et al. Short-term effect of colorectal cancer on income: analysis of an Italian cohort. *J Epidemiol Community Health* 2023;77:196-201.

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J Epidemiol Community Health 2025;**79**:72. doi:10.1136/jech-2022-220088corr1