










## Return to work after cancer. A multi-regional population-based study from Germany

Volker Arndt<sup>a</sup> , Lena Koch-Gallenkamp<sup>b</sup> , Heike Bertram<sup>c</sup>, Andrea Eberle<sup>d</sup> , Bernd Holleczeck<sup>e</sup> , Ron Pritzkuleit<sup>f</sup>, Mechthild Waldeyer-Sauerland<sup>g</sup>, Annika Waldmann<sup>g,h</sup> , Sylke Ruth Zeissig<sup>i</sup> , Daniela Doege<sup>a</sup> , Melissa S. Y. Thong<sup>a</sup>  and Hermann Brenner<sup>b,j,k</sup> 

<sup>a</sup>Unit of Cancer Survivorship, Division of Clinical Epidemiology and Aging Research, German Cancer Research Center (DKFZ), Heidelberg, Germany; <sup>b</sup>Division of Clinical Epidemiology and Aging Research, German Cancer Research Center (DKFZ), Heidelberg, Germany; <sup>c</sup>Cancer Registry of North Rhine-Westphalia, Münster, Germany; <sup>d</sup>Bremen Cancer Registry, Leibniz Institute for Prevention Research and Epidemiology – BIPS, Bremen, Germany; <sup>e</sup>Saarland Cancer Registry, Saarbrücken, Germany; <sup>f</sup>Cancer Registry of Schleswig-Holstein, Lübeck, Germany; <sup>g</sup>Ministry of Health and Consumer Protection, Hamburg Cancer Registry, Hamburg, Germany; <sup>h</sup>Institute of Social Medicine and Epidemiology, University Lübeck, Lübeck, Germany; <sup>i</sup>Cancer Registry of Rhineland-Palatinate, Mainz, Germany; <sup>j</sup>Division of Preventive Oncology, German Cancer Research Center (DKFZ), Heidelberg, Germany; <sup>k</sup>German Cancer Consortium (DKTK), German Cancer Research Center (DKFZ), Heidelberg, Germany

### ABSTRACT

**Background:** With improving prognosis, the ability to return to work after cancer has become a realistic goal but only little is known regarding details such as sustainability, financial consequences, and potential determinants of return to work in long-term survivors in Germany.

**Methods:** We studied return to work in a population-based sample of 1558 long-term cancer survivors, diagnosed in 1994–2004 with breast, colorectal or prostate cancer before age 60 (mean 50.1). Information regarding employment status and financial difficulties was obtained via mailed questionnaires from patients who were identified by six population-based cancer registries in Germany. Cumulative incidence of return to work was determined by time-to-event analysis with consideration of competing events. Chi<sup>2</sup> tests and multiple logistic regression modeling were employed to identify potential sociodemographic and clinical determinants of return to work.

**Results:** Within a mean period since diagnosis of 8.3 years, 63% of all working-age cancer survivors initially returned to their old job and another 7% took up a new job. Seventeen percent were granted a disability pension, 6% were early retired (not cancer-related), 4% became unemployed, and 1% left the job market for other reasons. Resumption of work occurred within the first 2 years after diagnosis in 90% of all returnees. Cancer-related reduction of working hours was reported by 17% among all returnees and 6% quit their job due to cancer within 5 years past return to work. The probability of return to work was strongly related with age at diagnosis, tumor stage, education, and occupational class but did not differ with respect to the tumor site, gender nor marital status.

**Conclusions:** Most long-term survivors after breast, colorectal, or prostate cancer of working-age are able to return to work. However, financial problems might arise due to a reduction in working hours. An additional provision of targeted interventions for high-risk groups should be discussed.

### ARTICLE HISTORY

Received 15 August 2018  
Accepted 8 November 2018

## Introduction

Diagnosis and treatment of cancer often have a significant impact on the physical, emotional, and social functioning in patients and their families. With the increasing number of cancer survivors due to earlier diagnosis and improved prognosis, work ability, (re-)employment, and social reintegration represent a relevant and important issue for cancer survivors [1,2] and the ability to return to work after cancer has become a realistic goal.

Working-age individuals (age 15–64) represent around 40% of all newly diagnosed cancer patients in Europe [3]. Although most cancer survivors (85%) are motivated either to return to work or be re-employed after rehabilitation [4],

cancer survivors experience a significantly increased risk for unemployment and early retirement, and they are less likely to be re-employed [5].

All European countries provide some type of social security for employees – and some countries also for the self-employed. However, national solutions for employees with chronic health conditions and for the unemployed greatly differ [1,6]. In Germany, in contrast to many other countries, employers, health insurance, and pension insurance pay for (partial) wage continuation. As a result, these stakeholders have an intrinsic interest and financial incentive to support quick and successful resumption of work [6]. In addition, cancer patients in Germany are entitled to participate in a

3-week inpatient cancer rehabilitation program at specialized institutions, which is usually initiated by hospital physicians or social workers after completion of primary treatment. The cancer rehabilitation program has a multidimensional therapeutic approach that includes patient education, exercise and physical therapy along with psychosocial as well as occupational counseling to enhance coping skills and facilitate return to work at the earliest possible time [1]. In addition, specific programs for gradual reintegration into the working life are provided.

Despite Germany being the biggest economy within Europe and having a unique rehabilitation program, only a few studies focusing on patients after rehabilitation with a maximum follow-up of 1 year have been published so far [4,7,8]. With almost 500,000 new cancer cases per year, an estimated number of 3.5–4 million cancer survivors and 150,000 cancer-related in-patient rehabilitation measures per year [9,10], return to work represents an issue of high relevance for public health and social security.

We, therefore, used data from a large population-based cancer survivorship study to address the following questions:

- How many breast, colorectal and prostate cancer survivors below age 60 at diagnosis return to work and how long does it take?
- How many survivors take up a new job rather than return to their former job, reduce their working hours, or have to quit their job after the resumption of work and are these changes related with subsequent financial difficulties?
- How does the proportion of return to work vary with specific socio-demographical and clinical characteristics, such as age, sex, education, occupation, tumor type, stage of disease, and type of therapy?

## Methods

### Study participants

The study population included long-term breast, colorectal, and prostate cancer survivors who participated in the German population-based CAESAR-study ('Cancer Survivorship – a multi-regional population-based study'). The study was conducted by the German Cancer Research Center (Deutsches Krebsforschungszentrum, DKFZ) in collaboration with six population-based cancer registries in Germany (Bremen, Hamburg, North Rhine-Westphalia, Rhineland-Palatinate, Saarland, and Schleswig-Holstein) to study health-related quality of life and other psychosocial aspects in long-term survivors. Study details have been reported elsewhere [11]. In brief, patients aged 20–75 years, being diagnosed with either invasive breast, colorectal, or prostate cancer (ICD-10: C18–C20, C50, C61) during 1994–2004, being registered in the participating cancer registries and having had survived cancer at least 5 years were recruited in 2009–2011. Of the 14,526 eligible contacted potential participants, 6057 (42%) returned the full-length questionnaire. Non-participation was associated with a diagnosis of colorectal cancer,

age at diagnosis below 45 years or 70 years and older, and more years since diagnosis (Supplementary Table 1). The participation rate was slightly higher (44%) when we restricted our population to working age survivors.

Inclusion criteria for the present analysis were age 20–59 and gainfully employed or self-employed at the time of diagnosis. Although old age pension in Germany generally became effective at 65 years until 2012, only 30% of the 60–64-year-old men and women in Germany were employed in 2006 (in contrast to 56% in 2016) [10]. We, therefore, chose the age limit of 60 years in accordance to the study of Mehnert and Koch [4] to enable survivors to have a sufficient time period left to return to work. In total, we had to exclude 3921 cancer survivors age 60 years and older and 578 cancer survivors not working at the time of diagnosis, leaving 1558 cancer survivors for analysis.

### Data collection

Data were collected via a postal questionnaire including detailed questions regarding changes in employment status since the time of diagnosis in addition to baseline information regarding sociodemographics (school education, occupation, marital status), therapeutic, and rehabilitation measures. Participants were specifically asked whether and when they had returned to their former work, and whether and when there had been changes such as uptake of a new job, reduction of working hours, vocational retraining, unemployment, disability pension, early or old-age retirement. We also asked whether these changes were directly related to their cancer disease or not. Financial difficulties were assessed with the EORTC QLQ-C30 single item measure 'financial difficulties' which asks survivors whether their physical condition or medical treatment has caused financial difficulties [12]. Answers range from 1 (not at all) to 4 (very much) and were linearly transformed to a scale of 0–100 using standard procedures [13]. Tumor-related data (e.g., date of diagnosis, tumor type, and stage) were provided by the respective cancer registries.

### Statistical analyses

Return to work status after cancer was classified as

- Returned to former job
- Uptake of a new job
- Unemployment
- Disability pension
- Early retirement (not cancer-related)
- Other reasons for leaving (e.g., became housewife/househusband)

These events are not mutually exclusive and may have occurred sequentially, e.g., disability pension after initial return to work or uptake of a new job after a period of unemployment and vocational retraining. An algorithm based on predefined test criteria was employed to determine the relevant outcome (see Supplementary Table 2). The

**Table 1.** Description of study population overall and by tumor site and sex (after multiple imputation).

	Breast Ca (females)		Colorectal Ca (females)		Colorectal Ca (males)		Prostate Ca (males)		Total	
	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%
Age <sup>a</sup>										
18–44	296	27.7	27	24.3	24	14.1	1	0.5	348	22.3
45–49	247	23.1	16	14.4	33	19.4	11	5.3	307	19.7
50–54	249	23.3	28	25.2	40	23.5	55	26.6	372	23.9
55–59	278	26.0	40	36.0	73	42.9	140	67.6	531	34.1
Mean (sd)	48.8	(7.1)	50.1	(7.3)	51.8	(5.9)	55.4	(3.4)	50.1	(7.0)
Years since diagnosis <sup>b</sup>										
5–9 years	833	77.9	70	63.1	114	67.1	166	80.2	1183	75.9
10–15 years	237	22.1	41	36.9	56	32.9	41	19.8	375	24.1
Mean (sd)	8.3	(2.2)	9.1	(2.8)	8.6	(2.7)	8.0	(2.2)	8.3	(2.3)
German nationality	1054	98.5	110	99.1	165	97.1	203	98.1	1532	98.3
Education										
<10 years	408	38.1	52	46.8	86	50.6	87	42.0	633	40.6
10 years	363	33.9	28	25.2	30	17.6	44	21.3	465	29.8
12+ years	299	27.9	31	27.9	54	31.8	76	36.7	460	29.5
Occupation <sup>a</sup>										
Manual worker	108	10.1	13	11.7	42	24.7	42	20.3	205	13.2
Non-manual employee	807	75.4	80	72.1	97	57.1	132	63.8	1116	71.6
Self-employed	80	7.5	7	6.3	14	8.2	21	10.1	122	7.8
Other and multiple answers	75	7.0	11	9.9	17	10.0	12	5.8	115	7.4
Married/with partner	763	71.3	80	72.1	149	87.6	170	82.1	1162	74.6
UICC Stage <sup>a</sup>										
I/II	969	90.6	60	54.1	101	59.4	122	58.9	1252	80.4
III/IV	101	9.4	51	45.9	69	40.6	85	41.1	306	19.6
Surgery (open)	1063	99.3	96	86.5	145	85.3	175	84.5	1479	94.9
Chemotherapy	773	72.2	65	58.6	94	55.3	23	11.1	955	61.3
Radiotherapy	915	85.5	34	30.6	46	27.1	92	44.4	1087	69.8
Hormone therapy	580	54.2	—	—	—	—	52	25.1	632	40.6
Rehabilitation	746	69.7	75	67.6	105	61.8	124	59.9	1050	67.4
Total	1070	100.0	111	100.0	170	100.0	207	100.0	1558	100.0

<sup>a</sup>At time of diagnosis.<sup>b</sup>Interval (in years) between date of diagnosis and survey.**Table 2.** Initial return to work status by tumor site and sex (after multiple imputation).

Initial return to work status	Breast Ca (females)		Colorectal Ca (females)		Colorectal Ca (males)		Prostate Ca (males)		Total	
	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%
Returned to former job <sup>a</sup>	688	64.3	67	60.4	101	59.4	129	62.3	985	63.2
Uptake of new job <sup>b</sup>	91	8.5	9	8.1	13	7.6	3	1.4	116	7.4
Unemployment	50	4.7	4	3.6	6	3.5	8	3.9	68	4.4
Disability pension	165	15.4	24	21.6	38	22.4	44	21.3	271	17.4
Early retirement (not cancer-related)	61	5.7	6	5.4	12	7.1	22	10.6	101	6.5
Left job market for other reasons <sup>c</sup>	15	1.4	1	0.9	0	0.0	1	0.5	17	1.1
Total	1070	100.0	111	100.0	170	100.0	207	100.0	1558	100.0

<sup>a</sup>Including 60 survivors overall (43 female breast, four female colorectal, seven male colorectal, and six male prostate cancer patients who initially returned to former job but took up a new job later).<sup>b</sup>Including those cases with prior period of unemployment and occupational retraining.<sup>c</sup>E.g., became housewife or house husband.Chi-square test-statistic for association between tumor-sex-group and return to work status:  $\chi^2 = 31.25$ , 15 df,  $p = .008$ .

algorithm follows the concept of looking at the primary employment after the period of sick leave. For example, in determining the return to work status as shown in Table 2, a person taking up a new job after a period of unemployment and occupational retraining was classified as 'uptake of new job', whereas a survivor experiencing unemployment and participating in a vocation retraining without successful resumption of work would be classified as 'unemployed'.

To determine the cumulative incidence of return to work by time since diagnosis, we performed a time-to-event analysis with return to work (former or a new job) as the

outcome and considering reaching age 65 and being granted an old-age pension or early retirement (not cancer-related) as competing events which may preclude the resumption of work. All other events, such as unemployment, disability pension, and becoming housewife/househusband were considered as censoring events as these persons might still aim to return to work.

Subsequently, we assessed the proportion of survivors who – due to their cancer disease – either reduced their working hours or had to quit their job after the resumption of work and whether these changes were related with self-reported financial difficulties. Similarly, we assessed whether

return to former job and uptake of a new job might differ with respect to financial consequences.

Descriptive analysis (contingency tables) were used to describe the proportion of cancer survivors returning to work according to survivors' characteristics. Chi<sup>2</sup> tests and multiple logistic regression modeling were employed to test the null hypothesis of no association between sociodemographic and clinical characteristics and proportion of return to work. Covariates in the multivariable analysis included sociodemographic characteristics, tumor type, stage at diagnosis, and treatment information. Based on the assumption that return to former work and uptake of a new job may have different underlying mechanisms and both may differ with respect to financial consequences, this analysis was limited to return to former work.

The study population was divided into four tumor-sex groups to assess potential tumor and sex specific associations: breast cancer (females), colorectal cancer (females), colorectal cancer (males), and prostate cancer (males). All analyses were performed on the entire study population and by the tumor-sex group. Equality of cumulative incidence functions across all four tumor-sex groups was assessed by Gray's test. Two-sided statistical significance was determined at a *p* value of less than .05.

All analyses were conducted with SAS (version 9.4 for Windows; SAS Institute Inc., Cary, NC).

To reduce possible bias due to missing data (generally less than 10%), multiple imputations was conducted. Data were imputed with the Markov chain Monte Carlo method with 25 imputations.

### **Ethical approval**

The study was approved by the Ethics Committee of the University of Heidelberg and the appropriate ethics committees of all participating cancer registries. Written informed consent was obtained from all participants.

## **Results**

### **Description of the study population**

The sample of 1558 cancer survivors included in our analysis consisted of 1070 breast cancer survivors (69%), 281 colorectal cancer survivors (18%), and 207 prostate cancer survivors (13%). Overall, females accounted for over 75% of the study population, but the number of male colorectal cancer survivors (*n* = 170) outnumbered the number of female colorectal cancer survivors (*n* = 111). Further details of the study population are shown in Table 1. Mean age at diagnosis of study participants was 50.1 years with prostate cancer survivors representing the oldest group. Three quarter of all survivors were in their 5th–9th year after diagnosis of cancer, and one quarter had survived cancer for 10 years and more. Over 70% of all survivors were engaged in non-manual work at the time of diagnosis with higher proportions in females (75%) than in males (61%), whereas more males (22%) than females (10%) were employed as manual workers.

Participation in oncologic rehabilitation after primary therapy was reported by two thirds, with the highest proportions among breast cancer survivors (70%) and lowest among prostate cancer survivors (60%).

### **Return to work**

Within a mean period since diagnosis of 8.3 years, 63% of all cancer survivors initially returned to their old job, another 7% took up a new job. Overall, 17% were granted a disability pension, 6% were early retired (not cancer-related), 4% became unemployed, and 1% left the job market for other reasons (Table 2). The proportion of survivors returning to their former job was the highest for breast cancer survivors (64%) and lowest for colorectal cancer survivors (60%). Conversely, disability pension was less frequently observed in breast cancer survivors (15%) than in the other tumor groups (22%). Early retirement (not cancer-related) was more common among male survivors (9%) than among female survivors (6%).

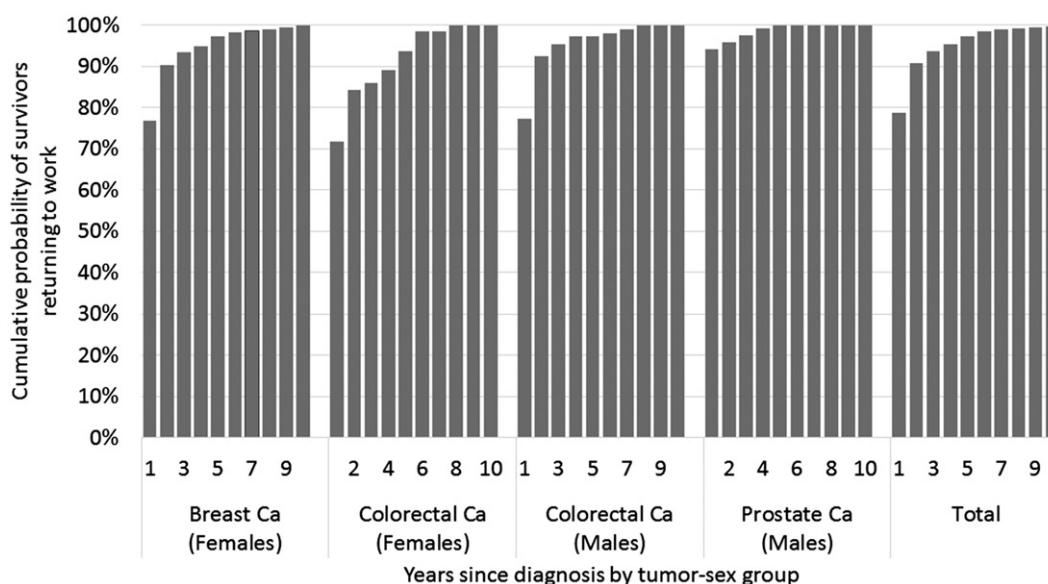
Resumption of work occurred within the first 2 years in 90% of all returnees (Figure 1). The speed of return to work appears to differ between the tumor groups; however, the difference was not statistically significant (*p* = .39). The curves do not flatten after year 2, indicating that a substantial proportion of survivors required 2 years or even more for being able to return to work.

The cumulative incidence of survivors returning to work by time since diagnosis among all participants is shown in Figure 2. After taking censoring and competing for events into account, the probability of return to work over the entire follow-up period mounted up to 83% across all tumor-sex groups. Female survivors had a higher prevalence of return to work (breast cancer: 85%, colorectal cancer 86%) than male survivors (prostate cancer: 73%, colorectal cancer 80%); however, the differences were not statistically significant (*p* = .43).

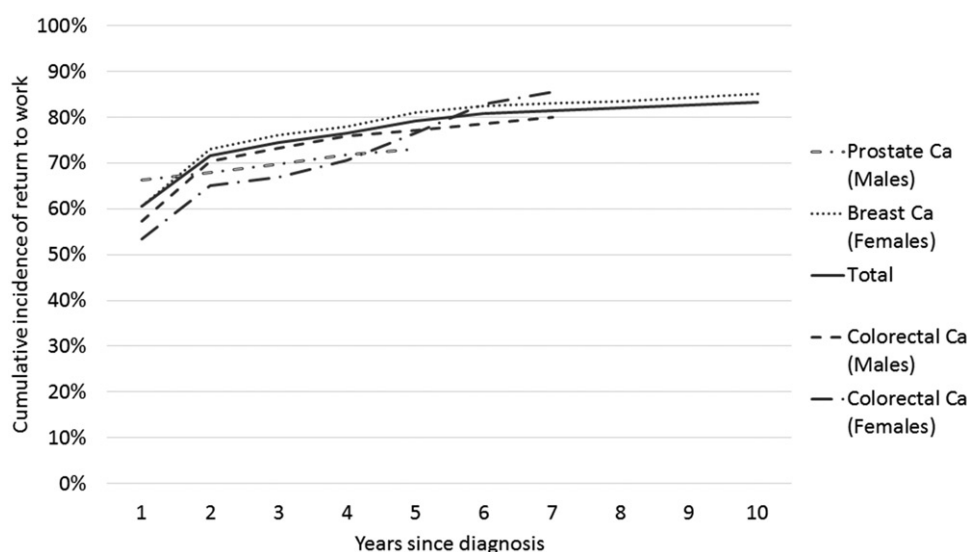
### **Reduction of working hours and financial difficulties**

Cancer-related reduction of working hours was reported by 17% among all returnees and only 6% quitted their job due to cancer within 5 years past return to work (Table 3). Reduction of working hours was more common (*p* = .01) among female survivors (breast cancer: 19%, colorectal cancer 17%) than among male survivors (colorectal cancer: 11%, prostate cancer: 9%) and was associated with more financial difficulties (mean score: 25.6 versus 13.7, *p* = .0004). Financial difficulties were also more common among those who had to quit their job after return to work (*p* = .033).

In general, cancer survivors who did not return to work at all or those survivors who took up a new job reported more financial difficulties than survivors who were able to return to their former job (mean score: 27.6 versus 29.6 versus 13.0, *p* < .0001; Table 3).



**Figure 1.** Resumption of work (former or new job) by tumor site, sex, and years since diagnosis among those who returned to work. Gray’s test for equality of cumulative probability functions:  $p = .39$ .



**Figure 2.** Cumulative incidence of return to work (former or new job) by tumor site, sex, and years since diagnosis. Gray’s test for equality of cumulative incidence functions:  $p = .43$ . No further events occurred in prostate and colorectal cancer survivors beyond the fifth and the seventh year past diagnosis, respectively, due to censoring or reaching age 65.

**Factors associated with return to former work**

The probability of return to former work was strongly related with younger age at diagnosis, less advanced stage of disease, higher education, non-manual work, or being self-employed (Table 4). In contrast, the proportion of survivors returning to work did not notably differ with respect to the tumor site, gender, marital status, nor the type of (neo)adjuvant therapy. Adjustment for potential confounding did not substantially change the pattern. The associations were similar in all tumor groups (Supplementary Table 3). In addition, most associations did not differ between males and females except for the association between participation in an oncologic rehabilitation program and the probability to return to former work. Regarding the latter, we observed an inverse association between participation in rehabilitation and return

to former work among breast cancer survivors ( $p = .0005$ ), but no statistically significant association in female colorectal ( $p = .26$ ), male colorectal ( $p = .67$ ), and prostate ( $p = .48$ ) cancer survivors.

**Discussion**

In our multiregional, population-based study, 63% of all cancer survivors returned to their old job within a mean period since diagnosis of 8.3 years. Another 7% took up a new job instead. One of the most interesting findings in our study is the difference regarding financial consequences between those who either successfully returned to their former job versus those who took up a new job, who had to reduce their working hours, or who had to quit their job. This

**Table 3.** Cancer-related reduction of working hours, job quitting, and financial difficulties after initial return to former work or uptake of new job, by tumor site, and sex.

Cancer-related ...	Breast Ca (Females)		Colorectal Ca (Females)		Colorectal Ca (Males)		Prostate Ca (Males)		Total		$P_{\chi^2\text{-Test}}^a$
	N	Col%	N	Col%	N	Col%	N	Col%	N	Col%	
	779	100%	76	100%	114	100%	132	100%	1101	100%	
... reduction of working hours within 1 year	151	19.4%	13	17.1%	13	11.4%	12	9.1%	189	17.2%	0.01
... quitting job within 5 years	28	5.4%	3	6.6%	4	5.6%	8	9.7%	43	6.0%	0.64

Financial difficulties <sup>b</sup> according to ...	Breast Ca (Females)		Colorectal Ca (Females)		Colorectal Ca (Males)		Prostate Ca (Males)		Total		$P_{F\text{-Test}}^c$
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	
	... cancer related reduction of working hours within 1 year after return to work										
Yes	25.6	2.7	17.9	8.9	31.2	9.9	27.8	8.0	25.6	2.4	0.0004
No	14.0	2.1	5.6	3.3	21.8	5.8	11.1	3.5	13.7	1.6	
... cancer related quitting job due to cancer within 5 years after return to work											
Yes	20.0	5.5	22.2	22.2	25.0	16.0	8.3	5.5	18.5	4.2	0.033
No	10.4	1.0	7.8	2.7	15.9	3.0	7.5	1.8	10.5	0.8	

Financial difficulties <sup>b</sup> according to initial work status	Breast Ca (Females)		Colorectal Ca (Females)		Colorectal Ca (Males)		Prostate Ca (Males)		Total		$P_{F\text{-Test}}^d$
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	
	Returned to former job	13.2	1.0	11.5	2.9	17.2	2.7	9.6	1.9	13.0	
Uptake of new job	28.6	3.7	14.8	11.3	54.3	11.2	(0) <sup>e</sup>	(0) <sup>e</sup>	29.6	3.4	
No resumption of work	27.5	2.0	42.9	7.3	23.8	4.4	24.0	4.2	27.6	1.7	

<sup>a</sup>Chi-square test-statistic for null hypothesis: No association between tumor-sex-group and proportion of cancer-related reduction of working hours or proportion of survivors quitting job after initial return to work.

<sup>b</sup>Financial difficulties assessed by EORTC QLQ-C30 (scale 0 – 100).

<sup>c</sup>T-Test statistic for null hypothesis: No difference in financial difficulties according to reduction of working hours or quitting job after initial return to work.

<sup>d</sup>F-Test statistic (ANOVA) for null hypothesis: No difference in financial difficulties according to initial return to work status (entire study population).

<sup>e</sup>Based on three observations.

finding highlights the importance of sustainability of re-employment as well as that return to former work should be the primary objective of occupational rehabilitation.

Resumption of work occurred within the first 2 years in 90% of all returnees. The observation that over 20% of returnees require more than 1 year of sick-leave and rehabilitation emphasizes the need of more long-term studies. This will allow a better understanding of why some survivors regain their work capacity earlier than others. The proportion of 63% of survivors returning to former work (70% to any work) as well as their speed of returning is comparable to studies from other European countries [14–23] but lower than in two other studies from Germany (76–87%) [4,7]. The latter two studies were based on participants of in-patient rehabilitation programs, who were followed over a 12 months period. Besides the direct effect of rehabilitation, differences in the composition of study participants might represent an explanation for the different return to work rates. As our study population comprises cancer survivors having survived 5 and more years, our results do not fully reflect the return to work perspectives of newly diagnosed cancer patients. Patients who had died before the survey or were too sick to participate, presumably experienced a lower probability of return to work.

Ongoing physical and/or cognitive limitations, such as difficulties with lifting, persisting fatigue, treatment-induced menopausal symptoms, coping issues, depression, and anxiety, may be present in occupationally active cancer survivors

and may limit work ability of cancer survivors [24]. In our study, cancer-related reduction of working hours was reported by 17% among all returnees. Overall, re-employment appears to be very successful among those who return to work. In our study, only 6% quitted their job due to cancer within 5 years past return to work. This might reflect the effect of the multidisciplinary approach in occupational rehabilitation in conjunction with the optional gradual reintegration into the working life in Germany. Survivors may return to work part-time and are entitled to gradually increase their working hours up to the number of hours they had before the diagnosis of cancer. Losses in salary are partly compensated by the pension fund during the phase of reintegration but only for a limited duration of time. Return to work resulting in a permanent part-time job is not compensated by the social security system and financial problems might arise in those survivors as supported by our data.

Our findings highlight the importance of return to former work. The probability of return to former work was strongly related with age at diagnosis, stage of disease, education, occupational class but did not substantially differ with respect to the tumor site, gender, or marital status. These findings are in line with most other pertinent studies as summarized by Van Muijen et al. [25], who reported that old age, low education, and low income were negatively associated with employment. Several studies indicate that return to work varies with the type of cancer, whereby higher proportions of return to work were found in survivors of skin,

**Table 4.** Return to work (former job) according to sociodemographic and clinical characteristics.

	Crude analysis <sup>b</sup>			Multivariable analysis <sup>c</sup>			
	Return to work			Model 1		Model 2	
	N	%	P	OR	95% CI	OR	95% CI
Tumor type							
Breast	688	64.3	.36	1.00	(Referent)	1.00	(Referent)
Colorectal	168	59.8		1.09	(0.71–1.69)	0.98	(0.59–1.61)
Prostate	129	62.3		1.41	(0.76–2.63)	1.25	(0.64–2.42)
Sex							
Male	230	61.0	.31	1.01	(0.61–1.70)	1.00	(0.60–1.69)
Female	755	63.9		1.00	(Referent)	1.00	(Referent)
Age <sup>a</sup>							
18–44	246	70.7	<.0001	2.25	(1.65–3.08)	2.38	(1.73–3.27)
45–49	217	70.7		2.40	(1.74–3.29)	2.53	(1.84–3.49)
50–54	257	69.1		2.29	(1.72–3.06)	2.39	(1.78–3.20)
55–59	265	49.9		1.00	(Referent)	1.00	(Referent)
Years since diagnosis							
5–9 years	763	64.5	.064	1.00	(Referent)	1.00	(Referent)
10–15 years	222	59.2		0.87	(0.67–1.11)	0.84	(0.65–1.09)
Nationality							
German	970	63.3	.56	1.00	(Referent)	1.00	(Referent)
Other	15	57.7		0.72	(0.31–1.64)	0.74	(0.32–1.69)
Education							
<10 years	340	53.7	.005	1.00	(Referent)	1.00	(Referent)
10 years	308	66.2		1.46	(1.11–1.92)	1.47	(1.12–1.94)
12+ years	337	73.3		1.95	(1.46–2.60)	1.92	(1.43–2.58)
Occupation <sup>a</sup>							
Manual worker	108	52.7	<.0001	0.82	(0.59–1.15)	0.82	(0.58–1.15)
Non-manual employee	723	64.8		1.00	(Referent)	1.00	(Referent)
Self-employed	88	72.1		1.45	(0.94–2.23)	1.31	(0.84–2.05)
Other	66	57.4		0.84	(0.56–1.26)	0.81	(0.53–1.22)
Married/with partner							
Yes	736	63.3	.89	1.00	(Referent)	1.00	(Referent)
No	249	62.9		0.95	(0.74–1.21)	0.97	(0.76–1.25)
UICC stage <sup>a</sup>							
I/II	812	64.9	.009	1.00	(Referent)	1.00	(Referent)
III/IV	173	56.5		0.74	(0.54–1.01)	0.80	(0.58–1.11)
Surgery (open)							
Yes	947	64.0	.005			1.00	(Referent)
No	38	48.1				0.50	(0.30–0.85)
Chemotherapy							
Yes	598	62.6	.59			1.00	(Referent)
No	387	64.2				1.20	(0.91–1.57)
Radiotherapy							
Yes	683	62.8	.61			1.00	(Referent)
No	302	64.1				1.18	(0.88–1.58)
Hormone therapy							
Yes	405	64.1	.55			1.00	(Referent)
No	580	62.6				0.90	(0.69–1.16)
Rehabilitation							
Yes	642	61.1	.012			1.00	(Referent)
No	343	67.5				1.44	(1.12–1.86)
Total	985	63.2					

<sup>a</sup>At time of diagnosis.

<sup>b</sup>The corresponding numerators are displayed in Table 1; *P* values derived from Chi<sup>2</sup>-statistic referring to null hypothesis: No association between socio-demographic resp. clinical characteristics and return to work (entire study population).

<sup>c</sup>Model 1: adjusted for all age, years since diagnosis, nationality, education, occupation, marital status, UICC stage. Model 2: model 1 plus adjustment for surgery, chemotherapy, radiotherapy, hormone therapy and rehabilitation.

breast and various types of genital cancer, and lower proportions in survivors with gastrointestinal, lung, and blood cancer [14,15,17,18]. The results of our study are in line with this statement, but we were not able to observe statistically significant differences and we only had cancer types with comparatively good prognosis in our sample. Our observation that participation in an oncologic rehabilitation program was negatively associated with return to work has to be

interpreted cautiously. Given that our study is based on observational data, the possibility of confounding by indication (i.e., those who are at higher risk of losing their work capacity might be more likely to participate in a rehabilitation program) has to be discussed as a potential explanation regarding the unexpected negative association between rehabilitation and return to work.

### Strengths and limitations

As outlined above, a major limitation of our study is that we were only able to include information from survivors being alive at the time of survey, who had been able to complete the study questionnaire, and that our study was a priori restricted to cancer types with relatively good prognosis. These selection criteria might result in an overestimation of the return to work rate and our findings should not be generalized to survivors with other types of cancer. In addition, the response rate of 42% overall (44% among working age survivors) suggests that there could be an issue of generalizability of results, as colorectal cancer survivors, survivors at a younger age or with a longer time period since diagnosis were underrepresented in our study. Other limitations of our study include that information regarding changes in employment status were collected retrospectively and potential recall bias cannot be ruled out. Also, no information regarding work-related characteristics, such as job requirements, work load, the pressure of competition, work responsibilities, work arrangements as well as information regarding individual attitudes toward return to work, such as job satisfaction, financial pressure, and motivation, was available. Strengths of our study are the population-based study design, the inclusion of registry, and self-reported data, the enrollment of cancer survivors from different regions with a heterogeneous economic structure, the large sample size, the long follow-up period which allowed to study the sustainability of return to work, and the detailed information regarding work history after cancer and financial difficulties. Up to now, research on predictors of return to work in cancer survivors has focused on clinical and personal factors [14]. Further studies, ideally prospective cohort studies, which also cover information regarding work-related factors are warranted. In addition, more long-term studies are warranted in order to assess the long-term effects of occupational reintegration.

### Conclusions

In conclusion, our study demonstrates that successful return to work is a realistic goal for the majority of long-term survivors after breast, colorectal or prostate cancer in Germany. However, financial problems might arise due to a reduction in working hours and loss of former job. More research is needed to study the performance of the cancer survivor once back at work in order to gain a better understanding of the challenges in cancer survivors after resumption of work and to better address the professional needs of individuals with cancer. As cancer survivors being at higher working age, less educated or manually working represent high risk groups for work disability,

it has to be discussed whether additional targeted interventions and more options for vocational retraining should be offered. In particular, we see an urgent need for effective rehabilitation measures for older workers given their numbers are on the rise due to the ageing of baby boomer generation.


## Disclosure statement

No potential conflict of interest was reported by the authors.

## Funding

This work was supported by the German Cancer Aid under Grant no. 108262.

## ORCID

Volker Arndt  <http://orcid.org/0000-0001-9320-8684>  
 Lena Koch-Gallenkamp  <http://orcid.org/0000-0001-7290-906X>  
 Andrea Eberle  <http://orcid.org/0000-0003-4195-5236>  
 Bernd Holleczeck  <http://orcid.org/0000-0001-8759-4371>  
 Annika Waldmann  <http://orcid.org/0000-0002-5909-9936>  
 Sylke Ruth Zeissig  <http://orcid.org/0000-0002-0743-6128>  
 Daniela Doege  <http://orcid.org/0000-0002-7499-5376>  
 Melissa S. Y. Thong  <http://orcid.org/0000-0002-6987-705X>  
 Hermann Brenner  <http://orcid.org/0000-0002-6129-1572>

## References

- [1] Mehnert A, de Boer A, Feuerstein M. Employment challenges for cancer survivors. *Cancer*. 2013;119:S2151–S2159.
- [2] Crevenna R. Return-to-work outcomes in cancer survivors. *Support Care Cancer*. 2017;25:3005–3006.
- [3] Ferlay J, Ervik M, Lam F, et al. *Global cancer observatory: cancer today* Lyon, France: International Agency for Research on Cancer; 2018. [05.11.2018]. Available from: <https://gco.iarc.fr/today/home>.
- [4] Mehnert A, Koch U. Predictors of employment among cancer survivors after medical rehabilitation – a prospective study. *Scand J Work Environ Health*. 2013;39:76–87.
- [5] de Boer AG, Taskila T, Ojajarvi A, et al. Cancer survivors and unemployment: a meta-analysis and meta-regression. *JAMA*. 2009;301:753–762.
- [6] Mewes JC, Steuten LM, Groeneveld IF, et al. Return-to-work intervention for cancer survivors: budget impact and allocation of costs and returns in the Netherlands and six major EU-countries. *BMC Cancer*. 2015;15:899.
- [7] Ullrich A, Rath HM, Otto U, et al. Return to work in prostate cancer survivors – findings from a prospective study on occupational reintegration following a cancer rehabilitation program. *BMC Cancer*. 2018;18:751.
- [8] Mehnert A, Barth J, Gaspar M, et al. Predictors of early retirement after cancer rehabilitation – a longitudinal study. *Eur J Cancer Care (Engl)*. 2017;26: PubMed PMID: 27334307. Epub 2016/06/24.
- [9] Zentrum für Krebsregisterdaten im Robert Koch-Institut. Bericht zum Krebsgeschehen in Deutschland 2016. Berlin: Robert Koch-Institut; 2016.
- [10] Deutsche Rentenversicherung. *Rentenversicherung in Zahlen 2017*. Berlin: Deutsche Rentenversicherung Bund; 2017.
- [11] Koch-Gallenkamp L, Bertram H, Eberle A, et al. Fear of recurrence in long-term cancer survivors – do cancer type, sex, time since diagnosis, and social support matter? *Health Psychol*. 2016;35:1329–1333.
- [12] Aaronson NK, Ahmedzai S, Bergman B, et al. The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. *J Natl Cancer Inst*. 1993;85:365–376.
- [13] Fayers PM, Aaronson NK, Bjordal K, et al. *The EORTC QLQ-C30 scoring manual*. 3rd ed. Brussels: European Organisation for Research and Treatment of Cancer; 2001.
- [14] Paltrinieri S, Fugazzaro S, Bertozzi L, et al. Return to work in European Cancer survivors: a systematic review. *Support Care Cancer*. 2018.
- [15] Paraponaris A, Teyssier LS, Ventelou B. Job tenure and self-reported workplace discrimination for cancer survivors 2 years after diagnosis: does employment legislation matter? *Health Policy*. 2010;98:144–155.
- [16] Lindbohm ML, Kuosma E, Taskila T, et al. Cancer as the cause of changes in work situation (a NOCWO study). *Psychooncology*. 2011;20:805–812.
- [17] Roelen CA, Koopmans PC, Groothoff JW, et al. Return to work after cancer diagnosed in 2002, 2005 and 2008. *J Occup Rehabil*. 2011;21:335–341.
- [18] Roelen CA, Koopmans PC, Groothoff JW, et al. Sickness absence and full return to work after cancer: 2-year follow-up of register data for different cancer sites. *Psychooncology*. 2011;20:1001–1006.
- [19] Ross L, Petersen MA, Johnsen AT, et al. Factors associated with Danish cancer patients' return to work. A report from the population-based study 'The Cancer Patient's World'. *Cancer Epidemiol*. 2012;36:222–229.
- [20] Cooper AF, Hankins M, Rixon L, et al. Distinct work-related, clinical and psychological factors predict return to work following treatment in four different cancer types. *Psychooncology*. 2013;22:659–667.
- [21] Luker K, Campbell M, Amir Z, et al. A UK survey of the impact of cancer on employment. *Occup Med (Lond)*. 2013;63:494–500.
- [22] Marino P, Teyssier LS, Malavolti L, Corroller-Soriano AG. Sex differences in the return-to-work process of cancer survivors 2 years after diagnosis: results from a large French population-based sample. *Jco*. 2013;31:1277.
- [23] Torp S, Nielsen RA, Fossa SD, et al. Change in employment status of 5-year cancer survivors. *Eur J Public Health*. 2013;23:116–122.
- [24] Duijts SF, van Egmond MP, Spelten E, et al. Physical and psychosocial problems in cancer survivors beyond return to work: a systematic review. *Psychooncology*. 2014;23:481–492.
- [25] van Muijen P, Weevers NL, Snels IA, et al. Predictors of return to work and employment in cancer survivors: a systematic review. *Eur J Cancer Care (Engl)*. 2013;22:144–160.