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ORIGINAL ARTICLE

The role of psychosocial resources for long-term breast, colorectal, and prostate cancer survivors: prevalence and associations with health-related quality of life

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Abstract

Purpose Many long-term cancer survivors still have to adjust to possible adverse consequences of the illness or treatment. Resources can play an important role in this adjustment process, but research on this topic is limited, especially for very long-term survivors. This study explores, which resources are most frequently indicated by different subgroups of cancer survivors, and what role resources play for functioning and health-related quality of life (HRQL) in cancer survivors with and without recurrence.

Methods The sample of 6030 breast, colorectal, and prostate cancer survivors (5–16 years post-diagnosis) was recruited in a German multi-regional population-based study. Personal resources were assessed by a 27-item checklist; HRQL was assessed by the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30 (EORTC QLQ-C30). General linear models were used to analyze associations of resources with HRQL.

Results Participants indicated on average 11.4 (SD 5.1) resources as helpful. Family, activities with others, and partnership were indicated most commonly overall, but frequencies varied according to age, sex, and tumor site. Physical activity, health, professional help, calmness, hope, optimism, and hobbies were most important in explaining HRQL variance. Cancer survivors with recurrence and many resources were found to report similar HRQL as survivors without recurrence and only few resources.

Conclusions The study underlines the importance and situational variability of personal and social resources for cancer survivors' HRQL, even years post-diagnosis. Not only the availability, but also the individual perception and significance of resources should be considered in follow-up cancer care.

Keywords Cancer survivorship · Population-based · Personal resources · Social resources · Resilience · Health-related quality of life

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Introduction

Breast, colorectal, and prostate cancers are among the most frequently diagnosed cancers worldwide [1]. Due to advances in treatment, the number of cancer survivors has increased over the last decades [2–4]. They often experience ongoing impact of the cancer and its treatment on daily life, like long-term and late effects [5], fear of disease progression, or of death [6]. Despite these potential stresses and strains, many cancer survivors report quality of life levels comparable to the general population [7]. The availability and appraisal of resources play an important role during stress adaptation [8]. Resources in a psychological context can be defined as "those objects, personal characteristics, conditions, or energies that are valued by the individual or that serve as a means for attainment of these objects, personal characteristics, conditions, or energies" [9].

Resources and cancer The value of certain resources, e. g., hopefulness, spirituality, optimism, and social support, for cancer patients' adaptation, well-being, and health, has widely been shown [10]. Personal resources and cognitive appraisal are better determinants for adjustment to cancer than illness-related variables [11]. Time factors seem to play an important role: Handling initial screening results may require different resources than coping with a terminal diagnosis [12]. Recently, diagnosed cancer patients before their first cycle of chemotherapy were found to report more optimism and purpose in life than healthy controls, but those resources declined to the levels of the control group 9 months later over the course of chemotherapy [13]. The initial level of some self-reported resources (social support, self-esteem, optimism, purpose in life) however was associated with higher subjective well-being after therapy [14]. Hence, high levels of resource utilization may on the one hand reflect the level of perceived distress but on the other hand may also reduce it. However, hardly anything is known about the role of resources later in the adjustment process (> 5-years past diagnosis).

Total resource pool size Although there are instruments developed assessing multiple resources [15–18], no study could be found that has explored the significance of cancer survivors' resource pool size to their HRQL. It is still unclear to what extent resources overlap and if having more resources is always better [19]. For example, the associations between the number of resources and adjustment to cancer could also be curvilinear, like it was already found for benefit finding [20].

Age and sex effects on resource utilization Some authors assume that older cancer survivors have fewer resources due to higher comorbidity, retirement, or partner loss, while on the other hand, these survivors may have more time and more experience in dealing with critical life events [21]. Age effects seem to be resource-specific. More hope was found in younger survivors, while older survivors had more internal locus of control (independent from functional status), but perceptions of self-worth and social support were comparable [21].

Some sex effects concerning resources have also been found. In an Israeli study with colorectal cancer survivors (age > 60), women were found to have less distress, more fighting spirit, and less helplessness and fatalism than men. Men reported more spiritual-religious support and spouse support than women. No difference was found for anxiety. Unmarried women and married men reported least stress intrusion and avoidance [22].

Resources in long-term cancer survivors There are hardly any studies about resources in long-term cancer survivors (> 5 years after diagnosis). To understand the adaptation process of these survivors, it is essential to keep track of those positive aspects that help them deal with daily strains and long-term consequences, or to cope with a recurrence. It is of further interest, whether the subjective perception of a big resource pool corresponds with a higher HRQL. The current study can contribute to the filling of this gap. By comparing different tumor, sex, and age subgroups, the study could also explain some of the discrepancies of previous studies concerning resource utilization of cancer survivors, as most studies only examined specific tumor or age groups.

Study objectives The objectives of the study are to (1) describe the frequencies of particular resources found in a sample of long-term cancer survivors, according to sex, age, and tumor type, (2) analyze the predictive value of the overall resource pool, as well as specific resources, for HRQL, and (3) find out to what extent the experience of resources can compensate a possibly lower HRQL after disease progression.

Method

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") in 2009. Study details have been reported elsewhere [7]. Inclusion criteria were age at diagnosis 20–75 years and a histological confirmation of breast, colorectal, or prostate cancer in the time period 1994–2004. Of the 14,526 eligible and contacted participants, 6030 (response rate 42%) answered the full length questionnaire, including a checklist of personal resources. Participants who did not complete the relevant page ($n = 26$), had a missing age in the data ($n = 1$) or who only filled out the short questionnaire which did not include the resource checklist ($n = 86$), were excluded from the analyses for the current study.

Instruments/measures *Personal resources* were assessed by a 27-item-checklist that was developed in the context of another study [23, 24]. This checklist included emotional, motivational, interpersonal, and social aspects were derived from pre-existing resource and resilience questionnaires [15, 16, 18, 25] selected by face validity (see items in Table 2), as those instruments themselves would have been too extensive and burdensome for the elderly sample. Participants were asked to indicate all aspects in the checklist that currently give them power and strength in their life (coding: 0/1). The total score was defined as the sum of all indicated resources and thus ranged from 0 to 27 (Cronbach's α 0.81, see results). *Health-related quality of life* was assessed using the European Organization for Research and Treatment of Cancer Quality of Life-Core 30 (EORTC QLQ-C30) questionnaire [26]. It is an internationally validated generic instrument that measures HRQL in cancer survivors. The 30-item questionnaire consists of five functioning scales (physical, role, cognitive, emotional, and social), a global health status/quality of life scale, three symptom scales, and single-symptom items. Answers for the functioning and symptom scales are rated from 1 (not at all) to 4 (very much) and for global health status/quality of life from 1 (very poor) to 7 (excellent). Cronbach's α for the subscales ranges from 0.52 to 0.89 [26]. For the current analyses, only the functioning scales and the global health status/quality of life scale were included. Higher scores on these scales indicate better functioning. *Sociodemographic information* was assessed by self-report. *Disease progression (recurrence)* was assessed by self-report, defined as a recurrence of the initial tumor, or metastasis, or both.

Hypotheses The analyses of the study are based on the following a priori hypotheses:

1. The frequencies of particular resources differ by sex and age.
2. Reporting a greater number of resources is associated with a higher HRQL.
3. The extent of HRQL detriments in survivors with a disease progression depends on the resource pool size of these survivors.

Statistical analysis *Psychometric analysis of resource questionnaire:* As no previous validation for the resource checklist existed, an exploratory factor analysis with subsequent varimax rotation was conducted to see whether subscales (e.g., social, psychological, material resources) could be derived from the items to aid in the analyses. Cronbach's α was calculated to test for internal consistency. *Particular resources as outcomes:* Frequencies were calculated by subgroups of tumor (breast, colorectal, prostate), sex (female, male), and age (< 60 years, 60–69 years, ≥ 70 years). Subgroup differences were analyzed by using regression analyses for each resource (27 models). *Particular resources as predictors:* Stepwise regression analyses (SAS regression, method "stepwise") by sex and age (adjusted for tumor type) were used to observe which resources explain most variance in the EORTC QLQ-C30 functioning scales (42 models). *Resource pool as outcome:* Tumor type, age, sex, further sociodemographic factors, and comorbidities were inserted in a regression model. *Resource pool as predictor:* Regression analyses with five resource groups, based on quintiles of the overall distribution (0–6, 7–9, 10–12, 13–15, and 16–27 resources), were calculated to explore associations with the EORTC QLQ-C30 functioning scales, by tumor, sex, and age (24 models). As only few colorectal and prostate cancer survivors ≤ 60 years were in the sample, the age groups for these cancer types were set to < 70 years, 70–74 years, and ≥ 75 years here. Further regression analyses were conducted to compare associations between resource pool and EORTC QLQ-C30 functioning scales for survivors with and without a recurrence (6 models, adjusted for age, sex, and tumor type). All analyses were performed using the SAS statistical software (Version 9.4). Unless otherwise noted, a p value of 0.05 (two-sided) was chosen as level of statistical significance. The p values were not adjusted for multiple testing, so the p values refer to the individual tests rather than a global test for differences.

Results

Description of the study population A total of 2645 breast, 1211 colorectal, and 2174 prostate cancer survivors was included (Table 1). Mean age of participants at time of survey was 69 years (34–89 years), with prostate cancer survivors being the oldest and breast cancer survivors the youngest participants. Females were slightly overrepresented. Almost 80% of the participants were currently in a partnered relationship, 86% had children. Arthrosis (30%) and depression (17%) were the most common comorbidities.

Factor analysis and Cronbach's *α* According to the Kaiser criterion (eigenvalue > 1), only one factor could be extracted, having an eigenvalue of 3.8 (factor 2: 0.7, data not shown). The Proportion-criterion with 75% variance explanation also indicated only one factor (Supplementary Table S1), for 90%, two highly intercorrelated factors emerged, without evident explanation for item mapping (Supp. Table S2). Cronbach's α (0.81) did not increase when deleting items with the lowest item-scale correlations. The smallest item-scale correlations were found for *religion* (0.11) and *other resources* (0.09), the highest for *optimism* (0.47), and *talking to others* (0.45).

Table 1 Description of study population by tumor type and sex

Tumor type (sex)	Breast		Colorectal (women)		Colorectal (men)		Prostate		All	
	n	%[a]	*n*	%	*n*	%	*n*	%	*n*	%
Total	2645	100.0	500	100.0	711	100.0	2174	100.0	*6030*	*100.0*
Age at survey (0% unknown)										
34–59 years	737	27.9	70	14.0	71	10.0	46	2.1	*924*	*15.3*
60–69 years	950	35.9	128	25.6	205	28.8	499	23.0	*1782*	*29.6*
70–74 years	562	21.3	131	26.2	202	28.4	733	33.7	*1628*	*27.0*
75–89 years	396	15.0	171	34.2	233	32.8	896	41.2	*1696*	*28.1*
Mean age (SD)	65.0	9.7	70.1	9.4	70.5	8.1	73.1	5.9	*69.0*	*9.1*
Nationality (3.4–5.8% unknown)										
German	2450	92.6	471	94.2	676	95.1	2071	95.3	*5668*	*94.0*
Education (1.4–3.0% unknown)										
≤ 9 years	1350	51.0	300	60.0	396	55.7	1101	50.6	*3147*	*52.2*
10 years	781	29.5	114	22.8	117	16.5	404	18.6	*1416*	*23.5*
≥ 12 years	477	18.0	71	14.2	183	25.7	621	28.6	*1352*	*22.4*
Family situation (0.2–5.0% unknown)										
Partnership	1890	71.5	331	66.2	622	87.5	1895	87.2	*4738*	*78.6*
Living with a spouse	1711	64.7	278	55.6	549	77.2	1672	76.9	*4210*	*69.8*
Having children	2222	84.0	416	83.2	610	85.8	1956	90.0	*5204*	*86.3*
Current household size (3.8–7.2% unknown)										
1 person	600	22.7	145	29.0	71	10.0	250	11.5	*1066*	*17.7*
2 persons	1507	57.0	263	52.6	537	75.5	1710	78.7	*4017*	*66.6*
≥ 3 persons	390	14.7	56	11.2	71	10.0	132	6.1	*649*	*10.8*
Time since diagnosis (0.2–2.0% unknown)										
5–7 years	1148	43.4	185	37.0	323	45.4	1187	54.6	*2843*	*47.2*
8–10 years	1169	44.2	194	38.8	255	35.9	764	35.1	*2382*	*39.5*
11–16 years	323	12.2	111	22.2	128	18.0	205	9.4	*767*	*12.7*
Comorbidity (0.6–6.2% unknown)										
Stroke	64	2.4	18	3.6	35	4.9	135	6.2	*252*	*4.2*
Myocardial infarction	49	1.9	10	2.0	62	8.7	199	9.2	*320*	*5.3*
Angina pectoris	166	6.3	47	9.4	112	15.8	388	17.9	*713*	*11.8*
Heart failure	205	7.8	57	11.4	83	11.7	290	13.3	*635*	*10.5*
Arthrosis	1003	37.9	175	35.0	149	21.0	493	22.7	*1820*	*30.2*
Rheumatism	181	6.8	33	6.6	45	6.3	160	7.4	*419*	*7.0*
Osteoporosis	457	17.3	84	16.8	28	3.9	124	5.7	*693*	*11.5*
Diabetes mellitus	248	9.4	60	12.0	126	17.7	327	15.0	*761*	*12.6*
Depression	593	22.4	89	17.8	74	10.4	253	11.6	*1009*	*16.7*
Other cancer disease	303	11.5	66	13.2	105	14.8	309	14.2	*783*	*13.0*
Disease recurrence (0.6–2.3% unknown)										
Yes (local or distant)	357	13.5	68	13.6	127	17.9	376	17.3	*928*	*15.4*

[a] Percentages refer to column-percent

Due to these results and the explorative character of the study, the scale as a whole was used for further analyses.

Size of the resource pool Out of the 27 resources in the questionnaire, participants indicated on average 11.4 resources (42% of the whole list; SD: 5.1) as being current sources of power in their lives (data not shown). The resource pool size did not differ significantly between sex groups and tumor types. Younger survivors (< 60 years old) reported statistically significant fewer resources (mean 10.7) than older participants (60–69 years: 11.5; ≥ 70 years: 11.6; all means adjusted for tumor type and sex). Employment, higher income, as well as having a partner, children, or a pet were also positively associated with the total number of resources. However, education,

city size, marital status, number of persons in the household, or time since diagnosis were not related to the resource pool size. Regarding disease progression and other diseases, only chronic depression and diabetes were associated with a significantly smaller resource pool (− 0.8 and − 0.5 respectively, data not shown).

Frequencies of resources Table 2 shows the frequencies of resources by tumor type, sex, and age, ordered by overall frequencies. In general, *family* was the resource indicated most frequently by 73% of the participants. Further resources indicated frequently (by > 50% of the sample) were *joint activities* (e.g., with family, friends), *partnership*, *financial security*, *the feeling of being needed*, *optimism*, *hobbies*, *friends*, *humor*, *self-determination*, *conversation/ talking*, *and hope*. However, there was a considerable variance concerning resource perception between the subgroups. Results from the general linear models showed the following associations: *Tumor type:* Breast cancer survivors indicated *physical activity* more frequently than colorectal and prostate cancer survivors but scored lower for *feeling needed* and *religion*. *Sex:* Women (breast and colorectal cancer survivors) reported *feeling needed*, *conversation*, *received social support*, *social contact*, *creativity* and *religion* more frequently than men (prostate and colorectal cancer survivors). Men indicated *partnership*, *hobbies*, and *calmness* more frequently as a resource than women. *Age:* Age played a role for nearly every resource. *Work* was indicated more often (30–44%) by younger participants (< 60 years) in contrast to older participants (> 60 years), yet still nearly 20% of those indicated it. *Social contact as a whole* was reported more frequently in younger survivors, while *optimism*, *health*, and *financial security* were mentioned less often than in the other age groups. In the age group 60–69 years, *physical activity*, *goals*, *hobbies*, and *joint activities* were more prevalent than in younger and older cancer survivors. For the age group > 70 years, *religion*, *self-determination*, *self-efficacy*, *hope*, *calmness*, *conversation*, and *professional help* were more frequently mentioned than in the other age groups. *Partnership* was mentioned least in the oldest age group, especially among women, of whom 36% were widowed in contrast to 10% of men in that age group.

Resource pool associated with quality of life Table 3 shows the numbers of indicated resources by tumor type, sex, and age. Resource pool size showed small ($r = 0.10$–0.18) but significant correlations with all functioning scales (Supp. Table S3). Figure 1 shows the mean HRQL scores according to categorized number of resources by tumor, sex, and (tumor specific) age groups. For all scales in most of the subgroups, the resource pool explained a small but significant amount of the cancer survivors' functioning (R-squares 0.01–0.07). Interactions between age and resources were significant for physical and role functioning in males with colorectal cancer. Here, older survivors seemed to profit predominantly from the "increase" from 0 to 6 to 7–9 resources. There was also a significant age interaction for physical functioning in prostate cancer survivors, where the overall association was higher for older survivors.

Variance explanation of specific resources For every functioning scale, the first five resources that emerged as significant determinants ($p < .10$) in a stepwise regression analysis are presented in Table 4. Overall, and for most sex-age subgroups, *health* played a role for all the functioning scales. *Physical activity* was important for physical, role, and social functioning, and global health status. *Hobbies* were a determinant for physical and role functioning in the overall group. *Professional help* (by physicians, psychologists, or therapists) and *hope* played a role for all functioning scales and in many subgroups. *Optimism* mainly played a role for emotional and cognitive functioning, as well as for global health status, while *calmness* was associated with emotional and social functioning. *Subgroup differences:* Some resources only played a role in certain subgroups. For men of working age (< 60 years), *financial security* was one of the strongest determinants for physical, role, emotional, social functioning, and global health status; *conversation* was associated with physical functioning and global health status. In the same subgroup, cognitive functioning was only explained by *work*. For the functioning of younger women (< 60 years), *work* was an important resource associated with all functioning aspects, except emotional functioning. *Joint activities* were a resource most important for the group of women > 70 years, in regard to their global health status, physical, cognitive, and emotional functioning.

Resources and HRQL in survivors with disease progression Figure 2 shows the association of the sum of resources and the functioning scales for survivors with and without disease progression. In both groups, a larger resource pool was associated with better HRQL without indication of a meaningful interaction (parallel lines). Hence, the role of the resource pool size for patient's HRQL did not differ between survivors with and without a disease progression. However, resources seemed to compensate functioning "deficits." Survivors with disease progression and many resources achieved equal functioning as those without disease progression and only few resources.

Discussion

Personal and social resources are assumed to play important roles in the resilience process of cancer survivors. Since most

Table 2 Unadjusted percentages of resource indication by tumor type, sex, and age, and significant tumor type, sex, and age differences

Tumor type (sex)	Breast			Colorectal (women)			Colorectal (men)			Prostate			All	Significant subgroup differences[a]		
Age group (in years)	< 60	60–69	≥ 70	< 60	60–69	≥ 70	< 60	60–69	≥ 70	< 60	60–69	≥ 70				
N	737	950	958	70	128	302	71	205	435	46	499	1629	6030	*TT*	*Sex*	*Age*
Family	71.1	72.3	72.0	77.1	81.3	71.9	74.6	66.8	73.1	78.3	72.3	75.3	73.1	–	–	–
Joint activities	63.8	70.1	68.4	70.0	67.2	60.9	60.6	62.9	62.5	58.7	69.9	64.2	65.9	–	–	*2*
Partnership	56.7	58.9	45.1	62.9	62.5	41.7	77.5	71.7	69.2	69.6	73.9	69.4	61.3	–	*m*	*1*, *2*
Financial security	44.8	55.3	56.3	51.4	53.1	51.3	46.5	59.5	66.2	50.0	61.7	64.5	57.7	–	–	*2*, *3*
Feeling needed	49.3	56.0	60.8	60.0	65.6	62.6	40.8	51.7	55.2	56.5	48.9	52.9	54.7	*c*, *p*	*w*	–
Optimism	48.8	54.1	54.6	57.1	57.0	51.3	42.3	54.1	53.8	30.4	49.7	54.2	52.8	–	–	*2*, *3*
Hobbies	47.2	51.6	47.3	40.0	53.1	41.7	47.9	59.0	57.7	60.9	62.7	56.5	52.7	–	*m*	*2*
Friends, acquaintances	51.4	54.8	57.5	51.4	54.7	53.6	49.3	51.2	50.1	47.8	46.9	50.4	52.3	–	–	–
Humor	50.2	49.5	52.1	58.6	43.8	47.0	56.3	54.1	51.7	43.5	50.5	52.4	51.1	–	–	–
Self-determination	41.2	48.0	56.2	42.9	47.7	56.0	35.2	52.2	52.4	37.0	50.5	53.3	50.7	–	–	*3*
Conversation	48.0	55.7	60.8	54.3	50.8	60.3	28.2	49.8	47.4	41.3	40.3	45.5	50.4	–	*w*	*3*
Hope	45.2	50.3	55.1	60.0	47.7	55.0	49.3	46.8	52.0	43.5	43.5	50.5	50.1	–	–	*3*
Self-efficacy	47.5	45.7	51.9	48.6	44.5	46.4	46.5	53.7	53.8	32.6	47.9	51.2	49.4	–	–	*3*
Calmness	33.6	40.8	45.1	35.7	37.5	45.0	49.3	55.1	57.0	45.7	53.7	55.8	47.6	–	*m*	*3*
Health	46.0	46.9	48.3	45.7	46.1	44.7	40.8	46.3	55.2	32.6	44.7	48.5	47.5	–	–	*2*, *3*
Received social support	42.6	44.5	46.1	45.7	44.5	42.4	35.2	37.1	38.2	39.1	37.7	40.1	41.8	–	*w*	–
Physical activity	47.2	49.6	38.7	35.7	35.9	37.4	31.0	41.5	37.9	41.3	42.7	36.8	41.1	*b*	–	*2*
Social contact	48.4	45.7	41.5	52.9	39.8	38.4	25.4	38.5	32.2	52.2	35.1	32.4	39.1	–	*w*	*1*
Religion	25.0	34.7	39.4	48.6	35.2	46.4	26.8	25.9	35.9	26.1	26.3	32.0	33.2	*c*, *p*	*w*	*3*
Professional help	24.6	26.5	30.5	30.0	27.3	26.5	15.5	34.1	34.9	28.3	30.9	36.8	30.8	–	–	*3*
Goals	29.7	33.8	28.6	32.9	27.3	25.2	19.7	33.7	26.0	34.8	34.5	31.1	30.5	–	–	*2*
Creativity	24.4	29.9	28.8	32.9	32.8	29.8	18.3	26.8	21.4	23.9	26.5	24.5	26.5	–	*w*	–
Work	39.9	20.9	20.3	31.4	18.8	19.9	43.7	19.0	18.4	30.4	19.2	18.9	22.6	–	–	*1*
Individual activities	19.8	21.8	23.9	22.9	23.4	18.5	14.1	23.9	23.2	26.1	21.4	22.5	22.1	–	–	–
Voluntary engagement	16.6	20.7	19.7	25.7	21.1	19.9	11.3	24.4	23.0	15.2	23.2	22.0	20.8	–	–	–
New friends	12.2	14.6	16.5	11.4	10.2	13.6	7.0	16.1	13.1	8.7	13.2	13.5	13.8	–	–	–
Other resources	4.7	4.8	4.7	7.1	3.1	5.6	5.6	2.4	4.4	4.3	3.2	3.6	4.2	–	–	–

[a] Index indicates group with highest overall indication of the particular resource (GLM, type III, $p < 0.05$). Tumor type (TT): *b* breast cancer, *c* colorectal cancer (men + women), *p* prostate cancer, Sex: *w* women, *m* men, Age: *1* < 60 years, *2* 60–69 years, *3* ≥ 70 years

studies only focus on one or a few key resources, this study analyzed a broader spectrum of resources and their associations with HRQL in a large population-based sample of 6030 long-term breast, colorectal, and prostate cancer survivors.

Hypothesis 1 ("The frequencies of particular resources differ by sex and age") can be maintained. However, regarding the absolute number of resources, no sex and only small age differences were found. Previous assumptions of a general resource loss in older age were not supported by the current results. Losses in the field of *work*, *social contact*, or *partnership* in older age could be compensated by an increased experience of *hope*, *calmness*, *professional help*, or *self-efficacy*. In the 60–69 years age group, *physical activity*, *goals*, *hobbies*, and *joint activities* were more prevalent than in younger and older survivors. Younger participants possibly experience these factors as "normal" or have too little time for them due to their work, while older survivors are less able to conduct such activities due to possible physical functioning detriments. The resource *work* was indicated by 18–20% of the participants ≥ 70 years, of whom 96% were already retired. Overall, many participants who experienced *work* as helpful were retired (49%), unemployed (1%), or homemakers (11%, data not shown). Thus, the indication of work as a resource could also refer to home or garden work and is not limited to paid employment.

Hypothesis 2 ("Reporting a greater number of resources is associated with a higher HRQL") can likewise be maintained. This is in line with previous research highlighting the importance of personal and social resources in the process of coping with cancer [10]. Analyses showed that it is not only the sum of resources that counts, as specific resources explained more

Table 3 Subgroup sizes and row-percent according to tumor type, sex, age, and number of resources

Number of resources		0–6		7–9		10–12		13–15		16–27		All	
Tumor type (sex)	Age group	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
Breast	< 60 years	151	20.6	163	22.2	171	23.3	126	17.2	123	16.8	734	100.0
	60–69 years	151	15.9	196	20.7	218	23.0	171	18.0	212	22.4	948	100.0
	≥ 70 years	154	16.2	172	18.1	213	22.4	177	18.6	237	24.9	953	100.0
Colorectal (women)	< 70 years	33	16.7	46	23.2	41	20.7	36	18.2	42	21.2	198	100.0
	70–74 years	29	22.1	23	17.6	22	16.8	23	17.6	34	26.0	131	100.0
	≥ 75 years	39	22.9	35	20.6	30	17.7	39	22.9	27	15.9	170	100.0
Colorectal (men)	< 70 years	55	19.9	59	21.4	65	23.6	34	12.3	63	22.8	276	100.0
	70–74 years	29	14.4	32	15.8	48	23.8	37	18.3	56	27.7	202	100.0
	≥ 75 years	46	19.8	52	22.4	42	18.1	46	19.8	46	19.8	232	100.0
Prostate	< 70 years	108	19.8	111	20.4	117	21.5	99	18.2	110	20.2	545	100.0
	70–74 years	121	16.6	141	19.3	173	23.7	114	15.6	182	24.9	731	100.0
	≥ 75 years	175	19.6	166	18.6	152	17.0	191	21.4	209	23.4	893	100.0
All		1091	18.1	1196	19.9	1292	21.5	1093	18.2	1341	22.3	6013	100.0

Percentages refer to row-percent

HRQL variance (up to 26%) than the number of resources (1–7%). This could be justified by the finding that different resources played a role for different aspects of functioning and for different age groups. *Health*, *physical activity*, and *hope* seem to be almost universally important. The universal relevance of *professional help* stresses the importance of continued care and contact with a health specialist throughout the survivorship trajectory. Many resources showed differential explanative values according to functioning aspects and subgroups. The spectrum of meaningful resources was higher in older age.

For clinical practice, the important role of professional help itself as a resource, even years after diagnosis, should be considered. Furthermore, clinicians should explore cancer survivors' resources and reflect the resources' role for HRQL. Therefore, exploring and highlighting particular, individually important resources seems to be more important than just considering the sum of resources a person has. However, there is still more need to study the mutual influence of resources and to find out how they can be enhanced by intervention [19].

Hypothesis 3 ("The extent of HRQL detriments in survivors with a disease progression depends on the resource pool size of these survivors") can be maintained. Although having a disease progression was associated with a poorer functioning in most domains, a larger pool of resources was associated with better HRQL in both survivors with and without disease progression. This suggests that the perception of one's resource pool could be a buffer against the burden of recurrence on HRQL, which is in line with stress theory [8]. Health care providers could raise patients' awareness about the importance of resources in the adaptation process following a recurrence.

Limitations of the study Despite the generally good response rate of 42%, there is a possibility of selection bias as survivors with poorer health condition or poorer knowledge of the German language were less likely to participate. As such, the average resource pool size could have been overestimated, assuming that these survivors would have fewer resources. Besides, as the average functioning in the sample was quite high, there could be a healthy survivor bias. The inclusion of breast and prostate cancer restricts the analysis of sex-related differences independently from tumor type. To overcome this restriction, we stratified the colorectal cancer group into male and female. Another limitation was the differences in age groups, whereby breast cancer survivors were significantly younger than colorectal and prostate cancer survivors. To address this problem, different age groups were used for particular analyses, so that the age groups were not directly comparable any more. The cross-sectional design does not allow for causal interpretation of the results. The relationship between resources and HRQL could also be bidirectional, as the utilization of many resources (especially those involving social or activity aspects) requires a certain level of functioning and mobility. Furthermore, resources were assessed by a checklist which does not take into account the situational or personal significance of particular resources. Besides, checklists can tempt study participants into checking resources that in fact are not relevant for them, especially those of high social desirability like *family*, *partnership*, or *optimism*. Due to the explorative character of this study, we tested a high number of regression models without adjusting *p* values. Multiple testing can lead to an increased risk of type I errors, so that some results found in this study could be false positive.

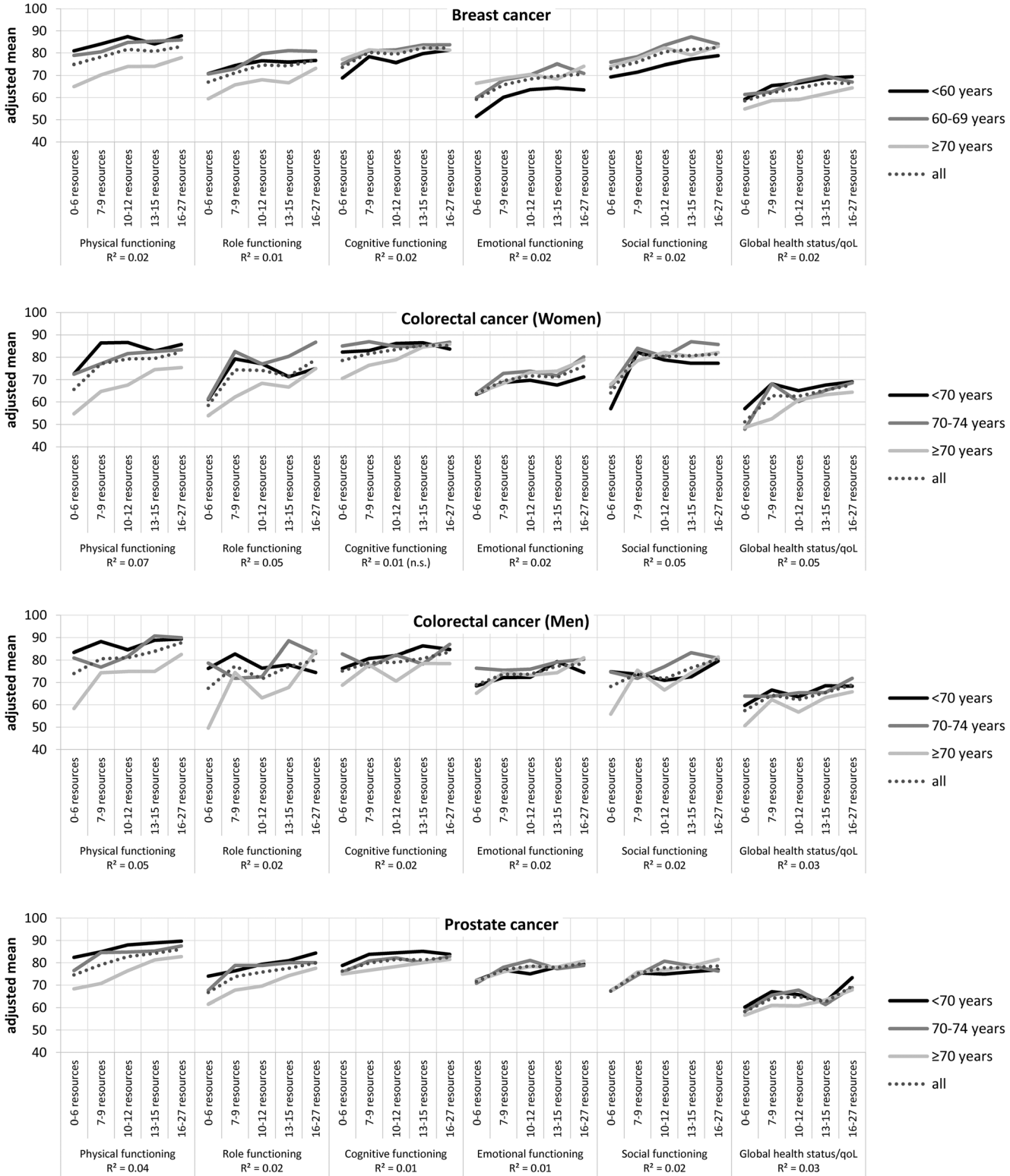

Fig. 1 Mean HRQL scores (EORTC QLQ-C30 functioning scales and global health status/QoL) according to number of resources, stratified by tumor, sex, and age. R^2 refer to change in HRQL according to the change in the number of resources for the whole group (dotted line)—if not indicated otherwise, R^2 were statistically significant (GLM, type III, $p < 0.05$).

Table 4 Specific resources as determinants of EORTC QLQ-C30 functioning scales and global health status/QoL, stratified by sex and age

		Physical functioning	R^2	Role functioning	R^2	Cognitive functioning	R^2	Emotional functioning	R^2	Social functioning	R^2	Global health status/QoL	R^2
Overall	1	physical activity	.08	health	.04	optimism	.02	calmness	.04	health	.03	health	.04
	2	health	.02	physical activity	.03	health	.01	hope	.02	professional help	.02	physical activity	.03
	3	professional help	.02	professional help	.02	professional help	.01	health	.03	physical activity	.01	professional help	.02
	4	hobbies	.01	hope	.01	self-efficacy	.01	optimism	.01	hope	.01	hope	.01
	5	hope	.01	hobbies	.01	hope	.01	professional help	.01	calmness	.01	optimism	.01
Final model		*17 resources*	*.18*	*16 resources*	*.12*	*14 resources*	*.06*	*22 resources*	*.15*	*16 resources*	*.11*	*18 resources*	*.13*
Women < 60 years	1	health	.07	health	.06	professional help	.05	health	.07	health	.07	health	.11
	2	physical activity	.04	professional help	.04	health	.05	professional help	.05	professional help	.05	professional help	.06
	3	professional help	.04	work	.02	optimism	.01	joint activities	.02	work	.02	physical activity	.02
	4	work	.01	hope	.01	joint activities	.01	hope	.01	calmness	.01	hope	.01
	5	hope	.01	physical activity	.01	work	.01	calmness	.02	hope	.01	work	.01
Final model		*8 resources*	*.20*	*8 resources*	*.16*	*7 resources*	*.13*	*8 resources*	*.19*	*8 resources*	*.17*	*11 resources*	*.22*
Women 60–69 years	1	physical activity	.06	health	.04	health	.02	optimism	.04	health	.04	health	.04
	2	health	.03	professional help	.02	optimism	.01	professional help	.03	professional help	.02	professional help	.02
	3	hope	.02	physical activity	.02	hope	.02	health	.03	physical activity	.02	physical activity	.02
	4	professional help	.01	hope	.01	professional help	.01	hope	.03	hope	.01	hope	.02
	5	individual activities	.01	family	.01	partnership	.01	calmness	.01	calmness	.01	hobbies	.01
Final model		*14 resources*	*.17*	*10 resources*	*.12*	*7 resources*	*.07*	*14 resources*	*.18*	*11 resources*	*.12*	*12 resources*	*.14*
Women ≥ 70 years	1	physical activity	.08	physical activity	.03	self-efficacy	.02	calmness	.03	health	.02	physical activity	.04
	2	health	.03	health	.02	joint activities	.01	hope	.02	professional help	.02	health	.01
	3	joint activities	.01	professional help	.02	hope	.01	optimism	.03	physical activity	.01	hope	.01
	4	professional help	.01	hobbies	.01	optimism	.01	joint activities	.01	hope	.01	self-efficacy	.01
	5	hobbies	.01	feeling needed	.00	conversation	.01	professional help	.01	calmness	.01	joint activities	.01

Table 4 (continued)

		Physical functioning	R^2	Role functioning	R^2	Cognitive functioning	R^2	Emotional functioning	R^2	Social functioning	R^2	Global health status/QoL	R^2
Final model		*13 resources*	*.18*	*11 resources*	*.11*	*8 resources*	*.05*	*13 resources*	*.14*	*13 resources*	*.11*	*11 resources*	*.10*
Men < 60 years	1	financial security	.08	financial security	.09	work	.02	professional help	.08	professional help	.08	financial security	.08
	2	physical activity	.06	professional help	.06			financial security	.08	hobbies	.07	conversation	.06
	3	conversation	.06	joint activities	.03			optimism	.03	new friends	.02	hobbies	.07
	4	health	.02	individual activities	.02					financial security	.02	work	.03
	5									calmness	.02	professional help	.02
Final model		*4 resources*	*.22*	*4 resources*	*.20*	*1 resource*	*.02*	*3 resources*	*.18*	*5 resources*	*.22*	*5 resources*	*.26*
Men 60–69 years	1	physical activity	.08	health	.03	optimism	.02	health	.03	health	.04	health	.04
	2	professional help	.02	professional help	.03	new friends	.02	hope	.03	hope	.03	professional help	.03
	3	health	.02	physical activity	.02	health	.01	optimism	.02	physical activity	.02	physical activity	.03
	4	hobbies	.01	social support	.01	partnership	.00	hobbies	.01	goals	.01	partnership	.01
	5	conversation	.01			hope	.00	conversation	.01	social support	.01	hope	.01
Final model		*8 resources*	*.15*	*4 resources*	*.09*	*5 resources*	*.06*	*8 resources*	*.12*	*6 resources*	*.12*	*9 resources*	*.13*
Men ≥ 70 years	1	physical activity	.09	physical activity	.04	self-efficacy	.02	calmness	.03	health	.03	physical activity	.05
	2	hobbies	.03	health	.02	social support	.01	hope	.02	hope	.02	health	.02
	3	health	.02	hope	.02	friends	.01	health	.02	physical activity	.02	hope	.02
	4	professional help	.01	hobbies	.02	hobbies	.01	hobbies	.01	hobbies	.01	optimism	.01
	5	hope	.01	professional help	.01	individual activities	.00	professional help	.01	professional help	.01	professional help	.01
Final model		*15 resources*	*.19*	*14 resources*	*.14*	*12 resources*	*.07*	*14 resources*	*.12*	*15 resources*	*.11*	*14 resources*	*.13*

R^2 for the resources refer to the variance explained by the particular resource in HRQL; R^2 for the final model refer to the variance explained by all resources

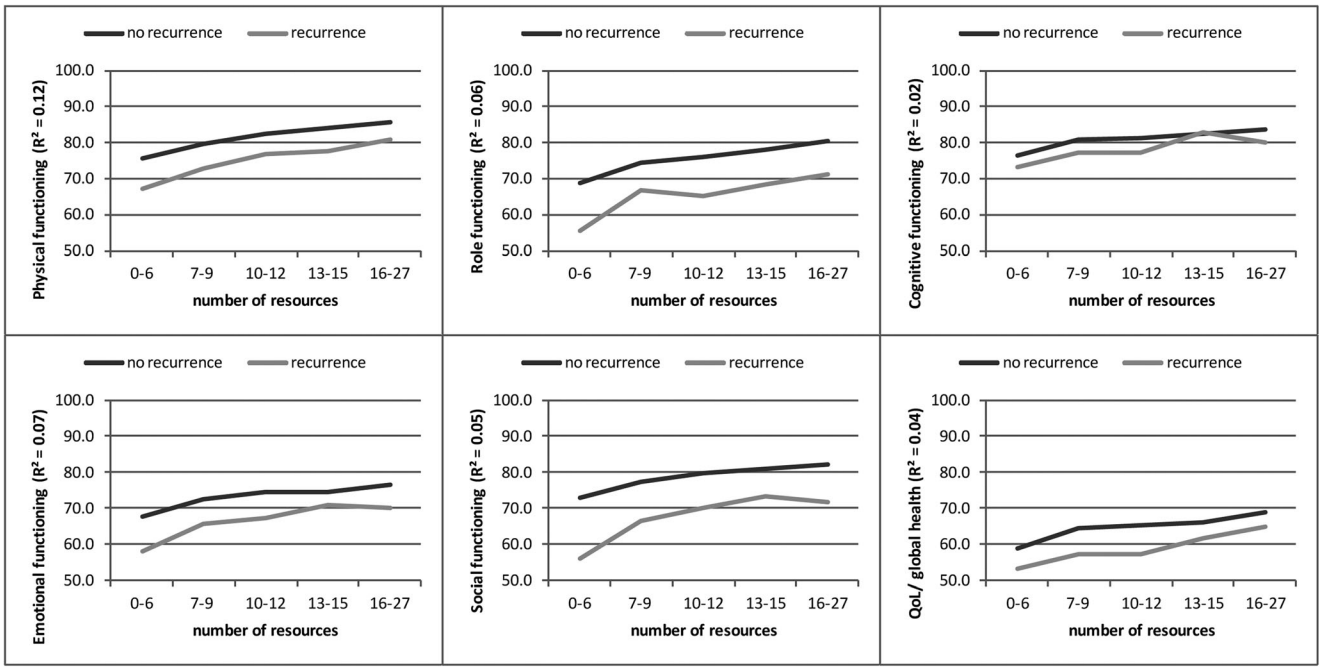

Fig. 2 Mean HRQL scores (EORTC QLQ-C30 functioning scales and global health status/QoL) according to number of resources, for participants with and without a recurrence; adjusted for age, sex, and tumor type, R^2 refer to change in HRQL according to the change in the number of resources

Conclusions

Regarding cancer survivors' functioning, it is not only the clinical and tumor characteristics that count, but also psychosocial aspects. This study demonstrated the role of resources in the adaptation process, even many years after treatment cessation. No comparable study could be found for long-term cancer survivors. This study could potentially help to generate hypotheses for future research. The analyses showed different frequencies and importance of specific resources for age, sex, and tumor groups, as well as for different aspects of functioning. The finding supports resilience theory, postulating that resources can have a situational worth and meaning. The frequency in which a particular resource is indicated does not seem to be related to its general explanative value regarding functioning and HRQL. For follow-up care, the view and understanding of cancer survivors' subjective resources as protective factors should be considered in addition to medical and physical issues.

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Compliance with ethical standards

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors. Informed consent was obtained from all individual participants included in the study.

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