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Benefit finding, posttraumatic growth and health-related quality of life in long-term cancer survivors: a prospective population-based study

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ABSTRACT

Background: We explored the relationship between benefit finding (BF)/posttraumatic growth (PTG) at baseline and health-related quality of life (HRQOL) at baseline and follow-up in long-term cancer survivors (LTCS; ≥ 5 -year post-diagnosis).

Materials and methods: HRQOL was assessed in LTCS in 2009–2011 (5- to 16-year post-diagnosis, baseline) and re-assessed in 2018/2019 (14- to 24-year post-diagnosis, follow-up). BF and PTG were measured at baseline; mean scores were dichotomized into ‘none-to-low’ (< 3) and ‘moderate-to-high’ (≥ 3). Linear regression models and linear mixed regression models were employed to assess the association of BF/PTG with HRQOL.

Results: Of the 6057 baseline participants, 4373 were alive in 2019, of whom 2704 completed the follow-up questionnaire. Cross-sectionally, LTCS with none-to-low BF reported better HRQOL at baseline and at follow-up than LTCS with higher BF. Longitudinally, no difference was found between none-to-low and moderate-to-high BF on the HRQOL change from baseline to follow-up. HRQOL differences between the PTG groups were not statistically significant cross-sectionally and longitudinally, except those participants with moderate-to-high PTG reported higher role functioning and global health status/QOL.

Conclusions: Cross-sectionally, BF was significantly negatively related to subscales of HRQOL, while PTG was positively correlated to role functioning and global health status/QOL. The results add further evidence that BF and PTG are two different positive psychological concepts.

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Background

Longer survival with high quality of life is one of the aims of oncology. Survival rates for many types of cancer have increased [1] due to improvements in early detection and treatment advances. Despite these advances, cancer and its treatments can still negatively affect health-related quality of life (HRQOL) and these detriments can persist indeterminately [2]. Likewise, survivors can also attribute positive growth to their cancer experiences [3]. The positive growth which cancer survivors experience during their trajectory is an important aspect of mental well-being for their life after cancer. According to stress, coping, and adaptation theories, positive growth is thought to be positively associated with HRQOL [4,5]. However, more empirical research on the

relationship between positive growth and HRQOL in cancer survivors is needed, especially in long-term cancer survivors (LTCS; 5 or more years post-diagnosis).

Theoretical and empirical studies label positive growth from cancer as benefit finding (BF) and posttraumatic growth (PTG) [6,7]. Although the two concepts are related and often used synonymously in publications [8], slight differences exist [9]. BF is a form of cognitive adaptation to adversity via positive evaluation of the circumstances survivors encountered [10], whereas PTG refers to the positive psychological changes experienced after struggling with a traumatic event [11]. BF encompasses broader and less specific aspects and is not necessarily triggered by a traumatic event, in contrast to PTG [12]. Another difference between BF and PTG is the initiation process. BF can be experienced immediately after

cancer diagnosis, while the traumatic event of cancer needs to be processed before PTG is supposed to be initiated [13].

Research into the association of BF with HRQOL in cancer survivors is limited. Studies used heterogeneous samples (e.g., age groups, cancer types) and instruments, and their results are inconsistent [14]. Even less research has been done on BF and HRQOL in LTCS. In contrast, there has been considerable research addressing the relationship between PTG and HRQOL in cancer survivors. A recent systematic review of the relationship between PTG and overall HRQOL in cancer survivors concluded that there is a statistically significant positive relationship [8]. However, this relationship is small and no inferences could be made to the direction of discovered associations because the included studies (a) had small sample sizes and (b) were largely of cross-sectional design [8]. Evidence from prospective studies of good quality on PTG and HRQOL that specifically include LTCS is lacking.

It is important to study the relationship between positive growth and HRQOL in LTCS in order to promote better HRQOL in cancer survivors in the long run. This population-based, prospective cohort study that consisted of LTCS of breast, colorectal, and prostate cancer was conducted to address the following aims: (1) investigate the cross-sectional association between baseline BF/PTG with baseline HRQOL, and the association between baseline BF/PTG and HRQOL at follow-up, and (2) explore whether baseline BF/PTG was associated with differences in HRQOL between baseline and follow-up. As we previously found that the age-adjusted prevalence of BF and PTG differed according to cancer type (breast > colorectal > prostate) and sex (female > male) [15], we also posed the third aim: (3) examine whether the relationship between BF/PTG and HRQOL differ by cancer type and by sex.

Material and methods

Study participants

The study population came from the CAESAR study (CAnCER Survivorship – A multi-Regional population-based study – an observational cohort study) [16] conducted by the German Cancer Research Center (Deutsches Krebsforschungszentrum, DKFZ) in close collaboration with six population-based cancer registries in Germany (including the federal states of Bremen, Hamburg, Münster/North Rhine-Westphalia, Rhineland-Palatinate, Saarland, and Schleswig-Holstein). In brief, the study included breast, prostate, and colorectal cancer survivors diagnosed during 1994–2004 as registered in one of the six participating cancer registries and with an age at diagnosis of 20–75 years. Eligible participants were contacted in 2008–2011 (baseline) and recontacted in 2018–2019 (follow-up) [17]. The ethics committee of the University of Heidelberg and the ethics committees responsible for the involved cancer registries approved both the baseline and the follow-up study protocol. All participants gave written informed consent for each assessment. As illustrated in the study flowchart (Supplementary Figure 1), of the 14,526 cancer survivors eligible for the CAESAR core study, 6057 completed the long questionnaire in the baseline study.

According to records in the cancer registries, 4373 were still alive in 2019, of whom 2704 completed the follow-up questionnaire. Differences between participants who dropped out and those with follow-up data had been assessed previously [17]: those who participated in the follow-up study were younger at cancer diagnosis, less frequently diagnosed with stage IV cancer, had shorter time from diagnosis, were more frequently to be breast cancer survivors, and less frequently to be colorectal cancer survivors.

Outcomes and measurements

Sociodemographic and clinical data

Cancer registry data at recruitment included sex, year of birth, year of diagnosis, cancer diagnosis, and stage. Education was collected at baseline by survivors' self-report. Number of comorbidities, recurrence, metastasis, and new cancer since index diagnosis were collected both in the baseline and follow-up questionnaires by self-report. Age at survey for both the baseline and the follow-up study was calculated as the year of survey completion minus the year of birth. Time since diagnosis at baseline and follow-up survey was defined as the year of survey minus the year of diagnosis.

Benefit finding

BF was evaluated by the German short form of the Benefit Finding Scale (BFS) with 10 items [18]. For each item, agreement to a pre-defined statement was rated on 5-point Likert scale ranging from 1 (*not at all*) to 5 (*extremely*). BF was measured at baseline.

Posttraumatic growth

PTG was measured by three subscales (appreciation of life/spiritual change/new possibilities) of the German Posttraumatic Growth Inventory (PTGI). The other two scales of the original questionnaire (personal strengths/relationship to others) were not included to reduce overall questionnaire length [13]. The 10 items were measured on 6-point Likert scale (0 = *I did not experience this change as a result of my cancer*, 5 = *I experienced this change to a very great degree as a result of my cancer*). PTG was measured at baseline.

Intensity of BF and PTG

According to previously reported prevalence rates [15], the intensity levels of BF and PTG were each determined using a cutoff of 3 (indicated as 'moderate' according to a previous report [19]). As such, the mean scores for the overall scales were dichotomized into 'none-to-low' (<3) and 'moderate-to-high' (>= 3).

Health-related quality of life

HRQOL was measured by the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire–Core 30 (EORTC QLQ-C30) Version 3.0. This internationally validated questionnaire with 30 items includes

a global health status/quality of life (QOL) and five functioning scales, and nine aspects on symptoms and financial difficulties. Answers range from 1 (*not at all*) to 4 (*very much*), except for the global health status/QOL scale which ranges from 1 (*very poor*) to 7 (*excellent*). HRQOL was measured at baseline and follow-up. We performed linear transformations of the raw sum scores to a scale of 0–100 according to the EORTC scoring manual [20]. Higher scores on the functioning and global health status/QOL scales imply better functioning and global health status/QOL, whereas higher scores on the symptom and financial difficulties scales imply greater symptom severity and financial problems.

Statistical analysis

Descriptive statistics were conducted on sociodemographic and clinical variables in the baseline and follow-up sample (Table 1).

Linear regression models were used to assess the relationship of BF/PTG with HRQOL at baseline and HRQOL at follow-up. The covariate 'active cancer disease' included stage IV at diagnosis or self-report of subsequent recurrence/metastasis/new cancer after initial diagnosis. To achieve aim 1, least-square means of HRQOL scores at baseline and at follow-up were computed and compared between the none-to-low and moderate-to-high BF/PTG groups adjusted for age at survey, time since diagnosis, comorbidity, active cancer disease, sex, cancer type, UICC stage at diagnosis, and education. To achieve aim 2, linear mixed regression models (LMM) were employed to compare the baseline and follow-up HRQOL scores of LTCS with moderate-to-high versus none-to-low BF or PTG. An unstructured covariance matrix structure and maximum likelihood estimation were used for LMM. The study round was defined as baseline or follow-up. The study time interval was defined as the number of years between baseline study and follow-up study, and it was included in the models as a continuous predictor. The models

Table 1. Baseline characteristics of samples at baseline study and follow-up study.

	Sample at baseline (N = 6057)		Sample at follow-up (N = 2704)	
	N	% ^a	N	% ^a
Sex				
Male	2899	47.9	1266	46.8
Female	3158	52.1	1438	53.2
Age at baseline (years)				
34–49	242	4.0	127	4.7
50–59	683	11.3	425	15.7
60–69	1786	29.5	965	35.7
70–79	2734	45.1	1102	40.8
80–89	611	10.1	85	3.1
Missing	1	0.0	–	–
Education (years)				
≤9	3162	52.2	1260	46.6
10–11	1416	23.4	699	25.9
≥12	1359	22.4	719	26.6
Missing	120	2.0	26	1.0
Cancer type at diagnosis				
Breast	2654	43.8	1231	45.5
Colorectal	1217	20.1	507	18.8
Prostate	2186	36.1	966	35.7
UICC stage at diagnosis				
I–II	3712	61.3	1757	65.0
III–IV	1183	19.5	501	18.5
Missing	1162	19.2	446	16.5
Years since diagnosis				
5–9	4824	79.6	2224	82.3
10–16	1192	19.7	474	17.5
Missing	41	0.7	6	0.2
Comorbidity ^b				
None	1545	25.5	767	28.4
1	1561	25.8	735	27.2
≥2	2938	48.5	1201	44.4
Missing	13	0.2	1	0.0
Active cancer disease ^c				
Yes (any)	759	12.5	260	9.6
No	5036	83.1	2337	86.4
Missing	262	4.3	107	4.0
Benefit finding				
None-to-low	2111	34.9	970	35.9
Moderate-to-high	3840	63.4	1708	63.2
Missing	106	1.8	26	1.0
Posttraumatic growth				
None-to-low	4828	79.7	2168	80.2
Moderate-to-high	1129	18.6	518	19.2
Missing	100	1.7	18	0.7

Note. ^a% column might not add up to 100% due to rounding up of decimals.

^bComorbidities include stroke, heart attack, coronary heart disease, heart failure, arthrosis, rheumatism, osteoporosis, diabetes, depression, and 'other' diseases.

^cActive cancer disease is defined as any recurrence, metastasis, or new primary cancer after index cancer.

Table 2. Tests of effects on longitudinal relationship between benefit finding and health-related quality of life (functional scales and global health status/QOL of EORTC QLQ-C30).

Outcome	Estimate	t	p
Physical functioning			
BF groups	1.46	2.37	0.02
Study time interval	−0.73	−13.00	<0.001
BF Groups × Study time interval	0.06	0.63	0.53
Role functioning			
BF groups	2.86	2.87	0.004
Study time interval	−0.42	−4.55	<0.001
BF Groups × Study time interval	−0.004	−0.03	0.98
Emotional functioning			
BF groups	1.40	1.49	0.14
Study time interval	0.36	4.92	<0.001
BF Groups × Study time interval	0.01	0.50	0.96
Cognitive functioning			
BF groups	1.09	1.37	0.17
Study time interval	0.02	0.36	0.72
BF Groups × Study time interval	−0.10	−1.03	0.31
Social functioning			
BF groups	3.57	3.51	<0.001
Study time interval	0.15	1.94	0.05
BF Groups × Study time interval	−0.09	−0.73	0.47
Global health status/quality of life			
BF groups	−0.22	−0.27	0.79
Study time interval	0.18	2.53	0.01
BF Groups × Study time interval	0.13	1.15	0.25

Note. 'BF groups': none-to-low benefit finding group compared to the moderate-to-high benefit finding group (reference). BF: benefit finding. Bold values indicate $p < 0.05$.

were adjusted for time-variant covariates (age at diagnosis, time since diagnosis, comorbidity, and active cancer disease both at baseline and follow-up), and time-invariant baseline factors (sex, cancer type, UICC stage at diagnosis, education at baseline). The collinearity among the variables in the regression models was assessed by the variance inflation factor (VIF), with a VIF value ≥ 5 indicating the presence of collinearity [21]. The model effect 'BF/PTG groups' described the HRQOL difference at baseline between the none-to-low BF/PTG group and the moderate-to-high BF/PTG group (control group). The model effect 'study time interval' revealed the HRQOL change in the years between baseline study and follow-up study. The interaction effect of 'BF/PTG group' and 'study time interval' compared the difference between the relationship of BF/PTG and HRQOL at baseline versus the relationship of BF/PTG at baseline and HRQOL at follow-up. The significance testing of the results is based on F tests (Tables 2 and 3). To achieve aim 3, the linear regression models as described before were additionally tested in four subgroups of LTCS, namely breast cancer, colorectal cancer – females, colorectal cancer – males, and prostate cancer (Supplementary Figure 2 for BF, Supplementary Figure 3 for PTG).

As there were nearly 20% missings in the variable UICC stage at diagnosis, a separate category was created for these cases to reduce possible bias due to an exclusion of these participants in analyses that require complete cases. Sensitivity analysis was carried out for the BF prevalence and PTG prevalence by excluding participants who had been lost to follow-up. The HRQOL differences between the none-to-low and moderate-to-high BF/PTG groups at baseline were also compared in three subsamples: the sample who

Table 3. Tests of effects on longitudinal relationship between posttraumatic growth and health-related quality of life (functional scales and global health status/QOL of EORTC QLQ-C30).

Outcome	Estimate	t	p
Physical functioning			
PTG groups	−0.15	−0.20	0.84
Study time interval	−0.74	−7.49	<0.001
PTG Groups × Study time interval	0.04	0.35	0.73
Role functioning			
PTG groups	−1.66	1.39	0.17
Study time interval	−0.49	−3.06	0.002
PTG Groups × Study time interval	0.09	0.52	0.61
Emotional functioning			
PTG groups	0.31	0.27	0.79
Study time interval	0.24	1.87	0.06
PTG Groups × Study time interval	0.16	1.15	0.25
Cognitive functioning			
PTG groups	−0.59	−0.61	0.54
Study time interval	−0.05	−0.48	0.63
PTG Groups × Study time interval	0.05	0.43	0.67
Social functioning			
PTG groups	0.90	0.73	0.47
Study time interval	0.17	1.32	0.19
PTG Groups × Study time interval	−0.06	−0.45	0.66
Global health status/quality of life			
PTG groups	−3.12	−3.08	0.002
Study time interval	0.02	0.16	0.88
PTG Groups × Study time interval	0.25	1.96	0.50

Note. 'PTG groups' means the none-to-low posttraumatic growth group compared with the moderate-to-high posttraumatic growth group (reference). PTG: posttraumatic growth. Bold values indicate $p < 0.05$.

participated in both rounds ($n = 2704$), the sample who only participated in the baseline study ($n = 3353$), and the whole sample ($n = 6057$) to detect potential survival bias.

SAS statistical software (Version 9.4) was used to perform all analyses. For all analyses, a p value < 0.05 (two-sided) was considered statistically significant. The p values refer to individual tests rather than a global test for differences and were not adjusted for multiple testing.

Results

Descriptive statistics

Of the baseline sample ($N = 6057$), 52.1% were female, 55.2% were over 69 years old at survey, 52.2% had less than 10 years of education, 43.8% were breast LTCS, 36.1% were prostate LTCS, and 20.1% were colorectal LTCS. Among the baseline sample, 61.3% had initially early-stage cancer diagnosis, 48.5% had more than one comorbidity, and 83.1% had no active cancer disease at the survey (Table 1). In the follow-up sample ($N = 2704$, 62.6% of the 4321 survivors who had survived and were eligible to participate in the follow-up), 53.2% were female, 43.9% were over 69 years old at baseline survey, 46.6% had less than 10 years of education, 65.0% had early-stage disease, 44.4% had more than 1 comorbidity, and 86.4% had no active cancer disease at survey. The prevalence of moderate-to-high BF was 63% and the prevalence of moderate-to-high PTG was 19%, both for the entire baseline sample ($n = 6057$) and the baseline subsample who completed the follow-up survey ($n = 2704$). Sensitivity analysis revealed that the prevalence for BF/PTG

at baseline was comparable between the subsamples according to participation at follow-up. BFS and PTG were highly correlated (odds ratio = 24.6, co-prevalence of BF and PTG are presented in [Supplementary Table 1](#)).

Relationships between BF and HRQOL

HRQOL differences between BF groups at baseline and at follow-up

LTCs with none-to-low BF reported higher scores in the functioning scales at baseline ([Figure 1](#)). Statistically significant differences between none-to-low and moderate-to-high BF were noted for physical functioning, role functioning, emotional functioning, and social functioning at baseline. The differences in follow-up HRQOL scores showed a similar pattern but were not statistically significant. In both BF groups, there was a decrease in HRQOL scores from baseline to follow-up.

Differences in the relationship between BF and HRQOL at baseline versus follow-up

When including study time interval as an independent predictor in the LMM models, the interaction between BF groups and study time interval was not statistically significant ([Table 2](#)).

Relationships between BF and HRQOL by cancer type and sex

When stratifying the sample by cancer type and sex, the results were similar to the overall sample: There was a decrease in HRQOL scores from baseline to follow-up for both BF groups, and LTCs with none-to-low BF tended to report higher scores in functioning scales ([Supplementary Figure 2](#)).

Relationship between PTG and HRQOL

HRQOL differences between PTG groups at baseline and at follow-up

LTCs with none-to-low PTG reported lower HRQOL scores compared to those with moderate-to-high PTG, at baseline and at follow-up ([Figure 2](#)). However, statistically significant differences between none-to-low and moderate-to-high PTG were only noted for role functioning and global health status/QOL at baseline. The differences in follow-up HRQOL were not statistically significant. A decrease in HRQOL scores from baseline ($n = 6057$) to follow-up ($n = 2704$) for both PTG groups was observed.

Differences in the relationships between PTG and HRQOL at baseline versus follow-up

When study time interval was included as an independent predictor, the LMM models showed no significance on the interaction between PTG groups and study time interval in any subscale of HRQOL ([Table 3](#)).

Relationships between PTG and HRQOL by cancer type and sex

The relationships between PTG and HRQOL for breast cancer survivors were the same as in the overall sample, but not for colorectal cancer survivors and prostate cancer survivors ([Supplementary Figure 3](#)).

Discussion

This study assessed the longitudinal relationship between baseline BF/PTG and changes in HRQOL from baseline to follow-up in a population-based cohort of LTCs. In most HRQOL scales, including global health status, the results

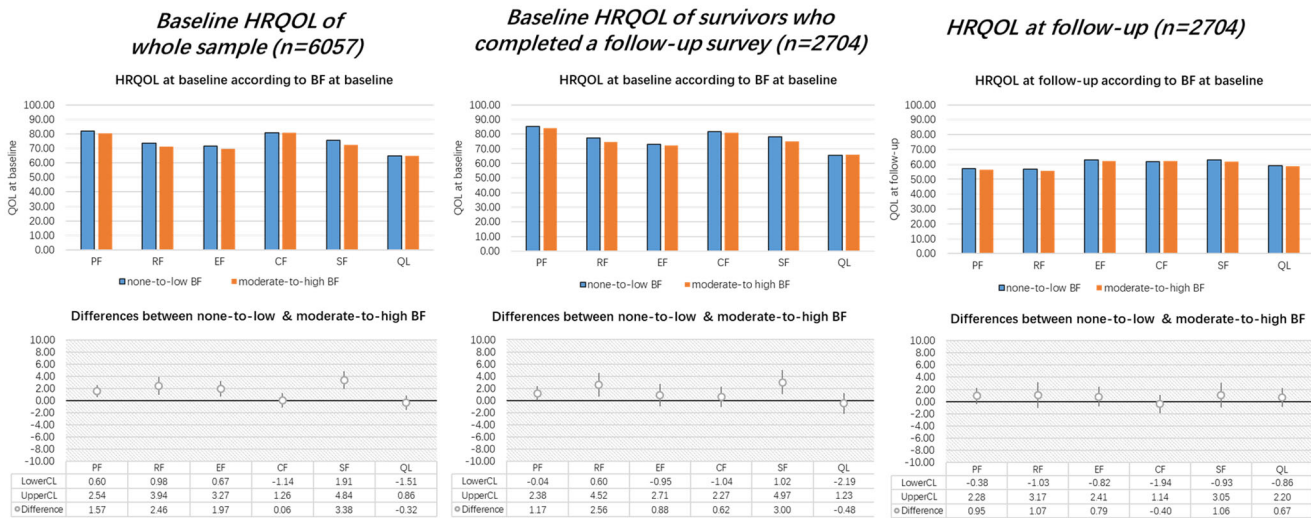


Figure 1. Distribution of HRQOL scores in none-to-low and moderate-to-high BF group (upper line) and the differences of HRQOL between none-to-low and moderate-to-high BF (lower line). Note. HRQOL: health-related quality of life; BF: benefit finding. PF: physical functioning; EF: emotional functioning; CF: cognitive functioning; RF: role functioning; SF: social functioning; QL: the global health status/quality of life. LowerCL/upperCL: lower level/upper level of 95% confidence interval on the HRQOL difference between none-to-low group and moderate-to-high BF group. Baseline HRQOL was adjusted for cancer type, sex, age at survey, education, time since diagnosis, UICC stage, comorbidities, and active cancer disease. Follow-up HRQOL was adjusted for baseline HRQOL, other baseline variables (cancer type, sex, education, UICC stage), and follow-up variables (age at survey, time since diagnosis, comorbidities, and active cancer disease).

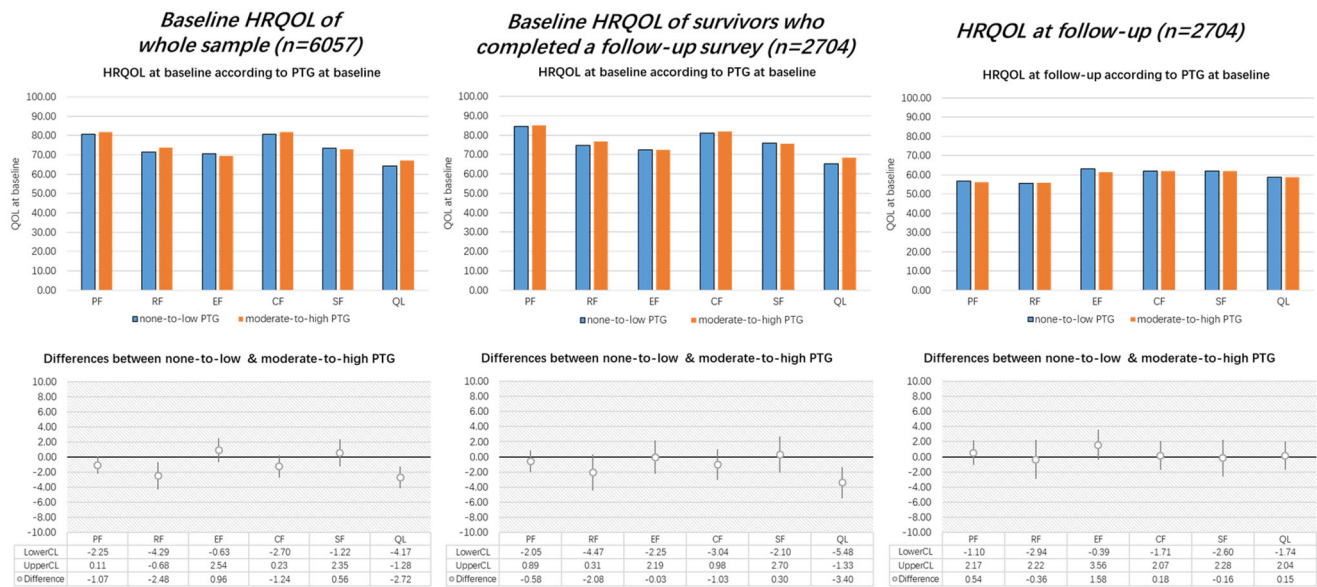


Figure 2. Distribution of HRQOL scores in none-to-low and moderate-to-high PTG group (upper line) and the differences of HRQOL between none-to-low and moderate-to-high PTG (lower line). Note. HRQOL: health-related quality of life; PTG: posttraumatic growth. PF: physical functioning; EF: emotional functioning; CF: cognitive functioning; RF: role functioning; SF: social functioning; QL: the global health status/quality of life. LowerCL/upperCL: lower level/upper level of 95% confidence interval on the HRQOL difference between none-to-low group and moderate-to-high PTG group. Baseline HRQOL was adjusted for cancer type, sex, age at survey, education, time since diagnosis, UICC stage, comorbidities, and active cancer disease. Follow-up HRQOL was adjusted for baseline HRQOL, other baseline variables (cancer type, sex, education, UICC stage), and follow-up variables (age at survey, time since diagnosis, comorbidities, and active cancer disease).

revealed significant difference between none-to-low and moderate-to-high BF, in which LTCS with none-to-low BF tended to report better HRQOL. We found no statistically significant difference between the relationship of BF and HRQOL at baseline versus the relationship of BF at baseline and HRQOL at follow-up. For PTG, the pattern was contrary to that of BF, with the moderate-to-high PTG group reporting higher HRQOL than the none-to-low PTG group. However, the differences did not reach statistical significance, except for role functioning and global health status/QOL. Interactions between PTG and study time interval were not statistically significant in any subscale. Overall, the relationship between BF/PTG and HRQOL by cancer type and sex showed the same trend as for the overall group.

In this study, none of the included HRQOL scales revealed a positive relationship with BF, which is inconsistent with previous research that suggests BF was associated with specific QOL subscales, e.g., better social/family, functional, and colorectal cancer-specific well-being [22], and increased physical health [23]. The sample in our study was older than in other studies and living with cancer for more than 5 years. A possible explanation for the different findings could be that the relationship weakened with a longer time since diagnosis. The most stressful memories of having cancer and the consequences of cancer treatment may have declined with time. Another possible explanation could be that survivors who did not view cancer as a stressful event were less likely to experience BF. These survivors may have better health or have better adaption to cancer and therefore were more likely to report better HRQOL. The relationship between BF and HRQOL might also be mediated through factors such as social support [24] or depression and anxiety [25], which were not controlled for in the current study.

In concordance with a previous study [13], PTG in our study had a positive relationship with global health status/QOL and no statistically significant relationship with functioning scales at baseline (5- to 16-year post-diagnosis). However, baseline PTG was not associated with HRQOL at follow-up (14- to 24-year post-diagnosis) in our study. This is inconsistent with another study involving LTCS of various cancer types that found a positive association, even 13.7 ± 6.0 years after diagnosis [26]. The discrepancy in the results might be explained by the younger age of the samples in those studies and the cross-sectional assessment of the outcomes. In our study, the time interval between the measurements of PTG and HRQOL (on average 8.5 years) was much longer than in previous studies [27,28]. Our results add new insight into the longitudinal relationship between PTG and HRQOL in LTCS.

In our previous analysis, we observed some overlaps between BFS and PTGI [15], as well as differences between BF and PTG. An explanation for this difference could be that BF contains more extensive and less specific changes than PTG [15]. In the present analysis, we found that BF and PTG were associated with different aspects of HRQOL. This suggests that BF and PTG reflect heterogeneous aspects in the experience of survivors after cancer diagnosis, which is in line with another study [13]. Taken together, our study supports the view that BF and PTG are two associated but slightly different concepts in the framework of positive psychology.

Strengths and limitations

The strengths of our study are the large, longitudinal cohort study of LTCS encompassing three common cancer types, and HRQOL measured with the validated EORTC QLQ-C30.

However, the following limitations should also be noted. One caveat is the possibility of healthy survivor bias [17]. Another caveat is a limited generalizability with only the most common cancers for cancer type and sex-specific analyses (lung cancer survivors were not included, for which the proportion of long-term survivors is very low). Another factor to be considered when interpreting the results is that potential factors (e.g., personality, social support) that might moderate the association between BF/PTG and HRQOL were not assessed. Furthermore, there were only two assessment points and the time interval between assessments was long, which may not adequately capture the trajectory of the relationship. Future studies could include other potential moderating factors and assess the outcomes earlier after diagnosis with follow-ups at narrower intervals to analyze the trajectory of the relationship more in detail. The differences in the two conceptualizations of positive growth may be proved by more frequent measurements with narrower intervals, as the more general concept of PTG may depend on other factors than cancer and thus may not be stable enough to predict outcomes many years later. We acknowledge the differences between respondents and non-respondents to the follow-up survey. This potential participation bias may influence the reported mean HRQOL estimates, so as to the relationship with BF/PTG.

Conclusion

In this study, we found negative relationships between BF and HRQOL in general, the association between BF and HRQOL was the same in cross-sectional and prospective analyses. For PTG, there was a positive relationship between PTG and global health status/QOL, and between PTG and role functioning, but these relationships changed to non-significant over time. In general, PTG does not seem to predict later functioning or global health status/QOL. When stratified by sex and cancer type, no clear pattern was found in the longitudinal relationship between BF/PTG and HRQOL. These different HRQOL results between BF and PTG add further evidence that BF and PTG represent two different positive psychological concepts. These findings are important for future research addressing theory building, study comparison, and development of interventions for improving HRQOL of LTCS in the long run.

Ethical approval

This study was approved by the ethics committees of the University of Heidelberg and the cancer registries. All participants provided written informed consent.

Author contributions

Z.L. analyzed the data and wrote the draft. M.S.Y.T. and D.D. reviewed and edited the article. L.K.-G. was the study manager of the CAESAR study. H.Be, A.E., B.H., A.W., S.R.Z., and R.P. contributed to the recruitment of study participants and data collection. H.Br and V.A. are the principal investigators of the CAESAR study. All authors read and approved the article.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Data availability statement

Due to the nature of the research, ethical supporting data are not available.

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