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# Impact of social support on psychosocial symptoms and quality of life in cancer patients: results of a multilevel model approach from a longitudinal multicenter study

Christina Sauer[a]*, Joachim Weis[b]*, Hermann Faller[c], Florian Junne[d], Klaus Hönig[e], Corinna Bergelt[f], Beate Hornemann[g], Barbara Stein[h], Martin Teufel[i], Ute Goerling[j], Yesim Erim[k], Franziska Geiser[l], Alexander Niecke[m], Bianca Senf[n], Dorothea Weber[o] and Imad Maatouk[a]

[a]Department of General Internal Medicine and Psychosomatics and National Center for Tumor Diseases Heidelberg, University Hospital Heidelberg, Heidelberg, Germany; [b]Comprehensive Cancer Center, Department of Self-Help Research, Faculty of Medicine and Medical Center University of Freiburg, Freiburg, Germany; [c]Department of Medical Psychology and Psychotherapy, Medical Sociology and Rehabilitation Sciences, and Comprehensive Cancer Center Mainfranken, University of Wuerzburg, Wuerzburg, Germany; [d]Department of Psychosomatic Medicine and Psychotherapy, Medical University Hospital Tuebingen, Tuebingen, Germany; [e]Department of Psychosomatic Medicine and Psychotherapy, Comprehensive Cancer Center Ulm (CCCU), Ulm University Clinic, Ulm, Germany; [f]University Clinic Center, Hubertus Wald, University Cancer Center (CCC), Hamburg, Germany; [g]Comprehensive Cancer Center, University Clinic Center Dresden, Dresden, Germany; [h]Department of Psychosomatic Medicine and Psychotherapy, Paracelsus Medical University, General Hospital Nuremberg, Nuremberg, Germany; [i]Department of Psychosomatic Medicine and Psychotherapy, Comprehensive Cancer Center Essen (WTZ) and LVR Hospital, University of Duisburg-Essen, Essen, Germany; [j]Charité Comprehensive Cancer Center, Berlin, Germany; [k]Department of Psychosomatic Medicine, University Clinic Center Erlangen, Erlangen, Germany; [l]Department of Psychosomatic Medicine, University Clinic Center Bonn, Bonn, Germany; [m]Department of Psychosomatic Medicine & Centre Psychooncology (CePO), University Clinic Center Cologne, Cologne, Germany; [n]University Clinic Center Frankfurt, Frankfurt, Germany; [o]Institute of Medical Biometry and Informatics, University Clinic Center of Heidelberg, Heidelberg, Germany

**ABSTRACT**

**Background:** This prospective multicenter study aimed to investigate the courses of positive support (PS) and detrimental interaction (DI), two different aspects of social support, and the relation between social support and psychosocial distress and/or health-related quality of life (HRQOL) in a large sample of patients with different cancers.

**Methods:** For this observational study, we enrolled adult patients with cancer from 13 comprehensive cancer centers (CCCs) in Germany. We included a total of 1087 patients in our analysis. We assessed the outcomes via standardized self-report questionnaires at three measurement points: at admission for acute care (T1), 6 (T2) and 12 months (T3) thereafter. Our outcome variables included PS and DI, depression and anxiety symptoms, distress, mental quality of life (MQoL) and physical QoL (PQoL). Data were analyzed using three-level hierarchical linear modeling (HLM) and group-based trajectory modeling.

**Results:** During the first year after the cancer diagnosis, both PS and DI decreased in our sample. Baseline depression symptom severity was a significant predictor of PS and DI. Further analyses revealed significant associations between PS, DI and the course of depression and anxiety symptoms, and MQoL. PS buffered the negative effects of DI with regards to these variables. Low DI was associated with better PQoL, whereas PS was not. In general, the impact of social support on psychosocial outcomes was weak to moderate.

**Conclusions:** Our findings provide evidence for the influence of PS and DI on psychosocial symptoms and HRQOL, and emphasize the importance of psycho-oncological interventions that strengthen PS and prevent or reduce DI for patients with cancer and their relatives.

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## Background

The adaption to a cancer diagnosis and its treatment is associated with high levels of psychological burden. Cancer patients have to cope with the disease symptoms and treatment side-effects that deteriorate their health-related quality of life (HRQOL). Social support has positive effects on health and longevity and acts as a buffer under high levels of stress [1]. Positive social support, which encompasses emotional, instrumental, and informational support, seems to be associated with several psychological and medical outcomes, for example, less psychological distress [2], improved mental and physical HRQOL [3–5], work functioning [6], and

CONTACT Imad Maatouk Imad.Maatouk@med.uni-heidelberg.de Department of General Internal Medicine and Psychosomatics and National Center for Tumor Diseases Heidelberg, University Hospital Heidelberg, Im Neuenheimer Feld 460, 9120 Heidelberg, Germany
*Both authors contributed equally.

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posttraumatic growth [7]. In contrast, low social support is associated with psychological comorbidities [3] (adjustment disorder or major depression [8]), and the utilization of psychological care [9]; however, social support is a double-edged sword and also entails negative aspects of social interactions (i.e., detrimental interaction [DI], overprotection, pessimism, or negative emotional reactions) creating high psychological distress in cancer patients [10,11]. The negative aspects of social support have received little attention in cancer research [12].

To the best of our knowledge, only one study has examined the longitudinal course of social support after cancer diagnosis in patients with different cancer types [13]. Most findings are based on cross-sectional investigations or are focused on certain entities [such as breast cancer; e.g., 7, 14]. Haviland et al. [15] investigated a cohort of 871 colorectal cancer patients, and reported a decline of perceived social support in around 30% of participants over a time period of 2 years after diagnosis, with strong associations between several risk factors (e.g., older age and being female); however, the negative aspects of social support were not considered.

Furthermore, no investigation of several aspects of social support in a large sample of patients with different cancer types exists.

Against this background, we primarily aimed at examining the course of both positive support (PS) and DI in a large sample of patients with cancer in comprehensive cancer centers (CCCs) in Germany over a follow-up period of 12 months. Additionally, we investigated the effects of sex, age, marital status and depressive symptoms on PS and DI adjusted for medical characteristics. In addition to considering the overall cohort, we identified subgroups showing a similar course of PS and DI over time. Our secondary aim included investigating possible associations between PS, DI and psychological outcomes (depression and anxiety symptoms, distress, and HRQOL [MQoL and PQoL]) during the first year after the cancer diagnosis.

## Methods

### Study design and population

We enrolled adults with cancer from CCCs in Germany for this multicenter, observational longitudinal study. Details of the study are described elsewhere [16]. Briefly, we aimed to investigate and analyze the use and (non-use) of professional psychological care and possible influencing factors. We assessed the data at three measurement points: at admission for acute care or during acute care (T1), 6 months (T2) and 12 months (T3) after T1. All CCCs in Germany certified by the German Cancer Aid in 2013 ($N = 13$; Berlin, Dresden, Erlangen, Essen, Frankfurt, Freiburg, Hamburg, Heidelberg, Cologne/Bonn, Nuremberg, Tuebingen, Ulm, Wuerzburg) collaborated in this study. A table with an overview of the recruitment from the different CCCs is available in the supplementary material.

Eligible adult patients had confirmed cancer diagnoses (irrespective of prognosis, disease stage, curative or palliative care or time since diagnosis); they were treated in a CCC; and they were able to speak and read German. We excluded patients with acute and severe psychiatric (e.g., acute psychosis) or chronic neurological disorders (e.g., dementia). All participants provided written informed consents and were registered in the trial coordination center in Freiburg. The study complied with the Declaration of Helsinki, and the Ethics Committee of the University Clinic Center Freiburg (number 139/13) as well as the respective local responsible ethics committees of the CCCs approved the protocol. We registered the study in the German Clinical Trials Registry (registration no. DRKS00004860).

Newly admitted patients fulfilling the inclusion criteria were consecutively recruited at each CCC. A research assistant explained the study to patients, and collected the signed informed consents.

### Outcome measurement

We used standardized questionnaires and medical records to gather data. We assessed social support using the short form of the Illness-specific Social Support Scale (ISSS) [10, 17] (a validated eight-item German version including two subscales, PS and DI). The ISSS contains questions about the social support within a person's social network. Four items reflect PS and four items assess DI. Items are scored on a 5-point Likert scale ranging from 0 (never) to 4 (always). The confirmatory analysis of the ISSS revealed satisfactory results and validated the model [17].

We measured depression symptoms using the Patient Health Questionnaire (depression module, PHQ-9) [18], a widely used screening tool in several clinical settings. The questionnaire evaluates the presence of nine symptoms of depressive episodes contained in the Diagnostic and Statistical Manual of Mental Disorders, 4th Revision (DSM-IV). The PHQ-9 reveals good reliability, criterion, and construct validity, and is able to detect depressive symptoms and changes over time [18–21]. Higher values indicate more severe symptoms. A cutoff value between 8 and 11 screens for major depressive disorders [22].

In addition, we assessed anxiety levels using the German GAD-7 [23], another reliable PHQ module to measure general anxiety symptoms showing good factorial and construct validity [24]. A cutoff value of $\geq$10 screens for anxiety disorders [24].

We measured the HRQOL using the short-form health survey (SF-12), a generic questionnaire with good psychometric properties [25] allowing multidimensional assessment of HRQOL in various disease groups [26]. The SF-12 provides two subscales: mental component summary (MCS) scores assessing MQoL, and physical component summary (PCS) scores assessing PQoL. Scores range from 0 to 100, and higher scores indicate higher quality of life.

The NCCN distress thermometer (DT) [27] was used to assess the patients' distress on an 11-point numerical scale with endpoints of 'no distress' or 'extreme distress'. The short standardized DT has been proven highly sensitive when evaluated against the established criteria [28]. For its German version, a cutoff score of 5 has been recommended [27].

### Statistical analyses

We computed descriptive statistics and hierarchical linear modeling (HLM) using the IBM SPSS software version 25. We considered a two-sided $p < .05$ as statistically significant. From the original data set, we excluded those who did not complete both scales of social support at T1 ($N = 1443$, see Figure 1). Moreover, as we were interested in the course of social support after cancer diagnosis, we included only patients who had received their diagnosis within the last 12 months for our analyses ($N = 1087$).

Because the data conformed to a multilevel data structure with observations at each measurement time nested within individuals, who again were nested within different centers, we used a three-level HLM, based on the maximum likelihood estimation and with an unstructured covariance structure, to evaluate the trajectory of social support (separate models for PS and DI) over time.

Additionally, we assessed three-level HLMs to analyze the influence of social support on depression symptoms, anxiety symptoms, distress, MQoL and PQoL over time (adjusted for control variables, see supplementary material). Both three-level HLMs (description of each level and procedures) are described in the supplement in detail.

To identify subgroups showing a similar course of PS and DI, we conducted group-based trajectory analysis with a three-step procedure to determine the optimal number of trajectories and relevant covariates. This analysis was done using SAS 9.4 and the procedure PROC TRAJ [29,30], as described in more depth in the supplementary material.

## Results

### Participants

Refer to Table 1 for the sociodemographic and medical sample characteristics. The proportion of women was 58.2%. A majority of patients was married and had received higher education. Patients with breast, gastrointestinal, gynecological cancers and melanoma, made up the largest part of the sample. On average, the patients had received their cancer diagnosis 2.78 months (range 0–12 months) before enrollment.

### Course of social support

Table 2 presents the descriptive statistics of social support, depression and anxiety symptoms, distress and HRQOL.

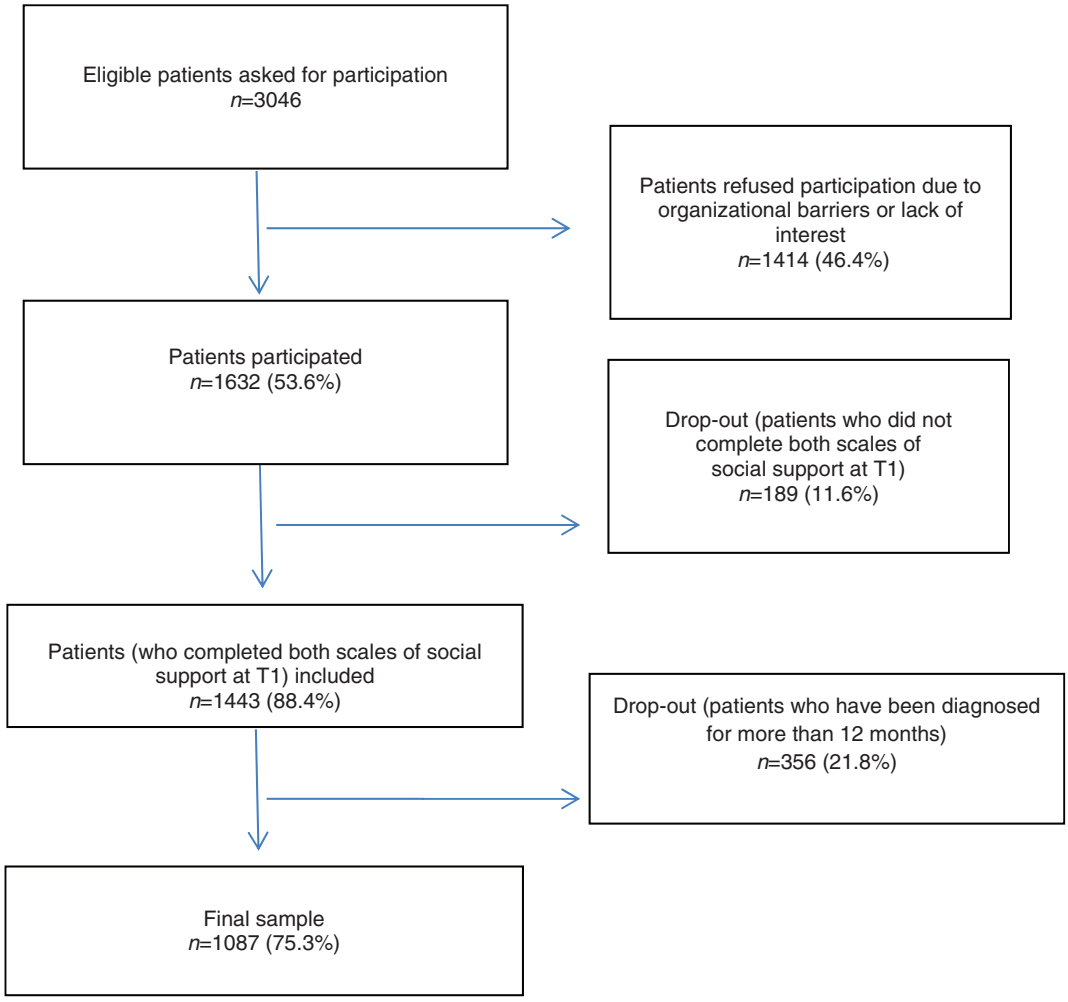


**Figure 1.** Enrollment of patients who complete both scales of social support (positive support and detrimental interaction) at T1 and who have been diagnosed within the last 12-month before T1.

**Table 1.** Sample: sociodemographic and medical characteristics ($N = 1087$).

| Characteristics | Mean (SD) | |
|---|---|---|
| Mean age (years) | 58.88 (12.29) | |
| | $N = 1087$ | % |
| Sex | | |
| Female | 633 | 58.2 |
| Male | 454 | 41.8 |
| Marital status | | |
| Single | 136 | 12.5 |
| Married | 716 | 65.9 |
| Divorced/separated | 149 | 13.7 |
| Widowed | 76 | 7.0 |
| Missing | 10 | 0.9 |
| Education (graduation) | | |
| None/other | 3 | 0.3 |
| Secondary school (5–9 years) | 372 | 34.2 |
| Secondary school (10 years) | 277 | 25.5 |
| High level (>10 years) | 410 | 37.8 |
| Missing | 25 | 2.3 |
| Cancer diagnosis | | |
| Breast | 234 | 21.5 |
| Gastrointestinal | 205 | 18.9 |
| Melanoma | 179 | 16.5 |
| Gynecological | 152 | 14.0 |
| Lung | 89 | 8.2 |
| Male genital, prostate | 60 | 5.5 |
| Head and neck | 69 | 6.3 |
| Hematological | 43 | 4.0 |
| Sarcoma | 16 | 1.5 |
| CNS – Neoplasien | 6 | 0.6 |
| Urological | 7 | 0.6 |
| Others | 27 | 2.5 |
| Metastases | | |
| Yes | 279 | 25.7 |
| No | 512 | 47.9 |
| Unclear | 277 | 25.9 |
| Missing | 19 | 1.7 |
| Medical treatment, multiple resp. (planned, ongoing or completed) | | |
| Surgery | 929 | |
| Chemotherapy | 773 | |
| Radiotherapy | 589 | |
| Antihormonal therapy | 332 | |
| Immuntherapy | 284 | |
| Others | 700 | |
| Time since diagnoses (month) | Mean (SD) | |
| | 2.78 *(2.53)* | |

SD: Standard deviation.

**Table 2.** Means and standard deviations of social support (positive support and detrimental interaction), depression, anxiety, distress and HRQOL.

| | *T1* *Mean (SD)* | *T2* *Mean (SD)* | *T3* *Mean (SD)* |
|---|---|---|---|
| PS | 13.72 (2.71)[a] | 13.01 (3.15)[c] | 12.74 (3.31)[d] |
| DI | 3.62 (3.27)[a] | 3.12 (2.96)[c] | 3.12 (3.07)[d] |
| Depression | 6.62 (4.88)[a] | 5.52 (4.75)[c] | 5.11 (4.82)[d] |
| Anxiety | 4.83 (4.45)[a] | 3.81 (3.99)[c] | 3.60 (4.10)[d] |
| Distress | 4.97 (2.52)[b] | 4.14 (2.59)[c] | 3.71 (2.68)[d] |
| MCS | 43.87 (11.26)[a] | 45.57 (10.82)[c] | 46.74 (10.61)[d] |
| PCS | 36.84 (8.98)[a] | 39.69 (9.09)[c] | 41.00 (9.08)[d] |

HRQOL: health-related quality of life; SD: standard deviation; PS: sum-score of the positive support subscale of the illness-specific social support scale (ISSS); DI: sum-score of the detrimental interaction subscale of the ISSS; Depression symptoms assessed with the Patient Health Questionnaire, Depression Module (PHQ-9). Anxiety symptoms assessed with the Patient Health Questionnaire, General Anxiety Module (GAD-7). Distress assessed with the NCCN Distress Thermometer. MCS = SF-12 mental component score assesses MQoL. PCS = SF-12 physical component score PQoL.
[a]$N = 1087$.
[b]$N = 1061$.
[c]$N = 604–667$.
[d]$N = 552–625$.

### *Positive support*

We constructed a base model with a first- and second-order polynomial term (to investigate changes in the growth rate over time) to describe PS pattern over time. Results revealed a linear ($F$ [1, 665.74] = 14.71, ß = −1.36, $p < .001$), and a quadratic trend ($F$ [1, 651.03] = 6.19, ß = 0.22, $p = .013$), suggesting an initial decrease in PS 6 months after the baseline assessment, and a subsequent downshift of that decrease with time. We included the quadratic term in further analyses because it improved the model fit (Chi-square$_{change}$ = 6.16, $p < .05$).

Moreover, we operated a Level-2 model that included between-person control variables. Adjusting for the between-person variables did not change the linear and quadratic PS time effect. Compared to the base model, the model fit improved significantly once we included the Level-2 variables ($p < .01$). The final Level-3 random intercept model (model 2, see Table 3) also includes the effect of centers. Calculating Chi-square$_{change}$ showed that including Level 3 did not improve the fit of the model (all $p$'s > .05). In the final model, we found no effects of center, sex, age or the interactions between sex and age, but married patients reported higher PS. Model 3a showed that the addition of baseline depression symptoms had a significant effect on PS, and it significantly improved the model fit of the analyses ($p < .01$). Thus, our results indicate that lower depression symptoms are associated with higher PS in the course of cancer illness.

### *Detrimental interaction*

In model 1b, the quadratic term was nonsignificant ($p = .19$); hence, we only included the linear term in further analyses. Results of the base model revealed a significant effect of time, ($F$ [1, 748.33] = 10.92, ß = –0.20, $p = .001$) suggesting that DI decreased in the course of cancer.

Table 3 shows results of the Level-3 model. Compared to model 1b, the model fit improved significantly once we included Level-2 variables ($p < .01$). The final Level-3 random intercept model (model 2b, see Table 3) also includes the effect of centers. Calculating Chi-square$_{change}$ showed that including Level-3 did not improve the fit of the model (all $p$'s > .05). The significant main effect of sex revealed that men suffer more from DI than women. Moreover, we found a significant interaction effect between sex and age that indicates that especially older men report DI in the course of cancer illness. Model 3b revealed that depression symptoms are positively associated with DI in the disease trajectory.

### *Association between social support and psychological symptoms*

In model 4 (depression symptoms), model 5 (anxiety symptoms), and model 6 (distress), we investigated the course of these variables and the association between social support and psychological symptoms. All psychological symptoms declined in the first year after treatment initiation: depression symptoms ($F$ [1, 694.27] = 36.51), anxiety symptoms ($F$ [1, 710.87] = 47.04), and distress ($F$ [1, 947.67] = 54.95, all

**Table 3.** Results of the three-level hierarchical linear models showing the course of positive support and detrimental interaction adjusted for sociodemographical and medical data, using a random intercept model (center) and maximum likelihood estimation.

| | Model 2a: positive support | | | Model 2b: detrimental interaction | | |
|---|---|---|---|---|---|---|
| Fixed effects | Unstandardized coefficients [95% CI] | *t*, *p* | | Unstandardized coefficients [95% CI] | *t*, *p* | |
| Level-2 Intercept | 14.07 [13.23, 14.92] | 32.60, | <.001 | 4.01 [3.32, 4.71] | 11.34, | <.001 |
| Time | −1.36 [−2.06, 0.66] | −3.83, | <.001 | −0.17 [−0.29, −0.05] | −2.83, | .005 |
| Time × time | 0.22 [0.05, 0.39] | 2.48, | .013 | – | | – |
| Sex[a] | −0.37 [−0.79, 0.04] | −1.77, | .077 | 0.54 [0.10, 0.98] | 2.43, | .015 |
| Age | −0.02 [−0.23, 0.20] | −.16, | .873 | 0.09 [−0.14, 0.31] | 0.76, | .450 |
| Sex × age | 0.01 [−0.31, 0.32] | 0.04, | .966 | 0.56 [0.22, 0.90] | 3.27, | <.001 |
| Marital status[b] | 0.91 [0.42, 1.39] | 3.70, | <.001 | −0.29 [−0.80, 0.22] | −1.12, | .263 |
| Random Intercept Level-3 | 0.06 [0.00, 0.80] | 0.74,[c] | .462 | 0.05 [0.01, 0.37] | 0.94,[c] | .346 |
| | Model 3a | | | Model 3b | | |
| Intercept | 14.79 [13.91, 15.68] | 32.78, | <.001 | 2.84 [2.11, 3.58] | 7.60, | <.001 |
| Time | −1.39 [−2.09, −.69] | −3.91, | <.001 | −0.16 [−0.28, −0.04] | −2.61, | .009 |
| Time × time | 0.23 [0.05, 0.40] | 2.54, | .011 | – | | – |
| DS | −0.09 [−0.12, −0.05] | −5.30, | <.001 | 0.15 [0.12, 0.18] | 8.83, | <.001 |
| Sex[a] | −0.48 [−0.89, −0.07] | −2.29, | .022 | 0.74 [0.31, 1.17] | 3.38, | <.001 |
| Age | −0.08 [−0.29, 0.13] | −0.76, | .449 | 0.21 [−0.01, 0.43] | 1.84, | .065 |
| Sex × age | 0.08 [−0.23, 0.39] | 0.50, | .618 | 0.42 [0.09, 0.75] | 2.50, | .012 |
| Marital status[b] | 0.88 [0.40, 1.35] | 3.61, | <.001 | −0.25 [−0.75, 0.24] | −1.00, | .317 |
| Random intercept Level-3 | 0.07 [0.01, 0.67] | 0.85,[c] | .398 | 0.07 [0.01, 0.67] | 1.11,[c] | .266 |

Note: DS = Baseline depressive symptoms assessed with the PHQ-9. Results are adjusted for time since diagnosis, metastasis and tumor entity. Results of the adjusted variables are available in the supplemental material.
In Model 2a, the reduction in deviance (calculated using the difference of the -2LL of model 1a and model 2a), was significant (Chi-square$_{change}$ = 74.96, $df$ = 21; $p \leq .001$). In Model 3a, the reduction of deviance between model 2 and 3 was significant (Chi-square$_{change}$ = 27.68, $df$ = 1; $p \leq .001$).
In Model 2b, the reduction in deviance was significant (Chi-square$_{change}$ = 69.24, $df$ = 20; $p \leq .001$). In Model 3b, the reduction of deviance between model 2b and 3b was significant (Chi-square$_{change}$ = 50.98, $df$ = 1; $p \leq .001$).
[a]0 = women, 1 = men.
[b]0 =single, 1 = married. No effect of divorced or widowed ($p > .08$).
[c]Wald *Z*.

$p$'s $\leq .001$). Lack of PS and high DI indicated strong associations to high depression and anxiety symptoms over time. In addition, the interaction term between PS and DI was significant (all $p$'s $\leq .001$), indicating that PS mitigates the negative effects of high DI in depression and anxiety symptoms. In model 6, we found a significant positive association between DI and distress symptoms ($p \leq .001$); but no association between PS and distress symptoms ($p = .146$). We adjusted all results for sex, age, sex × age, time since diagnosis, marital status, metastases and tumor type. PS, DI and PS × DI all significantly improved the fit of models 4–6 (Chi-square$_{change}$ > 57.31, $df$ = 3; all $p$'s $\leq .001$), although the explained variance of social support was low ($0.02 \leq R^2 \leq 0.10$). At Level 3, the effect of center reached no significance in model 4–6. The results of model 4–6 are presented in the supplement.

### Association of social support and HRQOL

MCS and PCS increased significantly over the course of the disease (MCS, $F$ [1, 740.84] = 31.74; PCS, $F$ [1, 697.23] = 74.57, all $p$'s $\leq .001$). High PS and low DI revealed strong associations with high MCS summary scores over time (all $p$'s $\leq .001$). We found a significant interaction between PS and DI ($p = .008$), reflecting that PS mitigates the negative effects of DI on the MQoL. Model 8 results indicate that PS was not associated with PCS summary scores ($p = .290$); however, low DI was significantly associated with better PCS summary scores ($p \leq .001$). We adjusted all the results for sex, age, sex × age, time since diagnosis, marital status, metastases and tumor type. All PS, DI and PS × DI significantly improved the fit of models 7 and 8 (Chi-square$_{change}$ > 28.21, $df$ = 3; $p \leq .001$); however, the explained variance was low ($0.02 \leq R^2 \leq 0.10$). At Level 3, the effect of center reached no significance in model 7 and 8. The results of model 7 and 8 are presented in the supplement.

### Group-based trajectory modeling

Group-based trajectories of PS and DI are depicted in Figure 2. Further statistical parameters of these analyses are presented in the supplement in detail.

P it e Support: Analysis identified three distinct pathways: (1) low and declining levels of PS, with an estimated 6.9% of participants (group 1a); (2) high and declining levels of PS, with an estimated 26.6% of participants (group 2a); (3) very high and constant PS over time, with an estimated 66.5% of participants (group 3a) (see Figure 2).

Detrimental interaction: Our analysis identified three distinct DI pathways, including baseline depression symptoms as a covariate: (1) low and constant levels of DI, with an estimated 69.9% of participants (group 1b); (2) moderate and declining levels of DI, with an estimated 26.8% of participants (group 2b); (3) high and increasing levels over time (with a kink at T2), with an estimated of 3.3% of participants (group 3b) (see Figure 2).

## Discussion

To the best of our knowledge, this is the first study longitudinally describing the course of positive and negative aspects of social support and its associations with psychological outcomes in a large multicenter sample of patients with different tumor types. Our results revealed that both PS and DI decrease during the first year after cancer diagnosis.

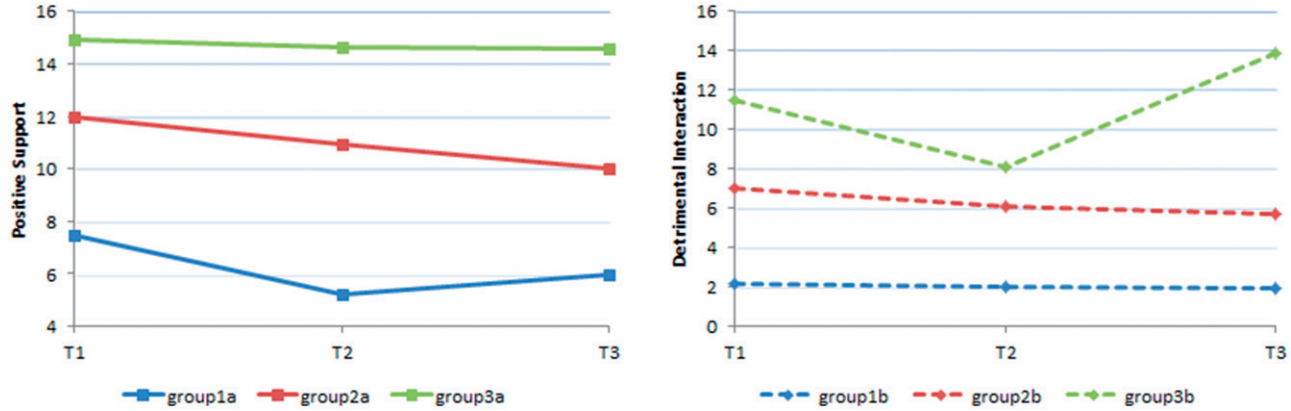


**Figure 2.** Group-based trajectories of positive support (group 1–3a) and detrimental interaction (group 1–3b) from T1 to T3.

We found that social support was associated with the course of depression and anxiety symptoms, and MQoL, and that PS can buffer the negative effects of DI with regards to these variables. Low DI was associated with better PQoL, whereas high DI was associated with higher distress. Additionally, group-based trajectory analyses identified distinct subgroups of PS and DI, some of which had relatively stable levels over time (PS: 66.5%; DI: 69.9%) and others with poorer and declining support in the first year after diagnosis.

### *Course of PS and DI*

In the overall cohort, PS declined in the course of cancer illness, in particular in the first six months after diagnosis. This replicates findings from studies with smaller samples [13] and in patients with colorectal [15] or breast cancer [31,32]; however, it stands in contrast to studies reporting an increase or no changes in PS over time [33,34]. In accordance with other studies, we found current marriage to be an important source of PS [11]. Additionally, trajectory modeling identified three different subgroups of PS (low-declining, high-declining, very high-constant, see Figure 2), showing that patients with high PS at T1 had relatively stable levels of PS in the first year after diagnosis (group 3a); however, patients with high (group 2a) or low levels of PS (group 1a) at T1 show a decrease over time. Patients of group 3a were mostly married and had lower levels of depressive symptoms (see supplementary data), underlining that those who are in stable relationships and with low psychological burden show a stable course of PS. These results are in line with the findings of Haviland et al. [15].

High PS after diagnosis may indicate that cancer diagnosis frequently lead to enhanced involvement of family members as caregivers [35]. Since the diagnosis notification affects the disease management and treatment, high PS at those times presumably help prevent recurrence fears [36] and strengthen the patients' coherence sense, an important determinant of acceptance [37]; however, during this 'diagnosis shock', both positive and negative aspects of social support seem to be intensified, as our data reveal, since the level of DI is increased in the postdiagnostic phase, especially in men. Trajectory analyses revealed a subgroup of patients with high levels and an overall increase of DI over time (group 3b), which also show higher levels of depressive symptoms compared to patients with lower and stable levels of DI. High levels of DI at the time around diagnosis may be explained by dyadic stress caused by the cancer diagnosis or the uncertainty of the situation, or by suboptimal communication between patients and their caregivers or relatives.

In sum, the results of trajectory analyses indicate that especially the small subpopulation of patients with low PS (6.9%) or high DI (3.3%) at the time around diagnosis show problematic patterns of social support in the first year thereafter. It is therefore important to identify these patients at an early stage and offer psycho-oncological interventions. With regard to DI, these findings suggest the importance of exploring dyadic or family communication patterns (e.g., with the CCAT-PF; [38]) and offer communication training for couples and families [e.g., 39]. As more distant relationships can also be a source of DI, it might be important to coach patients how to deal with DI from the environment to improve their wellbeing.

Moreover, studies have suggested strong evidence for the association between social support and cancer progression or mortality, for breast cancer and multiple myeloma [40]. As our results indicate a decline of PS in the first year after diagnosis, resources of PS should be strengthened, especially in patients who have had their diagnosis for a long period of time and for cancer survivors.

### *Association of social support and psychological symptoms*

Our results indicate that, after diagnosis, psychological burden and distress are increased – at least for a short period. This is in accordance with the findings of a large observational study [41]. In accordance with other studies with smaller samples or cross-sectional designs, our findings revealed that social support after the diagnosis predicts depression [8,42,43], anxiety [44] and distress [45] in cancer patients. Moreover, other findings indicate that social support at this time may be linked to biological factors such as inflammation in cancer survivors [42]; however, in accordance with previous studies, the explained variance of the

influence of social support on psychological outcomes was low to moderate [3,5]; however, our results emphasize the importance of assessing PS and DI after the diagnosis, and of offering early interventions targeting the social network of cancer patients to prevent mental burden and distress.

In accordance with other studies [46] and the stress-buffering hypothesis [47], PS revealed a buffering effect of DI on depression and anxiety symptoms as well as on MQoL. Based on our finding that DI is enhanced close to diagnosis, this result emphasizes the importance of a supportive social network at that time. As aforementioned, the partners and family members can be highly burdened after the diagnosis. Thus, the social network outside the family may provide a more functional resource of PS. A previous study indicated that the PS of friends and extended family members can compensate for the negative effects of a partner's dysfunctional support [48]. Even though we did not investigate the source of PS or DI in our study and this interpretation must be considered with caution, our results suggest the importance of supportive resources outside the close family.

### *Association of social support and HRQOL*

Our findings suggest that PS and DI predict the MQoL level, whereas PS is not associated with the PQoL; however, low DI was associated with better PQoL. These results are in contrast with those of a cross-sectional study in outpatients with prostate cancer that reported that PS was positively correlated with MQoL and PQoL, whereas DI was negatively associated only with MQoL [3]. Moreover, other studies reported evidence of a general association between social support and PQoL [49]; however, different types of social support (e.g., source and type) make it difficult to compare the results of several studies. In accordance to other studies [3], the impact of social support on PQoL was rather weak. One explanation for this might be that the aspects of PQoL assessed by the SF-12 may be more influenced by age or disease-specific factors than by cancer type, severity, or progression. The association between low DI and better PQoL may reflect the overall physical functioning of patients indicating less psychological burden and disease-related distress, which, in turn, may lead to less dyadic stress and DI. Future studies should investigate the influence of social support aspects on the physical components of QoL and vice versa.

### *Strengths and limitations*

Our study has several important strengths and extends prior research on the role of social support in patients with cancer. First, a major strength is our longitudinal design with data from a large multicenter sample with a diverse cancer population. Second, to the best of our knowledge, this is the first study investigating the course of social support in cancer patients with HLM, revealing methodological advantages over the repeated ANOVA [50]. Third, we investigated both a positive and a negative aspect of social support after cancer diagnosis, allowing for differentiated statements on the influences of these two social support components. Our findings provide evidence that this differentiation is important as both facets influence our outcomes in different ways, and suggest different targets for psycho-oncological interventions.

Nevertheless, we are also aware of our study's limitations. The investigation period of our longitudinal data was rather short (one year), thus limiting the validity of analysis; however, we analyzed the first year *after the diagnosis*, which is an important time for the patients and their relatives. We investigated a large German sample of patients, but as cultural backgrounds can influence the need for social support [51], the generalizability to people from other cultures may be limited. In addition, other than PS and DI, we did not investigate other important aspects of social support such as structural support (size of the social network) or the sources of PS and DI. Studies have reported that social support from close family members and friends can buffer dysfunctional support of patient's spouses [48]; therefore, a closer look at the sources of support would be important for the development of psycho-oncological interventions and communication trainings. Since this was an observational study, no claims regarding causation can be made.

## Conclusions

Collectively, the results of our longitudinal study emphasize the importance of both positive and negative aspects of social support for psychological symptoms and HRQOL after the cancer diagnosis in patients with different tumor types. Our results underscore PS as an important 'stress buffer' for depression and anxiety symptoms and MQoL, and show that the time after the diagnosis is extremely burdening for patients, might strengthening the PS, but, reinforcing DI. Additionally, our findings emphasize the need to detect patients with low PS and high DI, who might have fewer sources of PS or be more in strain. This could be as part of the doctor's consultation or with economic and efficient screening instruments that assess the different aspects of social support and psychosocial distress. This might be a pivotal step for the prevention of psychological symptoms and dyadic stress in patients with cancer and their relatives.

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