Supportive Care in Cancer (2019) 27:3521–3529
https://doi.org/10.1007/s00520-019-04665-9

ORIGINAL ARTICLE

Fear of disease progression in adult ambulatory patients with brain cancer: prevalence and clinical correlates

Simone Goebel[1] · Hubertus Maximilian Mehdorn[2]

Received: 14 September 2018 / Accepted: 17 January 2019 / Published online: 25 January 2019

Abstract

Background Fear of progression (FoP) is frequent in patients with cancer and of high clinical relevance. Despite the often devastating prognosis of brain cancer, FoP has not yet been assessed in neurooncological patients.

Objective The aim of this study was thus the assessment of FoP and its clinical correlates.

Methods In an ambulatory setting, 42 patients with a primary brain tumour completed the Fear of Progression questionnaire FoP-Q-12. Clinical correlates of FoP were assessed via a variety of measures, including patients' physical state (Karnofsky Performance Status, KPS), cancer-related psychosocial distress (Distress Thermometer, DT), anxiety (General Anxiety Disorder Scale, GAD-7), depression (Patient Health Questionnaire, PHQ-9), Quality of Life (Short Form Health Survey, SF-8), and unmet supportive care needs (Supportive Care Needs Survey, SCNS).

Results Eighteen patients (42%) suffered from high FoP (i.e. scored ≥ 34 in the FoP-Q-12). According to the 12 items of the FoP-Q-12, the greatest fears were worrying about what would happen to their family and being afraid of severe medical treatments. No sociodemographic variables (e.g. age, gender) or medical tumour characteristics (e.g. tumour malignancy, first or recurrent tumour) were related to FoP. Patients with more severe physical symptoms reported higher FoP. Patients with higher FoP were more anxious, more depressed, reported lower Quality of Life, and suffered from more unmet supportive care needs.

Conclusion Our results demonstrate that FoP is frequent and of high clinical relevance for neurooncological patients. Its assessment is not sufficiently covered by instruments for assessment of other areas of psychological morbidity (e.g. general anxiety). Moreover, FoP cannot be predicted by objective characteristics of the patients and disease. Thus, the routine screening for FoP is recommended in neurooncological patients. Clinicians should bear in mind that patients with high FoP are likely to suffer from high emotional distress and unmet supportive care needs and initiate treatment accordingly.

Keywords Brain tumour · Fear of cancer progression · Cancer · Recurrence · Psychooncology · Neurooncology

Introduction

Brain tumours are a heterogeneous group of neoplasms within the brain. Primary brain tumours originate from cells within the brain and rank among the most deadly forms of cancer, affecting approximately 10.82 in 100,000 people [1]. Patients diagnosed with a brain tumour face a multitude of both cancer-related and brain tumour–specific threats throughout the disease trajectory. Thus, patients are faced with common threats inherent to a cancer diagnosis (e.g. tumour recurrence or surgery). However, patients also face specific threats attributable to the neurological features of the disease (e.g. personality changes, loss of communicative abilities). These unique challenges have been described as "double hazard" or "double threat" [2].

Despite successful surgery and intense post-surgery treatment, many patients experience tumour recurrence and ongoing functional decline. Over the course of the disease, brain tumours may show increasing malignancy whilst at the same time failing to respond to medical treatment. Overall, brain tumours are responsible for high morbidity and mortality [3].

Thus, it is not surprising that neurooncological patients rank among those cancer patients with the highest emotional

✉ Simone Goebel
goebel@psychologie.uni-kiel.de

Hubertus Maximilian Mehdorn
prof@mehdorn-consil.de

[1] Department of Clinical Psychology and Psychotherapy, Institute of Psychology, Christian-Albrechts University, Olshausenstraße 62, 24118 Kiel, Germany

[2] Mehdorn Consilium, Prüner Gang 7, 24103 Kiel, Germany

burden [4]. Many patients suffer from anxiety, depression, psychosocial distress, and reduced Health-Related Quality of Life (HRQoL) [5–7]. Despite this, patients with brain cancer are often neglected with regard to psychooncological research and treatment [8, 9].

Concordantly, role and relevance of one of the most important psychooncological constructs—fear of disease progression (FoP)—have not yet been assessed in neurooncological patients. FoP is one of the most frequent distress symptoms in patients with cancer [10–12]. It can be defined as a reactive, realistic (and thus, nonneurotic) fear patients are fully aware of [12]. These fears comprise illness-related fears, including fear of tumour recurrence or of ongoing functional decline with all its biopsychosocial consequences. It is important to note that FoP is a unique and independent psychological construct. Thus, it is only moderately related to general anxiety and cannot be adequately assessed by instruments for assessment of general anxiety. Due to the objective and realistic threat of cancer, most patients do not suffer from an anxiety disorder according to psychiatric classification systems. Thus, FoP needs to be assessed with specific instruments and treated with targeted interventions [13, 14].

Despite the generally adaptive nature of FoP, elevated levels of FoP can become dysfunctional and severely affect patients' well-being [12, 14, 15]. High levels of FoP are accompanied by high emotional distress and low HRQoL [14–18]. Patients with high FoP are more likely to suffer from depression, anxiety, stress, sleep disorders, and behavioural dysfunction [14, 16, 19–21] and patients experience more unmet supportive are needs [12, 22]. High levels of FoP tend to persist over time if not adequately diagnosed and treated [23]. Moreover, health care utilisation and cost of health care are increased in patients with high FoP [16, 24]. Despite this, patients are less satisfied with treatment, medical staff, and communication [25].

We hypothesise that FoP is also a clinically relevant issue for patients with brain cancer. Due to the specific neurological features and threats of brain cancer, FoP might differ with regard to quantity and content compared to patients with other forms of cancer. Thus, the following research questions were addressed in this study:

(1) What is the extent of FoP in neurooncological patients? What is the prevalence of clinically relevant FoP in this specific patient group?
(2) Besides these two questions addressing the *quantity* of FoP, we additionally aimed to assess the *content* of FoP and thus the specific fears in order to better understand the patients' experience.
(3) What are the clinical correlates of FoP? This question aimed to address clinical relevance, possible risk factors, and targets with regard to psychooncological care.

Methods

Participants and procedure

This cross-sectional study included adult ambulatory patients after primary brain tumour surgery in our department aged 18 years or older. The following exclusion criteria were applied: insufficient German language as well as severe physical, psychological, and/or cognitive impairment preventing study participation. Patients with other forms of intracranial neoplasms (e.g. meningioma, other CNS tumours, secondary brain tumours/metastases) were not included in this study. Patients were recruited consecutively between January and June 2011 during a routine ambulatory control examination. This study was not part of another study. After written informed consent and screening for exclusion criteria, patients were able to choose between (a) taking the study questionnaires home and mailing them back or (b) scheduling an appointment for completion of the study questionnaire with the Clinical Neuropsychologist or a trained major level psychology student. This study was performed in accordance with the Helsinki standard and approved by the local ethics committee.

Measures

Sociodemographic and medical characteristics were collected from medical charts and by a standardised self-report questionnaire. The Karnofsky Performance Status (KPS) as global measure of a patient's physical status, ranging from 0 (death) to 100 (no complaints; no evidence of disease), was rated by the attending neurosurgeon.

The following questionnaires were included in this study:

For assessment of FoP, the *Fear of Progression Questionnaire-Short Form (FoP-Q-SF)* was applied [26]. It consists of 12 items scored on a 5-point Likert scale ranging from 1 ("never") to 5 ("very often") with higher values indicating higher FoP. The FoP-Q-SF is the short form of the original FoP-Q [13] with good reliability and validity. Patients were also asked to report any additional future-related fears regarding their illness.

The following measures for psychosocial clinical correlates of FoP were applied:

(1) The one-item visual analogue scale *Distress Thermometer (DT)* for assessment of patients' cancer-related psychosocial distress, ranging from 0 to 10 with higher values indicating higher distress [27, 28];
(2) The *General Anxiety Disorder Scale (GAD-7)* as screening for general anxiety disorder symptoms via seven items scored on a 4-point Likert scale ranging from 0 (not at all) to 3 (nearly every day) with higher values indicating higher anxiety [29, 30];

(3) The *Patient Health Questionnaire (PHQ-9)* to screen for depression via nine items scored analogously to the GAD-7 with higher values indicating higher depression [31, 32];
(4) The *Short Form Health Survey (SF-8)* for assessment of patients' physical (4 items, physical composite score PCS) and mental (4 items, mental composite score MCS) Health-Related Quality of Life (HRQoL) with each subscale ranging from 0 (very low HRQoL) to 100 (very high HRQoL) [33]; and
(5) The *Supportive Care Needs Survey (SCNS-SF-59)* [34] for assessment of patients' perceived type and magnitude of supportive care needs in five domains: health system and information, psychological, physical and daily living, patient care and support, and sexuality needs. Items are rated on a 5-point Likert scale (1 = no need, not applicable; 2 = no need, satisfied; 3 = low need; 4 = moderate need; 5 = high need) [34]. The mean score was used for each scale.

Statistical analyses

Data were analysed descriptively and the following cutoff scores were applied in the questionnaires for identification of patients with clinically relevant symptoms: FoP-Q-SF ≥ 34 [18]; DT ≥ 5 [27]; GAD-7 ≥ 15 [30]; PHQ-9 ≥ 15 [31]. For comparison of groups, *T* tests for independent sample were applied. Pearson correlations were used for calculation of associations between variables. Linear regression analyses were performed in order to assess possible medical or sociodemographic predictors for FoP. Statistical analyses were performed via SPSS Statistics version 21.0 (IBM SPSS, Chicago, IL).

Results

Sample description

Of 62 approached patients, 3 declined participation, 9 did not send back the questionnaires or the questionnaires were incompletely filled out, and 8 met the exclusion criteria. Thus, the sample consists of 42 patients. Eight patients (19%) scheduled an appointment for completion of the study questionnaires. Sociodemographic and medical characteristics are displayed in Table 1. None of the patients had received another cancer diagnosis before the brain tumour diagnosis and none of the patients was diagnosed with another neurological disease or potentially life-threatening illness.

Research questions 1 and 2: extent and content of fear of disease progression (FoP)

Mean score of the FoP-Q-12 was 32.1 (SD = 9.6, range 0–56). Eighteen patients (43%) were classified as suffering from high FoP if the cutoff score of ≥ 34 was applied. In all items, patients used the full range of the scale.

With regard to content of FoP in brain tumour patients, we present patients' detailed answers in the FoP-Q-12 in Table 2.

Seven patients reported one or more additional contents of fear: of death/dying ($n = 4$), of changes in their identity/personality ($n = 4$), of ongoing functional decline in cognitive and/or motor functioning ($n = 3$), of the possibility of having to undergo awake brain tumour surgery ($n = 1$), of becoming a burden to the family ($n = 1$), of no more being able to live at home ($n = 1$).

Research question 3: clinical correlates of FoP

Relationships between FoP and medical/sociodemographic characteristics

FoP was not related to any sociodemographic or medical data displayed in Table 1 ($p > .1$). The only exception was patients' physical status as measured via the KPS: There was a significant negative association between KPS and FoP ($r = -.454$; $p < .01$) and the KPS predicted 20.7% of the variance in patients' FoP scores ($T = -3.227$; $p = .002$).

Relationships between FoP and psychosocial variables

Regarding the associations with psychosocial variables, the following results were found: Patients with higher FoP were more anxious, more depressed, reported lower physical and mental HRQoL, and higher unmet supportive care needs (Table 3). Regarding the different subscales of the SCNS, patients with more severe FoP reported significantly higher unmet supportive care needs in all domains with exception of sexuality needs ($r = .253$; $p = .110$). In detail, the associations were as follows: psychological domain: $r = .490$, $p = .001$; needs regarding the health system and information: $r = .335$, $p = .032$; physical and daily living needs: $r = .542$, $p < .001$; patient care and support: $r = .458$, $p = .003$.

Discussion

Brain cancer is a unique disease due to the often devastating prognosis and the combination of oncological and neurological symptom stress for patients. For other forms of cancer, fear of disease progression (FoP) is of high clinical relevance. This was the first study assessing FoP in patients with brain tumours.

Table 1 Sociodemographic and medical characteristics of the sample and descriptive results of the accompanying measures (n = 42)

Variable	*N*	%
Mean age in years	Mx = 45.95 (SD = 12.31), range = 22–67	
Gender		
Female	23	55
Male	19	45
School education		
Junior high school/middle school	30	72
High school/university entrance diploma	12	29
Employment status		
Currently employed/in education	16	38
Retired	11	26
Housekeeper/unemployed	15	36
Marital status		
Married/in partnership	30	72
Divorced/widowed	8	19
Single	4	10
Family status		
No children	19	45
Children	23	55
WHO grade		
WHO I	7	17
WHO II	8	19
WHO III	14	33
WHO IV	13	31
Karnofsky performance status	Mx = 77.62 (SD = 16.20), range = 50–100	
Time since initial tumour diagnosis in weeks	Mx = 42.24 (SD = 41.08), range = 4–159	
Histological diagnosis		
Astrocytoma	16	38
Glioblastoma multiforme (GBM)	12	29
Oligodendroglioma	5	12
Other (e.g. oligoastrocytoma, gliosarcoma)*	9	21
Tumour localization		
Left infratentorial	12	29
Right infratentorial	27	64
Supratentorial	3	7
Tumour recurrence		
No	29	69
Yes	13	31
Number of neurosurgical tumour resections	Mx = 1.57 (SD = .80), range = 1–4	
Degree of (last) tumour resection		
Complete	25	60
Incomplete	17	41
Radiotherapy		
No	12	29
Yes	30	71
Chemotherapy		
No	20	48
Yes	22	52
Above cutoff score in psychological measures		
DT (distress)	21	50

Table 1 (continued)

Variable	*N*	%
GAD-7 (anxiety)	2	5
PHQ-9 (depression)	3	7
Descriptive results of the measures for clinical correlates of FoP (Mx (SD); range)		
GAD (anxiety)	Mx = 5.57 (SD = 4.21); range 0–17	
PHQ (depression)	Mx = 6.36 (SD = 4.62); range 0–18	
DT (distress)	Mx = 5.45 (SD = 2.62); range 1–10	
SF-8–PCS (physical Quality of Life)	Mx = 45.82 (SD = 9.13); range 27–60	
SF-8–MCS (mental Quality of Life)	Mx = 44.84 (SD = 9.42); range 22–59	
SCNS–health system and information needs	Mx = 2.26 (SD = 1.29); range 1–5	
SCNS–psychological needs	Mx = 2.12 (SD = .90); range 1–4	
SCNS–physical and daily living needs	Mx = 1.78 (SD = .80); range 1–4	
SCNS–patient care and support needs	Mx = 1.72 (SD = .74); range 1–4	
SCNS–sexuality needs	Mx = 1.66 (SD = .97); range 1–4	

WHO World Health Organisation's tumour grade classification, *DT* distress thermometer, *GAD-7* General Anxiety Disorder Scale, *PHQ-9* Patient Health Questionnaire, *SF-8–PCS* Short Form Health Survey–Physical Composite Score, *SF-8–MCS* Short Form Health Survey–Mental Composite Score, *SCNS* Supportive Care Needs Survey; *no patient had received the diagnosis of a lymphoma

The first study question focused on the extent of FoP in brain tumour patients. We included 42 patients with a brain tumour in an ambulatory setting on average 10 months after initial tumour diagnosis. We found that, applying the conservative cutoff score of ≥ 34 in the FoP-Q-12, 43% of our patients suffered from high levels of FoP. Mean score of the FoP-Q-SF was 32.1 (SD = 9.6, range 0–56).

As in previous studies, a multitude of different instruments for assessment of FoP have been applied [14], comparison of our data is difficult. Sarkar and colleagues [22] report data from a sample of 335 patients with mixed cancer diagnoses consecutively recruited at the inpatient and outpatient cancer care facilities of a University Medical Centre. Mean time of diagnosis was 12 months (range 0–228). In their sample, mean score of the FoP-Q-12 was 16.7 (range 0–46) and 17 patients (5.1%) were classified as suffering from high FoP. In the validation study of the FoP-Q-12 [35], which included 2059 patients after cancer rehabilitation, 25% of the patients met the cutoff score of ≥ 34 with a total mean of 24.9. Only Mehnert and colleagues [19] reported mean scores of the FoP-Q-12 comparable to ours (mean score = 35.0, range 12–60) in a large sample of mixed cancer patients ($n = 1.281$) at the beginning of cancer rehabilitation. Eighteen percent of their sample suffered from high FoP; however, a different classification method was applied.

Table 2 Descriptive results of the Fear of Progression questionnaire FoP-Q-12

Item no.	Item	% (No.) of patients with high FoP*	Mean score (SD)
11	I worry about what will become of my family if something should happen to me	45 (19)	3.12 (1.38)
9	I am afraid of severe medical treatments during the course of my illness	33 (14)	3.02 (1.32)
2	I am nervous prior to doctors' appointments or periodic examinations	33 (14)	2.93 (1.26)
1	I become anxious if I think my disease may progress	24 (10)	2.86 (1.12)
10	I worry that my treatment could damage my body	29 (12)	2.86 (1.32)
5	When I am anxious, I have physical symptoms such as a rapid heartbeat, stomach ache, or agitation	33 (14)	2.83 (1.36)
7	It disturbs me that I may have to rely on strangers for activities of daily living	24 (10)	2.67 (1.28)
8	I am worried that at some point in time I will no longer be able to pursue my hobbies because of my illness	29 (12)	2.62 (1.36)
4	I have concerns about reaching my professional goals because of my illness	26 (11)	2.55 (1.40)
12	The thought that I might not be able to work due to my illness disturbs me	17 (8)	2.45 (1.26)
3	I am afraid of pain	17 (7)	2.36 (1.21)
6	The possibility of my children contracting my disease disturbs me	12 (5)	2.05 (1.22)

*This includes patients scoring 4 ("often") or 5 ("very often") at the respective item; *FoP* Fear of Progression

Table 3 Associations between Fear of Disease Progression (FoP) and psychosocial measures (Pearson's *r*)

	Fear of Disease Progression (FoP)	*p*
Cancer-related psychosocial distress (DT)	.101	.524
Anxiety (GAD)	.599	< .001**
Depression (PHQ-9)	.508	.001**
Physical Quality of Life (SF-8)	− .521	< .001**
Mental Quality of Life (SF-8)	− .492	.001**
Unmet Supportive Care Needs—total (SCNS)	.472	.002**

DT distress thermometer, *GAD-7* General Anxiety Disorder Scale, *PHQ-9* Patient Health Questionnaire, *SF-8* Short Form Health Survey, *SCNS* Supportive Care Needs Survey

** = significant with p < .01

Thus, altogether, our data indicate that extent and prevalence of FoP in brain tumour patients is comparable or even exceeds FoP in patients with other forms of cancer.

The second study question focused on the content of FoP in order to better understand the clinical situation of the patient. With regard to content of FoP, patients' greatest fears were worrying about what would happen to their family (mean score = 3.12) as well as fears regarding severe medical treatments (mean score = 3.02). Thus, our data somewhat differ from previous studies. In a study of Hanprasertpong and colleagues [36] for example, who assessed FoP in 699 cervical cancer survivors, worrying about the family also was the most important fear. However, the mean score was with 2.34 considerably lower. The second most important content of FoP in their study was pain (mean score = 2.28) and whereas the mean score was comparable in our sample (2.36), it was one of the least important fears due to the high levels of FoP with regard to other content in our sample. The same is true with regard to the third most important fear in the study of Hanprasertpong et al. [36], fear of disease progression, with a mean score of 2.25 in their and 2.86 in our study. Hinz and colleagues [35] reported the highest values for the items "Being nervous prior to doctor's appointment" (mean score = 2.41) and "Worrying about what will become of the family" (mean score = 2.37). Nervousness prior to doctor's appointment was the third most important content of FoP in our sample (mean score = 2.93).

Hence, our data indicate that brain tumour patients do not differ with regard to some fears many cancer patients share, including the fear of what will become of the family, of pain, and of disease progression. A specific content of fear however, which was identified in our study, is the intense fear regarding future severe medical treatments (Mx = 3.02). The mean score for this item was 2.07 in the study of Hinz et al. [35] and 2.10 in the study of Hanprasertpong et al. [36]. This is consistent with previous studies in which neurosurgical brain tumour removal was identified as major stressor and extraordinarily high levels of surgery-related anxiety in brain tumour patients were reported [37, 38].

Moreover, we found some evidence for brain tumour–specific content of FoP related to the neurological characteristics of the disease, mainly regarding neuropsychological changes. These fears are likely underdiagnosed in our study as the FOP-Q-12 does not include correspondent items. Qualitative research however has demonstrated that changes in personality and cognition might pose the most burdening symptoms for brain tumour patients. In a previous study of ours, including brain cancer patients in the early disease stage, this fear of functional loss fulfilled the DSM-IV classification of a traumatic event in 17% of 47 patients [39]. In order to give consideration to these specific fears, it might be necessary to adapt instruments for FoP-assessment in brain tumour patients accordingly.

Finally, about 10% of our sample spontaneously reported fears of death and dying. As Sharpe and colleagues [40] recently pointed out, this link between FoP and fear of death and dying has so far been understudied. However, establishing the relationship between FoP and death anxiety would have important clinical as well as theoretical implications.

Research question 3 focused on the clinical relevance of FoP in brain tumour patients. Patients with higher FoP suffered from higher levels of anxiety, depression, unmet supportive care needs, and lower mental as well as physical HRQoL. Thus, it may be speculated that FoP is of high clinical relevance for neurooncological patients. Due to our sample size, we did not apply linear regression analyses and thus, our data are based on correlation analyses only, not allowing for causal interpretation. However, our results are consistent with previous studies cited above in which FoP was identified as a factor of major impact on cancer patients' mental well-being.

In contrast to these relations between FoP and psychosocial measures, FoP was not related to objective features—neither to characteristics of the patient nor to medical or disease-related characteristics. The only exception was patients' physical state (KPS). The major impact of brain cancer patients' physical condition on their psychosocial well-being has been thoroughly demonstrated before [7]. Salander and colleagues [41] for example identified patients' perception of their physical well-being as the most important factor for the creation of protection and hope throughout the brain tumour experience. This higher amount of physical complaints in patients with higher FoP might contribute to the higher amount of

supportive care needs reported in our and previous studies [16, 22]. Future studies might add objective medical data in order to control for this. Also, with regard to health care economics and optimal patient care, it could be studied to which extent patients' levels of unmet supportive care needs decrease by medical attention as compared to a possible decrease following psychooncological treatment of FoP.

Previous studies aimed to assess whether sociodemographic or medical factors are associated with FoP in order to see if patients at risk of high FoP can be identified early in order to initiate appropriate treatment. Whereas some studies reported such risk factors (e.g. female gender, young age, or more progressed disease), others failed at this and overall, results remain inconclusive [14, 15, 17, 23, 36]. An explanation was provided by Cohee and colleagues [42] who propose the major impact of patients' cognitive processes. These might pose an important mediator between objective information and psychological adaptation. This is important with regard to treatment of FoP as cognitive processes are possibly amendable. Thus, future studies might concentrate on identifying those mental processes, e.g. from the context of coping, which facilitate adjustment. To date, research regarding the nature, extent, and result of psychological coping in brain cancer patients is sparse. In a previous study of ours, we found that brain tumour patients undertake considerable coping efforts in order to adapt to preoperative anxiety. Constructive coping mechanisms, especially optimism and finding trust in the treating physician, facilitate mental well-being. In contrast, intense repetitive negative thinking in terms of worry and rumination severely impede psychological adaptation [38]. Identifying brain tumour patients' coping mechanisms which facilitate or hinder psychological adaptation to FoP might have important clinical implications with regard to psychooncological treatment.

Due to the similarities between our patients and patients with other forms of cancer, targeted interventions for FoP, which have been developed and evaluated for patients with other forms of cancer [20], might also be effective in patients with brain cancer. This, however, needs to be examined in future studies. To date, it is unclear if the specific neurological features of brain cancer would need to be specifically taken into account—either in terms of patients' neuropsychological impairment or in terms of the brain tumour specific content of FoP. In our sample, the median time since initial tumour diagnosis was approximately 10 months. Authors before us have stressed that during the adjustment period after initial medical treatment, patients often need support which is, however, often reduced by healthcare professionals [43]. Thus, our data support the need for the continuous offer of psychooncological support for patients throughout the disease trajectory. Future studies should also use longitudinal designs as these can provide a more comprehensive overview of the course of FoP throughout the disease trajectory.

Future studies might also account for brain tumour patients' relatives. In a sample of 26 brain tumour patients and their partners shortly after neurosurgical treatment [7], uncertainty about the future was reported by 39% of the patients as major stressor. This proportion was 50% of the patients' partners which might be indicative of the need to account for FoP in patients' relatives [44]. This is supported by Mellon and colleagues [45], who found that caregivers had significantly more FoP than cancer survivors themselves. Importantly, they found empirical support for a family-based model for the prediction of FoP in which patients' and family caregivers' FoP influence each other.

The following shortcomings should be taken into account when interpreting our data: The sample size is small and thus, calculations are likely underpowered. Our data do not allow to analyse the development of FoP throughout different disease stages due to the cross-sectional study design, the sample was heterogeneous with regard to time since diagnosis and patients were recruited in different stages in the disease trajectory, resulting in very small subgroups of patients for detailed analyses (e.g. patients with first or recurrent tumour). The small sample size also hindered the identification of psychological factors which might moderate FoP. The mean age of our sample was quite young, suggesting that this sample has an age bias. Also, all patients were recruited from a single department. Thus, our results need to be validated in future studies, ideally in multicentre prospective long-term studies with adequate sample sizes. Finally, brain tumour–specific content of FoP is likely underdiagnosed as this is not sufficiently covered in the FoP-Q-12. Our study pointed to the importance of the inclusion of items reflecting the neurological features of brain tumour diseases. In future studies, applying qualitative research designs, crucial aspects of FoP for brain tumour patients should be specified and integrated in a brain tumour specific version of the FoP for further validation.

Conclusion

Overall, this was the first study which assessed the extent, content, and clinical relevance of FoP in patients with brain cancer. FoP is frequent and of high clinical relevance for neurooncological patients. We found evidence for content of FoP common in cancer patients as well as for specific content related to the neurological features of the disease and to neurosurgical treatment. Assessment of FoP is not sufficiently covered by instruments for assessment of other areas of psychological morbidity (e.g. general anxiety). Moreover, FoP cannot be predicted by objective characteristics of the patients and disease. Thus, the routine screening for FoP is recommended in neurooncological patients. Clinicians should bear in mind that patients with high FoP are likely to suffer from

high emotional distress and unmet supportive care needs and initiate treatment accordingly.

Acknowledgements The authors are grateful to Anja Mehnert for providing the SCNS and to Hannah Schmale for the valuable support during data collection.

Compliance with ethical standards

This study was performed in accordance with the Helsinki standard and approved by the local ethics committee.

Conflict of interest The authors declare that they have no conflict of interest.

We have full control of all primary data and agree to allow the journal to review the data if requested.

References

1. de Robles P, Fiest KM, Frolkis AD, Pringsheim T, Atta C, St. Germaine-Smith C, Day L, Lam D, Jette N (2015) The worldwide incidence and prevalence of primary brain tumors: a systematic review and meta-analysis. Neuro-Oncology 17:776–783. https://doi.org/10.1093/neuonc/nou283
2. Ownsworth T, Hawkes A, Steginga S, Walker D, Shum D (2009) A biopsychosocial perspective on adjustment and quality of life following brain tumor. Disabil Rehabil 31:1038–1055. https://doi.org/10.1080/09638280802509538
3. Ostrom QT, Gittleman H, Fulop J et al (2015) CBTRUS statistical report: primary brain and central nervous system tumors diagnosed in the United States in 2008-2012. Neuro-Oncology 17(Suppl 4): iv1–iv62. https://doi.org/10.1093/neuonc/nov189
4. Chochinov HM (2001) Depression in cancer patients. Lancet Oncol 2:499–505. https://doi.org/10.1016/S1470-2045(01)00456-9
5. Huang J, Zeng C, Xiao J, Zhao D, Tang H, Wu H, Chen J (2017) Association between depression and brain tumor: a systematic review and meta-analysis. Oncotarget 8:94932–94943. https://doi.org/10.18632/oncotarget.19843
6. Huang ME, Wartella J, Kreutzer J, Broaddus W, Lyckholm L (2001) Functional outcomes and quality of life in patients with brain tumours: a review of the literature. Brain Inj 15(10):843–856. https://doi.org/10.1080/02699050010013653
7. Goebel S, Stark AM, Kaup L, von Harscher M, Mehdorn HM (2011) Distress in patients with newly diagnosed brain tumours. Psycho-Oncology 20:623–630. https://doi.org/10.1002/pon.1958
8. Pace A, Metro G, Fabi A (2010) Supportive care in neurooncology. Curr Opin Oncol 22:621–626. https://doi.org/10.1097/CCO.0b013e32833e078c
9. Salander P (2010) Facilitating interventions and/or relationships in malignant brain tumors. Adv Ther 27:17–27. https://doi.org/10.1007/s12325-010-0003-z
10. Berg P, Book K, Dinkel A, Henrich G, Marten-Mittag B, Mertens D, Ossner C, Volmer S, Herschbach P (2011) Progredienzangst bei chronischen Erkrankungen. Psychother Psychosom Med Psychol 61:32–37. https://doi.org/10.1055/s-0030-1267927
11. Dankert A, Duran G, Engst-Hastreiter U et al (2003) Progredienzangst bei Patienten mit Tumorerkrankungen, Diabetes mellitus und entzündlich-rheumatischen Erkrankungen. Rehabilitation 42:155–163. https://doi.org/10.1055/s-2003-40094
12. Herschbach P, Dinkel A (2014) Fear of progression. In: Goerling U (ed) Psycho-Oncology. Springer, Berlin s.l, pp 11–29
13. Herschbach P, Berg P, Dankert A, Duran G, Engst-Hastreiter U, Waadt S, Keller M, Ukat R, Henrich G (2005) Fear of progression in chronic diseases: psychometric properties of the Fear of Progression Questionnaire. J Psychosom Res 58:505–511. https://doi.org/10.1016/j.jpsychores.2005.02.007
14. Simard S, Thewes B, Humphris G, Dixon M, Hayden C, Mireskandari S, Ozakinci G (2013) Fear of cancer recurrence in adult cancer survivors: a systematic review of quantitative studies. J Cancer Surviv 7:300–322. https://doi.org/10.1007/s11764-013-0272-z
15. Koch L, Jansen L, Brenner H, Arndt V (2013) Fear of recurrence and disease progression in long-term (≥ 5 years) cancer survivors- a systematic review of quantitative studies. Psycho-Oncology 22(1): 1–11. https://doi.org/10.1002/pon.3022
16. Lebel S, Tomei C, Feldstain A, Beattie S, McCallum M (2013) Does fear of cancer recurrence predict cancer survivors' health care use? Support Care Cancer 21:901–906. https://doi.org/10.1007/s00520-012-1685-3
17. Mehnert A, Berg P, Henrich G, Herschbach P (2009) Fear of cancer progression and cancer-related intrusive cognitions in breast cancer survivors. Psycho-Oncology 18:1273–1280. https://doi.org/10.1002/pon.1481
18. Sarkar S, Scherwath A, Schirmer L, Schulz-Kindermann F, Neumann K, Kruse M, Dinkel A, Kunze S, Balck F, Kröger N, Koch U, Mehnert A (2014) Fear of recurrence and its impact on quality of life in patients with hematological cancers in the course of allogeneic hematopoietic SCT. Bone Marrow Transplant 49: 1217–1222. https://doi.org/10.1038/bmt.2014.139
19. Mehnert A, Koch U, Sundermann C et al (2013) Predictors of fear of recurrence in patients one year after cancer rehabilitation: a prospective study. Acta Oncol (Stockholm, Sweden) 52:1102–1109. https://doi.org/10.3109/0284186X.2013.765063
20. Hall DL, Luberto CM, Philpotts LL, Song R, Park ER, Yeh GY (2018) Mind-body interventions for fear of cancer recurrence: a systematic review and meta-analysis. Psycho-Oncology 27:2546–2558. https://doi.org/10.1002/pon.4757
21. Berrett-Abebe J, Cadet T, Pirl W, Lennes I (2015) Exploring the relationship between fear of cancer recurrence and sleep quality in cancer survivors. J Psychosoc Oncol 33:297–309. https://doi.org/10.1080/07347332.2015.1020586
22. Sarkar S, Sautier L, Schilling G, Bokemeyer C, Koch U, Mehnert A (2015) Anxiety and fear of cancer recurrence and its association with supportive care needs and health-care service utilization in cancer patients. J Cancer Surviv 9:567–575. https://doi.org/10.1007/s11764-015-0434-2
23. Crist JV, Grunfeld EA (2013) Factors reported to influence fear of recurrence in cancer patients: a systematic review. Psycho-Oncology 22:978–986. https://doi.org/10.1002/pon.3114
24. Champagne A, Ivers H, Savard J (2018) Utilization of health care services in cancer patients with elevated fear of cancer recurrence. Psycho-Oncology 27:1958–1964. https://doi.org/10.1002/pon.4748
25. Shim E-J, Shin Y-W, Oh D-Y, Hahm BJ (2010) Increased fear of progression in cancer patients with recurrence. Gen Hosp Psychiatry 32:169–175. https://doi.org/10.1016/j.genhosppsych.2009.11.017
26. Mehnert A, Herschbach P, Berg P, Henrich G, Koch U (2006) Fear of progression in breast cancer patients – validation of the short form of the fear of progression questionnaire (FoP-Q-SF). Z Psychosom Med Psychother 52:274–288. https://doi.org/10.13109/zptm.2006.52.3.274
27. Mehnert A, Müller D, Lehmann C, Koch U (2006) Die deutsche Version des NCCN Distress-Thermometers. Z Psychiatr Psychol

Psychother 54:213–223. https://doi.org/10.1024/1661-4747.54.3.213
28. National Comprehensive Cancer Network (NCCN) (2003) Distress management. Clinical practice guidelines. J Natl Compr Cancer Netw 1:344–374
29. Spitzer RL, Kroenke K, Williams JBW, Löwe B (2006) A brief measure for assessing generalized anxiety disorder: the GAD-7. Arch Intern Med 166:1092–1097. https://doi.org/10.1001/archinte.166.10.1092
30. Löwe B, Decker O, Müller S, Brähler E, Schellberg D, Herzog W, Herzberg PY (2008) Validation and standardization of the Generalized Anxiety Disorder Screener (GAD-7) in the general population. Med Care 46:266–274. https://doi.org/10.1097/MLR.0b013e318160d093
31. Löwe B, Spitzer RL, Zipfel S, Herzog W (2000) Der Gesundheitsfragebogen für Patienten (PHQ-D). Manual und Testunterlagen
32. Spitzer RL (1999) Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. JAMA 282:1737. https://doi.org/10.1001/jama.282.18.1737
33. Ware JE, Kosinski M, Dewey JE, Gandek B, Ware JE, Kisinski M, Ware J, Dewey J (2008) How to score and interpret single-item health status measures. A manual for users of the SF-8™ Health Survey
34. Bonevski B, Sanson-Fisher R, Girgis A, Burton L, Cook P, Boyes A, the Supportive Care Review Group (2000) Evaluation of an instrument to assess the needs of patients with cancer. Cancer 88:217–225. https://doi.org/10.1002/(SICI)1097-0142(20000101)88:1<217:AID-CNCR29>3.0.CO;2-Y
35. Hinz A, Mehnert A, Ernst J, Herschbach P, Schulte T (2015) Fear of progression in patients 6 months after cancer rehabilitation- a validation study of the fear of progression questionnaire FoP-Q-12. Support Care Cancer 23:1579–1587. https://doi.org/10.1007/s00520-014-2516-5
36. Hanprasertpong J, Geater A, Jiamset I, Padungkul L, Hirunkajonpan P, Songhong N (2017) Fear of cancer recurrence and its predictors among cervical cancer survivors. J Gynecol Oncol 28:e72. https://doi.org/10.3802/jgo.2017.28.e72
37. Goebel S, Kaup L, Mehdorn HM (2011) Measuring preoperative anxiety in patients with intracranial tumors: the Amsterdam preoperative anxiety and information scale. J Neurosurg Anesthesiol 23:297–303. https://doi.org/10.1097/ANA.0b013e318222b787
38. Goebel S, Mederer D, Mehdorn HM (2018) Surgery-related coping in surgery patients with intracranial tumors. World Neurosurg 116:e775–e782. https://doi.org/10.1016/j.wneu.2018.05.091
39. Goebel S, Strenge H, Mehdorn HM (2012) Acute stress in patients with brain cancer during primary care. Support Care Cancer 20(7):1425–1434. https://doi.org/10.1007/s00520-011-1225-6
40. Sharpe L, Curran L, Butow P, Thewes B (2018) Fear of cancer recurrence and death anxiety. Psycho-Oncology 27:2559–2565. https://doi.org/10.1002/pon.4783
41. Salander P (1996) Brain tumor as a threat to life and personality. J Psychosoc Oncol 14:1–18. https://doi.org/10.1300/J077v14n03_01
42. Cohee AA, Adams RN, Johns SA, von Ah D, Zoppi K, Fife B, Monahan PO, Stump T, Cella D, Champion VL (2017) Long-term fear of recurrence in young breast cancer survivors and partners. Psycho-Oncology 26:22–28. https://doi.org/10.1002/pon.4008
43. Ganz PA, Kwan L, Stanton AL, Krupnick JL, Rowland JH, Meyerowitz BE, Bower JE, Belin TR (2004) Quality of life at the end of primary treatment of breast cancer: first results from the moving beyond cancer randomized trial. J Natl Cancer Inst 96:376–387
44. Zimmermann T, Herschbach P, Wessarges M et al (2011) Fear of progression in partners of chronically ill patients. Behav Med (Washington, D.C.) 37:95–104. https://doi.org/10.1080/08964289.2011.605399
45. Mellon S, Kershaw TS, Northouse LL, Freeman-Gibb L (2007) A family-based model to predict fear of recurrence for cancer survivors and their caregivers. Psycho-Oncology 16:214–223. https://doi.org/10.1002/pon.1074