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ORIGINAL REPORT

COGNITIVE AND EMOTIONAL PROBLEMS IN PATIENTS AFTER CEREBRAL MENINGIOMA SURGERY

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Objectives: **To determine long-term cognitive complaints and symptoms of depression or anxiety in patients following surgery for a cerebral meningioma, and to examine factors associated with these outcomes.**
Design: **Cross-sectional study.**
Patients: **Patients operated on for a cerebral meningioma in the University Medical Center Utrecht, The Netherlands, between 2007 and 2009.**
Methods: **Clinical data were retrieved from medical files. Patients completed a postal questionnaire. Cognitive complaints were measured with the Cognitive Failures Questionnaire. A score above 43.5 was defined as presence of cognitive complaints. Anxiety and depressive symptoms were measured with the Hospital Anxiety and Depression Scale, and were considered present if the scale score was ≥8.**
Results: **The response rate was 76% (*n* = 136). Mean time after operation was 32.6 months (standard deviation 10.6 months). Overall, 40% of patients experienced cognitive and/or emotional problems. Thirty-one patients (23%) experienced cognitive complaints, 39 (29%) showed anxiety, and 31 (23%) showed depressive symptoms. Country of birth and previous depression/burn-out were the most important factors. Scores on all outcome measures were related to each other.**
Conclusion: **Forty percent of patients experienced cognitive or emotional problems following surgery for a cerebral meningioma. Screening for these problems is therefore important in order to provide patients with the care they require as soon as possible.**

Key words: meningioma; cognition; depression; anxiety; outcomes research.

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INTRODUCTION

Meningiomas are tumours arising from the meninges. The majority of meningiomas are classified as benign (98%) (1) and meningiomas account for 13–26% of all intracranial tumours (2). Dependent on various factors, treatment can consist of (a combination of) surgical excision, radiotherapy, endovascular treatment or conservative management (2). Three- and 5-year survival rates are high (70–93%) (3, 4). Therefore, understanding of long-term morbidity due to (treatment of) meningiomas is of increasing importance as it may impair the long-term quality of life of patients.

Previous studies have shown that patients with a meningioma often experience post-operative problems in different cognitive areas. Neuropsychological testing has revealed problems in attention, memory functions, executive functioning and processing speed (5–9). The timing of neuropsychological assessment in these studies varied widely, from 12 weeks to 3.4 years post-operation. Most studies carried out neuropsychological examination only after surgery (7–9). Two studies assessed both pre- and post-operative neuropsychological functioning (5, 6). These studies showed that neuropsychological impairments found before brain surgery can diminish after the procedure, but do not completely subside (5, 6).

All available studies explored cognitive functioning using neuropsychological examination. None of the available studies reported on experienced cognitive complaints. Studies in other diagnostic groups have shown discrepancies between experienced cognitive complaints and findings of neuropsychological tests. These studies also frequently found experienced cognitive complaints to be more widespread than impairments on neuropsychological assessment (10–14). These problems can adversely affect daily life, thus it is important to increase our knowledge of the cognitive complaints experienced after surgery for cerebral meningioma.

Little is known about the presence of anxiety and depressive symptoms in patients who have undergone surgery for a meningioma. A previous study showed that psychological disturbances are present in 44% of patients (15). However, another study showed no difference on the Short Form-36 (SF-36) mental health score between patients after meningioma resection and healthy controls (9). In order to be able to make useful recommendations for improving medical care after a cerebral meningioma operation it is important to gain further insight into the experienced cognitive and emotional consequences of an operation in this patient group. It is known that experienced cognitive complaints, anxiety, and depressive symptoms are closely related (14, 16–20). Therefore, it is important to focus on both of these factors after an operation for a meningioma.

The objectives of this study are: first, to examine the presence of long-term experienced cognitive complaints, anxiety and depressive symptoms in patients who have undergone surgery for a cerebral meningioma; and, secondly, to examine associations between demographic and medical factors and cognitive and emotional problems in order to identify subgroups of patients who are at risk of developing these problems.

METHODS

Subjects

The study group consisted of all patients operated on for a cerebral meningioma in the University Medical Center Utrecht (UMCU) between January 2007 and December 2009. Inclusion criteria were: age ≥ 18 years and sufficient knowledge of the Dutch language to complete the questionnaires.

Procedure

Contact addresses were retrieved from the hospital database and checked. Information about the study, informed consent forms, and the study questionnaire were sent to all patients known to have survived. Patients were asked to complete and return the questionnaire and informed consent form if they agreed to participate. Several weeks after the initial mailing, a reminder was sent to all patients who had not returned the questionnaire. Medical files were searched for data about the meningioma and comorbidities. The study design was approved by the medical ethics committee of UMCU.

Assessment

The study questionnaire included general questions about demographic characteristics, such as age, gender, country of birth, education level, marital status, and employment status before and after the operation. In addition, questions about medical information, such as comorbidities, according to an extensive list of possible comorbidities (21), and care characteristics, such as discharge destination and possible rehabilitation care, were systematically asked. Rehabilitation care was defined as inpatient or outpatient multidisciplinary treatment, coordinated by a rehabilitation physician.

The Cognitive Failures Questionnaire (CFQ) and the Hospital Anxiety and Depression Scale (HADS) were part of the study questionnaire. The CFQ measures everyday cognitive functioning (22). It consists of 25 items on experienced failures in 3 domains: perception, motor function and memory. All items are scored between 0 (never) and 4 (very often). A higher total score indicates worse perceived cognitive functioning. The psychometric properties of the Dutch translation of the CFQ are good, with a test-retest stability of 0.83 and Cronbach's alphas of 0.75 and 0.81 (23).

The HADS is a screening instrument for the presence of anxiety or depressive states (24, 25). It consists of 14 questions, 7 about anxiety and 7 about depression. Each answer is scored between 0 and 3, thus both subscores can vary between 0 and 21. Higher scores indicate greater emotional problems. Satisfactory to good psychometric qualities of the HADS in a Dutch population have been found (25).

Medical files were searched to complete the information regarding comorbidities. In addition, information about the meningioma was searched in the medical files: location of meningioma, World Health Organization (WHO) grade (26), completeness of resection, neurological deficits after operation, postoperative radiotherapy, and post-operative course.

Statistical analysis

SPSS version 18.0 was used for all analyses. Patients were excluded from the analyses if they had more than 7 missing values on the CFQ. A maximum of one missing value per subscore of the HADS was allowed. The study population, meningioma and operation characteristics were reported using descriptive statistics. Age was dichotomized, with the mean age of participants as cut-off value. Educational level was classified according to the Dutch classification system, where 1 means that the patient only underwent primary education, and 5 means they underwent higher vocational or university education. This score was dichotomized as lower education (1–3) and higher education (4–5).

The outcome measures were also dichotomized. The mean and standard deviation (SD) of the CFQ scores in two general population studies were used to estimate the general population mean of the CFQ score (32.5) and SD (11) (27, 28). The cut-off point for cognitive problems was set at 1 SD above the population mean (43.5) to indicate that the presence of cognitive complaints is more than one would expect.

For both subscores of the HADS the established cut-off point of 8 or higher was used to indicate the presence of anxiety or depressive symptoms. With this cut-off point an optimal balance between sensitivity and specificity is achieved (29).

Bivariate relationships were calculated in order to gain insight into the possible factors that influence the different outcome measures. Either Fisher's exact tests (factors with two groups) or Pearson χ^2 tests (factors with 3 or more groups) were used. Spearman's correlation coefficients were used to assess the correlations between the different outcome measures. The interpretation of correlation coefficients was carried out according to the guidelines of Cohen (30). Correlations below 0.30 were interpreted as weak, and correlations of 0.50 or higher were interpreted as strong. A p-value < 0.05 was considered statistically significant. As patients who were not born in the Netherlands had deviant scores on the outcome measures, all statistics were also calculated without these patients in order to check for distortion. When calculating the relationship between the factor location of meningioma and the outcome measures, the groups "intraventricular meningioma" and "meningioma on multiple locations" were not taken into account as these groups were too small and as a result could distort the findings.

RESULTS

Study population

A total of 194 patients underwent surgery for a meningioma in UMCU between January 2007 and December 2009. Twelve patients died and the contact details of 3 patients were missing. The remaining 179 patients were invited to participate in the study. A total of 136 patients (76.0%) agreed and completed the questionnaire. No significant differences were found between participants and non-participants concerning personal, meningioma and care characteristics (Table I).

Of the 136 patients included in this study, 106 (78%) were female. Mean time since resection was 32.6 months (SD 10.6 months) and, in the majority of patients, the meningioma was located either in convexity, anterior or middle cranial fossa. Ninety-six patients (71%) had undergone complete resection of the meningioma, and 21 had had post-operative radiotherapy. After the operation 58 patients (43%) were discharged without rehabilitation care, all other patients received outpatient rehabilitation or were discharged to a rehabilitation centre or nursing home (Table I).

Cognitive and emotional problems

The median scores and percentages of patients who scored above the cut-off score on both the CFQ and the HADS are shown in Table II. The two items on the CFQ with the highest scores were

Table I. *Characteristics of participants and non-participants*

Characteristics	Participants $n=136$	Non-participants $n=43$
Personal characteristics		
Females, *n* (%)	106 (78)	33 (77)
Age, years, mean (SD)	59.1 (12.7)	61.1 (15.1)
Country of birth: the Netherlands, *n* (%)	125 (92)	Unknown
Living with partner, *n* (%)	96 (71)	Unknown
High educational level, *n* (%)	54 (40)	Unknown
Employed before operation, *n* (%)	71 (52)	Unknown
Patients with depression/burn-out, *n* (%)	21 (15)	Unknown
Meningioma characteristics		
Location of meningioma, *n* (%)		
Convexity	66 (48)	22 (51)
Falx	10 (7)	5 (12)
Anterior and middle cranial fossa	43 (32)	10 (23)
Posterior fossa/cerebellar	16 (12)	5 (12)
Intraventricular	1 (1)	0 (0)
Multiple locations	0 (0)	1 (2)
WHO classification of meningioma, *n* (%)		
WHO grade 1	117 (86)	34 (79)
WHO grade 2	17 (12)	9 (21)
WHO grade 3	2 (2)	0 (0)
Complete resection of meningioma, *n* (%)	96 (71)	24 (56)
Relapse meningioma or meningioma on other location, *n* (%)	20 (15)	10 (23)
Medical/care characteristics		
Time since resection, months mean (SD)	32.6 (10.6)	32.0 (11.5)
No neurological deficits after operation, *n* (%)	83 (62)	19 (44)
Radiotherapy given after operation, *n* (%)	21 (15)	4 (9)
Patients with epilepsy, *n* (%)	18 (13)	Unknown
Discharged home without rehabilitation care, *n* (%)	58 (43)	19 (46)

WHO: World Health Organization; SD: standard deviation.

Table II. *Cognitive complaints and emotional problems after surgery for cerebral meningioma*

Outcome measure	Median (IQR)	Cut-off point	Above cut-off, *n* (%)
CFQ, range 0–100	28.0 (23.0)	43.5	31 (23)
HADS total score, range 0–42	10.4 (8.2)	n.a.	n.a.
HADS anxiety, range 0–21	5.0 (5.5)	≥8	39 (29)
HADS depression, range 0–21	3.0 (6.0)	≥8	31 (23)

IQR: interquartile range; CFQ: Cognitive Failures Questionnaire; HADS: Hospital Anxiety and Depression Scale; n.a.: not applicable.

"How often do you forget people's names?" and "How often do you fail to find a word when it is on the tip of your tongue?".

Factors associated with cognitive complaints and anxiety or depressive symptoms and their mutual relationships (Tables III and IV)

Personal characteristics. Country of birth was significantly related to the CFQ and HADS depression scores. Patients who were not born in the Netherlands had higher scores on both measures. The *p*-value of the relationship between country of birth and HADS anxiety was just above the significance level. Additional analyses showed that the relatively high scores of this subgroup of patients were not due to outliers. Patients with a depression or burn-out in their medical history scored more frequently above the cut-off on all 3 outcome measures than patients without depression or burn-out in their medical history. Patients who, due to health problems, were not employed after the operation scored more frequently above the cut-off on the HADS depression scale than patients who were employed or not employed for reasons other than health problems.

Table III. *Overview of relationships between possible factors and cognitive and emotional problems*

	CFQ			HADS anxiety			HADS depression	
Factor	*n*	% ≥+1 SD	*p*-value	*n*	% ≥8	*p*-value	% ≥8	*p*-value
Personal characteristics								
Sex								
Men	30	20.0	0.807	30	26.7	0.822	26.7	0.629
Women	105	23.8		103	30.1		22.3	
Age, years								
<59.1 years	66	24.2	0.838	64	28.1	0.850	17.2	0.150
≥59.1 years	69	21.7		69	30.4		29.0	
Country of birth								
The Netherlands	124	18.5	0.001	123	27.6	0.051	21.1	0.018
Other	8	75.0		8	62.5		62.5	
Marital status								
Living with partner	95	22.1	1.00	95	30.5	0.833	22.1	0.498
Living alone	37	21.6		36	27.8		27.8	
Level of education								
Low educated	73	20.5	0.830	73	26.0	0.550	20.5	0.666
High educated	54	22.2		53	32.1		24.5	
Depression or burn-out in medical history								
Yes	21	61.9	0.000	20	65.0	0.000	55.0	0.001
No	114	15.8		113	23.0		17.7	

Table III. *Contd.*

	CFQ			HADS anxiety			HADS depression	
Factor	*n*	% ≥ +1 SD	*p*-value	*n*	% ≥8	*p*-value	% ≥8	*p*-value
Employment status after operation								
Employed	42	23.8	0.120	42	26.2	0.935	7.1	0.004
Not employed; however, not due to health problems	57	15.8		57	28.1		26.3	
Not employed due to health problems	22	40.9		21	33.3		47.6	
Other	6	16.7		6	33.3		33.3	
Meningioma characteristics								
Location of meningioma								
Convexity	65	24.6	0.757	64	32.8	0.379	28.1	0.263
Falx	10	10.0		10	40.0		30.0	
Anterior and middle cranial fossa	43	20.9		43	25.6		18.6	
Posterior fossa and cerebellar	16	25.0		15	13.3		6.7	
WHO grade								
Grade 1	116	25.0	0.241	114	29.8	1.00	23.7	1.00
Grade 2–3	19	10.5		19	26.3		21.1	
Completeness of operation								
Complete resection	95	23.2	1.00	94	34.0	0.093	24.5	0.822
Incomplete resection	40	22.5		39	17.9		20.5	
Other/relapse meningioma								
No other meningioma	115	23.5	1.00	113	30.1	0.792	23.9	1.00
Known with relapse meningioma or meningioma on other location	20	20.0		20	25.0		20.0	
Medical/care characteristics								
Epilepsy in medical history								
Yes	18	33.3	0.365	18	33.3	0.782	44.4	0.034
No	117	21.4		115	28.7		20.0	
Cerebrovascular disease in medical history								
Yes	4	25.0	1.00	4	75.0	0.076	50.0	0.232
No	131	22.9		129	27.9		22.5	
Other diseases of CNS in medical history								
Yes	5	40.0	0.324	5	20.0	1.00	60.0	0.083
No	130	22.3		128	29.7		21.9	
Postoperative treatment								
None	114	22.8	1.00	112	29.5	1.00	25.0	0.402
Radiotherapy	21	23.8		21	28.6		14.3	
Neurological deficit after operation								
No neurological deficit	82	26.8	0.351	81	33.3	0383	22.2	0.440
Neurological deficit – cranial nerves	13	7.7		13	15.4		15.4	
Neurological deficit – parenchymal	31	16.1		30	26.7		33.3	
Neurological deficit – cranial nerves and parenchymal	8	25.0		8	12.5		12.5	
Peri- or post-operative complications								
No complications	60	25.0	0.678	57	36.8	0.121	24.6	1.00
Complications present	71	21.1		72	23.6		23.6	
Usage of HM								
No usage of HM or nothing stated in medical file	122	21.3	0.466	120	27.5	0.325	23.3	1.00
HM stopped before operation	12	33.3		12	41.7		25.0	
Destination and possible rehabilitation care after discharge								
Home without rehabilitation care	80	22.5	0.034	79	29.1	0.205	17.7	0.142
Home with outpatient rehabilitation care	27	40.7		26	38.5		30.8	
Rehabilitation care in nursing home/residential care home	8	12.5		8	37.5		50.0	
Rehabilitation centre	19	5.3		19	10.5		26.3	

CFQ: Cognitive Failures Questionnaire; HADS: Hospital Anxiety and Depression Scale; CNS: central nervous system; HM: haemodiluting medication; SD: standard deviation; WHO: World Health Organization.

Meningioma characteristics. No meningioma characteristics were related to a score above the cut-off on either of the 3 outcome measures. Without the patients who were not born in the Netherlands the WHO classification became significantly related to the CFQ (*p*-value 0.04).

Medical and care characteristics. The presence of epilepsy was related to a score above the cut-off on the HADS depression scale. Destination and possible rehabilitation care after discharge were significantly related to a score above the cut-off on the CFQ. Patients who were discharged with outpatient

Table IV. *Spearman's correlation coefficients between cognitive complaints, anxiety and depressive symptoms*

Outcome measure	CFQ	HADS anxiety	HADS depression
CFQ	–	0.590	0.481
HADS anxiety	0.590	–	0.623
HADS depression	0.481	0.623	–

CFQ: Cognitive Failures Questionnaire; HADS: Hospital Anxiety and Depression Scale.

rehabilitation care scored above the cut-off more often than other patient groups. Time since resection was not related to a score above the cut-off on one of the outcome measures.

Without the patients who were born outside the Netherlands, the presence of complications was significantly (p-value 0.041) related to the HADS anxiety subscale.

Mutual relationships between different outcome measures. Forty percent of patients scored above the cut-off for either cognitive or emotional problems, or both.

All outcome measures showed moderate to strong relationships with each other, with correlation coefficients between 0.481 and 0.623 (p-value for all comparisons < 0.01) (Table IV). Of all patients who scored above the cut-off on the CFQ, 58.6% also scored above the cut-off on the HADS depression scale and 72.4% scored above the cut-off on the anxiety subscale. Of the people who scored above the cut-off on the depression scale, 71.0% also scored above the cut-off on the anxiety scale. However, of the patients who scored above the cut-off on the anxiety subscale, 56.4% scored above the cut-off on the depression subscale.

DISCUSSION

Approximately 40% of patients in this study had either cognitive or emotional complaints at a mean time of 32 months after surgery for an intracranial meningioma. Twenty-three percent of patients had subjective cognitive complaints, 23% had depressive symptoms, and 29% anxiety problems. The most important factors associated with subjective cognitive complaints or emotional disturbances were country of birth and presence of depression or burn-out in the medical history. Emotional and cognitive complaints were related to each other.

This is the first study to focus on subjective cognitive complaints in patients operated on for cerebral meningioma. Previous studies used neuropsychological tests and demonstrated the presence of cognitive impairments after brain surgery for a meningioma (5–9). Studies in other patient populations (traumatic brain injury, epilepsy, cerebrovascular accident) have shown that subjective cognitive complaints are often more extensive than impairments on neuropsychological tests (10–14). Subjective cognitive complaints are more strongly related to patients' health-related quality of life than cognitive impairments (31, 32). For these reasons, this study focused on experienced cognitive complaints rather than cognitive impairments in neuropsychological assessment. The median CFQ score of this study population was 28.0, which is better than the score of general population (CFQ mean scores varying between 29.0 and 42.6) (16, 18, 23, 28) or other diagnostic groups, such as patients with depressive symptoms (CFQ mean score 59.4) (16) and patients after subarachnoid haemorrhage (mean CFQ score, respectively, 36.8 and 36.7) (32, 33). Yet it is worse than mean CFQ scores found in stroke survivors (CFQ mean score in two different treatment groups 23.5 and 28.0) (34). Twenty-three percent of the patients scored above the CFQ cut-off point set in this study, which is only slightly above the expected 15.6% of persons in the general population scoring above the cut-off of 1 SD above the mean. The results of this study therefore show that the prevalence of poorly experienced cognitive functioning was low, which is in contrast to the results of studies reporting neuropsychological impairments (6–9).

There are various possible explanations for this relatively low percentage of subjective cognitive complaints. As the patients were invited to participate in the study at a mean of 32.6 months after the operation, they had already been functioning with the possible cognitive side-effects of the operation for a long period of time. Patients may adopt specific compensatory strategies in daily life in order to minimize the effects of these cognitive complaints; thus, they may become less aware of the problems. In addition, the presence of pre-operative cognitive complaints can play a role. Previous studies have shown marked impairments on preoperative neuropsychological assessment with no deterioration in cognitive functions postoperatively and improvement in certain areas (5, 6). As a result of the preoperative impairments, patients may rate their cognitive functioning postoperatively as improved regardless of certain persistent cognitive impairments. A final explanation could be a lack of insight of the patient into his or her own cognitive functioning. In other patient groups discrepancies between the perceived impairments of patients and their carers have been reported (35, 36). However, other studies found patients with brain injuries to have more cognitive complaints than expected based on the results of neuropsychological tests (14, 19).

Anxiety and depressive symptoms were present in approximately one-quarter of our study population. Other studies have shown different results; one study found such symptoms in 44% of patients (15), and another study found no differences between patients after meningioma resection and healthy controls (9).

In the literature on other brain disorders (e.g. in patients after subarachnoid haemorrhage and stroke) higher percentages of anxiety and depressive symptoms have been found compared with our population (31, 37).

The CFQ and HADS subscales were correlated to each other. This relationship between subjective cognitive complaints and emotional disturbances is seen in various populations (14, 16–20). Because this study had a cross-sectional design, it is not possible to establish the direction of this relationship. Other studies show contradictory results. One study of cognitive functioning and depressive symptoms in older people found that more depressive symptoms led to a slight acceleration in

cognitive decline; however, this relationship was found only in a subgroup of people (38). Another study has reported that perceived cognitive difficulties predict a negative course of emotional disturbances, and that this relationship does not exist in the other direction (17). However, a more dynamic association between cognitive and emotional functioning is also possible (17). The relationship between cognitive and emotional problems is found in various patient groups. Thus, it can be hypothesized that the experienced cognitive and emotional problems encountered during or after an illness are, at least partly, the result of a more general reaction of the individual to a serious life event.

In this study we also looked for factors associated with cognitive or emotional problems. In order to plan appropriate daily care it is useful to know which groups of patients are at risk of developing certain problems.

Our study found that being born outside the Netherlands is an important factor for experienced cognitive complaints and depressive symptoms. However, the nature of the relationship between country of birth and these problems is difficult to unravel. Although sufficient knowledge of the Dutch language was an inclusion criterion for this study, language problems hindering the completion of questionnaires could still be a factor. In addition, culture could play a role. A previous study showed that cross-cultural differences in the prevalence of different anxiety disorders might reflect true differences in prevalence. Furthermore, it can be questioned whether an instrument measures the same phenomenon in patients with different cultural backgrounds (39).

Depression or burn-out in a patient's medical history was the most significant factor associated with experienced cognitive complaints. This is consistent with the findings of previous studies, which found associations between depressive or anxiety symptoms and experienced cognitive complaints (14, 16–20), and the strong relation between subjective cognitive complaints and emotional problems in this study. Presence of depression or burn-out in a patient's medical history was also the most significant variable associated with the HADS score.

In this study, no association between meningioma or medical treatment characteristics and subjective cognitive functioning or emotional disturbances were found. This is in contrast to the findings of two previous studies, which showed that lateralization was related to cognitive impairment (6, 8). However, one study included only patients with a frontal meningioma (6). The other study showed that patients with skull base meningioma had lower performance than patients with convexity meningioma (8). This association between tumour localization and cognitive functioning was not confirmed in our data. This difference could be due to the smaller number of patients with a frontal meningioma in our study population and the difference in follow-up duration. In addition, this study based the classification of the location of the meningioma on anatomical regions, and not on right or left hemisphere. The reason for this is that the meningioma was frequently not located solely in one hemisphere in our patient population. Furthermore, both other studies used a neuropsychological assessment and no measure of subjective cognitive functioning. In the CFQ no specific cognitive functions are tested. It might thus be more difficult to find a relation between subjective complaints and localization of the tumour than between specific neuropsychological functions tested in a neuropsychological assessment and localization of the tumour. Finally, awareness can play a role in the lack of found associations between meningioma or medical treatment characteristics and cognitive complaints. As CFQ is a self-report questionnaire, awareness of the patient of his or her own cognitive functioning might be an important factor. When using a neuropsychological assessment, awareness is less important for detecting neuropsychological impairments.

Patients who received radiotherapy postoperatively did not have more subjective cognitive complaints, and this is in agreement with the findings on neuropsychological assessment in a previous study (9). In addition, age was not associated with our outcome measures. This conflicts with an earlier study, which found a decline in cognitive functioning above the age of 55 years after a surgically treated meningioma (7).

Employment status after the operation was related to a score above the cut-off on the HADS depression scale. Patients who, due to health problems, were not employed were more likely to show depressive symptoms. A similar relation between employment and psychological complaints is seen in patients with epilepsy (33, 40).

The presence of epilepsy in patients was also related to depression, which is in agreement with a study showing that 27.8% of the patients with epilepsy had signs of borderline or clinical depression on the HADS (40).

Patients who were born outside the Netherlands had a relatively high score on the outcome measures. All analyses on both HADS and CFQ were repeated without this group of patients in order to check that they did not distort the findings. When not taking these patients into account, the above-mentioned relationships between different factors, cognitive complaints and emotional problems were still significant, and only two extra associations became significant; namely between the presence of complications after the operation and anxiety and between WHO grade and cognitive complaints.

To our knowledge this is the first study to investigate subjective cognitive and emotional problems in this diagnostic group. Other strengths of this study are the size of the study population and the high response rate. However, there are some limitations to our study. The design of this study was cross-sectional; therefore the course of cognitive complaints and mood disturbances was not elucidated. In addition, the relationships we found between the outcomes and possible influencing factors should be interpreted with caution because data on pre-operative cognitive and emotional problems were unavailable. Furthermore, this study used a postal questionnaire, with the risk of response bias. However, there was a high response rate of 76.0% and there were no significant differences between patients who responded and those who did not respond; therefore the risk of meaningful distortion of the data is small.

The cut-off point for the CFQ was defined using data of the general population. We chose to use two studies in the general

Dutch population; thus the CFQ values were based on a large population of the same nationality as our study population. It is not unusual to define a cut-off point using the distribution of scores in the general population. However, the validity of this cut-off point to distinguish between "normal" and "abnormal" scores has not yet been established. We nevertheless chose to use a cut-off point because it is advantageous in daily practice to have a clear cut-off above which scores are in a clinical range for which a referral is appropriate.

Another limitation of this study is that it did not take into account physical impairments caused by the meningioma or operation. Physical problems can influence the mood of patients, and indirectly also their experienced cognitive functioning. As a result, this study might have underestimated this factor. A final limitation is that, due to practical considerations, a full neuropsychological examination was not performed. As mentioned above, neuropsychological assessment and subjective cognitive functioning can differ in different patients.

Further research into the relationship between neuropsychological assessment and subjective cognitive functioning, assessed both pre- and post-operatively, would be valuable to further enlighten cognitive functioning and to explore the relationships between objective and subjective cognitive functioning in this group. Ideally, this would be done in a prospective study in which multiple measurements were taken after the operation, in order to investigate the course of cognitive and emotional problems. In addition, possible factors associated with these problems could be explored further in this way in order to find possible prognostic factors for experienced cognitive and emotional problems in this patient group.

The findings of this study may have consequences for the organization of care after surgery for a meningioma. Nearly 40% of the sample scored above the cut-off on the CFQ and/or HADS. This clearly indicates a need for systematic screening of cognitive and emotional problems after an operation for a meningioma. Such screening might help enable the provision of more timely care for patients who experience cognitive or emotional problems. In addition, the relationships found between country of birth and presence of depression or burnout in the medical history may help clinicians to become more aware of patients who are at risk of developing these problems.

The authors declare no conflicts of interest.

REFERENCES

1. Ostrom QT, Gittleman H, Farah P, Ondracek A, Chen Y, Wolinsky Y, Kruchko C, Barnholtz-Sloan JS, CBTRUS Statistical Report: Primary Brain and Central Nervous System Tumors Diagnosed in the United States 2006–2010. Neuro-Oncol 2013; 15 (Suppl 2): ii1–ii56.
2. Whittle IR, Smith C, Navoo P, Collie D. Meningiomas. Lancet 2004; 363: 1535–1543.
3. Cahill KS, Claus EB. Treatment and survival of patients with nonmalignant intracranial meningioma: results from the Surveillance, Epidemiology, and End Results Program of the National Cancer. J Neurosurg 2011; 115: 259–267.
4. McCarthy BJ, Davis FG, Freels S, Surawicz TS, Damek DM, Grutsch J, et al. Factors associated with survival in patients with meningioma. J Neurosurg 1998; 88: 831–839.
5. Tucha O, Smely C, Lange KW. Effects of surgery on cognitive functioning of elderly patients with intracranial meningioma. Br J Neurosurg 2001; 15: 184–188.
6. Tucha O, Smely C, Preier M, Becker G, Paul GM, Lange KW. Preoperative and postoperative cognitive functioning in patients with frontal meningiomas. J Neurosurg 2003; 98: 21–31.
7. Krupp W, Klein C, Koschny R, Holland H, Seifert V, Meixensberger J. Assessment of neuropsychological parameters and quality of life to evaluate outcome in patients with surgically treated supratentorial meningiomas. Neurosurgery 2009; 64: 40–47.
8. Dijkstra M, Van Nieuwenhuizen D, Stalpers LJA, Wumkes M, Waagemans M, Vandertop WP, et al. Late neurocognitive sequelae in patients with WHO grade I meningioma. J Neurol Neurosurg Psychiatry 2009; 80: 910–915.
9. Van Nieuwenhuizen D, Klein M, Stalpers LJA, Leenstra S, Heimans JJ, Reijneveld JC. Differential effect of surgery and radiotherapy on neurocognitive functioning and health-related quality of life in WHO grade I meningioma patients. J Neurooncol 2007; 84: 271–278.
10. Lannoo E, Colardyn F, Vandekerckhove T, De Deyne C, De Soete G, Jannes C. Subjective complaints versus neuropsychological test performance after moderate to severe head injury. Acta Neurochir (Wien) 1998; 140: 245–253.
11. Duits A, Munnecom T, Van Heugten C, Van Oostenbrugge RJ. Cognitive complaints in the early phase after stroke are not indicative of cognitive impairment. J Neurol Neurosurg Psychiatry 2008; 79: 143–146.
12. Liik M, Vahter L, Gross-Paju K, Haldre S. Subjective complaints compared to the results of neuropsychological assessment in patients with epilepsy: the influence of comorbid depression. Epilepsy Res 2009; 84: 194–200.
13. Piazzini A, Canevini MP, Maggiori G, Canger R. The perception of memory failures in patients with epilepsy. Eur J Neurol 2001; 8: 613–620.
14. Passier PECA, Visser-Meily JMA, Van Zandvoort MJE, Post MWM, Rinkel GJE, Van Heugten C. Prevalence and determinants of cognitive complaints after aneurysmal subarachnoid hemorrhage. Cerebrovasc Dis 2010; 29: 557–563.
15. Lang DA, Neil-Dwyer G, Garfield J. Outcome after complex neurosurgery: the caregiver's burden is forgotten. J Neurosurg 1999; 91: 359–363.
16. Farrin L, Hull L, Unwin C, Wykes T, David A. Effects of depressed mood on objective and subjective measures of attention. J Neuropsychiatry Clin Neurosci 2003; 15: 98–104.
17. Gallo LC, Malek MJ, Gilbertson AD, Moore JL. Perceived cognitive function and emotional distress following coronary artery bypass surgery. J Behav Med 2005; 28: 433–442.
18. Hohman TJ, Beason-Held LL, Resnick SM. Cognitive complaints, depressive symptoms, and cognitive impairment: are they related? J Am Geriatr Soc 2011; 59: 1908–1912.
19. Stulemeijer M, Vos PE, Bleijenberg G, Van der Werf SP. Cognitive complaints after mild traumatic brain injury: things are not always what they seem. J Psychosom Res 2007; 63: 637–645.
20. Sullivan B, Payne TW. Affective disorders and cognitive failures: a comparison of seasonal and nonseasonal depression. Am J Psychiatry 2007; 164: 1663–1667.
21. Van Roijen L, Essink-Bot ML, Koopmanschap MA, Bonsel G, Rutten FF. Labor and health status in economic evaluation of health care. The Health and Labor Questionnaire. Int J Technol Assess Health Care 1996; 12: 405–415.
22. Broadbent DE, Cooper PF, FitzGerald P, Parkes KR. The Cognitive Failures Questionnaire (CFQ) and its correlates. Br J Clin Psychol 1982; 21: 1–16.
23. Merckelbach H, Muris P, Nijman H, de Jong PJ. Self-reported cognitive failures and neurotic symptomatology. Person Individ Diff 1996; 20: 715–724.

24. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. Acta Psychiatr Scand 1983; 67: 361–370.
25. Spinhoven P, Ormel J, Sloekers PP, Kempen GIJM, Speckens AEM, Van Hemert AM. A validation study of the Hospital Anxiety and Depression Scale (HADS) in different groups of Dutch subjects. Psychol Med 1997; 27: 363–370.
26. Louis DN, Ohgaki H, Wiestler OD, Cavenee WK. WHO classification of tumours of the central nervous system. 4th ed. Lyon: IARC; 2007.
27. Pfeifer S, Van Os J, Hanssen M, Delespaul P, Krabbendam L. Subjective experience of cognitive failures as possible risk factor for negative symptoms of psychosis in the general population. Schizophr Bull 2009; 35: 766–774.
28. Boomsma DI. Genetic analysis of cognitive failures (CFQ): a study of Dutch adolescent twins and their parents. Eur J Personality 1998; 12: 321–330.
29. Bjelland I, Dahl AA, Haug T, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. J Psychosom Research 2002; 53: 69–77.
30. Cohen J. Statistical power analysis for the behavioral sciences. 2nd ed. Hillsdale: Lawrence Erlbaum Associates; 1988.
31. Passier PECA, Visser-Meily JMA, Van Zandvoort MJE, Rinkel GJE, Lindeman E, Post MWM. Predictors of long-term health-related quality of life in patients with aneurysmal subarachnoid hemorrhage. NeuroRehabilitation 2012; 30: 137–145.
32. Visser-Meily JMA, Rhebergen ML, Rinkel GJE, Van Zandvoort MJ, Post MWM. Long-term health-related quality of life after aneurysmal subarachnoid hemorrhage: relationship with psychological symptoms and personality characteristics. Stroke 2009; 40: 1526–1529.
33. Passier PECA, Visser-Meily JMA, Rinkel GJE, Lindeman E, Post MWM. Life satisfaction and return to work after aneurysmal subarachnoid haemorrhage. J Stroke Cerebrovasc Dis 2011; 20: 324–329.
34. Barker-Collo SL, Feigin VL, Lawes CMM, Parag V, Senior H, Rodgers A. Reducing attention deficits after stroke using attention process training: a randomized controlled trial. Stroke 2009; 40: 3293–3298.
35. Andrewes HE, Drummond KJ, Rosenthal M, Bucknill A, Andrewes DG. Awareness of psychological and relationship problems amongst brain tumour patients and its association with carer distress. Psycho-Oncology 2013 Mar 19 [Epub ahead of print].
36. Visser-Keijzer AC, Jong B, Deelman BG, Berg IJ, Gerritsen MJJ. Subjective change in emotive, cognition and behaviour after stroke: factors affecting the perception of patients and partners. J Clin Exp Neuropsychol 2002; 24: 1032–1045.
37. Hackett ML, Yapa C, Parag V, Anderson CS. Frequency of depression after stroke: a systematic review of observational studies. Stroke 2005; 36: 1330–1340.
38. Gale CR, Allerhand M, Deary IJ, HALCyon Study Team. Is there a bidirectional relationship between depressive symptoms and cognitive ability in older people? A prospective study using the English Longitudinal Study of Ageing. Psychol Med 2012; 42: 2057–2069.
39. Lewis-Fernández R, Hinton DE, Laria AJ, Patterson EH, Hofmann SG, Craske MG, et al. Culture and the anxiety disorders: recommendations for DSM-V. Depress Anxiety 2010; 27: 212–229.
40. Mensah SA, Beavis JM, Thapar AK, Kerr M. The presence and clinical implications of depression in a community population of adults with epilepsy. Epilepsy Behav 2006; 8: 213–219.