

BMJ Open Depression among adult patients with primary brain tumour: a cross-sectional study of risk factors in a low-middle-income country

Anum Sadruddin Pidani ¹, Amna Rehana Siddiqui,¹ Iqbal Azam,¹ Muhammad Shahzad shamim,² Adnan Abdul Jabbar,³ Shameel Khan⁴

To cite: Pidani AS, Siddiqui AR, Azam I, *et al.* Depression among adult patients with primary brain tumour: a cross-sectional study of risk factors in a low-middle-income country. *BMJ Open* 2020;**10**:e032748. doi:10.1136/bmjopen-2019-032748

► Prepublication history for this paper is available online. To view these files, please visit the journal online (<http://dx.doi.org/10.1136/bmjopen-2019-032748>).

Received 05 July 2019
Revised 04 June 2020
Accepted 21 July 2020



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¹Community Health Sciences, Aga Khan University, Karachi, Pakistan

²Surgery, Aga Khan University, Karachi, Pakistan

³Oncology, Aga Khan University Medical College Pakistan, Karachi, Sindh, Pakistan

⁴Psychiatry, Aga Khan University, Karachi, Pakistan

Correspondence to

Dr Muhammad Shahzad shamim;
shahzad.shamim@aku.edu

ABSTRACT

Objective The prevalence of depression among patients with primary brain tumour ranges from 15% to 40% globally. Several individual and clinical factors contribute to the development of depression. However, their association with depression in Pakistani setting has not yet been assessed. Thus, we aim to study the factors associated with depression among adult patients with primary brain tumour at a tertiary care hospital in Karachi, Pakistan.

Study design A prospective cross-sectional study.

Setting This study was conducted at a tertiary care hospital of Karachi, Pakistan.

Participants This study included 132 patients with confirmed diagnosis of primary brain tumour (initially diagnosed on MRI of the brain with contrast and later confirmed on histology of surgical specimen) in various stages of treatment.

Primary outcome The primary outcome of this study was to assess depression and its associated factors among adult patients with primary brain tumour. Depression was assessed using a validated screening tool Patient Health Questionnaire-9 (PHQ-9). Scores of 10–27 on PHQ-9 were indicative of screen positive for depressive symptoms. A set of the structured pre-tested questions was used to evaluate patient-related, tumor-related and treatment-related factors.

Results Fifty-one (39%, CI: 33.33–46.94) patients in our study screened positive for depressive symptoms on PHQ-9. There was a significant association between depressive symptoms and Karnofsky Performance Scores (KPS) (prevalence ratio: 3.25 and CI: 1.87–5.62) after controlling covariates. Propensity scores predicted a positive association between KPS (functional status) and unemployment, treatment stage, and tumour recurrence. Tumor-related and treatment-related factors including tumour grade, location, type and hemispheric lateralisation were found insignificant.

Conclusion Depression is common in patients with primary brain tumour. Impaired functional status has a direct impact on depression in these patients. Incorporating the psychosocial domain earlier in the course of treatment needs to be considered for better neuro-oncology management of patients with primary brain tumour.

Strengths and limitations of this study

- To our knowledge, this was the first study conducted in Pakistan to explore depression and its associated factors among patients with primary brain tumour.
- The study has assessed those associations which were not assessed in any of the previous studies on a similar population including treatment stage, extra ventricular drain insertion, number of admissions, stressful events, strategies use to handle stress and first symptoms. Moreover, the relation of different costs including travelling cost and overall treatment cost with depression was also evaluated in this study.
- A single screening tool to measure depression instead of physician-rated measures or mini-interviews was used to verify the results of Patient Health Questionnaire-9.
- The study design is cross-sectional which limits both temporality and direction of causation.

BACKGROUND

Although primary brain tumours account for a relatively small percentage of all cancers, it is considered one of the most devastating types of cancers among the adult population.¹ The incidence of primary brain tumours is approximately 9/100 000/year worldwide with higher rates in western countries as compared with low-middle-income countries (LMICs).² Interestingly, primary brain tumours rank highest among cancers that cause an emotional and psychological burden for patients.^{3,4}

Diagnostic and Statistical Manual-V defines depression as a feeling of sadness, loss of pleasure from daily living activities, body weight changes, reduction in physical activity, fatigue, failure to think or concentrate, lack of self-worth and recurrent suicidal ideations.⁵ It is estimated that depression affects about 350 million individuals worldwide and according to the Global Mental

Health Survey (2014), nearly 1 in 20 individuals report having at least one episode of depression within a year.⁶ Population-based researches report a prevalence of clinical depression ranging between 2% and 5% worldwide.⁷ The worldwide prevalence of depression in patients with cancer is 25% with higher rates among Asian countries.⁸ The estimated prevalence of clinically diagnosed depression in Pakistan is approximately 6% out of which 3% are patients with cancer.⁹ Depression rates among patients with primary brain tumour range from 15% to 40% with the highest rates among patients with glioma.¹⁰ However, it is suggested that these rates likely under-represent the true incidence of depression.¹¹ A systematic review of 42 observational studies reports that the prevalence of depression among patients with glioma ranges between 0% and 93% with a median prevalence of 27%.¹²

Depression in patients with brain tumour is multifactorial and there are several factors contributing to its development, including individual, tumor-related and disease-related factors.¹⁰ All the studies on this topic to date have been conducted in the western population, where the psychosocial circumstances are much different from the Pakistani population, for example, in the UK and US, where most of the data come from, the majority of patients are financially supported by third party payers, that is, state or insurance. In contrast, approximately 85% of patients in Pakistan and a few other South Asian LMICs are out-of-pocket payers both for their treatment and rehabilitation.¹³ This, we believe, may be the cause of the additional psychological burden on the patients. This and several other factors like social support, family set-up and social status are unknown in the context of settings of LMICs and require a series of researches to establish associations. The aim of this study was to assess the association between depression and patient-related, tumor-related and treatment-related variables among adult patients with primary brain tumour in an LMIC.

METHODS

Study design

The analytical cross-sectional study design was employed to determine the association between patient-related, tumor-related and treatment-related factors with depression among adult patients with primary brain tumour. Non-probability consecutive sampling was used to recruit subjects. All the patients who met the eligibility criteria of the study and were willing to give consent were included in the study.

Site and setting

The recruitment was conducted at tertiary care setting of Karachi, Pakistan and 132 patients with confirmed diagnosis of primary brain tumours at various stages of treatment were enrolled. These patients were contacted in neurosurgery wards, neurosurgery and oncology outpatient clinics, and oncology day care suits from November 2017 to July 2018.

Participants

Participants were all adult patients (aged 18 years and above) with a confirmed diagnosis of primary brain tumour (initially diagnosed on MRI of the brain with contrast and later confirmed on histology of surgical specimen) in various stages of treatment at a tertiary care set-up. Each patient was enrolled after written, informed consent. The exclusion criteria for study participants were as follows: diagnosis of depression for about 1 year prior to the diagnosis of primary brain tumour, confused or incoherent patients and patients having problems with speech or comprehension that prevents them from completing the questionnaire, patients with coexisting systemic malignancies apart from a primary brain tumour and any severe comorbid medical illness such as liver cirrhosis, systemic infections like HIV and hepatitis which can cause altered mental status.

Procedure

Participants' eligibility was determined by medical record files. Potentially eligible participants were approached by the investigator during a scheduled follow-up visit at neurosurgery and oncology outpatient clinics and inpatient hospital stay post-surgery. Each patient after the consent was interviewed for 15–20 min to fill a structured pre-tested questionnaire¹⁴ for assessing predictor variables and Patient Health Questionnaire-9 (PHQ-9) Scale for the screening of depression. The questionnaire was also pilot tested on 10 participants before the actual administration.

Measures

We divided all the associated factors into three distinct categories that were patient-related, tumor-related and treatment-related variables. Patient-related factors comprised of demographic and socioeconomic variables including age, gender, marital status, number of dependents, children under 18 years, education, occupation, employment status, residency, travelling cost, caregiver support, current smoking status, past/current medical illness, history of psychological distress, strategies to handle stress (isolation, aggression, prayers, crying, sleeping, addiction and mind diversions) and functional status. The participant's functional status was assessed using the Karnofsky Performance Score (KPS). KPS scores less than 70 were indicative of impaired functional status. Socio-economic status was also computed using factorial analysis. Tumor-related and treatment-related variables were assessed by medical record review and included tumour histology, tumour grade, recurrence, hemispheric lateralisation, first symptoms, brain structures involved and cognitive impairment. Treatment-related variables included stage of treatment, number of chemotherapy cycles, duration since diagnosed, radiation therapy, current use of steroids and anti-epileptic drugs, and treatment cost. The complete list of variables is mentioned in [table 1](#).

Table 1 Summary of the descriptive characteristics of study participants

		Screened positive for depressive symptoms (PHQ-9 ≥10)	
S#	Variables	Total N (%)	N (%)
Patient-related variables			
1	Marital status		
	Married	117 (89)	43 (37)
	Unmarried/single/separated/divorced	15 (11)	8 (53)
2	Children under 18 years		
	Yes	75 (57)	32 (43)
	No	33 (25)	10 (30)
	Unmarried	24 (18)	9 (38)
3	Current employment status		
	Able to work	65 (49)	18 (28)
	Unable to work	24 (18)	13 (54)
	Unpaid (retired/student/housewives)	43 (33)	20 (47)
4	Residence		
	In Karachi	49 (37)	19 (39)
	Outside Karachi	83 (63)	32 (39)
5	Travel cost for one visit (from hometown to hospital)		
	5000–10 000 Rupees	26 (20)	5 (19)
	11 000–20 000 Rupees	39 (30)	18 (46)
	>20 000 Rupees	18 (13)	9 (50)
	Not applicable	49 (37)	19 (39)
6	Caregiver at home		
	Spouse	92 (70)	33 (36)
	Parents	14 (10)	08 (57)
	Others (kids/neighbours/siblings/self)	26 (20)	10 (38)
7	Heading family		
	Yes	68 (52)	27 (40)
	No	64 (48)	24 (38)
8	Socioeconomic status (SES)		
	Low SES	22 (17)	9 (41)
	Middle SES	83 (63)	32 (39)
	High SES	27 (20)	10 (37)
9	Currently smoking (cigarette, huqa, beeri)		
	Yes	18 (14)	10 (56)
	No	114 (86)	41 (36)
10	History of psychological distress prior to the diagnosis of brain tumour		
	Yes	7 (5)	6 (86)
	No	125 (95)	45 (36)

Continued

Table 1 Continued

S#	Variables	Total	Screened positive for depressive symptoms (PHQ-9 ≥10)
		N (%)	N (%)
11	Strategies to handle stress		
	Isolation	26 (20)	10 (38)
	Crying	16 (12)	7 (44)
	Prayers	48 (36)	14 (29)
	Aggression	24 (18)	13 (54)
	Leaves home	1 (0.7)	1 (1.96)
	Sleeping	13 (9)	6 (45)
	Conversation with family/friends	10 (7)	1 (10)
	Addictions (smoking/drinking)	6 (4)	4 (66)
	Mind diversions (listening to music/shopping)	2 (1)	0 (0)
12	Karnofsky Performance Score (KPS) (functional status)		
	KPS scores >70	102 (77)	27 (26)
	KPS scores ≤70	30 (23)	24 (80)
<i>Treatment-related variables</i>			
13	Overall treatment cost during illness		
	200 000–800 000 Rupees	45 (34)	17 (38)
	800 000–1 200 000 Rupees	47 (36)	20 (43)
	>1 200 000 Rupees	40 (30)	14 (35)
14	Treatment cost management		
	Self-support	73 (55)	25 (34)
	Family/relative support	21 (16)	11 (52)
	Welfare from primary treating hospital	28 (21)	13 (46)
	Medical support from workplace/community	10 (8)	2 (20)
15	Access to health insurance		
	Yes	15 (11)	3 (20)
	No	117 (89)	48 (41)
16	Treatment stage at the time of interview		
	Only surgical procedure done	17 (13)	14 (82)
	Referral given to oncology after surgery	18 (13)	5 (28)
	Oncology treatment started/continued	25 (19)	10 (40)
	Treatment completed/follow-ups	72 (55)	22 (31)
17	Current use of steroids		
	Yes	22 (17)	13 (59)
	No	110 (83)	38 (35)
18	Current use of anti-epileptic drugs		
	Yes	48 (36)	17 (35)
	No	84 (64)	34 (40)
19	Surgical procedure performed to remove tumour		
	Craniotomy/craniectomy	96 (73)	41 (43)
	Trans-sphenoidal resection	36 (27)	10 (28)

Continued

Table 1 Continued

S#	Variables	Total	Screened positive for depressive symptoms (PHQ-9 ≥10)
		N (%)	N (%)
20	Type of surgery		
	Awake (local anaesthesia/scalp block)	37 (28)	12 (32)
	Conventional (general anaesthesia)	95 (72)	39 (41)
21	External ventricular drain insertion		
	Yes	7 (5)	5 (71)
	No	125 (95)	46 (37)
22	Time since diagnosis (in months)	Median: 9.5 Range:(1–74)	Median: 5 Range:(1–74)
25	Number of chemotherapy cycles	Median: 2.5 Range: (0–33)	Median: 0 Range:(0–27)
26	Number of radiation cycles	Median: 3.5 Range: (0–33)	Median: 0 Range:(0–54)
<i>Tumour-related variables</i>			
27	Tumour histology		
	Meningioma	30 (23)	16 (53)
	Pituitary adenoma	36 (27)	9 (25)
	High-grade glioma (astrocytoma, GBM)	21 (16)	9 (43)
	Oligodendroglioma	29 (22)	8 (28)
	Others (schwannoma, intraventricular SOLs, CNS lymphoma, ependymoma, hemangioblastoma, craniopharyngioma, choroid plexus papilloma)	16 (12)	9 (56)
28	Tumour type		
	Benign	69 (52)	28 (41)
	Malignant	63 (48)	23 (37)
29	Hemispheric lateralisation		
	Left	60 (45)	28 (47)
	Right	35 (27)	13 (37)
	Not specified	37 (28)	10 (27)
30	Tumour grade		
	Grade I	12 (9)	05 (42)
	Grade II	30 (23)	14 (47)
	Grade III	30 (23)	13 (43)
	Grade IV	16 (12)	7 (47)
	Not specified	44 (33)	12 (27)
31	Cognitive impairment		
	Yes	9 (7)	5 (56)
	No	123 (93)	46 (37)
32	Tumour recurrence		
	Yes	23 (17)	14 (61)
	No	109 (83)	37 (34)

Continued

Table 1 Continued

S#	Variables	Total	Screened positive for depressive symptoms (PHQ-9 ≥10)
		N (%)	N (%)
33	Brain structures involved (tumour location)		
	Frontal lobe	53 (40)	23 (43)
	Parietal lobe	30 (22)	13 (43)
	Temporal lobe	26 (19)	10 (38)
	Occipital lobe	5 (3)	1 (20)
	Pituitary gland (seller region)	36 (27)	9 (25)
	Ventricles	5 (4)	3 (60)
	Cerebellum/CP angle	7 (4)	6 (85)
	Posterior fossa	1 (1)	0 (0)
	Basal ganglia	1 (1)	0 (0)
34	First symptoms before brain tumour diagnosis		
	Seizures	40 (30)	14 (35)
	Headaches	55 (42)	25 (45)
	Weight loss/gain	3 (2)	1 (33)
	Mood changes/loss of interest	1 (1)	1 (100)
	Visual impairment	36 (27)	10 (28)
	Memory loss	5 (3)	3 (60)
	Gait instability	1 (1)	1 (2)
	Nausea/vomiting	5 (3)	2 (40)
	Unconsciousness	7 (5)	2 (29)
	Dizziness	1 (1)	0 (00)
	Slurred speech/unable to write and comprehend	3 (2)	1 (33)
	Numbness (arms, legs, body)	2 (1)	1 (50)
	Limb weakness	2 (1)	1 (50)
	Swelling (facial, orbital)	3 (2)	2 (67)
	Sexual dysfunction	1 (1)	0 (0)
	Hearing problems	1 (1)	0 (0)

CNS, central nervous system; CP, cerebellopontine; GBM, glioblastoma multiforme; PHQ-9, Patient Health Questionnaire-9; SOLs, space-occupying lesions.

Depression

Patients with primary brain tumour were screened for depression using the Urdu version (the national language of Pakistan) of PHQ-9. The PHQ-9 is a self-rated screening tool which contains nine items that correspond to DSM-V criteria of depression and rated on Likert Scale of 4 points. All the patients were classified into two groups based on the scores on the PHQ-9 Scale. Participants with a score of ≥10 were classified as screened positive for depression. PHQ-9 score of 10 or above has a sensitivity and specificity of 88% for major depressive symptoms. A recently conducted validation study on Urdu version of PHQ-9 by Gholizadeh *et al*,¹⁵ reported a specificity of 94% and a false-positive rate of 6% only.

Statistical analysis

Sample size was calculated from previous study¹⁶ using Openepi¹⁷ with a power of 80%, depression to no depression ratio of 1:2, prevalence ratio (PR) of 2% and 30%–70% range of depression for different factors yield a sample size of 108. Adding 20% of the attrition rate, the final sample size came out to be 130 participants. We used Stata V.12.0¹⁸ to perform all the analyses. For descriptive data of continuous variables, mean and SDs were computed. Frequencies and percentages were computed for all qualitative variables. We applied the Cox algorithm to obtain crude and adjusted prevalence ratios.¹⁹ At the univariate level, independent variables were considered significant if the p value was ≤0.25.²⁰ We also checked

multicollinearity between all the predictor variables. To assess multicollinearity, three different tests were used. Pearson's correlation was used for two normally distributed continuous variables, ETA was used for one qualitative and one quantitative variable; whereas, Cramer's V was used for two qualitative variables. Moreover, the cut-off for multicollinearity was 0.8. After multicollinearity, multivariable analysis was performed using the Cox algorithm to obtain adjusted PR. The cut-off for the significance of the predictor variable at multivariable analysis was ≤ 0.05 . We also calculated propensity scores for the only significant variable left after performing multivariable model building (functional status). The purpose of computing propensity scores was to identify the factor associated with the functional status and understand the vicious pathway of associations between explanatory variables and depression. To predict propensity scores, functional status was kept as a dependent variable and was regressed with other explanatory variables. After the final model was obtained for functional status, propensity scores were computed. At last, propensity scores were regressed against depression (dependent variable in the study) to see its association with depression. The cut-off for the significance of propensity scores was ≤ 0.05 .

Patient and public involvement

None of the study participants was involved in the design or conduct of this study and no patient opinion regarding the study has been obtained. The results have been reported to head of mind and brain service line at Aga Khan University Hospital (AKUH) in Karachi which primarily deals with neuro-oncology patients.

RESULTS

Descriptive characteristics of the study participants

The mean age ($\pm$ SD) of study participants was 43.25 (± 12.28) years, with 86 (65%) men and 46 (35%) women. Fifty-one (39%) study participants were screened positive (scores of 10 and greater on PHQ-9) for depression while 81 participants (61%) were screened negative (scores less than 10 on PHQ-9) for depression. Table 1 shows the descriptive characteristics of study participants.

Univariate analysis

Univariate analysis showed that impaired functional status ($p < 0.001$), unemployment ($p = 0.121$), travel cost ($p = 0.240$), current smoking status ($p = 0.238$), history of psychological distress prior to the diagnosis of brain tumour ($p = 0.073$), prayer (strategies to handle stress) ($p = 0.176$), aggression (strategies to handle stress) ($p = 0.195$), health insurance ($p = 0.178$), treatment stage at the time of interview ($p = 0.041$), current use of steroids ($p = 0.111$), surgical intervention performed to remove the tumour ($P = 0.203$), external ventricular drain insertion ($p = 0.196$), multiple hospital admissions ($p = 0.069$), number of surgeries ($p = 0.148$), tumour histology ($P = 0.221$), tumour recurrence ($p = 0.076$),

Table 2 Summary of final reduced multivariate models using Cox algorithm to predict prevalence of depressive symptoms and its association with functional status

Variable	PR and 95% CI	P value
KPS scores > 70 *	1	–
KPS scores ≤ 70	3.25 (1.87–5.62)	< 0.001

*Reference category which was kept as reference in analysis. KPS, Karnofsky Performance Scores; PR, prevalence ratio.

tumour involving seller region (brain structure involved) ($p = 0.106$) and tumour involving cerebellum/cerebellopontine angle ($p = 0.046$) had p value of ≤ 0.25 . After adjusting for the effect of other variables in the multivariable model, functional status (KPS) remained the only variable found associated with depressive symptoms among patients with primary brain tumour with $p < 0.001$.

Table 2 shows that the prevalence of depression among patients with KPS scores ≤ 70 is 3.25 times more as compared with patients with KPS scores > 70 .

Propensity scores for functional status showed three factors that were significantly associated with functional status including employment status, tumour recurrence and treatment stage at the time of the interview. Table 3 shows factors associated with functional status (KPS).

Propensity scores predicted from the above model were significantly associated with depression. Table 3 shows models to demonstrate the association of propensity scores for functional status (KPS) with depression after controlling for current employment status, treatment stage and tumour recurrence.

Table 4 shows that with each unit increase in propensity scores for functional status, the depression will increase up to 5%.

DISCUSSION

The purpose of the present study was to investigate the association between depression and patient-related, tumor-related and treatment-related variables among adult patients with primary brain tumours. Although similar studies have been conducted in different parts of the world, most notably in the US and UK, there is no literature from LMICs or even other South Asian countries. We believe that the circumstances for our patients differ from those of the west, for a number of reasons. According to WHO, Pakistan has one of the world's lowest public health expenditure as a percentage of gross domestic product, as well as one of the world's highest out-of-pocket health expenditure, where it shares the top slot with other South Asian LMICs. Thus approximately 85% of our patients are out-of-pocket payers, in a country already marred with poverty, compared with the high-income countries where the majority of patients are financially supported by third party payers, that is, state or insurance.¹³ In this setting, the high cost of treatment for brain tumours (surgery, chemotherapy, radiation

Table 3 Factors associated with functional status determined by using KPS among patients with primary brain tumour

S#	Variables	PR and 95% CI	P value (z)	P value (F)
1	Current employment status			
	Able to work *	1	–	
	Unable to work	2.56 (0.95–6.92)	0.063	
	Unpaid (student/retired/housewives)	2.66 (1.07–6.66)	0.034	
2	Treatment stage			
	Underwent surgery only	7.17 (2.88–17.89)	<0.001	<0.001
	Referral given to oncology after surgery	1.91 (0.55–6.64)	0.306	
	Oncology treatment started/continued	1.86 (0.59–5.79)	0.282	
	Treatment completed/follow-ups *	1	–	
3	Tumour recurrence			
	Yes	1.97 (0.89–4.35)	0.09	
	No*	1	–	

*Reference category which was kept as reference in analysis.

KPS, Karnofsky Performance Scores; PR, prevalence ratio.

therapy, rehabilitation and so on) should theoretically add to the psychological stress of the patients. Although government-run hospitals do exist, they cover only a fraction of the overall healthcare, and the majority of patients have to resort to private hospitals, especially for advanced healthcare. There are also very few state-run oncology or rehabilitation centres, and patients have to rely on private healthcare for all these services.

We found that 39% of patients with a primary brain tumour treated at AKUH, screened positive for depression on PHQ-9. Impaired functional status was the only significant variable associated with depression and propensity scores for functional status revealed a significant association between impaired functional status and treatment stage at the time of the interview, unemployment and tumour recurrence. We also found that decreasing KPS was directly linked to increased chances of depression; as in with each unit increase in propensity scores for functional status, chances of depression increased by up to 5%. Our findings are consistent with some of the previous studies on the same topic. Rooney *et al*¹² in their systematic review of observational studies concluded that the median prevalence of depression among patients with brain tumour using screening scales was about 27% (range 0%–93%), while clinician-rated measures returned up to 15% (5%–28%). Another meta-analysis conducted by Huang *et al*²¹ reported that

the prevalence of depression in patients with brain tumour is nearly 21% using screening scales and 19% with clinician-rated measures, specifically including mini-interviews. A 1-year follow-up study conducted by Mainio *et al*²² also found functional status as a significant predictor associated with depression among patients with brain tumour. Similar findings were observed in observational studies conducted by Anderson *et al*,²³ Litofsky *et al*,²⁴ Grant *et al*,²⁵ Fox *et al*,²⁶ Rooney *et al*²⁷ and Piil *et al*.^{28 29}

We found three factors associated with reduced functional status including unemployment, tumour recurrence and stage of treatment, more specifically, the early stage of treatment. Association between employment status and depression has been explored by other investigators too. A study conducted by Pelletier *et al*³⁰ found employment status positively associated with depression among patients with brain tumours. However, this association was significant only at the univariate level. Another study conducted by van der Vossen *et al*³¹ on cognitive and emotional problems among patients with meningioma reported a significant association between depression and employment status where depression was assessed by hospital anxiety and depression scale. However, when depression was assessed by other screening tools, no association was found. In contrast, employment status was found to be significantly associated with functional status. A follow-up study conducted by Hickmann *et al*³² reported a parallel trend of unemployment as the functional status declines. Though none of the studies have reported any definite association between unemployment and reduced functional status among similar populations, trends and figures explained by previous studies, as well as common sense, support this relationship, especially in countries without unemployment benefits or without adequate labour laws safeguarding employee rights during illnesses.

Table 4 Summary of association between propensity scores for functional status (KPS) with depressive symptoms after adjusting for current employment status, treatment stage and tumour recurrence

Variable	PR and 95% CI	P value
Propensity scores for KPS	1.05 (1.02–1.08)	<0.001

KPS, Karnofsky Performance Scores; PR, prevalence ratio.

We did not find any significant association between tumour recurrence and depression and similar findings were reported by van der Vossen *et al.*³¹ On the other hand, reduced functional status was significantly associated with tumour recurrence, as shown by other investigators as well.^{33,34} We included patients with brain tumour during different treatment stages after surgical procedure was done. Patients immediately after surgery and in their initial stage of treatment reported the highest prevalence of depression (82%). Weitzner,³⁵ Pringle *et al.*³⁶ and Mainio *et al.*²² also reported a higher level of depression during the initial stage of treatment that is within the first 3 months after surgery. This variable was also found significantly associated with an impaired functional status that is understandable given the physiological and psychological effects of major surgery and hospitalisation. As the treatment progresses and by the time it comes to its end, patients tend to regain their functional status and even resume their jobs. Most patients with brain tumour who have transient focal deficits because of surgery, by the time they reach the completion of their treatment, also improve in their overall functional status. However, no statistical evidence has been reported by any study on the association between functional status and treatment stage.

This study had few limitations. First, we conducted a cross-sectional study which by default does not conclude any temporal relationship between explanatory variables and the outcome. Though our study provides new insight into the psychological burden patients with brain tumour may experience along with its associated factors, the results of this study must be interpreted with caution. However, future studies with larger sample size and different prospective designs are required to hypothesise any specific association. Second, we used a single screening tool to measure depression. We did not use physician-rated measures or mini-interviews to verify the results of PHQ-9. This might have overestimated the prevalence of depression among study participants. However, our study aimed to screen patients for depressive symptoms and not to diagnose, thus, only one screening tool was used. Moreover, to prevent excessive fatigue to the patients, we decided to take less time off our participants. Therefore, a screening tool was considered best to screen for depressive symptoms instead of interviews which could have taken a long time. Third, this study was a single-centre study and thus results cannot be generalised to the entire population of patients with brain tumour. Though we included a diversified group of patients with different ethnic and cultural backgrounds, there is a possibility that patients who presented to government and semi-government sectors for the treatment of brain tumours might have different socioeconomic backgrounds and other demographic characteristics. There is a possibility that patients presented to other care settings apart from AKUH might have different predisposing factors that lead to depression. Therefore, we cannot generalise our results to all patients with brain tumour. However,

our findings do represent a group of patients with brain tumour presented to private tertiary care settings in Pakistan.

CONCLUSION

Our findings suggest that a high proportion of patients with brain tumour also suffer from depression. Whereas several individual and clinical factors may contribute to the development of depression, patients with reduced functional status should be specially monitored for any signs of psychiatric illness. Given the high proportion of depressed patients in our study population, we would recommend routine psychiatric evaluation, or at the least, the administration of simple self-rated screening tools that will allow healthcare providers to readily identify any prevailing neuropsychiatric ailments, for all patients with brain tumours, at the time of admission and during follow-ups.

Acknowledgements The authors would like to acknowledge Aga Khan University Hospital, all the nursing and paramedical staff, and all the residents and consultants who assisted in this project.

Contributors ASP—study design, formulation of questionnaire, data collection, data analysis, manuscript writing. ARS—study design, epidemiological expertise in design and implementation phase, manuscript writing and review. IA—biostatistician (analysis of study data), manuscript writing and review of study analysis. MSS—design and implementation of study, neurosurgery expert input in the design and analysis phase, manuscript review and writing. AAJ—design and implementation of study, oncology expert input in the design and analysis phase, manuscript reviewing. SK—design and implementation of study, selection of study tools, psychology expert input in the design and analysis phase, manuscript reviewing.

Funding This was a self-funded study

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval Aga Khan University Institution Review Board (5009-CHS-ERC-17).

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ORCID iD

Anum Sadruddin Pidani <http://orcid.org/0000-0003-1879-9917>

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