

## PAPER

# The importance of staying connected: Mediating and moderating effects of social group memberships on psychological well-being after brain tumor

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## Abstract

**Objective:** Functional impairments can lower psychological well-being after brain tumor. Changes in social groups and confidence in support potentially impact this relationship. This study aimed to investigate the influence of social group memberships (SGMs) on the relationship between perceived cognitive and physical impairment and psychological well-being.

**Methods:** Seventy adults (60% female) with primary brain tumor (46% benign; 18% low grade; 36% high grade) aged 22 to 75 years undertook a brief cognitive test (Brief Test of Adult Cognition by Telephone) then completed self-report measures of cognitive and physical impairment (Functional Assessment of Cancer Therapy), social groups (Exeter Identity Transition Scale), confidence in social support (Self-Efficacy Scale), depression (depression scale of the 21-item Depression, Anxiety and Stress Scale), anxiety (General Anxiety Disorder 7-item scale), and life satisfaction (Satisfaction With Life Scale). The mediating and moderating effects of SGMs were tested using a bootstrapping method and PROCESS macro.

**Results:** Greater perceived cognitive and physical impairments were significantly related to poorer psychological well-being. Mediation analyses indicated significant indirect effects of social group loss for depression and anxiety ( $P < .05$ ), whereby the relationship between perceived functional impairment and depression and anxiety was partly accounted for by loss of SGMs. Confidence in social groups was a moderator for depression and anxiety ( $P < .001$ ), such that those perceiving high levels of physical and cognitive impairments who were more confident in their social groups reported lower depression and anxiety.

**Conclusions:** Functional impairment is in part related to higher levels of depression and anxiety through loss of social groups. However, greater confidence in social support can buffer the effects of functional impairment on psychological well-being after brain tumor. Interventions focusing on ways to maintain social participation and supportive relationships may be beneficial.

## KEYWORDS

brain tumor, cancer, oncology, social identity theory

## 1 | BACKGROUND

Primary brain tumor is relatively rare, with rates of 7.02/100 000 and 14.56/100 000 for malignant and benign tumors, respectively.<sup>1</sup> Yet people often have a poor prognosis and experience significant functional effects.<sup>2</sup> High rates of psychological distress (eg, 48%)<sup>3</sup> have been reported following brain tumor, which persist across the spectrum of illness.<sup>4-6</sup> Illness appraisals, particularly subjective perceptions of functional impairment, have been found to be more closely related to psychological well-being after brain tumor than objective indices of functioning.<sup>7,8</sup>

Functional impairments or perceived physical, cognitive, and behavioral effects of brain tumor and its treatment can reduce individuals' capacity to maintain relationships, perform social roles, and remain engaged in valued social groups.<sup>9-11</sup> Therefore, people can experience social losses at a time when they could most benefit from support. A metasynthesis of qualitative research revealed that social networks and roles are often disrupted following diagnosis and this continues across the illness spectrum.<sup>9</sup> People viewed functional impairments as key barriers to staying connected to their social networks, which in turn negatively impacted on well-being. Yet it was also apparent that people found ways to maintain and build new social networks through using strategies to manage their impairments and alter their expectations of social participation. Although it is well recognized that people with brain tumor experience high levels of functional impairment<sup>2,3,8</sup> and reduced social functioning,<sup>10,11</sup> the influence of social networks on psychological well-being after brain tumor is unclear.

Social identity theory<sup>12</sup> perspectives highlight that people derive their sense of identity from social group memberships (SGMs), for example, family, work, and sports. In line with these perspectives, social neuroscience research has revealed physiological and psychological benefits of greater SGMs<sup>13,14</sup> and negative effects of social threat and exclusion.<sup>15</sup> The Social Identity Model of Identity Change (SIMIC) asserts that major life transitions, particularly those involving loss of social groups, negatively impact on psychological well-being.<sup>16-18</sup> For example, research on people with stroke<sup>16</sup> found that greater subjective cognitive impairment was associated with loss of SGMs, which in turn predicted poorer psychological well-being. Hence, loss of SGMs may mediate the relationship between functional impairment and poorer psychological well-being after brain tumor.

A wealth of literature indicates that strong social ties can buffer the adverse effects of serious illness and other stressors on psychological well-being.<sup>19-21</sup> Further, greater SGMs can alleviate depressive symptoms and protect against future depressive episodes.<sup>13</sup> The stress-buffering hypothesis of social support asserts that feeling connected with and having confidence in support from one's social groups is beneficial in times of adversity.<sup>22</sup> In line with this perspective, the psychological wellbeing of people experiencing high stress, including living with a chronic illness, is improved when they perceive high levels of social support<sup>22-24</sup> and is poorer when they feel socially isolated.<sup>25</sup> Perceiving high levels of functional impairment after brain tumor may be conceptualized as a stressor that places people at risk

of poorer psychological well-being.<sup>8</sup> Those who are more confident in receiving support or those able to build new social networks despite the functional effects may experience better well-being.<sup>9</sup> The potential moderating effects of confidence in support from SGMs and the ability to form new SGMs on the relationship between functional impairment and psychological well-being were of key interest in this study.

This study aimed to investigate two potential pathways through which SGMs may influence psychological well-being after brain tumor. First, in line with the SIMIC<sup>14</sup>, the *Social Network Vulnerability Hypothesis* predicts that higher levels of functional impairment will be associated with poorer psychological well-being through lower maintenance or loss of SGMs. Second, based on the stress-buffering hypothesis,<sup>22</sup> the *Social Network Buffering Hypothesis* predicts that forming new SGMs and greater confidence in support from SGMs will buffer the impact of high levels of functional impairment on psychological well-being.

## 2 | METHOD

### 2.1 | Participants and procedures

Over a 2-year period (2015-2017), adults with primary brain tumor were recruited from a major hospital and community cancer support service in Brisbane, Australia. Participants were screened by treating professionals during case conferences according to the following eligibility criteria: (a) diagnosis of primary brain tumor, (b) aged 18 to 75 years, and (c) adequate cognitive function and language skills to provide informed consent and complete questionnaires. Following informed consent, global cognitive status was assessed using the Brief Test of Adult Cognition by Telephone (BTACT), which is a validated cognitive screening tool. The BTACT measures working memory, episodic memory, processing speed, and executive function. All participants then completed a structured telephone-based interview that involved the researcher reading out aloud each item of the following measures. Rating scales for each measure were sent to participants prior to the interview.

### 2.2 | Measures

#### 2.2.1 | Functional impairment

Participants completed The Functional Assessment of Cancer Therapy-Cognitive Function (FACT-Cog),<sup>26</sup> which is a 37-item measure of perceived cognitive functioning. Only the 20-item Perceived Cognitive Impairment subscale of FACT-Cog<sup>26</sup> that assesses subjective cognitive impairment over the previous two weeks was used in the analyses. Participants completed the physical subscale of the Functional Assessment of Cancer Therapy-General, which contains seven items assessing physical limitations over the previous 2 weeks (eg, "I have pain").<sup>26</sup>

## 2.2.2 | Social group memberships

The Exeter Identity Transition Scale (EXITS)<sup>16</sup> is a 12-item measure with three subscales assessing pre-existing groups (eg, “before my brain tumor, I belonged to lots of different groups”), maintenance of groups (eg, “after my brain tumor I still belong to the same groups as before my brain tumor”), and new groups (eg, “since my brain tumor, I have formed one or more new groups”). Items on the EXITS are rated on a 7-point Likert scale (1 = “strongly disagree”; 7 = “strongly agree”), with scores averaged for each subscale. Participants also completed the four-item social subscale from the Traumatic Brain Injury Self-Efficacy (TBI-SE) scale,<sup>27</sup> which measures confidence in support from SGMs (eg, “how confident are you that you can get emotional support from friends and family, such as listening to you or talking over your concerns?”). Items are rated on a 10-point scale (1 = “not at all confident”; 10 = “totally confident”). The reliability and validity of the EXITS and TBI-SE is supported by previous brain injury research.<sup>16,27</sup>

## 2.2.3 | Psychological well-being

Participants completed three self-report measures commonly used to assess psychological well-being after brain tumor.<sup>3,21,28</sup> The seven-item depression scale<sup>29</sup> of Depression Anxiety Stress Scales 21 measures depressive symptoms experienced over the past week (eg, “I felt down hearted and blue”) with items rated on a 4-point scale (0 = “never”; 3 = “almost always”). Scores greater than 9 signify clinically elevated symptoms. The seven-item Generalized Anxiety Disorder Scale<sup>30</sup> measures how often the person has been bothered by symptoms of anxiety over the past 2 weeks (eg, “not being able to stop or control worrying”) with items rated on a 4-point scale (0 = “not at all”; 3 = “nearly every day”). Scores greater than 5 indicate clinically significant symptoms. The five-item Satisfaction With Life Scale<sup>31</sup> measures global judgements of satisfaction with one's life (eg, “the conditions of my life are excellent”) with items rated on a 7-point scale (1 = “strongly disagree”; 7 = “strongly agree”). Scores less than 20 signify dissatisfaction with life.

## 2.3 | Data analysis

The data were screened for missing values ( $n = 5$  on BTACT) and relevant parametric assumptions. Analyses were conducted using the Statistical Package for the Social Sciences (SPSS) v.24. As an initial step to build each model, associations between functional impairment, SGM variables and psychological well-being were examined using Pearson correlation. In line with previous research on factors influencing emotional well-being after brain tumor,<sup>7</sup> demographic and tumor-related factors (age, gender, relationship status, tumor type, time since diagnosis, tumor status, and global cognitive status) were investigated as potential covariates using  $t$  tests and Pearson correlation. To test the mediation hypotheses, Preacher and Hayes' PROCESS macro<sup>32</sup> was used with 10 000 bootstrap samples. To test the moderation hypotheses, moderated regression analyses were conducted using

the SPSS PROCESS macro.<sup>32</sup> Bias-corrected 95% confidence intervals are reported. The analytic procedures are outlined in Tables S2 and S3.

## 3 | RESULTS

Seventy adults (60% female) aged 22 to 75 years ( $M = 51.29$ ,  $SD = 12.08$ ) participated in the study. Tumor subtypes included benign (45.7%), low-grade (18.6%), and high-grade (35.7%) gliomas (see Table 1). Clinically significant levels of depressive and anxiety symptoms were reported by 40% and 56% of the sample, respectively.

Older age was related to greater maintenance of SGMs ( $r = .41$ ,  $P < .001$ ), fewer new SGMs ( $r = -.28$ ,  $P < .05$ ), and lower anxiety ( $r = -.33$ ,  $P < .001$ ) and depression ( $r = -.24$ ,  $P < .05$ ). Females reported greater anxiety ( $M = 7.33$ ,  $SD = 5.47$ ) than males ( $M = 4.54$ ,  $SD = 4.61$ ,  $t = -2.23$ ,  $P = .03$ ). There were no significant differences in psychological well-being according to time since diagnosis, tumor type, status, or grade ( $P > .05$ ). Further, there were no significant associations between time since diagnosis and SGMs and psychological well-being ( $r = .01-.19$ ,  $P > .05$ ). Individuals reporting higher perceived cognitive impairment (PCI) had poorer objective global cognitive status ( $r = -.32$ ,  $P < .01$ ); however, objective global cognitive status was not significantly associated with perceived physical impairment, SGMs or psychological well-being ( $r = .01-.20$ ,  $P > .05$ ).

As shown in Table S1, greater perceived physical impairment was significantly associated with lower maintenance or loss of SGMs ( $r = -.54$ ,  $P < .001$ ), lower confidence in SGMs ( $r = -.32$ ,  $P < .05$ ), and fewer new SGMs ( $r = -.23$ ,  $P < .05$ ). Greater PCI was significantly associated with loss of SGMs ( $r = -.48$ ,  $P < .001$ ) but was not associated with confidence in SGMs ( $r = -.14$ ,  $P > .05$ ) or new SGMs ( $r = -.03$ ,  $P > .05$ ). Greater perceived physical and cognitive impairment was significantly associated with higher depression ( $r = .47-.65$ ,  $P < .001$ ) and anxiety ( $r = .50-.57$ ,  $P < .001$ ). Greater perceived physical impairment was associated with lower life satisfaction ( $r = -.52$ ,  $P < .001$ ); however, PCI was not related to life satisfaction ( $r = -.22$ ,  $P > .05$ ). Loss of SGMs was significantly associated with higher levels of depression ( $r = -.51$ ,  $P < .001$ ) and anxiety ( $r = -.53$ ,  $P < .001$ ) and lower life satisfaction ( $r = .41$ ,  $P < .001$ ). Lower confidence in SGMs was associated with higher depression ( $r = -.51$ ,  $P < .001$ ) and anxiety ( $r = -.53$ ,  $P < .001$ ) and lower life satisfaction ( $r = .41$ ,  $P < .001$ ). New SGMs were not significantly associated with depression, anxiety, or life satisfaction ( $P > .05$ ).

### 3.1 | Social Network Vulnerability Hypothesis

As seen in Table S2, after accounting for age and gender, there was a significant total effect of PCI on depression and anxiety but not life satisfaction. There was a significant direct effect of PCI on depression and anxiety but no direct effect of PCI on life satisfaction. There were significant indirect effects through the mediator of maintenance of SGMs on depression and anxiety. Although there was an indirect effect of SGM maintenance on the relationship between PCI and life satisfaction, the confidence interval for the effect size (95% CI,

**TABLE 1** Demographic and tumor-related characteristics

Variable	M (SD), N (%)	Range	$\alpha$
Gender			
Male	28 (40%)		
Female	42 (60%)		
Age, years	51.29 (12.08)	22-75	
Global Cognitive Status (age-adjusted Z score)	-.30 (.77)	-2.13 to 2.27	.75
Months since diagnosis	61.7 (65.64)	1-264	
Relationship status			
Single	15 (21.4%)		
Partnered	55 (78.6%)		
Employment status			
Not employed	61.4%		
Volunteer work	1.4%		
Part-time work	12.9%		
Full-time work	24.3%		
Tumor type			
Benign	32 (45.7%)		
Low-grade tumor	13 (18.6%)		
High-grade glioma	25 (35.7%)		
Tumor status			
Initial	55 (78.6%)		
Recurrence	15 (21.4%)		
Treatment			
Monitoring/symptom management	16 (22.9%)		
Surgery	15 (21.4%)		
Surgery and radiotherapy	12 (17.1%)		
Radiotherapy and chemotherapy	1 (1.4%)		
Surgery and chemotherapy	2 (2.9%)		
Surgery, radiotherapy, and chemotherapy	24 (34.3%)		
DASS 21-D (doubled)	9.63 (8.58)	0-34/42	.90
% in clinical range	28 (40%)		
GAD-7	6.21 (5.29)	0-20/21	
% in clinical range	39 (55.7%)		.91
Life satisfaction	21.16 (7.67)	6-34	.84
% dissatisfied	30 (42.86%)		
FACT-cognitive	34.83 (20.65)	0-103	.93
FACT-physical	8.20 (6.34)	0-24	.85
Maintenance of SGMs	4.11 (1.88)	1-7	.92
New SGMs	3.97 (2.20)	1-7	.97
Confidence in SGMs	6.84 (2.07)	1-7	.80

Abbreviations: DASS 21-D, depression scale of the Depression Anxiety Stress Scales 21; FACT, Functional Assessment of Cancer Therapy; GAD-7, Generalized Anxiety Disorder 7-item Scale.

-0.023 to 0.168) indicated that this finding was not robust. These findings signify partial mediation whereby the relationship between greater PCI and higher depression and anxiety was partly accounted for by loss of SGMs.

There was a significant total effect of perceived physical impairment (PPI) on depression, anxiety, and life satisfaction. There was a significant direct effect of PPI on depression, anxiety, and life satisfaction. There were significant indirect effects through the mediator of maintenance of SGMs on depression and anxiety but not life satisfaction. Overall, these findings signify partial mediation whereby people with greater PPI reported higher depression and anxiety, which was partly accounted for by loss of SGMs.

### 3.2 | Social Network Buffering Hypothesis

Functional impairment (PPI/PCI) and SGM variables (new SGMs and confidence in SGMs) and covariates were entered in step 1 of the model, followed by the centered interaction term in step 2 (eg, PCI  $\times$  new SGMs). As shown in Table S3, there were no significant moderating effects of new SGMs.

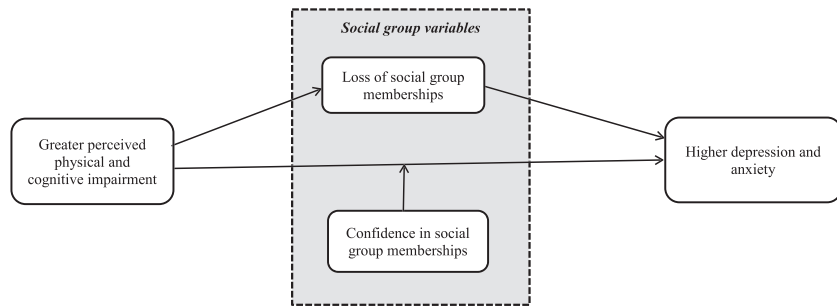
However, confidence in SGMs moderated the relationship between PPI and depression ( $R^2 = .63$ ,  $F = 37.16$ ,  $P < .001$ ;  $\Delta R^2 = .12$ ,  $b = -0.06$ ,  $F = 20.76$ ,  $P < .001$ ), PPI and anxiety ( $R^2 = .40$ ,  $F = 14.50$ ,  $P < .001$ ;  $\Delta R^2 = .05$ ,  $b = -0.02$ ,  $F = 5.01$ ,  $P = .03$ ), PCI and depression ( $R^2 = .45$ ,  $F = 18.07$ ,  $P < .001$ ;  $\Delta R^2 = .04$ ,  $b = -0.01$ ,  $F = 5.32$ ,  $P = .04$ ), and PCI and anxiety ( $R^2 = .52$ ,  $F = 23.64$ ,  $P < .001$ ;  $\Delta R^2 = .04$ ,  $b = -0.01$ ,  $F = 5.71$ ,  $P = .02$ ). Simple slopes analysis (see Figure S1) revealed that PPI was significantly associated with depression at low levels of confidence with SGMs ( $b = 1.31$ ,  $P < .001$ ) but not at high levels of confidence with SGMs ( $b = -0.03$ ,  $P = .85$ ). PPI was significantly associated with anxiety at low levels of confidence with SGMs ( $b = 0.55$ ,  $P < .001$ ) but not at high levels of confidence with SGMs ( $b = 0.02$ ,  $P = .88$ ). PCI was significantly associated with depression at low levels of confidence in SGMs ( $b = 0.33$ ,  $P < .001$ ) but not at high levels of confidence in SGMs ( $b = 0.02$ ,  $P = .13$ ). The relationship between PCI and anxiety was significant at both high ( $b = 0.23$ ,  $P < .001$ ) and low levels ( $b = 0.01$ ,  $P < .001$ ) of confidence in SGMs, although this was less pronounced at high levels of confidence.

A schematic overview of the findings from the separate mediation and moderation findings is presented in Figure 1.

## 4 | DISCUSSION

Two potential pathways through which functional impairments impact on psychological well-being after brain tumor were investigated, namely, the Social Network Vulnerability and Social Network Buffering hypotheses. Overall, as hypothesized, SGMs were found to have mediating and moderating effects on the relationship between functional impairment and psychological well-being.

Consistent with previous research, individuals perceiving greater functional impairment reported poorer psychological well-being.<sup>7,8</sup> Notably, global cognitive status was negatively associated with PCI



**FIGURE 1** A schematic overview of the mediation and moderation findings (note: this figure summarizes the findings of separate mediation and moderation analyses)

but was not significantly related to SGMs or psychological well-being. Hence, changes in SGMs and psychological distress do not appear to arise from global cognitive impairment. In line with the Social Network Vulnerability Hypothesis and SIMIC,<sup>16</sup> the relationship between higher functional impairment and poorer psychological well-being was partly explained by loss of SGMs. Specifically, perceiving higher levels of cognitive and physical impairment was associated with loss of SGMs, which in turn was related to higher depression and anxiety. These findings reinforce previous stroke research that identified that subjective cognitive impairment was associated with poorer psychological well-being through social losses.<sup>16</sup> Hence, people who perceive greater cognitive and physical impairments after brain tumor find it more difficult to maintain their pre-illness connections and, as a result, experience poor psychological well-being.

The partial mediating effects of SGM losses can be explained by Social Identity Theory,<sup>10</sup> which argues that SGMs help to define and strengthen an individual's sense of self. Identification with valued SGMs can help people to feel that they belong, matter to others, can receive support to cope with challenges, and contribute to others' well-being.<sup>33</sup> Perceiving changes in one's functioning after brain tumor may reduce people's confidence in their ability to participate in social roles and activities; therefore, they are more likely to withdraw from or avoid opportunities for interactions within their existing networks.<sup>33</sup> When SGMs are substantially disrupted, people can feel isolated and disconnected from part of their sense of self, which contributes to poorer psychological well-being.<sup>15</sup> Notably, older participants reported greater maintenance of SGMs compared with younger participants. This suggests that older adults are better able to capitalize on longstanding connections after brain tumor diagnosis than younger adults. Despite finding it harder to maintain SGMs, younger adults found it easier to establish new social connections than older adults. Interestingly, the mediating effects were not apparent for life satisfaction, despite the significant interrelationships among perceived physical impairment, SGM maintenance, and life satisfaction. Rather, a direct relationship between greater perceived physical impairment and lower life satisfaction was observed. Overall, the present findings support the utility of the SIMIC for understanding the impact of loss of SGMs on particular psychological outcomes after brain tumor.

In support of the Social Network Buffering Hypothesis, there was evidence that SGMs buffer the negative effects of functional impairment on psychological well-being. Specifically, individuals perceiving greater physical and cognitive impairment who were more confident

in receiving support from SGMs experienced lower depression and anxiety than those with less confidence in their SGMs. Such findings are broadly consistent with the stress-buffering hypothesis,<sup>19</sup> which asserts that under high stress connections with social groups are beneficial for psychological well-being through providing psychological and material resources to cope.<sup>19,34</sup> Interestingly, new SGMs did not moderate any of the relationships between functional impairment and psychological well-being, and there were no moderating effects of SGMs for life satisfaction. The mixed evidence for moderating effects of SGMs may be related to the nature of the SGM variables and ways that these were assessed.

In particular, the Self-Efficacy Scale measures the level of confidence people have in receiving support from their social groups or extent to which these groups can be relied upon. For individuals perceiving high levels of functional impairment, having confidence in being able to access emotional and practical support from SGMs may be important to protect from depression and anxiety. Conversely, the EXITS new groups subscale captures the extent to which people have formed new SGMs since their brain tumor with no information about their perceived meaning or function. Notably, the association between new SGMs and confidence in support was not significant ( $r = .17, P > .05$ ), thus suggesting that forming SGMs after brain tumor does not necessarily increase people's confidence in receiving support. Rather, the significant association between maintenance of SGMs and confidence in SGMs ( $r = .41, P < .01$ ) suggests that people's confidence in support is more closely related to their ability to maintain pre-existing social networks than to form new ones. Moreover, the buffering effect of SGMs might depend on their perceived meaning or function in the person's life.

Previous research in the broader stress and coping field<sup>34</sup> suggests that the functions of social support should match the resources needed to cope in order to have benefits for mental health. Further, as well as having positive functions, social groups can produce rather than alleviate stress during major life transitions.<sup>35</sup> A qualitative metasynthesis<sup>9</sup> of brain tumor research found that the perceived helpfulness of SGMs varied. Although many appreciated support provided by their SGMs, others reported an overabundance of support that evoked feelings of dependency.<sup>36-38</sup> In the current study, it is possible that for some people, SGMs produced rather than alleviated distress. Further research on the meaning and function of social groups is needed to understand the circumstances in which SGMs can have positive or detrimental effects on psychological well-being after brain tumor.

## 5 | CONCLUSION

In line with the SIMIC and the Social Network Vulnerability Hypothesis, perceived functional impairment was partially related to depression and anxiety through loss of SGMs. Further, there was support for the Social Network Buffering Hypothesis, whereby higher confidence in support moderated the effects of functional impairment on depression and anxiety. Overall, these findings highlight the importance of individuals staying connected to their social groups after brain tumor and signify the need for further research into barriers and facilitators of social participation and supportive relationships.

### 5.1 | Clinical implications

The findings of this study suggest that people perceiving high levels of functional impairment after brain tumor are at greater risk of experiencing a loss of SGMs, which in turn may contribute to higher levels of depression and anxiety. Therefore, it may be beneficial for clinicians to assess perceptions of functional impairment and the subsequent impact on participation in social activities and roles. Previous research identified that people may avoid social interaction due to self-consciousness about physical and cognitive symptoms.<sup>9</sup> It is recommended that psychological interventions focus on supporting people to maintain connection with valued SGMs through use of compensatory strategies and modified activity participation. Further, exploring the personal meaning or function of SGMs and how these can be harnessed to promote psychological well-being may be beneficial.

### 5.2 | Study limitations

Several limitations of the current study are important to acknowledge. Convenience sampling was used, with participants recruited on a nonconsecutive basis from hospital and community services. It is noteworthy that a lower proportion of participants had benign tumor (46%) relative to population-based data (68%)<sup>1</sup>; thus, the sample may not be representative of the broader primary brain tumor population. Further, sample characteristics were heterogeneous in terms of tumor type, treatment, and time since diagnosis, which may affect the generalizability of the findings. The cross-sectional study design limits the ability to infer directionality in the relationships assessed. It is also possible that depression and anxiety symptoms impact on peoples' perceptions of functional impairment and SGMs. Further, reliance on self-reports for assessing SGMs may be problematic, particularly as those many years post diagnosis may have difficulty accurately recalling their pre-illness social groups. Finally, the BTACTION is a screening tool that may not have been sensitive to detecting subtle cognitive impairments.

Prospective longitudinal research with a more homogenous sample is recommended in future research to address some limitations of the current study. Given the mixed support for the social network buffering hypothesis, there is a need for further research into the meaning

and function of SGMs. Qualitative methodology may have utility in this context to improve understanding of changes in SGMs and the psychological consequences after brain tumor.

### ACKNOWLEDGEMENTS

Lee Cubis received the Griffith Health Postgraduate Research Scholarship to support this study. The authors acknowledge the staff from the Multidisciplinary Brain Tumour Clinic and the Gamma Knife® Centre of Queensland at the Princess Alexandra Hospital, and the Cancer Council Queensland for their roles in facilitating recruitment. We are also very grateful to the participants for their time and interest in this study.

### CONFLICT OF INTEREST

The authors declared no conflicts of interest with respect to the research, authorship, and/or publication of this article.

### ETHICS APPROVAL

Ethical clearance was granted by the Griffith University (PSY/37/15/HREC) and Metro South Health (HREC/16/QPAH/188) Human Research Ethics Committees.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of the article.

**How to cite this article:** Cubis L, Ownsworth T, Pinkham MB, Foote M, Legg M, Chambers S. The importance of staying connected: Mediating and moderating effects of social group memberships on psychological well-being after brain tumor. *Psycho-Oncology.* 2019;28:1537-1543. <https://doi.org/10.1002/pon.5125>