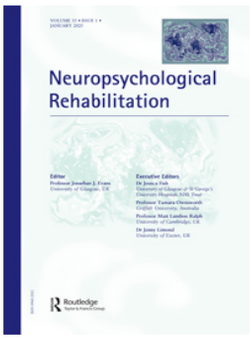

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Valued living after mild traumatic brain injury: Characteristics and relationship with outcomes

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ABSTRACT

Psychological factors are strong predictors of mild traumatic brain injury (mTBI) recovery, consequently, psychological interventions can form part of an individual's rehabilitation. This may include enhancing valued living (VL), an approach that is effective in severe and mixed acquired brain injury samples. This study aimed to characterize VL in mTBI and explore its relationship with mTBI and mental health outcomes. 56 participants with a mTBI completed self-report measures before engaging in a psychological intervention. Pre-injury mental health and other demographic and injury-related variables, VL, post-concussion symptoms (PCS), functional disability, and stress, anxiety and depression were measured. A pre-injury mental health condition was significantly associated with VL. VL was uniquely associated with depression after mTBI ($\beta = -0.08$, $p = .05$), however, there was no relationship with PCS, functional disability, stress or anxiety ($p > .05$). Following mTBI individuals with a pre-injury mental health condition or who experience heightened depressive symptoms may benefit from a values-based intervention as part of their rehabilitation. Future research, however, is needed to examine the role of VL in mTBI recovery.

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Mild traumatic brain injury; values; valued living; rehabilitation; post-Concussion symptoms

Following a mild traumatic brain injury (mTBI), psychological distress (i.e., heightened anxiety, low mood, irritability) can be common (Broshek et al., 2015; Silverberg et al., 2021). Psychological difficulties may be precipitated by the injury, a continuation or exacerbation of pre-existing psychological conditions,

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and/or a consequence of environmental factors (Faulkner & Snell, 2023; Silverberg & Iverson, 2011; Polinder et al., 2018). The treatment and management of psychological distress using psychological interventions have been recommended in mTBI practice guidelines (Silverberg et al., 2020). Cognitive behavioural therapy (CBT), which focuses on modifying unhelpful thought patterns in emotions and behaviour, training adaptive thinking, and engaging in enjoyable activities has been the front-line psychological intervention in mTBI (Tracey et al., 2023; Steven & Wendy, 2018; Warden et al., 2006). Recently, the psychotherapeutic frameworks adopted by clinicians have expanded with the introduction of third-wave therapies (Watson et al., 2021). Third-wave therapies are based on context and focus more on the person's relationship with thoughts and emotions than on content (Kahl et al., 2012). One such third-wave therapy is Acceptance and Commitment Therapy (ACT). ACT differs from CBT by increasing psychological flexibility and supporting a person to identify and work towards living in accordance with their values. Psychological flexibility is defined as being in contact with the present moment, being fully aware of current experiences, and moving in a pattern of behaviour in the service of chosen values (Kashdan & Rottenberg, 2010). Psychological flexibility has been found to play a key role in recovery following mTBI (Faulkner et al., 2021), however, the extent to which valued living (VL) has an impact on recovery following mTBI has received much less attention.

Human values have been defined as "desirable, trans-situational goals, varying in importance, that serve as guiding principles in people's lives" (Schwartz et al., 2001, p. 521). VL represents the extent to which an individual engages in actions consistent with these values (Wilson et al., 2010). It informs the development and prioritization of goals that give life a sense of meaning and cultivates and maintains self-concept. It has been proposed that by living in accordance with values, individuals can moderate their drive to control other distressing symptoms and increase their engagement in daily activities (McCracken et al., 2004; McCracken & Yang, 2006). VL has been associated with improved quality of life in a range of conditions including chronic pain (McCracken & Yang, 2006), anxiety and depression (Arch & Craske, 2008; Michelson et al., 2011) and substance dependence (Stotts et al., 2009). In a recent meta-analysis of 72 studies, Tunç et al. (2023) found negative associations between VL and depression ($r = -0.42$, 95% [CI −0.45,−0.39]) and anxiety ($r = -0.26$, 95%[−0.29,−0.22]).

With regards to traumatic brain injury (TBI), Pais et al. (2019) examined the relationship between VL and outcomes in moderate to severe TBI ($n = 70$). Compared to pre-injury estimates, VL was significantly reduced at 12 months post-injury and these reductions remained 2- and 3-years later. Higher VL was strongly associated with improved functional and psychosocial outcomes. Similarly, Baseotto et al. (2022) found that in 81 individuals with acquired brain injury (ABI; including stroke [29.6%], TBI [28.4%], subarachnoid haemorrhage [42%])

higher levels of VL was significantly associated with increased positive outcomes (wellbeing) and reduced negative outcomes (distress, post-traumatic stress symptoms). Furthermore, Villa et al. (2021) aimed to synthesize the qualitative literature (36 studies) on experiences of self-identify following TBI. Loss of valued roles/activities and comparisons between pre- and post-injury self was a central theme derived from their analysis. In ABI, VL can be reduced due to limitations in the capacity to engage in previously valued activities (Pais et al., 2019), due to ABI-related injury difficulties (Kangas & McDonald, 2011) or levels of anxiety and/or depression which can increase post-injury (Gould et al., 2011). Given these findings, it is therefore not surprising that the enablement of people to return to valued roles and activities is a well-established aim of TBI rehabilitation (Braininjuryguidelines.org). VL can be enhanced therapeutically by supporting individuals to understand their values (values identification) and engage in behaviours that are consistent with these values (value action) (Hayes et al., 2011). There is increasing evidence that adopting this therapeutic approach with the use of values-based interventions, such as ACT, reduces psychological distress and facilitates adjustment after TBI (Sander et al., 2021; Whiting et al., 2019).

In summary, a loss of or, a disconnect with a person's values can occur following TBI and can have implications on an individual's sense of self, wellbeing, mental health, functioning and overall recovery from this injury. Existing studies have examined VL in a severe TBI or a mixed ABI cohort and we are unaware of any existing studies that have exclusively examined VL following mTBI. As mTBI is unique in terms of pathophysiology, symptom severity and duration, as well as recovery trajectory, examination of VL in this population is important. The focus of treatment may also differ, where therapy strives to return an individual to their baseline functioning (Risdall & Menon, 2011). In more severe injuries, treatment can often focus on supporting the person to adjust to living with the permanent consequences of the injury (Sveen et al., 2022). VL though, may still be impacted in mTBI and could be a therapeutic avenue. Dealing with post-concussion symptoms (PCS) for some after a mTBI, can become the focus of daily efforts resulting in less time for family, intimate relations, friends, hobbies, vocational interests or developing as a person.

The overall objective of this study was to explore VL in mTBI. Specifically, this study aimed to: (1). characterize VL in individuals after mTBI and examine the association between demographic and injury-related factors and VL; (2). examine the relationship between mTBI outcomes (post-concussion symptoms and functional disability), post-injury mental health and VL; (3). explore whether mTBI outcomes can explain differences in VL beyond that explained by clinical, demographic variables, and mental health outcomes that are associated with VL; and (4). examine whether VL can explain differences in mental health outcomes beyond that explained by typical covariates associated with mTBI

mental health outcomes. To test these aims, a sample of individuals seeking psychological treatment after mTBI was recruited, given that VL may be a therapeutic target in values-based interventions (i.e., ACT) in mTBI rehabilitation.

Method

The present study used baseline data from a feasibility study of ACT for mTBI (Faulkner et al., in preparation). Adults with a mTBI were recruited from four outpatient clinics in the North Island of New Zealand between August 2021 and July 2023. In New Zealand, outpatient mTBI clinics (i.e., 'concussion clinics') adopt a multidisciplinary model of rehabilitation and include occupational therapists, physiotherapists, neuropsychologists, psychologists and medical specialists. Concussion clinics are funded by the no-fault insurance scheme of the Accident Compensation Corporation (ACC). Individuals eligible to participate were those: (1) 18 years or older; (2) who had sustained an mTBI in accordance with the World Health Organisation Neurotrauma Task Force Definition (Holm et al., 2005); (3) were fluent in English; (4) had no prior neurological conditions, and (5) self-reported a score of 16 or greater on the Rivermead Post-Concussion Symptom Questionnaire (RPQ) suggestive of severe ongoing symptoms (Thompson et al., 2016). Eligible participants were invited to consent and complete a baseline assessment before their first psychology appointment. The study was conducted with ethical approval from the Health and Disability Ethics Committee New Zealand (21/STH/117) and Auckland University of Technology Ethics Committee (21/159).

Measures

Demographic and Clinical Variables: Data on demographic and clinical variables were ascertained via a self-report questionnaire. Demographic variables included: age, gender, ethnicity, education and pre-injury employment status. Participants were also asked about their medical, concussion, and mental health history using a single dichotomous yes/no question (i.e., "Do you have a pre-injury mental health condition?"). Clinical variables were time since injury, mechanism of injury, and other injuries sustained.

Valued Living. The Valued Living Questionnaire (VLQ) is a two-part instrument designed to assess VL (Wilson et al., 2010). In the first part, participants rate the importance of 10 domains of living on a 10-point Likert Scale. These domains are family, couples relations, parenting, friendship, work, education, recreation, spirituality, community life, and physical well-being. In the second part participants rate, using a 10-point Likert scale, how consistently they had lived in accordance with the valued behavioural pattern within each domain over the past week. Responses from both parts are used to calculate a valued living composite (VLC), which quantifies the extent to which one is living out

particular values in everyday life. An overall VLC is calculated, as well as for each valued domain within the VLQ. The VLQ has demonstrated adequate inter-item consistency (α = .77) and test-retest reliability (r = .75) (Wilson et al., 2010). The VLQ has been used to measure VL in a range of clinical populations including anxiety, chronic pain, depression, and TBI (Pais et al., 2019; Michelson et al., 2011; Stavrinaki et al., 2014).

Post-Concussion Symptoms: The Rivermead Post-Concussion Symptom Questionnaire (RPQ) is a 16-item self-report questionnaire that assesses common symptoms following mTBI (Cronbach's alpha = 0.90) (King et al., 1995). Participants are required to rate the presence and problem status of these symptoms on a scale of 0–4 (0 = not experienced at all; 1 = no more of a problem than before injury; 2 = a mild problem; 3 = a moderate problem; 4 = a severe problem). Scores of 1 ("no more of a problem than before injury") were recoded to 0 as per the recommendations of King et al. (1995). Scores on each of the items are summed to yield a total symptom burden score.

Functional Disability. The 12-item World Health Organisation Disability Assessment Schedule (WHODAS 2.0) is a questionnaire evaluating disability representing six International Classification of Functioning (ICF) activity and participation domains including cognition, self-care, mobility, interpersonal functioning, life activities, and participation (Üstün, 2010; Federici et al., 2017). The 12-item WHODAS 2.0 asks respondents how much difficulty they have had in the past 30 days in relation to their health problems. The Likert scale options are: 0 = none, 1 = mild, 2 = moderate, 3 = severe, and 4 = extreme/cannot do (higher scores represent greater disability). Snell et al. (2020) showed that the 12-item WHODAS 2.0 had high internal consistency in mTBI (Cronbach's alpha = 0.92).

Psychological Distress: The Depression, Anxiety and Stress Scale-21 (DASS-21; Lovibond & Lovibond, 1995) is a 21-item self-report questionnaire with three subscales that measure depression, anxiety, and stress symptoms over the previous week. It utilizes a 4-point Likert scale with 0 = never, 1 = sometimes, 2 = often, and 3 = always. Higher scores on this measure are indicative of elevated levels of depression, anxiety, and stress symptoms. The DASS-21 has good psychometric properties (Cronbach's alpha = 0.73-0.81; Coker et al., 2018) and is a valid measure of depression, anxiety and stress symptoms in people with ABI (Ownsworth et al., 2008).

Statistical analysis

In accordance with our first aim, descriptive statistics were used to characterize VL in the sample; this was done for the overall score on the VLQ, as well as for each valued domain in the importance and consistency scale. In addition, to examine the relationship between clinical and demographic variables and VL, Pearson's correlations were generated to examine the association between

continuous variables (i.e., age) and VL; one-way ANOVA was used to determine differences in VL for categorical variables (i.e., education history). Due to the exploratory nature of this research aim, corrections for multiple analyzes were not conducted (Bender & Lange, 2001). In regard to our second aim, Pearson's correlations were computed to calculate the association between mTBI and mental health outcomes and VL.

To examine our third aim, hierarchical linear regression was used to examine if differences in VL are associated with mTBI outcomes whilst controlling for factors associated with VL. In the first step of the model, clinical and demographic variables that were found to be significantly associated with VL were included. This approach was taken as there is no research examining VL in mTBI that could inform the variable section (Cohen et al., 2013). A significant change in R^2 (ΔR^2) from Step 1 to Step 2 was interpreted as evidence of an independent relationship between the VL and mTBI outcomes. Finally, whether differences in VL predicted mental health outcomes, hierarchical linear regression was also used. In step one, variables known to impact mental health after mTBI were entered. This included pre-injury mental history (Silverberg et al., 2015; Ponsford et al., 2019), education (Vikane et al., 2019), age (Rao et al., 2010) and post-concussion symptoms (Ponsford et al., 2019). A significant change in R^2 (ΔR^2) from Step 1 to Step 2 was interpreted as evidence of an independent relationship between the mental health outcomes and VL. Power analysis, using G*Power, of a five-predictor regression model with an estimated moderate effect size (Tunç et al., 2023), power at .80 and alpha of 0.05, revealed an estimated sample size of 53 participants. Prior to each regression, multicollinearity and model assumptions were examined using the tolerance and variance inflation factor (VIF). The distribution of the residuals was examined for normality, and influential data points were examined using Cook's distance. All analyzes were computed in SPSS version 29.

Results

The sample consisted of 56 participants. Their demographic characteristics are summarized in Table 1. The sample comprised 54.6% males, who were predominately NZ European (66.1%) with a post-secondary school education (76.8%). The sample was on average 23.8 weeks post-injury, fall (37.0%) and being hit by an object (30.4%) were the most common causes of injury. The sample had an average score on the RPQ of 33.61 (11.61) and WHODAS of 21.29 (7.76). Their depression was predominately in the moderate (26.8%) and the normal range (23.2%), anxiety levels were predominately in the extremely severe (26.8%) and normal range (25.0%), and stress levels were in the moderate and normal range (26.8% respectively).

The average overall VLQ composite score of the sample was 35.53 (12.65). This value is lower than previously published norms for VL scores in an

Table 1. Demographic and injury-related characteristics.

Demographic Characteristics	Clinic Intake ($N = 56$)
Age [Mean (SD, range)]	34.1 (14.4, 18-66)
Sex (female) [N (%)]	26 (46.4%)
Ethnicity [N(%)]	
- NZ European	37 (66.1%)
- Māori	10 (17.9%)
- Other	9 (16%)
Education – n with post-secondary school qualification [N(%)]	43 (76.8%)
Pre-Injury Employment Status [N (%)]	
- Working	51 (91.1%)
- Not working	5 (8.9%)
Prior Mental Health History (yes) [N (%)]	22 (39.3%)
Prior Concussion History (yes) [N (%)]	32 (57.1%)
Medical History (yes) [N(%)]	26 (46.43%)
Injury Related Characteristics	
Time Since Injury (weeks) [Mean (SD, range)]	23.8 (21.8, 6-134)
Mechanism of Injury	
- Transport accident	9 (16.1%)
- Fall	21 (37.5%)
- Assault	9 (16.1%)
- Hit by object	17 (30.4%)
Other Injury Sustained (yes) [N(%)]	34 (60.7%)
Outcome Measures	
RPQ M(SD)	33.61 (11.61)
WHODAS M(SD)	21.29 (7.76)

DASS-21	Normal	Mild	Moderate	Severe	Extremely Severe
Depression	13 (23.2%)	11 (19.6%)	15 (26.8%)	9 (16.1%)	8 (14.3%)
Anxiety	14 (25.0%)	8 (14.3%)	11 (19.6%)	6 (10.7%)	15 (26.8%)
Stress	15 (26.8%)	10 (17.9%)	15 (26.8%)	9 (16.1%)	7 (12.5%)

undergraduate student sample by Wilson et al. (2010) (M = 63.68, SD = 15.41) and also in a healthy male control sample by Michelson et al. (2011) (M = 62.53, SD = 15.67), suggesting that overall engagement in VL is lower in this mTBI sample. As shown in Table 2, the most important valued domains

Table 2. Scores on the valued living questionnaire.

	Importance		Consistency		Difference
	Mean	*SD*	*Mean*	*SD*	
Family relations	8.62	1.87	6.93	2.34	1.70
Marriage/couple intimate relations	7.70	2.68	5.89	2.34	1.82
Parenting	6.28	3.91	6.27	3.30	0.01
Friendships/social relations	8.03	1.98	5.59	3.00	2.44
Employment	7.87	1.75	5.41	3.00	2.46
Education/training	6.83	2.38	4.98	3.27	1.85
Recreation	8.15	1.88	5.01	2.69	3.09
Spirituality	6.00	3.40	6.24	3.20	−0.24
Citizenship/community life	5.46	2.79	4.83	3.51	0.63
Physical well-being	8.33	1.83	5.38	2.72	2.94

endorsed by participants were: family relations, physical well-being, recreation, and friendships/social relations. The valued domains with the greatest difference between importance and consistency were recreation, physical well-being, employment and friendships/social relations. Spirituality showed a slight increase from importance to current consistency. The only demographic variable that was significantly associated with VL was having a pre-injury mental health condition (see Table 3). Specifically, participants with a pre-injury mental

Table 3. Association between demographic and injury-related variables and valued living.

Demographics		Pearson's Correlation (r)	p
Age		.18	.21
	Mean (SD)	F- Value	*p*
Gender			
Male	39.37 (16.50)	2.74	.10
Female	46.11 (13.06)		
Ethnicity			
Māori	36.57 (14.90)	1.26	.29
NZ European	42.78 (16.03)		
Other	47.53 (11.38)		
Education			
Secondary School or less	40.04 (13.30)	0.29	.75
Post-Secondary School	43.38 (16.15)		
Medical History			
Yes	41.56 (15.78)	.147	.70
No	43.16 (15.08)		
Concussion History			
Yes	40.04 (12.13)	1.77	.19
No	45.52 (18.40)		
Mental Health History			
Yes	36.93 (11.03)	5.11	.03*
No	46.10 (16.72)		
Injury Related Variables		Pearson's Correlation (r)	p
Time Since Injury		−.07	.64
		F Value	P
Mechanism of Injury			
Motor Vehicle Accident	38.97	0.48	.70
Fall	45.10		
Assault	44.49		
Hit by Object	40.18		
Other Injury Sustained			
Yes	43.42 (16.79)	0.40	.55
No	40.83 (12.69)		

Table 4. Correlations between valued living and mTBI outcomes.

	VLQ	RPQ	DASS-D	DASS-A	DASS-S	WHODAS
VLQ		−.28*	−.33*	−.04	−.086	−.16
RPQ			.34**	.45**	.45**	.55**
DASS-D				.44**	.58**	.26
DASS-A					.66**	.56**
DASS-S						.34**

* $p < .05$; **$p < .01$.

health condition had significantly lower VLQ composite scores (M = 36.93), than those without (M = 46.10; F(1,55) = 5.11, $p = .028$). There were no significant relationships between injury-related variables (time since injury, mechanism of injury and other injuries sustained) and VL ($p > .05$).

As shown in Table 4, there was a significant negative correlation between VL and PCS, and depression. There was no significant association between VL and anxiety, stress, and functional disability ($p > .05$). PCS were also significantly correlated with depression, anxiety, stress, and functional disability. Functional disability was significantly correlated with anxiety and stress, but not depression.

Hierarchical regression examining the predictive role of mTBI outcomes (post-concussion symptoms and functional disability) on VL, whilst controlling for variables associated with VL, was conducted. There were no violations of assumptions. In step one, mental health history and depression were added to the model given their significant relationship with VL (see Table 3 and Table 4). As shown in Table 5, when pre-injury mental health history and depression were included in the model 16.8% of the variance in VL was accounted for (F (2,54) = 5.26, $p = .008$). Post-concussion symptoms and functional disability were then added to the model. The model remained significant (F (4,52) = 5.26 $p = .017$) and accounted for 21.0% of the variance in VL. Examination of the standardized coefficients showed that VL was not uniquely associated with mTBI outcomes (post-concussion symptoms: $B = -.320$, $p = .127$; functional disability: $B = .191$, $p = .537$). However, in this model, pre-injury health was uniquely associated with VL ($B = 9.268$, $p = .030$).

Table 5. Results of hierarchical linear regression analyzes examining associations between VL and mTBI outcomes.

	Model change		Parameter estimate					
	ΔR^2	P	B	SEB	t	P	LLCI	ULCI
Model 1	0.17	.010						
Mental health history			8.48	4.06	2.09	.042*	0.32	16.63
Depression			−0.90	0.46	−1.94	.058	−1.83	.033
Model 2	0.21	.302						
Mental health history			9.27	4.16	2.23	.030*	0.92	17.63
Depression			−0.68	0.49	−1.41	.165	−1.66	0.29
RPQ			−0.32	0.21	−1.55	.127	−0.73	0.09
WHODAS			0.19	0.31	0.62	.537	−0.43	0.81

* $p < .05$.

Table 6. Results of hierarchical linear regression analyses examining associations between depression and VL after mTBI.

	Model change		Parameter estimate					
	ΔR^2	P	B	SEB	t	P	LLCI	ULCI
Model 1	0.13	.028*						
Age			−0.07	0.04	0.03	.098	−0.16	0.01
Education			0.02	0.60	0.03	.976	−1.18	1.21
Mental health history			−0.61	1.27	−0.48	.632	−3.17	1.94
RPQ			0.12	0.05	2.57	.632	−3.17	1.94
Model 2	0.26	.050*						
Age			−0.70	0.04	−1.66	.104	−0.15	0.02
Education			0.13	0.58	0.22	.829	−1.04	1.29
Mental health history			0.10	1.28	0.08	.938	−2.48	2.68
VLQ			−0.08	0.04	−2.01	.050*	−0.16	0.01

* $p < .05$.

Hierarchical linear regressions were also computed to examine if VL predicted mental health outcomes after mTBI. Given that the only significant correlation found was between VL and depression, one regression model was computed with depression as the outcome variable, and VL as a predictor variable, whilst controlling for variables known to be associated with mental health outcomes after mTBI. There were no violations of the assumptions in this model. As shown in Table 6, when age, education, pre-injury mental health history and post-concussion symptoms were included in the model 19.9% of the variance in depression was accounted for ($F(4,52) = 2.98$, $p = .028$). When VL was added to the model, the overall model remained significant ($F(5,51) = 3.35$, $p = .011$) with 26.3% of the variance explained. Examination of the standardized coefficients showed that VL was uniquely associated with depression, such that lower VL significantly predicted higher depression ($B = -0.08$, $p = .050$).

Discussion

The overall objective of this study was to explore VL in individuals who had experienced a mTBI. Given the paucity of research that has investigated VL within this population, we first aimed to characterize VL in a sample of participants seeking psychological treatment after mTBI. In our sample, the valued domains with the greatest difference between importance and consistency were in recreation, physical, employment and friendships/social relations. An individual's capacity to engage in activities consistent with these values is likely to be impacted by the ongoing PCS evident in our sample. As many activities associated with these domains require physical, cognitive and mental load, it is not surprising that these areas are impacted (Gaudette et al., 2022). Interestingly, although participants endorsed family relations as being a valued domain of importance, this area was not as impacted as others. This may be indicative of prioritization, where participants place their reduced resources into areas of most importance which has consequences on other valued domains. Resource

prioritization, graduated exposure, and pacing are all core features of mTBI rehabilitation (Silverberg et al., 2020). To further characterize VL in our mTBI sample, we also explored if VL was associated with demographic or injury-related factors. A pre-injury mental health history was the only variable found to be significantly associated with VL. Specifically, individuals with a pre-injury mental health diagnosis had significantly lower scores on the VLQ than those without.

This study further aimed to examine the relationship between VL and mTBI outcomes. Surprisingly, no significant association was found between functional disability and VL. Although, a significant negative correlation was found between VL and PCS. Said another way, the more severe an individual's PCS the greater the likelihood that they had reduced VL. However, hierarchical regression revealed that PCS was no longer predictive of VL when the factors that were also associated with VL (mental health history and depression) were included. The only variable that was uniquely associated with VL in the model was mental health history. A pre-injury mental health history is a robust predictor of mTBI outcomes (Silverberg et al., 2015). It is associated with more severe PCS and a longer recovery trajectory (Ponsford et al., 2019; Skandsen et al., 2021; Meares et al., 2008). Our findings suggest that one avenue in which pre-injury mental health may impact the severity of mTBI symptomology is through a reduction in VL. An important component of mTBI treatment is using rehabilitation strategies such as graduated exposure and nudging to support the process of habituation and prevent activity intolerance/avoidance (Silverberg et al., 2020). Individuals with a pre-injury mental health condition may be vulnerable to struggle with VL due to difficulties with motivation, avoidance, and pleasure-seeking, as well as issues with self-concept, purpose and meaning. These behavioural characteristics may have implications for an individual's ability to benefit from the neuro-rehabilitation strategies offered and consequently impact symptom severity.

In support of this possibility, a significant negative correlation was found between depression symptoms and VL. In addition, hierarchical regression found that this relationship remained even when including variables known to be associated with mTBI mental health outcomes (age, education, pre-injury mental health and PCS). Issues with motivation, anhedonia, fatigue, sleep disturbances and low mood are all hallmark features of depression and would impact engagement in VL (Tunç et al., 2023). Further, a bidirectional relationship is likely to exist where limiting engagement in VL results in limited positive experiences which contributes to and exacerbates depressive symptoms. Taken together, these results suggest VL may be an advantageous therapeutic target in individuals who present with depressive symptoms following mTBI.

Surprisingly, we found no association between valued living and symptoms of stress and anxiety. This is inconsistent with findings demonstrating a

consistent relationship between these constructs (Michelson et al., 2011; Tunç et al., 2023). Participants in this study had similar levels of anxiety and stress to depression. It is, therefore, difficult to make any inferences regarding these findings which may be a consequence of the limitations of this study. Although, one possibility for these findings could be due to how anxiety/stress was assessed. The DASS-21 has been found to perform less well than other self-report measures, such as the Hospital Depression and Anxiety Scale (HADS) in identifying anxiety disorders following TBI (Dahm et al., 2013). Replication using other measures of anxiety/stress with a larger more diverse sample of individuals after mTBI is needed before any conclusions can be drawn regarding the role of VL on other aspects of mental distress (i.e., anxiety and stress) following mTBI.

The findings of this study are limited to a sample seeking psychological treatment following mTBI. Future research is needed to examine the role of VL on mTBI outcomes using a more generalizable sample of individuals after mTBI, including those who did not engage in rehabilitation services. Our assessment of pre-injury clinical characteristics (i.e., mental health injury) was based on a single-item self-report question. Future research should include a more comprehensive review and assessment of these pre-injury factors. In addition, evidence has recently emerged that the VLQ may have psychometric weaknesses, poor clarity around its target population, and a lack of hypotheses for content validity testing (Reilly et al., 2019; Ong et al., 2023). Recently, Miller et al. (2022) recommended an adapted version of the VLQ based on their findings that individuals with ABI demonstrated poor understanding of instructions, key terms, and concepts within this measure. Given that cognitive difficulties may be evident in our sample, similar issues with interpretability may have occurred. Future research would benefit from using additional measures of VL (i.e., the Engaged Living Scale; Trompetter et al., 2013), and Valuing Questionnaire (VQ; Smout et al., 2014) and determining if adaptations are needed. This study is also limited in that it adopted a cross-sectional design and future research would benefit from using a longitudinal design. Finally, we also cannot infer the direct role that mTBI has had on VL and future research would benefit from creating estimates of pre-injury VL as has been done in previous studies (Pais et al., 2019).

In summary, the current study extends our knowledge of the role of VL living in TBI rehabilitation by focusing specifically on mild injuries. Our findings suggest that following a mTBI individuals with a pre-injury mental health condition or who present with heightened depressive symptoms may benefit from a values-based intervention (i.e., ACT), as part of their rehabilitation. Furthermore, this finding may also provide valuable insights into predictors of treatment outcomes following mTBI, as these individuals may benefit the most from these interventions. However, future

research is needed to examine the influence of VL on mTBI outcomes and recovery. This study highlights the need for a longitudinal study design with a larger more diverse sample with a more comprehensive assessment of outcomes.

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