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Apathy in a High Prevalence Population of Moderate to Severe Traumatic Brain Injury: An Investigation in Vietnam

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Objective: The reduction of goal-directed behavior, termed apathy, is a pervasive and debilitating syndrome after traumatic brain injury (TBI). However, understanding of apathy as a multifaceted construct is limited, especially in Southeast Asian nations. This study aimed to investigate the severity, insight, and psychosocial influences of apathy in executive, emotional, and initiation dimensions in Vietnam—a country with high prevalence of TBI. ***Method:*** One hundred and eleven Vietnamese participants (61 individuals with moderate to severe TBI and 50 healthy controls) and their informants completed the self-rated and informant-rated Dimensional Apathy Scale (DAS) for the assessment of executive, emotional, and initiation apathy severity. Insight of apathy was calculated by subtracting DAS self-ratings from informant ratings. Additionally, carers completed measures assessing psychosocial factors of overall family health and overprotective behavior, while participants rated their own self-efficacy. ***Results:*** Our results showed greater informant-rated apathy for all three dimensions in individuals with TBI relative to controls. However, while people with TBI had greater self-rated initiation apathy, they regarded their executive apathy as lower and their emotional apathy as similar compared with controls. Reduced insight in patients was seen for executive and initiation apathy. Across participants, executive apathy was predicted by family functioning and overprotectiveness, emotional apathy was predicted by family functioning, and initiation apathy was predicted by self-efficacy. ***Conclusions:*** These findings support the multidimensional characterizations and socio-cultural considerations of apathy after TBI, which will potentially develop both individual-specific and symptom-specific approaches in clinical practice.

Key Points

Question: What are the clinical profiles of apathy after TBI in Vietnam? ***Findings:*** While apathy manifests in executive, emotional, and initiation dimensions after TBI, patients have reduced insight into some of these symptoms. The severity of apathy is predicted by family functioning and carers' overprotectiveness and patients' self-efficacy in Vietnam. ***Importance:*** Apathy is a multifaceted construct after TBI. Evaluations and treatment of apathy in Vietnam should be based on carer reports, specific psychosocial influences, and cultural contexts. ***Next Steps:*** Future cross-cultural studies are needed to facilitate better comparisons of apathy presentation and enhance precision of clinical practice.

Keywords: motivation, TBI, DAS, family functioning, overprotectiveness

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Apathy, reflecting a decrease in goal-directed behavior, is one of the most pervasive behavioral sequelae caused by moderate to severe traumatic brain injury (TBI; Ciurli et al., 2011; Kant et al., 1998; Lane-Brown & Tate, 2009). The detrimental effects of apathy after TBI are widespread, ranging from low rates of rehabilitation participation to reluctance to engage in daily activities and interactions (Gray et al., 1994; Starkstein & Pahissa, 2014). Despite being a challenging syndrome in people with a TBI, the vast majority of clinical trials have failed to achieve positive outcomes in management of apathy (Lane-Brown & Tate, 2010; Manera et al., 2020).

Previous studies have indicated that about 60%–70% people with moderate to severe TBI have apathy (Andersson et al., 1999; Kant et al., 1998; Lane-Brown & Tate, 2009). Individuals with TBI have greater apathy compared to healthy controls as well as to their own premorbid levels on both self and informant ratings (Arnould et al., 2018b). While these research reports have provided a landscape attesting to the presence and severity of apathy, better specification and understanding of aspects in which goal-directed behavior is affected are needed to inform trial design and practical approaches (Arnould et al., 2013; Worthington & Wood, 2018). Increasingly, clinical presentations of apathy are recognized to reflect multiple dimensions, comprising aspects of executive apathy (i.e., reduced desire and ability to plan, organize and attend to things), emotional apathy (i.e., affective indifference and blunting) and initiation apathy (i.e., reluctance to initiate actions; Levy & Dubois, 2006; Marin, 1991; Radakovic & Abrahams, 2018). This multidimensional conceptualization has been widely applied in other neurological conditions, such as Parkinson's disease and dementia (Quang, Wong, et al., 2021; Radakovic et al., 2018, 2020; Wei et al., 2020), but rarely in TBI. To our knowledge, only one study has used the Apathy Inventory to assess lack of interest, lack of initiation, and emotional blunting as components of apathy in patients with severe TBI (Arnould et al., 2015). Using latent profile analyses, this research found four groups of apathy manifestation: (a) no apathy, (b) elevated global apathy, (c) lack of interest coexisting with lack of initiation, and (d) emotional blunting only. However, in the absence of a control group, it was not possible to confirm whether those apathy dimensions were specifically attributable to TBI, or whether they simply represented normal variation in neurologically intact community members with no or limited interventions implied. More importantly, this study and the majority of existing research on apathy after TBI have been conducted in Western and English-speaking countries only, while knowledge of the condition in other countries with a high prevalence of TBI, such as Vietnam, remains limited.

The extent to which people are aware of their own reductions in motivation is an important consideration for apathy management in clinical practice. However, whether insight into apathy is compromised after TBI is unclear. A comparison between informant- and self-ratings on the Frontal Systems Behaviour Scale–Apathy Subscale found abnormal insight in patients with moderate to severe TBI, with larger discrepancies between ratings for apathy levels postinjury relative to preinjury (Hart et al., 2019). In contrast, differences in awareness were not observed on the Initiation-Interest Scale of the Apathy Inventory (Arnould et al., 2018b). Some studies also investigated apathy and self-awareness using independent instruments (i.e., the Neuropsychiatric Inventory for apathy and the Patient Competency Rating Scale for self-awareness; Bivona et al., 2019). Results showed similar apathy levels between low self-awareness and high self-awareness groups of people with severe TBI, although a trend of difference was observed ($p = .064$; Bivona et al., 2019). These divergent findings may be attributed to the different measures used. The Frontal Systems Behaviour Scale–Apathy Subscale mainly reflects motivational changes in daily activities and behaviors (initiation apathy), whereas the Initiation-Interest Scale focuses on both executive and initiation apathy. Conversely, the Neuropsychiatric Inventory only evaluates the frequency and severity of apathy without examining specific apathy dimensions. This divergence emphasizes the need for comprehensive and specific assessment of distinct manifestations of apathy as well as better understanding of whether people with TBI have insight into the presence and impact of these symptoms.

Apathy is known to arise from neural disruptions to the prefrontal cortex and subcortical regions associated with reward processing (Hogeveen et al., 2017; Le Heron et al., 2019; Levy & Dubois, 2006). Importantly, psychosocial factors also contribute to the severity and prevalence of apathy in everyday life (Massimo et al., 2018). These factors are potentially modifiable and, therefore, a suitable target for clinical intervention. Psychosocial factors that influence apathy include both intra-personal (e.g., self-efficacy) and inter-personal (e.g., family functioning or carers' overprotective behavior) components. For example, elevated apathy is demonstrated to associate with lower levels of self-esteem or self-efficacy, decreased family functioning, and more controlling behavior (Arnould et al., 2018a; Dumont et al., 2004; Kreutzer et al., 1994). While many studies have highlighted the impact of behavioral problems, including apathy, on psychosocial factors (Anderson et al., 2002, 2013; Ponsford et al., 2003), influences in the opposite direction may also occur. In fact, adjustments to family structure and/or personal behavior occur early in the acute stages (Curtiss et al., 2000) and may affect outcomes for people with TBI (Vangel et al., 2011). However, the impact of pre-existing characteristics or post injury adjustments on apathy at both the individual level and family level remains to be established.

Situated in the Southeast Asia—a region with a high number of vulnerable road users (e.g., cyclists and motorcyclists) and developing road safety measures, Vietnam had approximately 18.74 thousands of traffic injuries in 2018 (General Statistics Office of Vietnam, 2019) and was among the countries with highest incidence of TBI caused by road traffic collisions (Dewan et al., 2018). Despite the pressing impact, understanding about apathy in Vietnamese patients with severe to moderate TBI is lacking. In one of our previous studies applying the dimensional apathy conceptualization to Vietnamese healthy subjects, higher cut-off scores were identified for executive, emotional, and initiation apathy on the Vietnamese Dimensional Apathy Scales (DASs) compared to the original English version (Quang, Sin, et al., 2021). Investigation of apathy in Vietnamese patients with TBI is important as results, again, may not match the current knowledge arising from Western/English speaking countries. In particular, Vietnamese cultural characteristics need to be considered when exanimating of psychosocial factors associated with apathy. With great economic burden and limited availability of healthcare and rehabilitation services in Vietnam, the majority of patients have to rely on nonprofessional and family support to facilitate recovery (Pekerti et al., 2017). Carers also receive inadequate education and resources to help them support their loved ones, and consequently lack knowledge

regarding what should or should not be implemented at home. The predominant Confucian culture in Vietnam, which values filial piety and sacrifice, means there is a focus on support and care within families of people with TBI. However, with insufficient guidance, overprotective behavior can occur in the carers, and greater dependence can be seen in the patients (Meyer et al., 2015; Nguyen & Levkoff, 2020). Taken together, understanding apathy and psychosocial mediators of apathy in Vietnamese patients is important to help accelerate the establishment of therapeutic interventions of apathy in Vietnam as well as offer initial evidence about the influences of culture on apathy.

Therefore, this study was conducted in Vietnam with three main aims: 1) to investigate executive, emotional, and initiation apathy after moderate to severe TBI, 2) to examine the extent to which people with TBI have insight into apathy post injury, and 3) to assess the impact of psychosocial factors, including family functioning, overprotectiveness, and self-efficacy, on apathy, taking into account demographic and injury-related variables. It was hypothesized that: (a) people with TBI will show greater executive, emotional, and initiation apathy compared to healthy controls, (b) people with TBI will have reduced insight into all apathy dimensions relative to healthy controls, and (c) psychosocial factors will affect apathy presentation, with potentially differential impact across the different dimensions.

Method

Participants

One-hundred and eleven participants (61 patients with TBI and 50 healthy controls) with their informants (the majority being immediate family members including spouses, parents, siblings, and adult children) took part in the study in Ho Chi Minh City and adjacent provinces, Vietnam. Given the well-established associations between apathy and damage to the frontal brain network (Hogeveen et al., 2021), we systematically searched the patient dataset at Cho Ray Hospital (the largest hospital specialized in brain injuries in Southern Vietnam) using the keyword "frontal contusion," with the hospital admission timeframe from 2016 to 2019. Inclusion criteria were: (a) from 18 to 65 years of age at the time of injury, (b) Glasgow Coma Scale < 13 within 24 hr of injury indicating moderate to severe injuries, and (c) brain scan evidence for brain damage. Patients were excluded if they (a) had been diagnosed with any significant neurological/psychiatric disorders and/or had prior moderate to severe brain injuries, (b) had vision or hearing problems that could not be corrected, (c) were unable to show some level of movement (e.g., sitting), (d) had substance misuse, or (e) had limited Vietnamese proficiency. At the time of assessment, all patients were discharged from hospital and living in the community for at least 9 months. The first screening was conducted based on patients' medical records and yielded 1,106 patients satisfying eligibility criteria. These patients were contacted and rescreened for criteria that could not be obtained via medical records. Of those, 64 patients with TBI were eligible, contactable, and agreed to participate in the research. Three patients were further excluded due to missing data for the questionnaire of interest. Healthy controls were recruited from the community using the same exclusion criteria (with an additional exclusion criterion of experiencing any form of brain damage). Patients with TBI and healthy controls were matched for age, education, and biological sex.

In the TBI group, although people with stroke were excluded from the study, information about cerebrovascular risk factors was collected. Informants reported whether their family members with TBI smoked on a daily basis or consumed alcohol three times or more a week before the injury.

As part of a comprehensive neurological and neuropsychological evaluation, all participants underwent the Montreal Cognitive Assessment (MoCA) for a brief evaluation of cognitive functions (Nasreddine et al., 2005). Maximum total score for the MoCA is 30 with higher scores indicating better cognitive performance. The Vietnamese version of the MoCA was retrieved from the MoCA official webpage: https://www.mocatest.org/.

The study was approved by the UNSW Human Ethics Committee and the Cho Ray Hospital's Ethics Committee for Biomedical Research. All participants and their informants/carers gave written informed consent prior to participation. Patients with TBI were reimbursed with medical costs (~USD30), and healthy controls received either course credits or VND200,000 (~USD10) for participating in this study. Data sharing from this study is restricted by ethics regulations and can only be considered upon requests sent to the corresponding author.

Apathy Measure

The 24-item DAS uses both informant- and self-ratings to assess executive, emotional, and initiation apathy (Radakovic & Abrahams, 2014; 8 items per dimension). An informant-rated example for each dimension includes: *"they need a bit of encouragement to get things started,"* (executive apathy) *"they express their emotions,"* (emotional apathy) and *"they contact their friends"* (initiation apathy). This instrument has been adapted in Vietnamese with good reliability ($\omega_t \geq .74$) and validity demonstrated (Quang, Sin, et al., 2021). Another advantage of the DAS is that it minimizes the confound of physical impairments, which are common in TBI (Radakovic & Abrahams, 2014). Here, all participants (patients with TBI and controls) and their informants individually rated each item on a 4-point Likert scale: 0 = *hardly ever*, 1 = *occasionally,* 2 = *sometimes* or 3 = *almost always*, with negative items being reversed scored. Higher scores indicate greater apathy. Individuals with TBI and their informants, who were unable to understand the questionnaire due to marked cognitive impairment or limited education, were assisted by the researcher to ensure accurate ratings. The maximum score for each apathy dimension was 24 with recommended cut-offs of 17, 16, and 18 for executive, emotional, and initiation apathy, respectively (Quang, Sin, et al., 2021). Insight was calculated based on discrepancy scores between informant ratings and self-ratings.

Measures for Psychosocial Factors

The Family Assessment Device–General Functioning (FAD-General) consists of 12 items quantifying the overall health of the family environment (e.g., "We are able to make decisions about how to solve problems"; Epstein et al., 1983). Healthy controls rated their agreement for each item on a 4-point Likert scale, from 1 = *strongly agree* to 4 = *strongly disagree*. For people with TBI, responses were made by their informants. Higher scores

reflected higher levels of unhealthy family functioning. Good to excellent internal consistency was found for the scale in our samples (α = .70 for patients with TBI and α = .81 for healthy controls).

The Overprotection Subscale of the Questionnaire for Resources and Stress in the Family (QRS-Overprotection) includes 13 items measuring overprotectiveness by the informants (e.g., "*At times I fear he/she will not be able to function in society if he/she is out of our house*") (Holroyd, 1987). Informants of all participants rated *yes* = 1 or *no* = 0 for each of the provided statements. The maximum score for the total scale was 13, which equated to the highest level of overprotection. Internal consistency of the scale was acceptable for the current cohorts with α = .65 for patients with TBI and α = .66 for healthy controls.

The General Self-Efficacy Scale (GSE) was used to evaluate participants' self-beliefs to handle challenging demands in life (e.g., "*I can always manage to solve difficult problems if I try hard enough*"; Schwarzer & Jerusalem, 1995). Participants provided their responses for each of 10 items on a 4-point Likert scale, from 1 = *not true at all* to 4 = *exactly true*. Higher scores indicated more self-efficacy. Cronbach's α values were .87 for people with TBI and .80 for healthy subjects, indicating excellent internal consistency of the scale.

The FAD-General, QRS-Overprotection, and GSE were all translated into Vietnamese based on a recommended adaption procedure (Sousa & Rojjanasrirat, 2011). The process included translation, back translation, and a pilot study to ensure the readability and cultural appropriateness of the scales.

Statistical Analyses

SPSS version 26 was used for statistical analyses. Categorical variables were analyzed using Chi-square tests. Depending on whether the data met parametric assumptions, independent sample *t*-tests or Mann–Whitney tests were conducted to compare continuous variables (e.g., age or family functioning) between the patient and control groups. With the distribution normality being met, a 3 × 2 × 2 ANOVA was performed to characterize severity of apathy and insight, with the within-subjects variable being dimension (executive, emotional, and initiation apathy) and rating (informant ratings vs. self-ratings), and the between-subjects variable being group (control vs. TBI).

To assess the predictors of apathy, three separate multiple regression models using the forced method were performed examining executive, emotional, and initiation apathy as dependent variables, across controls and participants with TBI. Independent variables for each model included age, biological sex, education, group (controls vs. TBI), general cognition (MoCA total score), informant-rated overprotectiveness (QRS-Overprotection), family functioning (FAD-General), and self-efficacy (GSE). Assumptions of residual normality and multicollinearity were checked and met for all final significant models. Statistical significance for all analyses was set at $p < .05$.

Results

Demographic Characteristics

No difference was found between TBI and healthy controls in biological sex distribution, age, or education (Table 1; all $p \geq .215$). Of note, men outnumbered women in our sample (88.52% vs. 11.48%), in line with national reports on the prevalence of traffic accidents—the leading cause of moderate to severe TBI—in Vietnam (i.e., 85.18% men and 14.81% women) (Ngoc & Thanh, 2020). However, people with TBI had significantly lower scores than controls on the MoCA total scale and subdomains (all $p \leq .002$). Regarding psychosocial factors, people with TBI experienced significantly higher levels of overprotective behavior compared to controls as rated by informants on the QRS-Overprotection ($U = 2{,}246$, $p < .001$). Significantly less self-efficacy on the GSE was also observed in people with TBI compared to controls ($U = 1137.50$, $p = .021$). In contrast, the two groups did not significantly differ in family functioning assessed with the FAD-General, $t(109) = .987$, $p = .326$.

Severity of Multidimensional Apathy Rated by Participants and Informants

Figure 1A and 1B depicts executive, emotional, and initiation apathy rated by informants and participants, respectively. ANOVA results showed a significant main effect of apathy dimension, $F(2, 218) = 142.007$, $p < .001$, $\eta_p^2 = .566$) and a significant group × dimension interaction, $F(2, 218) = 23.133$, $p < .001$, $\eta_p^2 = .175$). For informant-ratings, individuals with TBI were rated significantly higher than controls across executive ($p = .039$), emotional ($p = .015$), and initiation ($p < .001$) dimensions. However, for self-ratings, while the group with TBI reported higher initiation apathy compared to the control group ($p < .001$), people with TBI rated themselves as having significantly lower apathy than healthy controls in the executive dimension ($p = .039$). The two groups did not significantly differ in self-rated emotional apathy ($p = .074$).

To examine the potential effects of cerebrovascular risk factors, Chi square tests were conducted to compare the number of patients who smoked and the number of patients who consumed alcohol three times or more a week between TBI with apathy and TBI without apathy groups. People in the TBI with apathy and TBI without apathy groups were classified based on a recommended cut-off score of the DAS total scale—informant version (Quang, Sin, et al., 2021). No differences between groups were observed for alcohol consumption, $\chi^2(1, 61) = 2.76$, $p = .097$) or tobacco use, $\chi^2(1, 61) = 0$, $p = .993$), showing that cerebrovascular risk factors did not differ depending on the presence of apathy.

Insight Into Apathy After TBI

Figure 1C depicts apathy discrepancy scores, calculated by subtracting self-ratings from informant ratings, as an indication for insight into apathy. The ANOVA analysis showed that the rating × dimension × group interaction was marginally significant, $F(2, 218) = 3.196$, $p = .043$, $\eta_p^2 = .028$). In particular, controls had similar apathy levels between informant ratings and self-ratings across apathy dimensions ($ps > .220$). Conversely, people with TBI had significant discrepancies in ratings of executive function ($p = .001$) and initiation ($p = .023$), suggesting limited insight into these apathy symptoms in the patients. No significant difference between self-ratings and informant ratings in emotional apathy ($p = .177$) was observed for patients with TBI.

Table 1
Demographic and Neurocognitive Features Between TBI and Control Groups

Feature	TBI (N = 61)	Control (N = 50)	Statistic	p value
Biological sex (women:men)	7:54	10:40	1.540	.215
Age (years)	34.92 ± 11.86	36.96 ± 14.10	1440	.614
Education (years)	8.87 ± 4.09	9.58 ± 4.64	1370	.357
Age at injury (years)	32.46 ± 11.72	—	—	—
Time since injury (months)	29.36 ± 10.81	—	—	—
Alcohol use per week—Before TBI (≥3 times: <3 times)	13:48	—	—	—
Smoking—Before TBI (Yes:No)	29:32	—	—	—
MoCA—Total	17.70 ± 5.49	22.62 ± 4.66	773.50	<.001
MoCA—Memory	4.69 ± 3.85	8.32 ± 4.61	846.50	<.001
MoCA—Executive function	7.67 ± 3.02	9.64 ± 2.12	935.50	<.001
MoCA—Attention/concentration	12.31 ± 4.24	15.10 ± 3.19	905.50	<.001
MoCA—Language	3.48 ± 1.27	4.32 ± 1.20	1011.50	.002
MoCA—Visuospatial ability	5.05 ± 1.32	6.22 ±.91	731.50	<.001
MoCA—Orientation	4.84 ± 1.61	5.72 ±.61	1,024	.001
FAD-General functioning	26.61 ± 3.80	25.82 ± 4.59	.99	.326
QRS-Overprotection	6.62 ± 2.54	4.03 ± 2.61	2246	<.001
GSE (self-efficacy)	28.11 ± 5.24	30.32 ± 3.72	1137.50	.021

Note. Values are mean ± standard deviation. A Chi-square test was used for biological sex, an independent samples t-test were used for FAD-General functioning and Mann–Whitney U tests were used for the remaining variables. TBI = traumatic brain injury; MoCA = the Montreal cognitive assessment; FAD-General functioning = the family assessment device-general functioning; QRS-Overprotection = the overprotection subscale of questionnaire for resources and stress in family; GSE = the general self-efficacy scale.

The Impact of Psychosocial Factors on Apathy After TBI

Table 2 shows factors predicting executive, emotional, and initiation apathy. The multiple regression model for executive apathy was significant, $F(8, 101) = 4.665$, $p < .001$), accounting for 21.0% of the total variance. Self-rated overprotectiveness by informants and family functioning were significant predictors of executive apathy, individually explaining 7.56% and 4.71% of the variation in executive apathy. The multiple regression model with emotional apathy as the outcome variable was also significant, $F(8, 101) = 3.983$, $p < .001$), accounting for 17.9% of the total variance. Family functioning was the only significant predictor, uniquely explaining 13.84% of the total variance in emotional apathy. Age also showed marginal effects ($p = .053$), uniquely explaining 2.89% of the variance in emotional apathy. For initiation apathy, a significant multiple regression model was also observed, $F(8, 101) = 11.919$, $p < .001$), accounting for 44.3% of the total variance. Group (controls vs. TBI) and self-efficacy were the significant predictors, explaining 8.12% and 5.34% of the total variance in initiation apathy, respectively.

Discussion

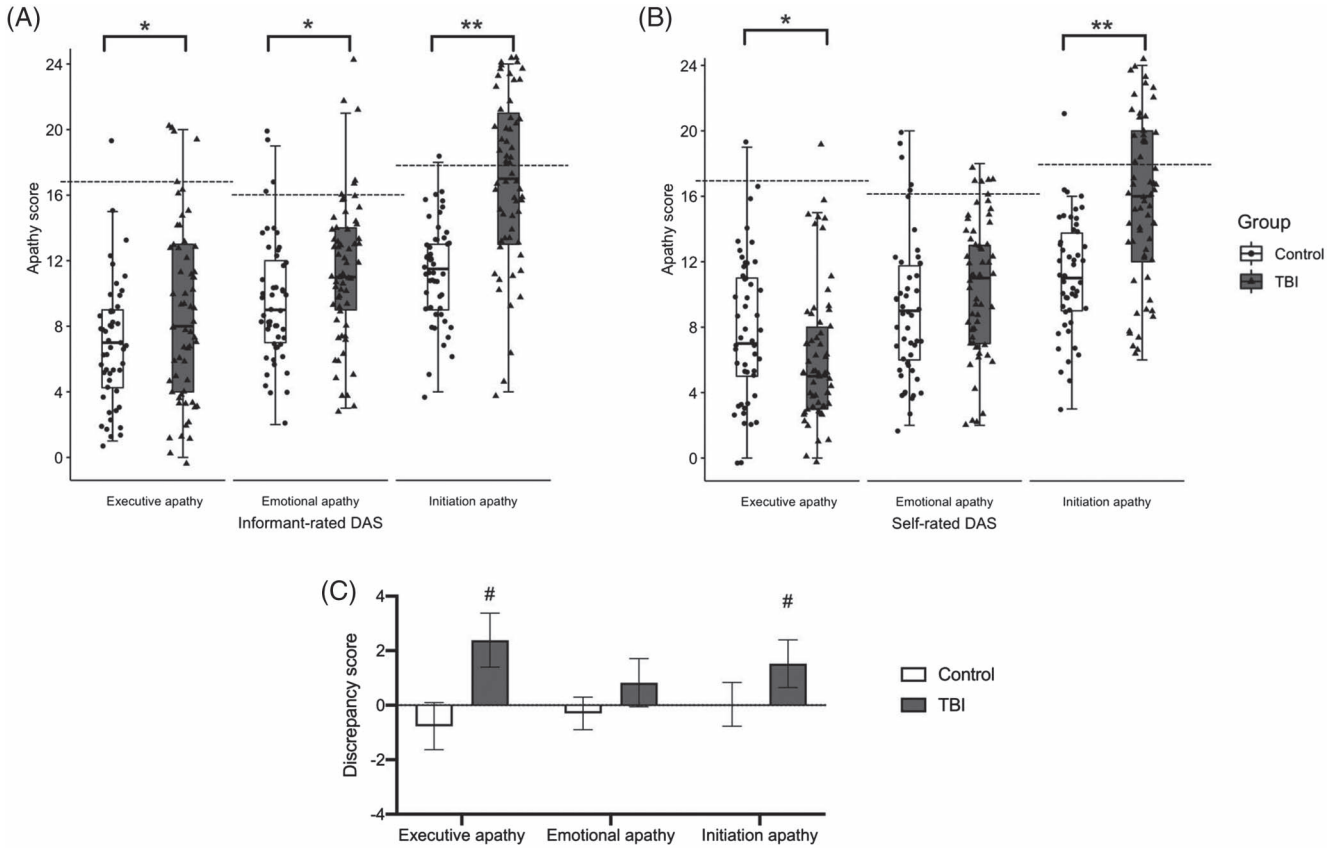
Maintaining motivation in various aspects of daily living is an essential component of human functioning, yet this drive can be affected by neurological conditions such as TBI. Here, we demonstrated that while Vietnamese individuals with TBI had greater apathy in executive, emotional, and initiation dimensions, they had limited insight into these symptoms, particularly in the executive and initiation domains. Across participants, apathy was predicted by family functioning, overprotectiveness, self-efficacy, and the presence of TBI, with different dimensions of apathy predicted by different psychosocial factors.

Our results of greater apathy in the TBI than the control group converges with reports of apathy following TBI in the literature (Arnould et al., 2018b; Kant et al., 1998; Lane-Brown & Tate, 2009). The presence of apathy across cultures confirms the organic nature of this syndrome such that apathy is caused by disrupted neural networks after TBI. For the first time, the DAS was applied to a TBI cohort to characterize apathy dimensions without being confounded by reduced physical abilities (Radakovic & Abrahams, 2014). Executive apathy was present, which fits with the known impairments in executive functioning and planning ability after mild-to-moderate TBI (Clark et al., 2020; Zakzanis et al., 2016). Increased emotional apathy (as reported by informants) meshes well with the documented difficulties that individuals with TBI experience in social interactions, including reduced facial reactions, empathy, and theory of mind (Bivona et al., 2015; de Sousa et al., 2010; Dethier et al., 2012; Wearne et al., 2020). We also found significant initiation apathy, which is consistent with reports of decline in spontaneous activity participation encountered by people sustaining TBI (Goverover et al., 2017). Taken together, our results underscore the intricate and widespread manifestation of apathy in people with moderate to severe TBI who live in Vietnam, a country known to have high prevalence of TBI. Therefore, timely recognition and intervention of apathy symptoms are imperative to the success of rehabilitation efforts and community reintegration in this region (Reid-Arndt et al., 2007). Whether the apathy profiles in executive, emotional, and initiation dimensions differ in a Vietnamese population compared to other Western populations is an important area for future investigation. Detailed identification of apathy symptoms in patients based on dimensions of executive, emotion, and initiation will facilitate the establishment of more targeted treatment and individualized care for patients with TBI and their family members.

Our comparisons between informant ratings and self-ratings revealed lack of insight into apathy after TBI in the executive and initiation dimensions. Although insight deficits in cognitive and daily functioning have been recognized widely in TBI (Hoofien

Figure 1

Comparisons Between Controls and People With TBI in Executive, Emotional and Initiation Apathy on the Informant-Rated DAS (A) and Self-Rated DAS (B), and the Magnitude of Discrepancy Scores Between Ratings (Calculated by Subtracting Self-Rated Scores From Informant-Rated Scores) in Each Group (C)



Note. $^{*}p < .05$, $^{**}p \leq .001$ for significant differences between control and TBI group; $\#p < .05$ for significant differences in apathy score between informant-ratings and self-ratings. Dashed lines represent recommended cut-off scores for each apathy dimensions (i.e., 17 for executive apathy, 16 for emotional apathy and 18 for initiation apathy; Quang, Sin, et al., 2021). DAS = dimensional apathy scale; TBI = traumatic brain injury.

et al., 2004), a recent study assessing executive and initiation apathy with the Apathy Inventory in France found relative agreement between patients' and carers' evaluations (Arnould et al., 2018b), which is divergent from our findings. One possible explanation for this is that our sample was selected based upon the presence of frontal contusions. This contrasts with the prior research that recruited people with TBI using less specific criteria. As neuroimaging studies have shown that self-awareness in TBI is implicated in the frontal brain network (Ham et al., 2014; Prigatano, 2005; Spikman & van der Naalt, 2010), patients in our study may be

Table 2

Multiple Regression Models for the Predictors of Executive, Emotional and Initiation Apathy

Predictor	Executive apathy				Emotional apathy				Initiation apathy			
	B	*SE*	β	*p*	*B*	*SE*	β	*p*	*B*	*SE*	β	*p*
(Constant)	4.221	4.983		.399	2.596	4.567		.571	20.374	4.529		<.001
Group (control vs. TBI)	−0.525	0.986	−0.055	.595	0.891	0.904	0.105	.327	**3.591**	**0.896**	**0.351**	**<.001**
Biological sex	1.238	1.245	0.095	.322	0.191	1.141	0.016	.867	−1.156	1.132	−0.082	.31
Age	−0.037	0.037	−0.1	.326	−0.067	0.034	−0.203	.053	−0.006	0.034	−0.016	.853
Education	−0.106	0.132	−0.097	.424	−0.036	0.121	−0.037	.765	−0.168	0.12	−0.143	.165
General cognitive performance	−0.105	0.11	−0.126	.344	−0.18	0.101	−0.241	.077	−0.128	0.1	−0.142	.204
Overprotectiveness self-rated by informants	**0.561**	**0.173**	**0.334**	**.002**	−0.053	0.159	−0.035	.739	0.224	0.157	0.123	.158
Family functioning	**0.265**	**0.103**	**0.234**	**.012**	**0.408**	**0.095**	**0.401**	**.001**	0.166	0.094	0.135	.081
Self-efficacy	−0.109	0.091	−0.109	.234	0.108	0.084	0.12	.198	**−0.269**	**0.083**	**−0.248**	**.002**

Note. Bold indicates the significant predictors of apathy dimensions with $p < .05$.

more prone to insight deficits than in a more heterogeneous group. Even so, frontal contusions are highly likely following TBI so it is reasonable to expect that a significant proportion of people with moderate to severe TBI will experience impairments in apathy and self-awareness as revealed in our study. Nevertheless, to obtain better verifications for the role of frontal brain circuits in insight into apathy after TBI, future neuroimaging studies are warranted.

Notably, distinct characteristics of healthcare system, including information accessibility and community education of TBI, can also underlie the divergent results in insight into apathy between the Vietnamese and French. However, evidence directly relevant to how insight impairment is differentially affected across different countries/cultures is lacking. It is, therefore, important that cultural factors and healthcare characteristics are considered in future investigations of behavioral problems in neurological diseases. Clinically, given the profound impact of insight on patients' functioning and post-TBI adaptation success (Robertson & Schmitter-Edgecombe, 2015), treatment trials that are focused on improving apathy would profit from the incorporation of therapeutic strategies and techniques for improving insight into apathy.

This study also demonstrated that family functioning, overprotectiveness, and self-efficacy were important predictors of apathy. The presumption that brain damage causes behavioral deficits, such as apathy, and that these behavioral problems subsequently influence family functioning, carers, and the patients' self-image has been longstanding (Anderson et al., 2002; Gray et al., 1994; Schönberger et al., 2010). However, such environmental and personal variables might also influence the severity of apathy in individuals with TBI. For example, in children with TBI, family and personal changes can occur prior to and/or after the TBI event, with both the pre- and post-injury family/personal characteristics influencing subsequent behavioral concerns (such as apathy; Lax Pericall & Taylor, 2014; Yeates et al., 2010). Our data provide the initial evidence for the possible impact of psychosocial factors on executive, emotional, and initiation apathy in Vietnamese adults with TBI. However, as the study was cross-sectional design, it cannot confirm cause–effect relationships. Future longitudinal examinations, which assess changes in family and personal variables and follow them over time, are warranted to capture detailed relationships between brain injury, apathy, and psychosocial factors in adults with TBI (Worthington & Wood, 2018). Such studies will be important to scrutinize whether apathy behavior is modifiable by pre-injury and post-injury environmental and personal adaptations, which is particularly informative for the precision of intervention and treatment.

Interestingly, different dimensions of apathy were associated with different psychosocial factors in our study. While executive apathy was linked to overprotectiveness and family functioning, emotional apathy pertained to family functioning only and initiation apathy was related with self-efficacy only. Clinically, these results suggest that different aspects of apathy may suit different therapeutic strategies. For example, patients who have elevated executive and emotional apathy may profit most from interventions that target familial environment and caregiving behavior, while those with heightened initiation apathy might benefit from interventions that address their self-identification attributions. Understanding the psychosocial predictors of apathy opens a window for characterizing both symptom- and individual-specific profiles for targeted prognosis and intervention.

It should be acknowledged that our Vietnamese sample had characteristics such as low education, limited accessibility to healthcare, and overdependence on the family, which are similar to some populations but divergent from others. However, the expansion of research into apathy post TBI in the population of Vietnam broadens the scope of such research beyond the typically narrow focus that is predominantly conducted in Western and English-speaking countries. Such diversity of population is critical for a complete picture of how behavioral problems manifest after brain disorders. In fact, the bias inherent in drawing conclusion based on Western, educated, industrialized, rich, and democratic people has been increasingly recognized (Henrich et al., 2010), given that people in different races and cultures have distinct perceptions and coping strategies in response to psychiatric and neurological conditions (Sodders et al., 2020). Another caveat is that, in our effort to target participants likely to experience apathy, we used frontal contusions as a core pathological feature guiding patient selection. Although this method likely increased the extent to which apathy symptoms were manifest in our patient sample, it needs to be recognized that TBI is typically heterogeneous in neuropathology. The neural substrates of executive, emotional, and initiation apathy after TBI, therefore, should be examined through future neuroimaging studies. Finally, while the translation and pilot process was undertaken carefully, the FAD-General, QRS-Overprotection, and GSE, as measures of social factors, need to be properly adapted in Vietnamese samples in standalone validation studies. Similarly, although a Vietnamese version of the MoCA appears to be the most appropriate cognitive screening tool available, it is yet to be validated. In fact, psychometrically sound screening tools for cognitive functions in the Vietnamese population are lacking. For these reasons, results from this study should be interpreted with caution. Importantly, development of cognitive and social measures appropriate for the Vietnamese is urgently needed.

To conclude, apathy is key feature of moderate to severe TBI in Vietnam, which manifests in executive, emotional, and initiation dimensions, and is predicted by psychosocial factors. However, patients have reduced insight into some of these symptoms. Together with the existing literature, we demonstrated that apathy has both organic and socio-cultural components, with the first being relatively consistent across cultures and the second dependent on the cultural setting. Knowledge of the manifestation of apathy in individuals post-TBI and better understanding of the socio-cultural mechanisms of apathy will aid clinical trial development and enhance current effectiveness in caring patients with TBI and supporting their caregivers.

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