Published in final edited form as:
J Head Trauma Rehabil. 2011 ; 26(5): 355–363. doi:10.1097/HTR.0b013e3181f20146.

Chronic Stress and Fatigue-Related Quality of Life after Mild-to-Moderate Traumatic Brain Injury (TBI)

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Abstract

Objective—To determine relationships between chronic stress, fatigue-related quality of life (QOL-F) and related covariates after mild-to-moderate traumatic brain injury (TBI).

Design—Observational and cross-sectional

Participants—A total of 84 community-dwelling individuals with mild-to-moderate TBI recruited from multiple out-patient rehabilitation clinics assessed on average 15 months after injury.

Method—Data were collected with self-report surveys and chart abstraction.

Measures—Neurofunctional Behavioral Inventory, Perceived Stress Scale-14, Impact of Events Scale, McGill Pain Short-form Scale, and modified version of the Fatigue Impact Scale.

Results—Fatigue-related quality of life was associated with somatic symptoms, perceived situational stress, but not with event-related stress (PTSD symptoms) related to index TBI, pre-injury demographic, or post-injury characteristics. Somatic symptoms and chronic situational stress accounted for 42% of the variance in QOL (F).

Conclusions—QOL (F) in community-dwelling individuals with mild-to- moderate TBI is associated with chronic situational stress and somatic symptoms. Symptom management strategies may need to include general stress management to reduce fatigue burden and improve quality of life.

Keywords

traumatic brain injury; fatigue; quality of life; stress; psychological

While fatigue is present in 14–22% of the general population, estimates among individuals with traumatic brain injury (TBI) range much higher: from 21% to as high as 70%.[1,2]. While fatigue occurs after TBI regardless of the severity of brain injury,[1–5] an effort to understand the variability of its frequency is found in comparison studies focused on those with mild TBI (MTBI). For example, Ponsford and associates[6] noted significantly higher fatigue levels at 1 week post mild TBI (MTBI) compared to a trauma control group, but these differences

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dissipated by three months after injury, while Kraus and associates claimed higher self-reported fatigue levels at 3 months post injury among those with MTBI compared to a trauma control group[7] and no difference in fatigue levels at 6 months.[8] In another comparison study with persons with MTBI and trauma controls who were directly discharged from the Emergency Department, fatigue at 12 months was associated with pre-injury physical and mental health, and not with the MTBI.[9] Recently, a cohort study reported that 23% of those with MTBI (N=2602) experienced mild-to-moderate fatigue intensity at 3 months.[10] Thus fatigue may be associated with the brain injury during the early recovery period, however because fatigue was not the primary phenomenon of interest in the above studies, these findings should be interpreted cautiously.

Post TBI fatigue appears to be persistent. It has been reported to occur from 1–5 years after TBI[2, 11] After mild-to-moderate TBI and in those who were hospitalized and followed prospectively for symptom persistence and disability outcome, fatigue was present in 57% and persisted in 42% of the sample at 1 year.[12] Subsequently, trauma comparison groups were examined to determine whether this persistence was attributed to the brain injury.[6 13] One study suggested that while fatigue was more problematic at 1 week post-injury, these differences were no longer significant 12 weeks later,[6] while another reported significantly high levels of fatigue in a third of those with TBI three and six months post-injury.[7, 13] The prevalence and persistence of this common phenomenon after TBI has the potential to impact daily functioning and lifestyle[2, 16] and consequently one's quality of life.[14] It has also been shown to interfere with an individual's ability to fully participate in rehabilitation therapies.[2,3] Thus, to improve quality of life after TBI, it is important to detect factors contributing to fatigue that are amenable to interventions.[14]

Determinants of post-TBI fatigue

Scientists focusing on post-TBI fatigue claim that it should be viewed as a multidimensional symptom that includes physical, psychological, motivational, situational, and activity-related components.[2,14–15] Mental fatigue was more prominent than physical fatigue according to Ouellette and Morin.[2] Further, these investigators reported that fatigue interfered with activities associated with daily routines, occupational and leisure activities and quality of life.[2] Similarly, our preliminary findings from a phenomenological study of persons interviewed in the chronic phase of TBI recovery noted a common theme of complete exhaustion that prohibits complex function and risk for “shut-down”.[17] Furthermore, those interviewed reported that fatigue “takes over their life”. Thus, fatigue is multi-dimensional and has the potential to disrupt functioning and day-to-day living.

Based on these findings, we believe study of post-TBI fatigue should shift to its impact on everyday living. Rather than focus on fatigue as a single symptom or symptom cluster, we sought to determine whether factors known to be associated with fatigue might also be associated with the broader outcome of fatigue-related quality of life (QOL-F), or the overall impact of fatigue on cognitive, physical, and psychosocial activities of every day living.

Factors found to be associated with post-TBI fatigue include sleep disorders, perceived stress, somatic symptoms, anxiety and depression.[2,18, 20] In their prospective comparative study, Stulemeijer and associates (2007)[19] noted that fatigue and emotional distress were associated with self-reported cognitive difficulties suggesting that treatment of distress and fatigue could improve perceived cognitive difficulties. Others claimed that fatigue and somatic symptoms, such as, `dizzy', `headaches' or `ringing in the ears' were positively associated.[13] Thus increased somatic complaints and emotional distress are associated with increased fatigue.

Indeed psychological factors (chronic stress) may contribute to fatigue after mild-to-moderate TBI[20]. In a prior study with persons following mild or moderate TBI who were referred to specialized rehabilitation clinics, we examined relationships between post-TBI fatigue, somatic symptoms, and situational stress. Nearly 50% of post-TBI fatigue was associated with somatic symptoms and chronic situational stress (N=75). Further, we noted that hypocortisolemia within a 12-hour period was present in a subsample (N=50), suggesting dysfunction of the hypothalamic-pituitary adrenal stress axis.[43, 44] The positive association of post-TBI fatigue and chronic stress, along with hypocortisolemia offers an intriguing possibility that post-TBI fatigue may be an indicator of allostatic load or chronic exposure of the body's stress system to psychological or physiological stressors as put forth in McEwen's allostatic load stress theory.[22–25] We further offer the possibility that chronic stress and fatigue-related quality of life, QOL (F), may be associated and if so, provide foci for therapeutic interventions to improve QOL (F).

According to McEwen's propositions, chronic exposure of the body's stress systems to psychological or physiological stressors, termed allostatic load and reflected by altered flexibility in the biological stress response, increases the likelihood for stress-related disorders or functional alterations. Chronic exposure and deterioration of the body's hypothalamic pituitary stress-axis (HPA) has been associated with hypercortisolemia, hypocortisolemia or dysregulation of the HPA.[22–25] After TBI, there is most likely change in the brain's ability to orchestrate the biological stress response (i.e., activation of stress hormones, then deactivation when the threat has subsided).[49] In addition, given the large aftermath of event-related, episodic, life event and daily stressors following trauma, a state of chronic stress may be present, further compromising the flexibility of the biological stress system.[22–25] This chronic stress, previously shown to mediate the relationship between depressive symptoms and psychological function after TBI,[43] may also mediate relationships between pre-injury (age or other demographic variables) or injury related factors, such as, severity of injury, frequency of somatic symptoms or time-since-injury and fatigue-related quality of life (QOL-F), reflecting the functional impact of fatigue on everyday living.

To that end, this study expands our previous findings by exploring whether chronic stress is associated with QOL (F) after mild or moderate TBI. According to Ferrans' Conceptual Model of Health-related Quality of life, (HRQOL)[26] it is characterized as subjective well-being and overall life satisfaction in regards to health, illness or treatment. HRQOL is distinct from the cultural, political or social aspects of quality of life. Rather, individual and environmental factors influence relationships between biology, symptoms, function and overall health perception, ultimately contributing to HRQOL. Of importance to our study are the relationships between somatic symptoms, chronic stress, health perceptions and their overall effect on QOL (F). In an effort to extend research about quality of life and mitigate community-living problems, as contended by Dijkers,[27] examination of quality of life in the context of common problems, such as living with fatigue, is necessary.

For this study, the central purpose is to determine whether a positive association exists between chronic stress and fatigue-related quality of life (QOL-F) in persons with mild to moderate TBI. Chronic stress has been operationalized as event-related, i.e., post-traumatic stress disorder symptoms (PTSD), and situation-dependent, i.e., the global appraisal of stressors experienced over the previous month. In order to best examine these associations, we first examined the extent to which pre-injury factors, such as, age, sex, and co-morbidities and injury-related factors, such as, time-since-injury, severity of injury, health perception or pain have been shown to contribute to chronic stress. Further, because somatic symptoms have been shown to be positively associated with fatigue,[20] we examined their unique relationship to QOL (F) (See Figure 1)

METHODS

Design

This is an analysis of an existing dataset obtained from a parent study that used an observational, cross-sectional design. This parent study examined the degree to which pre-injury, post-injury factors and perceived psychological stress were associated with post-injury depressive symptoms.[28]

Participants

Individuals aged 18–65, who sustained a mild-to-moderate TBI, were living in the community, and evaluated by a neuropsychologist with brain-injury expertise, were recruited from outpatient rehabilitation clinics affiliated with trauma facilities. The eligibility criteria included: (1) speaks English, (2) no psychosis at the time of their neuropsychological evaluation, (3) absence of severe TBI, as defined as a Glasgow Coma Scale score (GCS) score < 9 on admission to the Emergency Department,[29] and, (4) no pre-injury neurological impairment, such as stroke, Alzheimer's or Parkinson's disease. Those with more severe injures were excluded because it was suspected that there would be significant variation of self-awareness and perceived chronic stress. All participants were within three years of the injury (mean = 15.06 months, SD= 11.29). Human subject approval was received from each site's Institutional Review Boards. Informed and written consent was obtained from each participant. Eighty-four participants consented to participate.

Procedures

Data were collected over 18 months in eight out-patient rehabilitation clinics affiliated with large trauma hospitals in the Midwest. At each clinic site, the admitting neuropsychologist or their delegate compiled a list of eligible persons. Persons were then approached at the time of their clinic visits by treating staff or by phone to seek permission to discuss the study with the PI. Approximately 50% of those approached for permission to speak to the PI participated in this study. Data were not collected about those who refused to participate. Common reasons for not participating included: “too busy”, “I've answered all the questions I'm going to answer”, “not allowed by my attorney,” or “I have too much going on”.

All interview and self-report data, in the form of written questionnaires, from the injured person were completed in the presence of the trained research aides.

Measures

Outcome measure: Fatigue-related quality of life—We assessed fatigue-related quality of life with the Modified version of the Fatigue Impact Scale (MFIS).[29] The MFIS is a 21-item, 0–4 Likert-type measure reflecting the impact that fatigue has on realms of cognitive, physical and psychosocial functioning. Derived from the Fatigue Impact Scale (FIS), developed to assess symptom-specific quality of life in persons impacted by fatigue, such as, multiple sclerosis, lupus erythematosus, hepatitis and stroke, higher scores reflect worse fatigue-related quality of life (QOL-F).[45, 46]

This instrument has well-documented success in assessing the impact of fatigue in persons with chronic neurological difficulties, including TBI.[15, 30] It has demonstrated excellent internal consistency and test-retest reliability as well as convergent validity in healthy subjects and those with multiple sclerosis.[41] It was reported to have `moderate' sensitivity and specificity.[41] Sample items include: `because of my fatigue this past month, `my muscles have felt weak' or `I have been clumsy and uncoordinated' or `less alert' or `less motivated to participate in social activities'.

Primary predictor measures: Chronic stress—We evaluated the degree of chronic stress with two scales: the Perceived Stress Scale-14 (PSS)[31] and the Impact of Events scale (IES)[32]. The PSS-14 instrument retrospectively measures the extent to which people find their situations over the past 30 days to be unpredictable, uncontrollable, and unmanageable. It has been used in intervention or salivary cortisol studies, those involving persons with disabilities, pain and spinal cord injury, and those with chronic stress.[33] Reliability coefficients range .87–.92. It contains 14 positively or negatively worded items with a 5-point Likert scale. Higher scores denote increased stress (range = 0–56). Sample items include: `how often have you been upset in the past month because of something that happened unexpectedly' or `how often have you felt nervous or stressed'.

The Impact of Events Scale (IES) is a 15-item self-report symptom scale that assesses subjective distress associated with a specific traumatic event.[32] For this study, the most recent TBI was `the event'; a history of prior TBIs was collected with co-morbidity data. Two key elements are measured: event-intrusive and event-related avoidance. Items are scored on a 4-point scale, with higher scores indicating more frequent occurrence of the symptoms. The IES has been used to longitudinally assess post-traumatic stress after TBI, and has been found to be significantly associated with post-concussion symptoms[34] and life satisfaction.[35]. Internal consistencies range from .78 to .91.[32, 42] Generally, it has demonstrated the ability to provide a valid assessment and sensitive measure of self-reported post-traumatic stress symptoms.[42]

Relevant covariates: Pre-injury variables—Demographic data and the medical history were obtained via interview method and when possible, verified with the medical record. In this analysis, educational level referred to reported “educational attainment”, rather than number of years of education. Participants were classified as positive for premorbid psychiatric history if self-report or medical records indicated psychiatric or substance abuse treatment. Premorbid pain history was determined as positive if muscle- or pain-related health conditions (e.g., musculoskeletal problems or arthritis) or use of pain medication were reported.

Relevant covariates: Injury-related variables—Injury characteristics were obtained from the medical records. Injury severity was determined from a combination of information regarding GCS, posttraumatic amnesia (PTA), loss of consciousness (LOC), and CT results. The TBI was classified as “moderate” if hospital admitting GCS < 13, or GCS ≥ 13 and CT results were positive,[36] and mild if GCS ≥ 13 with negative CT. These chart data were rarely missing. In those cases, chart abstraction was performed to determine duration of LOC or post-traumatic amnesia (PTA). PTA data was obtained by questioning the participant regarding when their ability to make continuous and basic memories was restored. Those with documented LOC > 30 minutes or PTA> 24 hours were classified as having a moderate level of TBI. Time-since-injury was recorded in months. The participants were asked to rate their overall perception of health on a 1–5 Likert scale with excellent (1) and poor (5).

Neurobehavioral symptoms: Post-TBI symptoms were assessed with the Neurobehavioral Functioning Inventory (NFI).[37] The NFI is a 76-item self-report inventory and reflects frequency of symptoms and behaviors commonly encountered by persons with neurological disability. It was designed for and validated with a sample of 520 English-speaking brain injured persons and their families. This instrument and its subscales have been shown to be internally consistent, and have criterion validity with standard neuropsychological measures used with persons and their families after TBI.[38] Based on previous work indicating that somatic symptoms and fatigue were associated,[20] we used the somatic symptom subscale (NFI-S), measured with a Likert scale ranging from 1 (“never”) to 5 (“always”). Because the

parent study was focused on symptom burden associated with the TBI and not other injuries or co-morbidities, participants were asked: “please rate the frequency of the following difficulties that are attributed to this TBI and not specific to other injuries or illnesses.” The item on “nightmares” was removed from the total NFI-S score to prevent overlap with a similar item on the Impact of Events scale.

Pain: We assessed each participant's pain level and associated descriptors of intensity at the point of testing with the McGill Pain Questionnaire-Short Form (MPQ-SF)[38] The McGill Pain Questionnaire-Short Form (MPQ-SF), a self-report rating of present pain and subjective intensity was used to provide a pain-rating index and sensory and affective pain descriptors. In this analysis, we reported on the injured persons' present pain level according to the visual analogue scale portion (VAS) of the MPQ-SF.

Fatigue: We asked each participant to rate their present level of fatigue on a 0–6 visual scale when 0= `no present fatigue' and 6=`high level of present fatigue'.

Data analysis

A total sample size of 84 persons with mild or moderate TBI agreed to participate in this study. With this sample size, a medium effect was detectable with statistical power of .80 or greater for two-tailed tests with regression analysis using 8 continuous independent variables in the model.[38] A standard statistical package (SPSS for Windows version 17.0, SPSS, Inc., Chicago, IL, USA) was used to perform descriptive and inferential statistics, including multiple regression analyses. These regression analyses were done to identify which of the pre-injury and injury-related variables were significantly associated with the stress measures. Hierarchical regression analysis was used to examine the association between QOL (F) and chronic stress. QOL (F) was the dependent variable and blocks of variables were successively entered as predictors. These variable blocks included the covariates identified in the initial step described above, and the primary predictor, chronic stress, determined by the two measures PSS-14 and IES. Imputations were done by replacing 3 missing values for the IES and QOL (F) with linear regression trend values.

Results

Participant characteristics

Descriptive data on demographic, pre-injury health conditions and injury characteristics are summarized in Table 1. The 84 participants ranged in age from 18–61 (M=38.0, SD=11.8) and represented fairly equal numbers of males, females and those classified with mild or moderate brain injury. Time-since-injury ranged from 1–39 months (M=14.9, SD=11.4). In general, nearly 70% of the sample rated their current health as good to excellent.

Mean scores, ranges, standard deviations, and reliability coefficients for the predictor variables NFI-S, pain visual analogue scale (VAS), PSS-14 and IES, and the outcome variable QOL (F) are presented in Table 2. Twenty-seven percent of the sample reported no `present level of fatigue' on a 0–6 scale. (M=2.04, SD=1.75) Overall, this sample was considered to have more than average situational stress[31,33] and low levels of event-related stress[32, 42] and pain. We could not locate the cut-off scores for NFI-S and QOL (F) to determine their clinical significance.

Associations between QOL (F), chronic stress, pre-injury and injury variables

Multiple linear regression analyses were used to determine relevant covariates in a stepped approach.[40] At the first step, we conducted separate regression analyses to identify pre-injury characteristics and injury-related variables that were significantly associated with

chronic stress. The pre-injury demographic variables included age, sex, and pre-morbid history of mental health disorders, chronic pain, or previous TBI. Injury- related characteristics included somatic symptoms (NFI-S), current pain intensity, litigation status, TBI severity, and time-since-injury. From these analyses, NFI-S was significantly associated with both indicators of chronic stress, the PSS-14 (β=.372, p=.002) and IES (β=.491, p=.000). Sex and TBI severity were significantly associated with IES but not PSS-14. Females (β =.240, p=.032) and persons with MTBI (β =−.276, p =.006) had higher IES scores compared to males and those with moderate TBI. Table 3 summarizes the results of these regression analyses performed to detect covariate relationships on the predictor variables of chronic stress. We retained variables that were statistically significant at the .05 level for inclusion in the final regression model.

Hierarchical regression analysis was then performed to determine associations between chronic stress (PSS-14 and IES) and QOL (F). After accounting for the pre-injury covariates of stress and injury-related characteristics (NFI-S) identified in the first step, we entered variables in blocks based on their conceptual relevance. The first block consisted of the demographic variable sex; the second block consisted of injury-related variables TBI severity and NFI-S. The third and fourth blocks consisted of the chronic stress variables, entered separately and after the pre-injury and injury-related variables had been taken into account in order to determine their individual association with QOL (F). Table 4 summarizes the hierarchical regression analysis. Multicollinearity was not an issue in this analysis, with maximum VIF=1.89 and maximum Condition Index=13.7.

Situational stress (PSS-14) and somatic symptoms attributed to TBI (NFI-S), but not sex, TBI severity, or event-related stress (IES), were significantly associated with QOL (F). Situational stress appeared to mediate the relationship between TBI severity and QOL (F) for when TBI severity was introduced without the situational stress variable, it was a significant predictor of QOL (F). However, when both chronic stress variables (PSS-14 and IES) were added to the model, TBI severity was no longer a significant predictor. Similarly situational stress mediated the relationship between QOL (F) and event-related stress (IES). Event-related stress (IES) was a significant predictor of QOL (F) when entered separately from situational stress (PSS-14), (β=.239, p=.026) but was no longer a significant independent predictor after the addition of PSS-14 to the model (β=.096, p=.396).

Discussion

This study sought to determine whether a positive association existed between chronic stress and QOL (F) after mild-to-moderate TBI and to what extent relevant pre-injury conditions and injury-related covariates affected these relationships. Our findings support the idea that increased chronic situational stress, not event-related stress associated with TBI, and somatic symptoms are associated with QOL (F).

These results extend our previous findings that these same variables, chronic situational stress and somatic symptoms, were positively associated with fatigue, as measured by the fatigue subscale of the Profile of Mood States.[20] Chronic stress, as operationalized in this study, involved the individual perception of the past month's overall situational stress and event-related stress. Because our sample was on average 15 months post-injury, it is possible that their perceived stress was persistent and chronic for months. This finding is consistent with the quality of life framework by Ferran and associates.[26] In that model, symptoms can produce distress and interfere with one's ability to function within various domains of their life. However, the direction of these relationships can only be determined with prospective study of these proposed relationships. One possible interpretation to be derived from this

and our previous study is that chronic situational stress and somatic symptoms contribute to fatigue, which then affect QOL (F).

It is possible that the participants' perceived situational stress was exacerbated by sleep difficulties or depression that then affected QOL (F). Our previous study had found a significant relationship between PSS and depression and further examination is warranted that could clarify the relationship between stress, psychological status and QOL (F). In this analysis both somatic symptoms attributed to TBI and chronic stress significantly contributed to variance in QOL(F). Our findings also support those by Gordon et al. who noted that in a chronic sample, those with milder brain injuries reported more symptoms than those with more severe injuries[46] and Brown & Vandergoot[47] who noted that those with milder injuries reported poorer QOL compared to those with more severe injuries. In order to best capture the temporal progression of these relationships within the course of natural recovery, a longitudinal prospective study conducted early after injury is needed. In such a longitudinal prospective study, careful determination of the effects of somatic complaints associated with co-morbid conditions on QOL (F) should also be examined. This would provide us with time points and foci for testing interventions for somatic complaints associated with the TBI.

Contrary to our expectations, event-related stress (PTSD symptoms) associated with the index TBI was not significantly associated with QOL (F), despite its association with somatic symptoms. This finding that situational stress, not event-related stress was a significant predictor of QOL (F) may indicate the overwhelming nature of chronic situational stress in a group of persons who may be vulnerable to the effects of long-standing stress and are in the more chronic phase of recovery. Given that our sample were referred for post-injury assessment and treatment, it is noteworthy that their PTSD symptoms were on average mild, and thus may explain their lack of significance in the final statistical models. We believe that perceived chronic situational stress might best encompass the overall stress experience of TBI recovery and include those attributed to daily hassles, life events, and interpersonal stress. Concurrent examination of neuroendocrine profiles sensitive to the hypothalamic-pituitary stress axis response would further elucidate the contribution of biological factors in the chronic stress response following TBI.

Our findings extend those of Stulemeijer and associates[19] who found that in those with MTBI, determined in a hospital setting and who were assessed 6 months after their injury, those with higher levels of perceived cognitive complaints reported significantly greater emotional distress, event-related stress, higher levels of fatigue and worse physical functioning, despite no differences in neuropsychological performance. Our findings show that in the case of more chronic TBI recovery and in a referred sample of persons with mild or moderate severity of TBI, higher levels of chronic situational stress, not event-related stress, was more associated with worse QOL (F). Our findings suggest that interventions focused on management for stressful situations may improve fatigue-related QOL. However, prospective study of the development of chronic situational stress and cognitive complaints in relation to QOL (F) is needed.

An interesting finding was the paradoxical negative relationship between TBI severity and QOL (F), with mild rather than moderate TBI associated with higher QOL (F) scores (i.e., worse QOL (F), see Table 4, Model 2). This relationship was no longer significant when the chronic stress measures were added to the regression model. A hypothesized mediating role of chronic stress warrants further investigation. It may be that those with milder injuries are more aware of their symptoms especially if told their injury was mild and improvement was expected.

Future investigations on QOL (F) should focus on more clearly delineated TBI subgroups recruited early after injury and in comparison to a matched non-TBI group who are then followed prospectively to better elucidate relationships between QOL (F) and TBI severity versus trauma only. Since there are many variations of mild TBI, including those with complicated mild injuries, sports concussion injury, and those associated with very minor neurological complaints, the differential effects of these subgroups on relationships between chronic stress and QOL (F) would provide further foundation for intervention foci.

This study adds to the quality of life literature following TBI by examining a complex phenomenon's impact on social, cognitive and physical dimensions of everyday living. In our phenomenology study, our participants uniformly want us to know about their “lived experience” of fatigue.[17] Living with fatigue required planning, activity modification, refinement of social involvement, and regular rest. Fatigue, according to those interviewed, could not be ignored because it affected everyday living and if ignored, required days of restoration. We believe that the QOL (F) scale could be useful in evaluating the impact of interventions on QOL (F).

There are limitations in this study. First, this is a cross-sectional study and clearly an imperfect way to examine a dynamic phenomenon. Secondly, our results can only be generalized to those referred for outpatient therapies. Third, a comparison with healthy individuals and individuals with trauma who are without TBI are necessary to better understand the development of situational stress over time along with somatic complaints and their impact on QOL (F).

Conclusions

Fatigue-related quality of life is significantly related to situational stress and self-reported somatic symptoms. Such situational stressors may contribute to increased somatic complaints and together result in declines in day-to-day living, and deterioration of QOL. QOL (F) most likely provides a useful outcome measure for examination of the natural history of recovery of community-dwelling persons with TBI as they cope with event-related and situational stressors.

Acknowledgments

Disclosure of Funding This study was funded by Office of Vice-President of Research to Dr. Bay at Michigan State University. Dr. de Leon was supported by the National Institutes of Health (NIH), the National Institute of Child Health and Human Development (NICHD), the National Center for Medical Rehabilitation Research (NCMRR) Grant #5-T32-HD007422-17.

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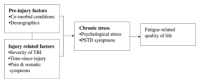

Figure I.
Psychological and Fatigue-Related Quality of Life after Mild-To-Moderate TBI

Table 1

Demographic, Pre-injury and Injury-related Characteristics (N=84)

Variable	N	%
Gender		
Females	41	48.8
Males	43	51.2
Ethnicity		
Caucasian	75	89.3
African American	4	4.8
Latino	4	4.8
Other	1	1.2
Education*		
Less than 12 years	7	8.3
High school graduate	42	50.0
Some college or degree	34	40.5
Marital status		
Married	40	47.6
Unmarried	44	52.4
Current employment		
Employed	21	25.0
Unemployed	63	75.0
Involved in Litigation*	28	33.3
TBI Injury Severity		
Mild	41	48.8
Moderate	43	51.2
Previous TBI	16	19.1
Psychiatric or Substance Abuse History	34	40.5
Pain history	12	14.3
Medication History (with CNS effects)	65	7: 7.4
Current health rating		
Excellent	4	4.8
Good to very good	54	64.3
Fair	20	23.8
Poor	6	7.1

NOTE: Education and TBI severity were categorized differently in this study and consequently numbers are different from those presented in an earlier paper.[27]

*Percentages may not add up to 100 because of missing data

Table 2

Descriptive and Reliability Statistics on Predictors and Outcome measures.

Measures	Range	Mean (SD)	Cronbach's alpha
Fatigue related quality of life, QOL(F)	4–80	42.76 (19.9)	0.97
NFI-somatic, NFI-S (missing item on “nightmares”)	10–41	21.50 (6.96)	0.81
Perceived Stress Scale-14, PSS-14	9–47	26.29 (8.98)	0.87
Impact of Events Scale, IES	0–41	18.33 (10.08)	0.88
Current pain intensity level, VAS of the McGill Pain Questionnaire, Short Form	0–8	2.15 (2.21)	N/A

Table 3

Regression Model Relating Pre-injury Factors and Injury-related Variables to Chronic Stress.

	PSS-14		IES	
	Beta	**P**	**Beta**	**P**
Demographic and Preinjury Variables				
Age	−.070	.541	−.056	.621
Sex	.217	.054	.240	.032
Previous TBI	.029	.797	.126	.266
Psychiatric history	−.059	.611	.040	.725
Chronic pain	.184	.118	.168	.146
Injury-related Variables				
Current pain	.109	.335	−.138	.204
Litigation	−.032	.752	−.077	.423
Time since injury	.028	.784	−.076	.446
TBI severity	−.182	.077	−.276	.006
NFI-Somatic	.372	.002	.491	.000

Table 4

Regression Model Relating Chronic Stress, and other Covariates to Fatigue-Related Quality of Life (N=84).

Model	Variables	B	Std Error	Beta	P	Semipartial r	Adjusted R^2	P of model
1							.006	.228
	Sex	5.275	4.340	.133	.228	.133		
2							.355	.000
	Sex	2.282	3.598	.058	.528	.056		
	TBI severity	−7.569	3.700	−.191	.044	−.180		
	NFI-Somatic	1.519	0.260	.531	.000	.515		
3							.387	.000
	Sex	1.055	3.549	.027	.767	.026		
	TBI severity	−5.091	3.768	−.128	.180	−.116		
	NFI-Somatic	1.237	0.282	.432	.000	.377		
	IES	0.472	.208	.239	.026	.195		
4							.429	.000
	Sex	0.037	3.449	.001	.991	.001		
	TBI severity	−4.688	3.641	−.118	.202	−.107		
	NFI-Somatic	1.038	0.283	.363	.000	.304		
	IES	0.194	0.227	.098	.396	.071		
	PSS-14	0.646	0.249	.291	.011	.215		

J Head Trauma Rehabil. Author manuscript; available in PMC 2012 September 1.