

ORIGINAL REPORT

FATIGUE, PSYCHOSOCIAL ADAPTATION AND QUALITY OF LIFE ONE YEAR AFTER TRAUMATIC BRAIN INJURY AND SUSPECTED TRAUMATIC AXONAL INJURY; EVALUATIONS OF PATIENTS AND RELATIVES: A PILOT STUDY

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**Objective:** To describe fatigue and its relationship to cognition, psychosocial adjustment, quality of life (QoL), work status and relative's experiences 12 months after suspected traumatic axonal injury.

**Methods:** Eighteen patients were assessed with the Daily Fatigue Impact Scale (D-FIS), the Barrow Neurological Institute Screen for Higher Cerebral Functions (BNIS), the European Questionnaire 5 Dimensions health-related quality of life, the Glasgow Coma Outcome Scale Extended, and the European Brain Injury Questionnaire (EBIQ) (patient and relative). Return to work was registered.

**Results:** At 1 year, fatigue still caused great problems in daily life. Although fatigue and cognition (BNIS) did not correlate, the more fatigued patients subjectively experienced significantly more cognitive dysfunction. Although D-FIS and QoL did not correlate, most patients reported that feelings of tiredness and dullness related to having lower QoL. However, lower QoL was associated with cognitive and attention disability (BNIS), subjective perception of executive dysfunction, lack of motivation, and mood disturbances (EBIQ). Neither fatigue nor cognition associated with return to work. The general consequences of traumatic axonal injury showed good agreement between patients' and relatives' experiences. **Conclusion:** The patient's subjective experience of the impact of traumatic axonal injury seems to be most essential, as it is the objective reality that the patient responds to, and this should therefore be assessed and treated.

**Key words:** head trauma; diffuse axonal injury; fatigue; cognition; quality of life; employment.

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INTRODUCTION

Axonal injury (AI) (traumatic axonal injury (TAI) diffuse axonal injury (DAI)), is common after traumatic brain injury (TBI) and may contribute to clinical manifestations (1). It is

poorly defined as a clinical syndrome and is difficult to verify when non-invasive (1). Although axonal degeneration is suggested to continue even years after injury (2), a "pure" DAI/TAI rarely seems to be identified (3).

Fatigue is a complex and subjective phenomenon with multifactorial origins. Psychological fatigue is defined as decreased motivation, extended mental activity, or boredom, occurring in situations that require effort, cause concern, or involve chronic depression (4). According to the coping hypothesis (4), the mental fatigue reported by 43–73% of TBI patients (4) is related to the increased mental effort (4, 5) necessary to overcome attention deficit and slowed processing, in order to reach an adequate level of performance in everyday life. Various hypotheses regarding an association between fatigue and the organic damage referred to by Johansson et al. (6) have suggested that metabolic and structural lesions disrupt the usual activation process in pathways that interconnect different regions of the brain, resulting in fatigue. Impaired information-processing speed is also related to TAI (7). A patient's slower speed when exposed to interference tasks suggested significant factors related to subjectively mental fatigue in persons with TBI (4, 6), such as difficulty resisting distractions and maintaining focus (8).

No associations have been found between fatigue and injury severity or time since injury, age (4, 5, 9, 10), cognitive impairment, or gender (4, 10), although fatigue has been shown to be more severe among women (9). Fatigue seems to improve during the first year, but not change later on (11), even though it can last for several years (6, 10). Fatigue may interfere with return to work (6, 12), quality of life (QoL), well-being (6, 9) and social and recreational life (6), but no association with participation in major life activities was reported (9). Fatigue-related QoL was reported to be associated with somatic symptoms and chronic perceived situational stress (13). It has been suggested that fatigue might be an effect of the brain injury itself (6, 9) and not a result of pain, depression or sleep deprivation (6).

Cognitive impairment and executive dysfunctions are common after TBI and TAI (3, 7, 14–20), as is impaired self-awareness (15, 21–22). It has been suggested that the medial prefrontal and posterior cingulate cortex are important regions

for self-reflective thought and a sense of self-reflection (23). Patients may under-report cognitive and behavioural difficulties, which are the true residuals of their brain injury (22). However, patients who had a more appropriate and realistic perception of their deficits, were reported to have less psychopathological symptoms, better neuropsychological function and greater independence (24).

With regard to behaviour, mood disturbance and disorders of behavioural control and regulation are particularly common (25) for patients with TBI. In particular, irritability, anger and aggression are suggested to be more characteristic of depression than sadness and tearfulness. Having a depressive mood endorsed more injury-related difficulties, which showed a strong relationship between mood and experienced psychosocial functioning, and indicated that perceived changes in daily functioning continue to influence emotional well-being over time after the injury (26).

Brain dysfunction associated with neuropsychological disturbances has appeared to influence the relationship between the distress level of family members and their ratings of impaired awareness in patients with TBI (27). Relatives have been found to report more difficulties than patients on all subscales of the European Brain Injury Questionnaire (EBIQ), most frequently regarding somatic and cognitive problems (28).

### Objectives

The objective of this study was to describe experienced fatigue and its relationship to cognition, psychosocial adjustment, health and QoL, and also related to work status 12 months after TBI and suspected TAI. A further objective was to describe the patient's self-reported problems, and compare these with their relatives' perceptions regarding the patient's cognitive function, behaviour and mental state.

## METHODS

The study population was examined in the acute phase, at 6 and 12 months, when orientation was recovered (Glasgow Coma Scale (GCS)=14) and the patients were testable, according to the pre-screen of the Barrow Neurological Institute Screen for Higher Cerebral Functions (BNIS). This study describes the situation of the patients 12 months after TBI. Results from the longitudinal study have been presented previously (16).

All patients <65 years of age were referred to Sahlgrenska University Hospital during the period June 2006 to September 2009 and had sustained TBI. Patients were included in the study if they fulfilled the criteria for a suspected pure TAI: patients who experienced an affected consciousness and/or focal neurological symptoms without an explanation seen on the computerized tomography (CT) scan of the brain. Thus, patients with haemorrhages and/or oedema that could explain their affected neurology were excluded.

The catchment area included the western part of southern Sweden, in the region of Västra Götaland, which has approximately 1 million inhabitants between the ages of 16 and 65 years.

At 12 months, self-reported fatigue, cognitive and executive function, psychosocial adaptation and health-related QoL were assessed by the patient and compared with their relatives' perceptions.

The Regional Ethical Review Board of the University of Gothenburg approved the study, and informed consent was obtained from all participants or their next of kin.

### Instruments

Demographics, Glasgow Coma Scale scores (GCS) and the cause of the trauma were obtained from each patient's chart upon arrival at the hospital. Level of consciousness was assessed using the Reaction Level Scale (RLS), which was translated to the GCS presented here (29).

The Daily Fatigue Impact Scale (D-FIS) was chosen to register subjectively perceived fatigue (30). For subjects who were followed longitudinally, the 8 items of D-FIS, selected from the original FIS items (31), were shown to reflect changes in patient's reports of fatigue (30). D-FIS measures the fatigue impact of physical tiredness and lack of energy. The response to each item is given on a 5-point scale, where 0=no problems and 4=extreme problems. The maximum score is 32 points.

The BNIS, which was used to measure cognitive function (32), was validated in Sweden (33, 34). The initial pre-screen assesses whether the patient is testable according to consciousness/alertness, basic communicative ability and participation. BNIS consists of 7 subscales, of which only attention/concentration is reported here. Scores are obtained for both the subscales and the total instrument. The maximum score is 50 points, where a score <47 points indicates cognitive dysfunction.

The European Questionnaire 5 Dimensions health-related quality of life (EQ-5D) was established by the EuroQoL Group in 1987 to describe and evaluate self-reported health outcomes and health-related QoL (35). The EQ-5D consists of 5 dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. The patients describe their actual health state by marking on a 3-point scale, where A=no problems, B=some or moderate problems, and C=unable or extreme problems. Each dimension is treated separately. The health dimensions are complemented by a visual analogue scale (VAS) for marking experienced general health status and QoL, where 0=worst imaginable health state and 100=best imaginable health state.

The EBIQ is a self-reporting questionnaire of the subjectively perceived cognitive, emotional and social difficulties resulting from TBI (36). EBIQ consists of 63 questions in 9 domains: somatic, cognitive, motivation, irritability/impulsivity, depression, isolation, consequences, communication, and core problems (in general). The cognitive domain is composed of 2 subscales: memory and planning. The patient answers the statements according to perceived difficulty on a 3-point scale, where 1=not at all, 2=a little, and 3=a lot. Three questions are added toward the end regarding the patient's evaluation of the extent to which the consequences of the trauma have impacted the lives of their next of kin. A parallel version is constructed for the nearest relative to estimate the consequences of the trauma for the patient. Both the patient and the relative answered these questionnaires.

Glasgow Outcome Scale Extended (GOSE) was used to estimate TBI outcomes (37). Along with TBI symptoms, the scale assesses disability in participation and activity on an extended 8-point scale.

Work status, qualified as  $\geq 25\%$  employment was registered.

### Statistics

Descriptive statistics are presented as frequencies and percentages, and as means with standard deviations and/or medians and ranges. Non-parametric statistics were used (Mann-Whitney *U* test, Wilcoxon signed-rank test, Kruskal-Wallis test and  $\chi^2$  test) for analysing the differences between groups, and Pearson correlation for analysing associations between variables. A significance level of  $p \leq 0.01$  was accepted as indicating significance. For statistical calculations, the SPSS program package 15.0 was used.

## RESULTS

### Background

A total of 22 patients was included; however, the study sample comprised 18 patients, as 2 patients were still not testable 1 year after the TBI, 1 had died and 1 was missing.

The median age for males ( $n=9$ ) was 25 years (range 19–48 years), and 42 years (range 20–62 years) for females ( $n=9$ ). The age difference was not significant. The majority of patients had higher ( $\geq 12$  years) education (males:  $n=9$ ; females:  $n=6$ ). The patient demographics are presented in Table I.

The median GCS for the study sample was 9.5 (range 3–15). Two patients did not have any affected consciousness. However, for these, MRI identified TAI subcortically in the white matter, in the hemispheres and in the brain stem, respectively.

#### Fatigue (Daily Fatigue Impact Scale)

After 1 year, the median value of D-FIS still indicated an experienced fatigue that resulted in great to extreme problems in daily life (median 15 (range 3–24)). No significant difference between the sexes or any association with age or GCS was found.

The D-FIS and the EBIQ scores correlated significantly ( $p=0.004$ ), where fatigue was associated with subjectively perceived cognitive problems ( $p<0.001$ ), especially difficulties in memory ( $p=0.001$ ) and planning ( $p<0.001$ ). Although patients who reported more fatigue also experienced worse cognitive dysfunction (Table II), no association was found between fatigue and cognition as measured by the BNIS.

Experiencing fatigue as a more comprehensive problem was associated with feeling generally more tired and dull (82.4%) ( $p<0.001$ ), having difficulties making decisions ( $p=0.004$ ), getting things done on time ( $p<0.001$ ), and having to work slowly in order to get things right ( $p<0.001$ ) (EBIQ). Fatigue also influenced reacting too quickly to things other people said and did ( $p<0.001$ ). Fatigue did not correlate with any of the dimensions of the EQ-5D, and no association was found between fatigue and activity and participation, as assessed by the GOSE.

#### Cognition (Barrow Neurological Institute Screen for Higher Cerebral Functions)

One year after TBI, 17 patients, including the 2 not testable patients, ( $n=20$ ; 85%) still had cognitive dysfunction (median 44 (range 18–49)). No significant cognitive difference was found between the sexes, and neither cognition (total BNIS score) nor the subscale of attention was associated with fatigue.

Patients with a less depressed mood functioned better cognitively ( $p=0.005$ ) than the more easily irritated and depressed patients who perceived themselves to be more isolated ( $p=0.009$ ) and considered TBI to have had a greater impact in general on their situation ( $p=0.001$ ).

Table I. Demographic data ( $n=18$ )

M/F, $n$	9/9
Age, years, M/F, median	25/42
Education, <12 years/ $\geq 12$ years, $n$	4/14
Cause, traffic accidents/falls/other, $n$	10/5/3
GCS, median (range)	9.5 (3–15)
Location of TAI, 0/1/2/3, $n$	4/11/7/6

GCS: Glasgow Coma Scale; TAI: traumatic axonal injury; M: male; F: female.

Location of TAI: 0=no; 1=subcortical; 2=corpus callosum; 3=brain stem.

Table II. Pearson correlation coefficients 12 months after traumatic brain injury (TBI) and traumatic axonal injury (TAI): between D-FIS and EBIQ total score and subscales; between D-FIS and the dimensions of the EQ-5D; between D-FIS and GOSE; and between BNIS total score and the subscale of attention and EBIQ, EQ-5D and GOSE

	D-FIS		BNIS		Attention	
	total score	$p$ -value	total score	$p$ -value	total score	$p$ -value
<b>EBIQ</b>						
Total score	0.660	0.004*	-0.631	0.009*	-0.630	0.009*
Somatic	0.576	0.015	-0.346	0.189	-0.433	0.094
Cognitive	0.837	0.000*	-0.518	0.040	-0.436	0.091
Memory	0.747	0.001*	-0.436	0.091	-0.282	0.290
Planning	0.809	0.000*	-0.514	0.042	-0.477	0.062
Motivation	0.273	0.289	-0.481	0.059	-0.390	0.135
Irritation	0.548	0.023	-0.509	0.044	-0.610	0.012
Depression	0.334	0.190	-0.665	0.005*	-0.608	0.013
Isolation	0.266	0.302	-0.633	0.009*	-0.776	0.000*
Consequences	0.557	0.020	-0.727	0.001*	-0.633	0.008*
Communication	0.577	0.015	-0.531	0.034	-0.492	0.053
“Core”	0.505	0.039	-0.344	0.192	-0.441	0.088
EQ-5D mobility	0.116	0.658	-0.693	0.003*	-0.813	0.000*
Hygiene	0.317	0.215	-0.602	0.014	0.501	0.048
Activity	0.262	0.309	-0.282	0.291	-0.392	0.133
Pain	0.411	0.101	-0.340	0.197	-0.252	0.347
Anxiety/depression	0.170	0.513	-0.257	0.337	-0.400	0.125
Health status (QoL)	-0.544	0.029	0.885	0.000*	0.747	0.001*
GOSE	0.007	0.980	0.628	0.007*	0.672	0.003*

\* $p\leq 0.01$  (Sig. 2-tailed); \*\* $p\leq 0.001$  (Sig. 2-tailed).

D-FIS: Daily Fatigue Impact Scale; EBIQ: European Brain Injury Questionnaire; EQ-5D: European Questionnaire 5 dimensions of health-related quality of life; BNIS: Barrow Neurological Institute Screen of Higher Cerebral Functions; GOSE: Glasgow Outcome Scale Extended.

On the subscale of attention it was found that the more inattentive a patient was, the stronger the feeling of being isolated ( $p<0.001$ ) and experiencing the consequences after the injury as more debilitating ( $p=0.008$ ).

#### Perceived health and quality of life (EuroQol-5D)

No significant difference was found in QoL between the sexes; likewise, age or GCS did not correlated with QoL. Of 17 patients, 70.6% described a moderate level of pain unrelated to headache, which was reported by more than half the group (53%). According to the EQ-5D, no patients reported major problems with anxiety/depression. However, anxiety/depression (EQ-5D) and the EBIQ total score correlated significantly ( $p=0.006$ ), wherein the more anxious persons reported more behavioural, psychosocial and mood problems (Table III).

Those who reported a moderate anxious/depressed mood (58.8%) were more easily irritated ( $p=0.008$ ), depressed ( $p=0.001$ ), socially isolated ( $p=0.004$ ) and unmotivated ( $p=0.004$ ) (EBIQ) than the less anxious/depressed. They also reported the injury as having more serious consequences on activity ( $p=0.005$ ).

Feeling tired and dull (82.4%), having to do things slowly (76.5%), being restless (76.5%) or stubborn (76.4%) and

having problems with concentration (76.5%) had the greatest effect on patients' QoL.

Health-related QoL correlated with the perception of general consequences of the trauma ( $p=0.001$ ), the primary interferences being an inability to manage one's own hygiene ( $p<0.001$ ) and major activities ( $p=0.005$ ) (Table III). Patients who reported a better QoL were found to have better cognitive function ( $p<0.001$ ) and attention ( $p=0.001$ ) (BNIS) (Table II) and perceived themselves to be more motivated ( $p=0.005$ ), to have fewer problems in planning ( $p=0.008$ ), to be less depressed ( $p=0.004$ ) and socially isolated ( $p=0.006$ ) (EBIQ) compared with those who had a lower QoL (Table III).

No significant difference was found in QoL between the sick-listed patients and those who had returned to work ( $p=0.017$ ).

#### Comparison between the reports of patients and their next of kin (European Brain Injury Questionnaire)

Significant positive correlations were found between the perceptions of patients and their relatives regarding the general consequences after the TBI ( $p<0.001$ ), particularly in the domains of cognition ( $p=0.001$ ), memory ( $p=0.002$ ) and planning ( $p=0.001$ ). Patients who felt more unmotivated were also reported by the next of kin to be more isolated ( $p=0.002$ ). There was no significant correlation between the patient and the next of kin in estimating the motivation of the patient ( $p=0.064$ ). The majority of the relatives regarded the patient as being tired and dull (93.4%) or stubborn (93.4%), having to do things more slowly (80%) or unable to get things done (71.4%) and being impulsive or too quick to react to things other people said (66.6%). Patients were also described as having problems with headache (73.4%), mood swings (73.3%), irritability (71.4%), outbursts (66.6%) and concentration (66.6%). Furthermore, they appeared to find everything troublesome (66.7%) and were insensitive to other people's mood (71.4%). Patients also reported these problems, but often perceived them as being less serious.

Both groups also reported family problems after the TBI, the patients to a somewhat lesser extent (53.4%) compared with the next of kin (73.3%). Change in the next of kin's mood was experienced by 60% of the patients, compared with 66.6% of the relatives, who were also more likely to report the patient as having a decreased libido (66.6%) than the patients (47%) themselves.

#### EuroQol-5D

Patients who had to depend upon others to manage their personal hygiene ( $p<0.001$ ) and activity in daily life ( $p=0.005$ ) were more likely to report greater consequences caused by the trauma. (Table III). The more mobile patients had significantly better cognition ( $p=0.003$ ) and attention ( $p<0.001$ ) (BNIS) than the more disabled patients (Table II).

#### Glasgow Outcome Scale Extended

The GOSE assessment did not differ significantly between the sexes and was not associated with age. No association was found between fatigue and GOSE, but activity and participation correlated significantly with cognition (BNIS) ( $p=0.007$ ) and the subscale of attention ( $p=0.003$ ) (Table II). Patients with better cognitive function were rated as less disabled. Also, patients who expressed a better QoL received somewhat higher GOSE scores ( $p=0.010$ ).

#### Return to work

Five patients had returned to 75–100% paid employment 12 months after TBI. No significant differences were found regarding fatigue, as the working group scored their fatigue (range 5–22) almost equally to the non-working group (range 3–24). Neither did cognitive function (BNIS) differ between the groups.

However, those who had returned to work were significantly more attentive ( $p=0.004$ ) (BNIS) and assessed as more active and participating ( $p=0.002$ ) (GOSE). No significant difference was found in QoL between the working group (median 80.0

Table III. Pearson correlation coefficients at 12 months between European Brain Injury Questionnaire (EBIQ) total score and subscales and European Questionnaire 5 Dimensions health-related quality of life (EQ-5D)

	EQ-5D						Anxiety/				QoL	p-value
	Mobility	p-value	Hygiene	p-value	Activity	p-value	Pain	p-value	depression	p-value		
EBIQ												
Total score	0.386	0.126	0.576	0.016	0.534	0.027	0.327	0.200	0.633	0.006**	-0.716	0.002*
Somatic	0.117	0.654	0.277	0.282	0.386	0.126	0.346	0.174	0.421	0.093	-0.346	0.190
Cognitive	0.258	0.318	0.559	0.020	0.446	0.073	0.372	0.141	0.335	0.188	-0.625	0.010*
Memory	0.175	0.501	0.381	0.131	0.310	0.226	0.305	0.233	0.303	0.237	-0.520	0.039
Planning	0.280	0.276	0.607	0.010*	0.481	0.050	0.375	0.138	0.322	0.207	-0.635	0.008*
Motivation	0.225	0.385	0.399	0.112	0.398	0.114	-0.009	0.971	0.661	0.004*	-0.660	0.005*
Irritation	0.351	0.167	0.383	0.130	0.353	0.164	0.449	0.071	0.617	0.008*	-0.601	0.014
Depression	0.427	0.087	0.564	0.018	0.520	0.032	0.144	0.582	0.735	0.001*	-0.674	0.004*
Isolation	0.462	0.062	0.500	0.041	0.486	0.048	0.329	0.198	0.664	0.004*	-0.652	0.006*
Consequences	0.501	0.041	0.764	0.000*	0.643	0.005*	0.229	0.376	0.478	0.052	-0.738	0.001*
Communication	0.254	0.325	0.325	0.203	0.449	0.070	0.443	0.075	0.523	0.031	-0.573	0.020
"Core"	0.267	0.301	0.345	0.175	0.281	0.275	0.107	0.684	0.431	0.084	-0.480	0.117

\* $p\leq 0.01$  (Sig. 2-tailed); \*\* $p\leq 0.001$  (Sig. 2-tailed).

(range 51–100)) and the patients still on sick leave (median 55 (range 35–75)) ( $p=0.017$ ). This could be compared with the normal value in Sweden of mean 83.49 (35).

## DISCUSSION

The objective of this study was to examine the experience of fatigue and its relationship with behavioural and psychosocial outcomes, cognitive function, and QoL, as well as with work status 12 months after TBI and suspected TAI. A further objective was to examine patients' self-reported problems, and to compare these with their relatives' experiences, regarding dysfunctions in the patient's behaviour, cognition and mood.

This study should be considered as a pilot study due to the small sample size, perhaps as a result of the inclusion criteria and the difficulty of identifying a "pure" TAI (3), which reduced the generalizability of the results.

Because fatigue is a complex and subjective phenomenon with multifactorial origins (4), it was important to cover various functions after TBI that could have impacted fatigue.

In choosing our instruments, we wanted to use short, reliable and validated instruments, that were easy to administer and easy for the patient to understand and respond to despite the cognitive impact and fatigue associated with TBI (38), especially during the acute phase. The instruments also needed to be sensitive enough to differentiate between the 3 assessments reported in the longitudinal follow-up study of the first year, which was previously reported (16).

Prolonged fatigue is a well-known consequence of TBI (4–6), and no recovery appears to occur after the first year post-injury (11). Supported by previous research, this study found no significant associations between fatigue and severity of injury (GCS), cause of trauma (4, 5, 9, 10), or age (5). In addition, no difference was shown between the sexes; a result supported by some research (4, 10) but contrary to others (9).

One year after TBI, 85% of the sample patients still had cognitive dysfunction (BNIS). Although no significant correlation was found between cognition (as measured by the BNIS) and fatigue (D-FIS), a similar finding to previously reported results (10), the subjective perception of general cognitive problems, especially memory and the executive function of planning, correlated significantly with fatigue (D-FIS); moreover, the majority of patients who reported that fatigue caused great to extreme problems in daily life also reported feeling tired and dull (82.4%).

In our study, the more fatigued patients (three-quarters of the sample) subjectively perceived concentration and memory problems; a need to do things slowly; difficulty in planning, making decisions, getting things done on time; more impulsive reactions; and a feeling of being dull and restless (EBIQ). The subjective perception of fatigue thus seems to include an interaction of cognitive dysfunctions, emotions and behavioural changes. It might also be that the cognitive dysfunctions, very common after TBI and TAI (3, 7, 14–20), were related to the mental effort necessary to sustain attention and compensate for slow processing (4–8), reported by 76.5% in our study, and

cognitive deficits resulting in an experience of fatigue. Encountering problems can lead to psychological fatigue, which works to protect the person from further frustration and failure, while potentially causing boredom or a decrease in motivation (4). It was found that the more unmotivated patients also experienced more anxiety/depressive mood ( $p=0.004$ ) and a lower QoL ( $p=0.005$ ) (Table III), which also might cause the patient (13) and family (27) distress.

That perceived changes in daily functioning appears to influence emotional well-being over time after TBI was reported by Pagulayan et al. (26), who found that patients who reported more depressive symptoms endorsed more injury-related difficulties, showing a strong relationship between depression and perceived psychosocial functioning. This research supports our results, as we found that the more anxious/depressed patients (EQ-5D) generally experienced more behavioural, psychosocial and mood problems (Table III), as they were significantly more irritated, depressed, unmotivated, inactive, and isolated (EBIQ) than the less anxious/depressed patients. These changes are common after TBI and might be a result of the brain injury itself (4, 6, 9), but these changes may also serve psychologically as protective strategies to reduce confrontation with inability, further fatigue, anxiety and stress. Bay & de-Leon (13) reported that chronic situational stress was associated with fatigue-related QoL in TBI. Irritability, as an expression of stress and anxiety (13), was found to associate significantly with experiencing more anxiety and isolation (Table III). More than half the group also reported mood swings, increased stubbornness and quick reactions to what others said and did, which might also be expressions of over-loading and stress (13).

Although no significant association was found between fatigue (D-FIS) and QoL, most patients (82.4%) reported a strong link between feelings of tiredness and dullness and perceiving a lower QoL, as previously reported (9). Also, significant correlations showed that cognitive and attention disability (BNIS), subjective perception of executive dysfunction, lack of motivation and mood disturbances (EBIQ) all resulted in a lower QoL (Table II and III).

Fatigue can interfere with return to work (6, 12), as evidenced by only 5 people in this study returning to adjusted employment during the first year; however, no significant difference was found in fatigue between this group and those still on sick-leave, in accordance with previously reported results (6). It might be that return to work requires increased mental effort to compensate for cognitive deficits and slowed processing, in order to reach an adequate level of performance (4, 5), which consumes mental energy and therefore leads to continuous fatigue.

Cognitive ability did not differ between the working and the sick-listed groups; however, those who returned to work showed a significantly better attention (BNIS), as reported previously (16). They were also assessed as more active and participating, according to the GOSE. No significant differences were found in perception of the consequences of TBI, mood or QoL between the working-group and the sick-listed

group. Although working patients were still fatigued, their ability to return to work after TBI might have given a feeling of more independence, less stress and less disability, resulting in greater confidence.

Patients may under-report cognitive and behavioural difficulties (22), but a more realistic perception of deficits that also testified to a better self-awareness was reported to associate with fewer psychopathological symptoms, better neuropsychological functioning and independence (15). When patients' reports were compared with those of their next of kin, significant agreement was found in experiences regarding the patient's cognitive ability, executive function and the general consequences after the injury. Regarding motivational, emotional and psychosocial variables, compared with their relatives, the patients seemed to somewhat under-report the severity of their dysfunctions. This might indicate deficits in self-awareness (12, 14) or a conscious suppression of the perceived remaining dysfunctions that poses a threat, which might trigger anxiety and stress and have a stressful impact on the family (4, 27).

The results indicate that fatigue and the subjective perception of overall cognitive, behavioural and psychosocial difficulties after TBI and TAI correlated. Although no correlation was found between fatigue and cognition, as measured by the BNIS, the subjective experience of cognitive dysfunction, particularly in planning and memory, was significantly associated with fatigue. For some people, the subjective experience is most essential, and seems to become the patient's objective reality, upon which his/her reactions are based.

Neither fatigue nor cognition differed significantly between the working and sick-listed groups. The non-working group still reported a greater impact of their injury regarding fatigue, cognition, executive function, mood, behaviour and QoL. However, family members did not report any significant differences in cognitive, emotional and behavioural functions between patients in the working and the sick-listed groups. One explanation for these results could be differences in the personalities between the two groups, where persons in the non-working group might be more fragile and vulnerable and react more strongly to alterations affecting their lives in ways they feel they cannot control, as they had before.

The results of this study indicate the importance of taking TBI patients with acute affected consciousness seriously, even if the CT scan does not verify any brain damage. Attending to the patient's own perceptions of the impact of the TBI and complementing rehabilitation with neuropsychological examination, treatment and support might improve the patient's outcome, although further research is needed.

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