

ORIGINAL ARTICLE

Comorbidity and Insurance as Predictors of Disability After Traumatic Brain Injury



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Abstract

Objective: To examine the unique contribution of self-reported medical comorbidity and insurance type on disability after traumatic brain injury (TBI).

Design: Inception cohort design at 1-year follow up.

Setting: A university affiliated rehabilitation hospital.

Participants: Adults with mild-complicated to severe TBI (N=70).

Intervention: Not applicable.

Main Outcome Measures: Self-reported medical comorbidities were measured using the Modified Cumulative Illness Rating Scale, while insurance type was classified as commercial or government-funded; disability was measured using the Disability Rating Scale.

Results: Two models were run using multiple linear regression, and the best-fitting model was selected on the basis of Bayesian information criterion. The full model, which included self-reported medical comorbidity and insurance type, was significantly better fitting than the reduced model. Participants with a longer duration of posttraumatic amnesia, more self-reported medical comorbidities, and government insurance were more likely to have higher levels of disability. Meanwhile, individual organ systems were not predictive of disability.

Conclusions: The cumulative effect of self-reported medical comorbidities and type of insurance coverage predict disability above and beyond well-known prognostic variables. Early assessment of medical complications and improving services provided by government-funded insurance may enhance quality of life and reduce long-term health care costs.

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Approximately 1.7 million individuals sustain a traumatic brain injury (TBI) in the United States each year.¹ Many of these individuals experience long-term physical disability that affects their quality of life and places a significant burden on the health care system.²⁻⁴ To improve rehabilitation outcomes and reduce disability for persons with TBI, treatment plans need to become more targeted. This can be accomplished by increasing our understanding regarding commonly overlooked rehabilitation-related factors such as medical comorbidity and insurance type.

Persons with TBI may experience medical comorbidities at a similar rate as the general population.⁵ Conversely, they are

susceptible to the development of novel comorbidities, which can generally be attributed to injury, treatment, or post-injury-related factors. For instance, moderate-to-severe TBI is known to cause neuropathological changes,⁶ some of which have been linked to the development of psychiatric illness.⁷⁻¹⁰ Epileptic seizures are also commonly caused by TBI and can be more difficult to treat relative to seizures in the absence of brain trauma.¹¹ Moreover, the violent causes of most TBIs can also cause persistent orthopedic injuries.¹²

Treatments associated with TBI can increase the risk for developing various complications. For example, induced hypothermia, which is used to improve neurological recovery in persons with severe TBI,¹³ may cause ventricular arrhythmia and atrioventricular blockage.¹⁴ Decompressive craniectomy has been associated with the development of brain infections, hydrocephalus, and syndrome of the trephined.¹⁵ Similarly, intubation and tracheotomy procedures can lead to the development of sinusitis,

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laryngotracheal stenosis, vocal cord damage, esophageal perforation, retropharyngeal abscess, and nerve injury.¹⁶⁻¹⁹

Lifestyle changes after TBI have also been associated with medical illness. For instance, physical inactivity resulting from disability²⁰ can lead to obesity, heart disease, and diabetes.²¹⁻²⁴ Furthermore, difficulties in coping with TBI can result in the development of psychological illness, especially depression.²⁵⁻²⁷

Having briefly discussed common medical comorbidities that affect persons with TBI, the next step is to better understand the cumulative effect of these complications on disability. For other rehabilitation populations (ie, patients with stroke and orthopedic problems), comorbidity has been shown to negatively affect disability.²⁸ Similarly, in persons with TBI, the presence of medical complications has also been associated with more disability.²⁹ However, the predictive ability of medical comorbidity in relation to other variables as well as its long-term effect on disability is poorly understood.

Type of insurance coverage may also be an important prognostic factor given its effect on quality of care.^{30,31} For example, research has found that patients with Medicaid are 68% more likely to be discharged to a skilled nursing facility rather than a rehabilitation facility relative to patients with commercial insurance.³² It was also found that patients who are funded through a health maintenance organization (HMO) are 23% more likely to be discharged to a skilled nursing facility than are patients with fee-for-service insurance.³² These results are important because inpatient rehabilitation facilities are thought to provide more intensive postacute rehabilitation care than do skilled nursing facilities or home health. Other studies have found that uninsured patients are less likely to be transferred to an inpatient rehabilitation facility relative to commercially funded individuals. Uninsured individuals are also more likely to leave against medical advice, and they have a significantly shorter length of stay.^{33,34}

These results suggest that type of insurance coverage has the potential to predict outcome. However, studies that have examined this issue tend to classify groups on the basis of individuals who are insured versus those who are uninsured. Not surprisingly, these investigations confirm that having insurance coverage is associated with lower levels of disability.³⁵ Conversely, the relation between the type of insurance coverage (ie, government-funded vs commercially funded) and disability requires further examination.

As such, the aim of this study was to investigate whether insurance type and the cumulative effect of self-reported medical comorbidities are predictive of disability above and beyond demographic and injury factors. It was hypothesized that government-funded insurance and greater self-reported medical problems would be associated with higher levels of disability after TBI.

List of abbreviations:

BIC	Bayesian information criterion
DRS	Disability Rating Scale
EENT	eye/ear/nose/throat
HMO	health maintenance organization
MCIRS	Modified Cumulative Illness Rating Scale
PTA	posttraumatic amnesia
TBI	traumatic brain injury
TBIMS	Traumatic Brain Injury Model Systems

Methods

Participants

This study used archival data from 70 individuals enrolled in the Southeastern Michigan Traumatic Brain Injury System, which is part of the National Institute on Disability and Rehabilitation Research—funded Traumatic Brain Injury Model Systems (TBIMS) project.³⁶ Approval for this study was granted by Wayne State University's Internal Review Board. Demographic and injury characteristics of the sample are described in tables 1 and 2, respectively. All participants received acute care at the TBIMS site within 72 hours of injury and had a Glasgow Coma Scale score of 3 to 12 or 13 to 15 with intracranial hemorrhage. Those with a Glasgow Coma Scale score of 13 to 15 with positive neuroimaging findings were classified as having a mild-complicated TBI.³⁷ Informed consent was obtained by the participant or a designated proxy if the participant was suffering from posttraumatic amnesia (PTA) at the time of inpatient rehabilitation.

Measures

The Modified Cumulative Illness Rating Scale (MCIRS) was used to assess medical comorbidities.²⁸ The MCIRS was selected because it allows a meaningful comparison of medical burden and treatment outcomes in individuals with variable and complex medical information and because it has been validated in a rehabilitation population.^{28,38} The MCIRS is a 14-item rating scale used to indicate medical burden by rating impairment across 13 different organ systems (cardiac, hypertension, vascular, respiratory, eye/ear/nose/throat [EENT], upper gastrointestinal, lower gastrointestinal, hepatic, renal, other genitourinary, musculoskeletal, neurological, and endocrine-metabolic) as well as psychiatric/behavioral disturbances (excluding dementia). Ratings are made on a 0 (no impairment) to 4 (extremely severe impairment) scale. For this study, ratings for the "neurological" category were excluded given the fact that it was already known that the participants sustained a TBI and the focus of this study was to look at comorbid issues in conjunction with a TBI; thus, total scores ranged from 0 to 52.

The Disability Rating Scale (DRS) was used to assess the level of participant disability.³⁹ The DRS consists of 4 categories (arousal and awareness, cognitive ability to handle self-care instructions, physical dependence on others, and psychosocial ability to work and perform daily functions). The scale was developed for use with adult individuals with moderate-to-severe TBI to track disability over the course of recovery. Total scores

Table 1 Demographic characteristics (N=70)

Characteristic	Mean ± SD	Range
Age (y)	37±14.2	16–67
Education (y)	12±2.2	8–18
Sex (%)		
Male	81	
Female	19	
Ethnicity (%)		
Black	61	
White	36	
Hispanic/Native	3	
American/Pacific Islander		

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