A cross sectional study of neuropsychiatric problems in patients with traumatic brain injury treated in a tertiary care rehabilitation center

Kattula Dheeraj

Dissertation submitted in partial fulfilment of the requirements of

The Tamilnadu Dr. M. G. R. Medical University for the award of the degree of

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C E R T I F I C A T E

I hereby declare that this dissertation titled “A CROSS-SECTIONAL STUDY OF NEUROPSYCHIATRIC PROBLEM IN PATIENTS WITH TRAUMATIC BRAIN INJURY TREATED IN A TERTIARY CARE REHABILITATION CENTER” is a bonafide work done by me under the guidance of Dr Anna Tharyan, Professor and Head of the Department of Psychiatry. This work has not been submitted to any university in part or full.

Dr Kattula Dheeraj
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C E R T I F I C A T E

Certified that the dissertation titled ‘A cross sectional study of neuropsychiatric problems in patients with traumatic brain injury treated in a tertiary care rehabilitation center’ is a bonafide record of original research work undertaken by Dr.Kattula Dheeraj under my guidance, at the Department of Psychiatry, Christian Medical College, Vellore, in partial fulfilment of the requirements for the award of the Degree of Doctor of Medicine (MD) in Psychiatry.

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D E C L A R A T I O N

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To my wife, who encouraged.

To my daughter, who has added meaning to my life.

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Table of Contents

Thesis Abstract

A cross sectional study of neuropsychiatric problems in patients with traumatic brain injury treated in a tertiary care rehabilitation center

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OBJECTIVES:

1. To measure and describe the nature and prevalence of neuropsychiatric problems and psychiatric disorder after Traumatic Brain Injury (TBI).
2. To measure disability consequent to TBI.
3. To study the association if any between socio-demographic variables, trauma related variables, cognitive status, presence of psychiatric illness prior to TBI and co-morbidities with the occurrence of neuropsychiatric problems and disability.

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METHODS:

Adult patients with TBI, who are admitted in Rehabilitation Institute who fulfil selection criteria are recruited into the study. The using standard tools neuropsychiatic symptoms, cognitive status, disability were measured. Clinical interview and review of records gave information about TBI and psychiatric disorders. Descriptive analysis of the outcomes was done. Comparison was made

between different groups with appropriate statistical tools. Univariate regression analyses were performed for all associated factors. Multivariate analysis was done for factors found to be associated by adjusting for other factors.

RESULTS:

In the subjects under study 30% had psychiatric disorders. 94 % of them had neuropsychiatric symptoms. Operation having been performed on them increased the risk significantly by 5 times for both outcomes. Indicating more severe head injury leads to greater neuropsychiatric morbidity. Distribution of NPI scores was skewed to right. Its median was 11.5 with inter-quartile range from 5 to 8. Symptoms of depression, agitation/aggression and irritability/lability had high care-giver distress. Symptoms of appetite change, irritability/lability, agitation/aggression and apathy and indifference had high burden scores on the patients.

Alcohol consumption at the time of injury and severity of injury measured in GCS was associated with worse level of functioning in Ranchos Los Amigos Level of Cognitive functioning scale. The same were associated with patients not assessable for cognitive function through Addenbrooke's Cognitive Examination- Revised test.

Distribution of Disability scores was skewed to right. It had a median of 7.25 with an inter-quartile range of 4 to 17.Presence of weakness in more than one limb was significantly associated with greater disability as measured by Disability Rating Scale.

CONCLUSION:

The prevalence of psychiatric disorder and neuropsychiatric symptoms in patients with traumatic brain injury admitted in the tertiary care Physical Medicine and Rehabilitation facility was very high. Needing a neurosurgery, a marker for severe injury was significantly associated with these. Presence of weakness of 2 or more limbs and consumption of alcohol at the time of injury was significantly associated with higher disability. The neuropsychiatric symptoms of agitation/aggression, irritability and weight/ appetite change were the most burdensome symptoms to patients and caregivers.

Treatment of patients with TBI should involve a multidisciplinary approach, in which there is a close collaboration between neurologist/neurosurgeon, physiatrist, family physician, social worker, psychologist, family members, patient and the psychiatrist.

Introduction

Traumatic Brain Injury [TBI] can be defined as an externally inflicted blow to the brain with a cause that is not of a degenerative, vascular, infectious or congenital nature. Most commonly TBI occurs following a fall, road traffic accidents, assaults and accidents related to sports. Worldwide TBI is acknowledged as a significant problem. A review of epidemiological studies done in Europe suggested an incidence of 235 hospitalized cases per 100,000 population *(Tagliaferri et al., 2006).* This had included fatalities as well. In the other side of Atlantic in United States of America, incidence is estimated at 150 per 100,000 population *(McAllister, 2008)*. There is insufficient data is available from other parts of the world. In India it can be estimated that nearly 15 lakh to 20 lakh people get injured and 10 lakh die every year due to TBI *(Gururaj, 2002).*

In the recent years due to improvement in health systems and care higher survival has been achieved for those who have suffered TBI, but many of those survivors suffer chronic neurobehavioral sequelae, personality changes and increased rate of psychiatric disorders. Neuropsychiatric problems may occur anytime after injury. They vary in nature from subtle changes in mood, behavior, and cognition to serious impairments as in severe depression, agitated behavior, or dementia. Well-defined syndromes occur, but also non-specific symptoms such as fatigue, insomnia, or apathy also occur. They may occur in isolation or in combination with other symptoms. Experts opine that a patient's neuropsychiatric symptoms may not fit neatly into DSM–IV diagnostic criteria in routine practice *(Vaishnavi et al., 2009).*

Justification

The reduction in TBI-associated mortality rates *(Sosin et al., 1996)* has significantly increased the number of people with long-term TBI related neurobehavioral disorders *(McAllister, 1992, Arciniegas et al., 2000).* Many times in clinical practice, the surviving patient's neuropsychiatric symptoms do not fit neatly into diagnostic criteria of DSM–IV *(Vaishnavi et al., 2009).* This necessitates studying if symptoms and not just psychiatric disorders.

In India it can be estimated that nearly 15 to 20 lakh people are injured and 10 lakh die every year due to TBI. About 60% of the injuries caused are related to Road traffic Accidents. The need for rehabilitation of persons with TBI is not only high but is increasing every year *(Gururaj, 2002).*

The presence of psychiatric disorder impedes the treatment and rehabilitation of a patient by interfering in compliance, reducing motivation, increasing suicidal risk and integration to normal community life even after physical recovery. Studies show prevalence of psychiatric disorders ranging from 50% *(Koponen et al., 2002)* to up to 80% *(Hibbard et al., 1998).*

There are no known studies done in patients admitted in Physical Medicine and Rehabilitation wards for neurobehavioral sequelae in India. Information regarding psychiatric illness following TBI in India would be essential to planning for services required as well as in the area of education and training of rehabilitation personnel. This would also help in assessing need of a psychiatrist in teams treating patients with TBI.

Review of Literature

Background

Traumatic Brain Injury [TBI] is defined as an externally inflicted blow to the brain with a cause that is not of a degenerative, vascular, infectious, or congenital nature Most commonly TBI occurs following a fall, road traffic accidents, assaults and accidents related to sports. Worldwide TBI is acknowledged as a significant problem. In the recent years due to improvement in health systems and care higher survival has been achieved for those who have suffered TBI, but many of those survivors suffer chronic neurobehavioral sequelae, personality changes and increased rate of psychiatric disorders.

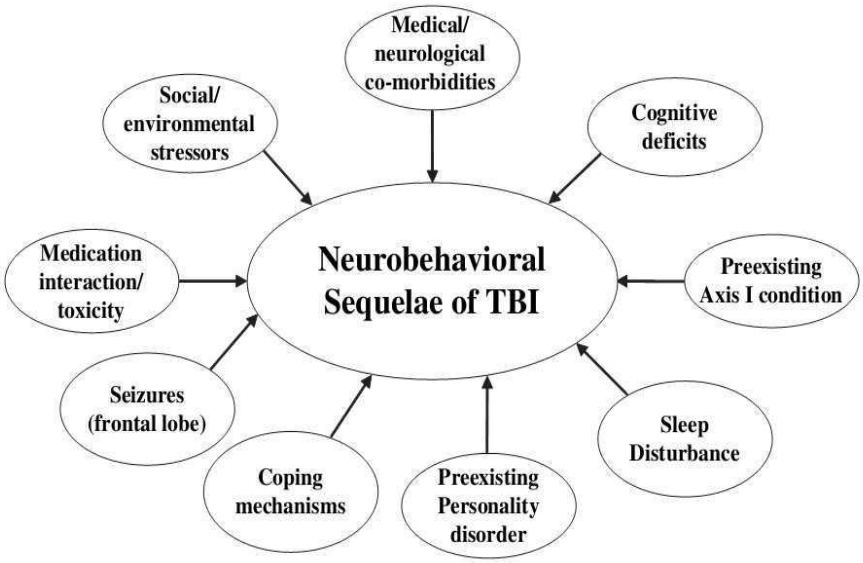
Neuropsychiatric problems may occur anytime after injury. They vary in nature from subtle changes in mood, behavior, and cognition to serious impairments as in severe depression, agitated behavior, or dementia. Well-defined syndromes occur, but also non-specific symptoms such as fatigue, insomnia, or apathy do occur. They may occur in isolation or in combination with other symptoms. Experts opine that a patient's neuropsychiatric symptoms may not fit neatly into DSM–IV diagnostic criteria in routine practice *(Vaishnavi et al., 2009).*

According to the World Health Organization Collaborating Centre Task Force, a diagnosis of TBI-related Neurobehavioral sequelae [NBS] requires the presence of at least three or more out of the following eight symptoms:

1. Insomnia
2. Concentration
3. Memory difficulties
4. Headache
5. Dizziness

6. Fatigue
7. Irritability
8. Intolerance to stress, emotion, or alcohol

The symptoms seen in TBI patients overlaps with many psychiatric, neurological disorders and medical disorders. Seizures which can occur in TBI can complicate the presentation, for example seizures arising from frontal lobe can be associated with bizarre behavioural manifestations and repetitive motor activity (RMA), which can easily be mistaken for a psychiatric problem. It cannot be overemphasized that symptoms may vary, based on which side of the brain injury is, which area of the brain injury occurred, how much is the extent of the injury, what the medical and psychiatric comorbidities are, and also the psychosocial variables. Only in a carefully designed evaluation these conditions can be sorted out. Factors that help one to distinguish among diagnoses include time of onset, duration of symptoms, and characteristics of the symptoms *(Riggio, 2010).*



Epidemiology

A review of epidemiological studies done in Europe suggested an incidence of 235 hospitalized cases per 100,000 population *(Tagliaferri et al., 2006)*. This had included fatalities as well. In the other side of Atlantic in United States of America, incidence is estimated at 150 per 100,000 population *(McAllister, 2008).* There is insufficient data is available from other parts of the world.

The incidence rates are usually calculated from hospitalized cases. They do not include injured people who do not seek or have no access to care. So, the real incidence of TBI is likely to be 3 to 4 fold higher than what studies quote. Many studies have suggested that the incidence rates for TBI are highest in the second and third decades of life. They also report an increase in TBI in the elderly age group due to risks from falls. Men are more likely to suffer a TBI than women *(Bruns and Hauser, 2003).*

In India estimates are that nearly 15 lakh to 20 lakh people are injured and 10 lakh die every year due to TBI. Road Traffic Accidents account for 60% of these injuries. A significant proportion of them, about 20% are associated with alcohol use at the time of trauma *(Gururaj, 2002).*

In the developed world, there has been a significant reduction in the mortality rates associated with TBI. This has happened over the last several decades. This can be generally attributed to improved systems. This applies to healthcare industry especially trauma care and also to automotive industry which has improved design of motor vehicles for increased safety. Most people with mild TBI and literally all people who survive moderate and severe TBI live with significant long-term neurobehavioral sequelae *(Levin et al., 1990)*. Therefore the reduction in TBI-associated mortality rates *(Sosin et al., 1996)* has significantly increased the number

of people with long-term TBI related neurobehavioral disorders *(McAllister, 1992, Arciniegas et al., 2000).*

Neurobiology of TBI

Broadly there are two types of TBI. They are closed and penetrating type of injuries. It is understandable that in penetrating injuries underlying areas are affected. Damage in the closed form of injuries is due to contact [impact] or inertial [acceleration and deceleration]. Contact mechanisms often end up damaging scalp, skull, and brain surface. These could be in form of contusions, lacerations or hematomas. Common sites for such injuries are frontal poles, anterior temporal poles, cortex on lateral and inferior aspect of temporal lobe and orbital frontal cortices.

Rapid acceleration or deceleration of brain may produce forces of shear, tensile, and compressive nature. These forces lead to inertial injuries. Their impact is maximal on axons and blood vessels. This leads to axonal injury, tissue tears, and intra-cerebral hematomas. A more widespread or diffuse injury (diffuse axonal injury) to white matter can also be produced. There are few particularly vulnerable areas like rostral brainstem, corpus callosum, and subfrontal white matter *(McAllister, 2011).*

Both forces combine and result in many injuries. When this occurs immediately, it is called as primary injury. The injury could also evolve over time, when it is referred to as secondary injury. Factors like hypoxia, edema, and elevated intracranial pressure cause secondary injury. Sometimes mechanical distortion of the neurons leads to massive release of neurotransmitters. This triggers excitotoxic injury cascades *(Raghupathi et al., 2000)*. These cascades added to other forms of secondary injury like tissue hypoxia affect certain brain regions disproportionately. Areas like hippocampus get affected even in the context of a mild injury *(Umile et al., 2002)*.

Damage that occurs could be diffuse or multifocal. Certain regions in the brain are extremely vulnerable to injury. This could account for the high rates of challenging behaviours. This also probably explains the higher rate of psychiatric illness in patients with TBI. These vulnerable areas are the temporal lobes including the hippocampi, deeper mid-line structures which include the basal ganglia, frontal cortex and sub-frontal white matter and the rostral brainstem.

Evidence suggests that neurotransmitters which play an important role in maintaining homeostasis in cognitive and behavioural domains are altered in TBI. One could consider the example of catecholaminergic systems, which suffer significant dysfunction of with TBI *(McAllister et al., 2004).* The is central cholinergic tone being altered following trauma is also evident *(Arciniegas, 2003)*. The cholinergic system is known to play a very important role in cognitive domains like memory and attention. It could also play a role in the birth of mood disorders like depression. Serotonergic system is found to be activated in TBI. There are increased levels of serotonin, especially in areas where there was significant tissue damage. This is also associated with lowered regional cerebral utilization of glucose *(McAllister, 2008)*.

Neuropsychiatric problems in TBI

Neuropsychiatric problems may occur anytime after injury. They vary in nature from subtle changes in mood, behavior, and cognition to serious impairments as in severe depression, agitated behavior, or dementia. Well-defined syndromes occur, but also non-specific symptoms such as fatigue, insomnia, or apathy also occur. They may occur in isolation or in combination with other symptoms. Experts opine that a patient's neuropsychiatric symptoms may not fit neatly into DSM–IV diagnostic criteria in routine practice *(Vaishnavi et al., 2009).*

Broadly they may be studied under the following heads.

- Cognitive deficits following TBI
- Personality changes following TBI
- Psychiatric disorders following TBI.

Cognitive deficits after TBI

Cognitive deficits are quite common after TBI. They could present initially and resolve or sometime even persist for longer periods of time *(Lovell M, 1994).* These hinder return to normal functioning in the domains of living independently, family life, fulfilment of social roles and maintaining a job *(McAllister, 2008).* Cognitive domains that are predictably impaired are:

1. Attention *(Mathias and Wheaton, 2007)*
2. Frontal executive functions (impulse control, self-monitoring, problem solving, set shifting) *(Lehtonen et al., 2005, Freedman et al., 1987)*
3. Short-term memory and learning *(Levin et al., 1988, Vakil, 2005)*
4. Emotion processing *(Jackson and Moffat, 1987)*
5. Speed of information processing *(Rassovsky et al., 2006, O'Jile et al., 2006)*
6. Speech and language functions *(Weintraub et al., 1981)*

These aren't completely independent domains, as anyone can understand. Clearly there is a mixture of deficits across domains in varying degrees. Studies from sports medicine literature demonstrate that cognitive deficits resulting from sports-related mild TBI rarely last more than 3 months and usually resolve within days. They also report that cognitive impairments are most severe immediately after a closed head injury and resolve within 48 hours, supporting the importance of cognitive rest immediately after a mild TBI *(Riggio, 2010).*

Castano et al used Neuropsychiatric Inventory to 53 patients with severe TBI and found that 92.5% of them have neuropsychiatric symptoms. They report the most commonly seen symptoms were that of irritability/lability, depression/dysphoria and apathy. Those patients who had history of drug abuse had more psychiatric symptoms. Presence of symptoms of agitation/aggression, apathy and disinhibition was correlated with more disability *(Castano Monsalve et al., 2010).*

Personality change after TBI

Caregivers or family members frequently describe a change in regulation of emotions and behaviour. They might call it "changes in personality". This can happen in two different ways:

1. Exaggeration of pre-injury traits
2. Fundamental change in patterns of response.

In the second category, the changes could be due to change in the frequency or intensity of predictable responses to various stimuli or due to unpredictable response patterns.

There are many recognizable symptom clusters which can be considered as "personality changes". Impulsivity is one such problem domain. It usually manifests as verbal utterances, snap decisions, physical acts and poor judgment. These seem to arise due to failure to fully consider consequences of one's given action. There is a related concept of stimulus boundedness. In this the person responds to the most salient cue in the surrounding. He/she could also attach exaggerated salience to a particular cue, without considering previously priorities or foci or attention.

Irritability is the second problem domain. People who survive head injuries are described as easily angered or irritable. Sometimes a cue may be perceived as a legitimate slight, but the response is dramatically out of proportion to the

precipitating stimulus. One's responses could range from outbursts of anger verbally to dangerous behaviours of aggression and assaulting. There is an individual to individual difference in how behavioural modulation gets affected. The variability occurs in intensity, onset, and duration of behaviour problems. Aggression as a symptom is most commonly associated with moderate and severe injuries. Tateno and colleagues studied 89 consecutive in-patients with moderate to severe TBI for the first 6 months of injury. They found that 34% of them showed aggressive behavior. The risk factors for aggression after TBI that they found were injury to frontal lobe, personality disorder, diagnosis of affective disorder before TBI and alcohol/ substance abuse *(Tateno et al., 2003).*

Affective instability is the third problem domain under consideration. Family members/caregivers describe displays of 'out of proportion' emotional expression quite frequently. The range is more than what the precipitating stimulus warrants or what the pre-injury response would have been similar stimuli. Little cues that once only elicited short lasting sadness would precipitate weeping or crying after TBI. Events which would have only provoked a frown or irritable reply after TBI would provoke loud verbal anger outbursts. This might at times be associated with sympathetic arousal. Other characteristics of such instability are sudden onset, short duration, and subsequent remorse. This phenomenon is also seen in other central nervous system disorders. This has also been called affective lability, pseudobulbar affect, pathological affect, and affective incontinence *(McAllister, 2008).*

The burden caused due to changes described in behaviour and personality is further complicated by a lack of awareness of these changes *(Flashman et al., 2001)* by the injured. This is in stark contrast to family/care-givers. They are fully aware that the injured individual has changed in fundamental ways and are usually pained by it.

Sometimes persons with TBI may sense vaguely that they are different. They may not be able to exactly state how different their behavior or personality became after the TBI. People with TBI are more aware of concrete domains such as motor function than domains of executive functioning and behaviour. It is found that the degree of awareness is correlated with functional and vocational outcome in many *(Sherer et al., 1998a, Sherer et al., 1998b),* though not all *(Cavallo et al., 1992)*, studies. There is literature available to suggest that lack of awareness is not just a part of global cognitive deficits, but could possibly indicate frontal-executive dysfunction *(Cuesta and Peralta, 1994, Cuesta et al., 1995).*

Apathy is the fourth cognitive domain under study. Apathy is quite common after TBI. Kant and his colleagues found that it often co-occurred with depression, at least in 60% of their sample *(Kant et al., 1998)*. Andersson and his colleagues found that almost 50% of their study patients with TBI had significant level of apathy. *(Andersson et al., 1999).*The deficit underlying this is associated with the realm of motivated behaviour *(Marin, 1991).* Although apathy is not as disturbing as few other changes described in the section above, it is of great concern. This is because apathy is a common reason for injured individuals to fail progressing in rehabilitation programs. Apathy can often be misinterpreted as laziness or the psychiatric disorder of depression. It sometimes is paradoxically linked to aggression. This happens when it is attempted to engage the patient in activities that they have little interest. This may even precipitate assaultive behavior *(McAllister, 2000).*

The association between the injury profile in a typical TBI and changed behaviours is understood in anatomical terms. There are five major frontal-subcortical circuits that have been identified. These circuits are very vulnerable to injury in any typical TBI.

1. Dorsolateral prefrontal cortex and its circuitry: Damage impairs executive functions like problem solving, working memory, decision making and mental flexibility.
2. Orbitofrontal cortex and related nodal points: Damage impairs social behaviors, which are intuitive and reflexive. The capacity to monitor and correct self in real time within a cultural social context is lost.
3. Anterior cingulate and related circuitry: Damage impairs motivated and reward-related behaviours.
4. Mesial temporal regions: Damage impairs emotional aspects of memory. There is impairment in assessment of real time experience leading to stimulus salience.
5. Frontal Sub-cortical circuits: These are responsible for higher intellectual function and complex human behaviours emanating from empathy and motivation. Damage leads to deficits in these functions.

Psychiatric disorders and TBI

Changes in cognition, behavior, and personality have been described in the section above. In addition to these, there is enough evidence to suggest that TBI leads to an increased risk of developing a range of psychiatric disorders. These include mood disorders, anxiety disorders, substance related disorders and psychotic disorders *(Deb et al., 1999, Hibbard et al., 1998, van Reekum et al., 2000, Koponen et al., 2002)*. Consider the work done by Kopenen and colleagues, who studied 60 people 30 years after their TBI in Finland. They found that nearly half of them (48%) had developed a new Axis I psychiatric disorder after their TBI. The most common diagnoses in their study were depression, anxiety disorders, and substance abuse. There were significantly different rates of lifetime and current psychotic disorders (8%; 8%),

panic disorder (8%; 6%), and depression (26%; 10%) compared to general population base rates found in the Epidemiologic Catchment Area (ECA) study *(Koponen et al., 2002, Bourdon et al., 1992)*. This Finnish study emphasized the importance of psychiatric follow-up after TBI as around half of them got a novel psychiatric disorder after the TBI.

Hibbard and colleagues studied 100 adult people who had TBI and found high prevalence of Axis 1 disorders. On an average TBI had occurred 8 years prior to assessment in their study. They found 51% as having Axis 1 psychopathology of whom 34% had one diagnosis and 17% had more than one diagnosis even before they had a TBI. After the TBI the prevalence of one diagnosis rose to 36%, and for two or more diagnosis it rose to 44%. This meant prevalence of at least one axis 1 diagnosis after a TBI is 80% *(Hibbard et al., 1998)*. The most frequent diagnoses after TBI were major depression and anxiety disorders. The term anxiety disorder was broad covering post-traumatic stress disorder (PTSD), obsessive-compulsive disorder and panic disorder.

A group reported a cohort study of 188 patients enrolled within four years of injury. They assessed the patients at yearly intervals on at least two occasions *(Ashman et al., 2004)*. They found higher rates of depression and substance abuse prior to injury compared to general population base rates found in the ECA study. After the TBI there was increased rate of depression and anxiety disorders including PTSD. The pre-injury psychiatric patients were particularly at risk for development of these disorders. They also reported that the rates were higher at assessments close to TBI and the risk decreased over time.

Deb and colleagues compared prevalence of psychiatric disorders in people with TBI with general population and found a greater prevalence of depressive disorders and panic in people with TBI *(Deb et al., 1999).*

Richard Bryant and colleagues studied a group of patients who had sustained mild TBI. In 817 patients interviewed 1 year after follow up, 31% had psychiatric disorder of which 22% had developed psychiatric disorder in the 1 year after the trauma. *(Bryant et al., 2010).*

Gould and colleagues studied predictive and associated factors of psychiatric disorders after one year of having had TBI and found individuals without distress in the acute post-injury stage, pre-injury psychiatric issues, or limb injury, were at lesser risk to develop a psychiatric disorder, particularly depression. This was at least at 1 year post-injury *(Gould et al., 2011)*.

Van Reekum and colleagues report in their review that there is very strong evidence to argue for causation for psychiatric disorders of bipolar affective disorder, major depression and the anxiety disorders after TBI. They found psychosis and substance abuse to occur only rarely after TBI. In the case of diagnosis of schizophrenia, the research suggests that TBI might be protective. However, this could be inaccurate due to methodological problems of psychosis being rare, difficult to detect, filtered off to psychiatric services, affecting access to care and participation in research. Selection biases might limit the evaluation of risks associated with developing substance abuse disorders. They also reported that the sparse research that exists suggested that few personality disorders might occur at high rates after TBI. In addition to pointing to strong association with few psychiatric disorders in people with TBI they also found a dose relationship. i.e. increased rates of psychiatric morbidity in people who have had more severe TBI. In the case of PTSD there was an inverse relationship *(van Reekum*

et al., 2000). Important psychiatric disorders of depression, anxiety disorders, substance abuse disorder and dementia have been described in detail in the following account. Common somatic symptoms have also been described in detail in the following description of psychiatric disorders.

Depression:

Major depressive disorder is one of the most frequent psychiatric disorder after TBI. Studies vary in prevalence due to differences based on methodology. It ranges approximately from 25% to 50% in people who had TBI of moderate to severe intensity versus a general population prevalence of 17%. Studies indicate a positive correlation between psychiatric disorder before TBI and the risk of developing psychiatric disorder after TBI.

The risk factors for developing major depression disorder after TBI include low socioeconomic status and psychiatric pathology before TBI. There is an unclear relationship between rates of depression and the severity of TBI. However it is found that chronicity of major depression is associated with patients with TBI of moderate to severe intensity and psychiatric illness before TBI. There are studies that have found links between suicidality and TBI. They have also found link between suicidality and psychiatric disorders in TBI setting. In a retrospective study of 5034 patients Silver and colleagues reported that patients with a history of loss of consciousness with TBI had a 4 times the risk of attempted suicide than those with history of loss of consciousness without TBI. The rates were 8.1% as against 1.9%, respectively. This risk of attempting suicide remained even after controlling for socio-demographics, variables on quality-of-life, alcohol related problems, and any comorbid psychiatric disorders *(Silver et al., 2001).* Hesdorffer and colleagues

reviewed literature and did not find sufficient evidence linking mild TBI and completed suicide *(Hesdorffer et al., 2009).*

Anxiety disorders/posttraumatic stress disorder:

Anxiety disorders are reported after mild TBI, most commonly in those who sustained a limb injury. The risk factors for acute stress symptoms after TBI are older age, a history of PTSD and an avoidant personality. Usually an acute stress disorder predisposes to the development of PTSD after TBI. PTSD has been associated with mild TBI in the military population whereas evidence linking it to mild TBI in the civilian population is insufficient. Recall of the traumatic event has been identified as a predictor of developing PTSD. Turnbull and colleagues reported that having traumatic memories of the injury was associated with higher psychological distress in a study of fifty five patients *(Turnbull et al., 2001)*.Amnesia for the event, was related to a less severe symptoms of PTSD, although not protective against it. There are other predictive factors for the development of PTSD. They are avoidant coping style and behavioral coping style as against cognitive coping style. The other factor was prior unemployment, which is an indicator of level of functioning premorbidly. There is ongoing controversy regarding the relationship between PTSD and post traumatic amnesia, the point being the likelihood of having the disorder if a patient doesn't recall the traumatic event. The main question is how patients can have PTSD if they cannot meet criteria for re-experiencing the trauma through flashbacks.

The proposed counterargument to the controversy is the theory that TBI patients with post traumatic amnesia for the traumatic event re-experience the trauma event through the imagination from second-hand accounts or the patients' own mind and that the patients may also be able to re-experience fragments or islands of memory within the amnestic period, thus meeting the re-experiencing criterion of PTSD.

The military and civilian experience regarding the association of PTSD with mild TBI are different: Hoge and colleagues studied veterans with mild TBI and a wide variety of post-injury symptoms. When adjusted for PTSD and depression, mild TBI wasn't associated significantly with symptoms except that of headache. The investigators proposed that PTSD and depression play role of mediators in the complex relationship between physical health problems and mild TBI *(Hoge et al., 2008).*

Substance related disorders:

A review of the literature by van Reekum and colleagues reported a 7% higher prevalence of substance abuse in TBI patients. It was 22% in post TBI patients versus 15% lifetime prevalence in the general population. Rogers and Read reviewed subsequent studies showed a prevalence of 12%. Post-TBI drug use was strongly associated with premorbid substance use. Many studies have shown that substance abuse is a risk factor for TBI rather than vice versa. Koponen and colleagues demonstrated in a 30 year longitudinal study that 71% of TBI patients who were currently using drugs also used them before TBI occurred. A systematic review of the literature found limited evidence of an association between TBI and decreased drug and alcohol use up to 3 years after injury *(Hesdorffer et al., 2009)*.

Dementia:

Relationship of TBI to dementia is of concern in addition to the psychiatric disorders discussed in the section above. Many patients with TBI have significant impairments in memory and executive function. They could meet the DSM-IV definition of dementia. However, whether TBI exposure increases the risk of a progressive disorder such as Alzheimer's disease cannot be stated definitively at this point in time. Jellinger reviewed this topic and concluded that both TBI and Alzheimer's

disease are associated with amyloid and tau protein deposition abnormalities. They also report that there are several epidemiological studies which suggested that Alzheimer's disease either occurs with increased rate in individuals with TBI or that the onset of the disease is earlier after TBI in comparison to controls with no history of TBI *(Jellinger, 2004).* Another interesting hypothesis is that reduced cognitive reserve in people with TBI facilitates earlier manifestation of symptoms dementia in people who were anyway destined to develop Alzheimer's disease *(Starkstein and Jorge, 2005).*

Somatic symptoms

Headache:

Headache is the one of the most common somatic symptom reported after TBI. Studies report prevalence ranging from 25% to 90%. It usually begins within two weeks of TBI. It is classified as acute if it lasts less than 8 weeks. If it lasts longer than that it is classified as chronic. The presence of headaches have been correlated with severity of injury, however few investigators have reported more headaches in those with mild TBI *(Couch and Bearss, 2001).*

Dizziness:

Dizziness/vertigo is also a common symptom reported in 24% to 78% of mild TBI patients in the acute phase. It occurs more frequently in the community than in people without history of TBI. Just like headache, dizziness usually resolves within the first 3 months of injury in patients with mild TBI. It may be persistent and problematic in others who had moderate and severe TBI *(Masson et al., 1996).*

Fatigue:

Fatigue is commonly reported after TBI. It occurs in up to 73% of patients. It sometimes becomes a chronic symptom and thus become a barrier to recovery. Its presence is associated with decreased level of productive activities, poorer social integration and lowered quality of life. It is usually a result of a potpourri of causes, including pain, sleep disorders, cognitive deficits, depression, and anxiety. Endocrine abnormalities, such as growth hormone deficiency and hypocortisolemia due to hypopituitarism could be associated with fatigue after exposure to TBI *(Cantor et al., 2008).*

Sleep disturbance:

Sleep disturbances are quite frequent after a TBI and are seen in up to three fourths of post-TBI patients. Their etiology is complex. Sleep disturbances span the entire spectrum of sleep disorders *(Rao and Rollings, 2002).*

Seizures:

Posttraumatic seizures like any seizures can be classified as follows:

1. Focal
    a. Simple
    b. Complex
2. Generalized

Focal seizures can be simple, where there is no loss of consciousness. It can be complex where there is loss of consciousness. Both simple and complex partial seizures may evolve into a generalized tonic-clonic seizure with process of secondary generalization. The usually is a state of post ictal confusion after the seizure episode. In TBI there is high incidence of injury to the frontal or temporal lobe. This understandably becomes the focus of posttraumatic seizures. Seizures of frontal lobe

origin are often difficult to diagnose. They have a wide range of clinical manifestations including mimicking of the psychiatric disorders. They can also create more diagnostic confusion by showing a normal electroencephalogram.

Seizures of frontal lobe origin are often have nonspecific auras like dizziness. They may also have bizarre clinical manifestations like repeated motor activity, simple or complex automatisms like trashing, kicking, tapping, running, or agitation.

The bizarreness of these seizures, without the usually associated tonic-clonic activity or loss of consciousness, easily leads to misdiagnosis. To compound issues further, many areas of the frontal lobe cannot be accessed for recording electrical activity; due to this a routine EEG might look normal even during active abnormal phase. A standard EEG in focal epilepsy regardless of the type detects inter-ictal epileptiform abnormalities in about 29%to 55% of patients. Many case series have reported that there is no ictal EEG change in upto one third of the patients. Few case series have reported that only about 15% of patients with seizures in frontal lobe have abnormal localized discharge *(Riggio, 2010).*

Many researchers have also reported increased indicators of psychiatric disorder after TBI. They also report increased medical costs in relation to those indicators *(Fann et al., 2004).* Patients with TBI report a wide variety of symptoms like anxiety, frustration, sadness, feeling disappointed, hopeless etc. These symptoms may not be severe enough to reach the diagnostic threshold of a disorder. Any symptom cluster that is consistent and sustained, causing distress severe enough to impair social or occupational function and reduce the quality of life should be arguably considered disorders. Lishman hypothesized that majority of psychiatric symptoms following a TBI are triggered by organic factors, but he added that in some patients symptoms are maintained more due to psychosocial factors *(Lishman, 1988).*

Approaching neurobehavioural symptoms [NBS] in TBI:

Evaluating the neurobehavioural symptoms of TBI requires a deep understanding of a patient's neurologic, psychiatric, and medical illness both pre- and post injury. It can be difficult to differentiate symptoms after a TBI from similar symptomatology secondary to a pre-existent psychiatric disorder. What complicates matters more is that affective symptoms can be the first clinical presentation of frontal lobe dysfunction. This is independent of its aetiology and also is manifestation of a concurrent or independent dementing process possibly secondary to past TBIs (i.e., chronic traumatic encephalopathy).

The symptoms are easier to put in context in patients with moderate or severe TBI who have demonstrable lesions on imaging the brain. Although the literature suggests the majority of patients with mild TBI make a complete recovery, there is a subset that does not *(Carroll et al., 2004).*

There are several studies which have tried to delineate the causes and establish the presence of NBS in TBI including mild TBI. The findings have not been conclusive and have become controversial. The literature reports a high incidence of depression, anxiety, sleep disturbances, headaches/pain syndrome, fatigue, and dizziness in TBI patients. Many of these studies, however, are underpowered, retrospective, or flawed by biases. Many studies included patients of all TBI severities and also included patients with prior psychiatric and substance abuse histories.

Studies on patients with pain and non-TBI related injuries report a surprisingly high incidence of neurobehavioral complaints just as in TBI patients. A correlation between persistent pain and NBS has been reported. Many non-TBI chronic pain patient also have cognitive deficits. This questions the direct relationship between TBI and NBS. Iverson and McCracken have reported that non-TBI patients have a

similar incidence of NBS to those patients with a TBI. They reported fatigue, disturbed sleep, and irritability in about 80% of patients and one or more cognitive problems in about 40% of patients *(Iverson and McCracken, 1997).*

Depression can be used as an example to demonstrate the difficulty linking neuro-behaviour syndrome symptoms with TBI. To meet criteria for depression, 5 symptoms need to be present during a 2-week period: depressed mood and/or lack of interest plus insomnia, increased sleep, anergia, decreased concentration, and other symptoms. Some of these symptoms are commonly reported as NBS, however: depression due to TBI might be differentiated from a premorbid depression based on the onset of the symptoms, associated presence of feeling worthlessness or hopelessness, significant weight changes, excessive guilt, or suicidal ideation.

Bombardier and colleagues studied a cohort of 559 TBI patients and reported that 53.1% of the patients were depressed at some time within 12 months after a TBI. The diagnosis was made after a telephone interview. They included patients with prior history of depression or depression at injury. Their study was conducted at a single level 1 trauma centre and a large number of participants were Medicaid recipients. These factors might potentially have skewed the results *(Bombardier et al., 2010).* They did not discuss that depressed mood can be a NBS of TBI in the absence of other criteria. The same is true for the symptoms of fatigue, decrease in energy, decreased concentration, and sleep disturbances. These symptoms need to be considered in the setting of the injury, the individual response, past and present comorbidities, and concomitant pharmacotherapy.

In adjustment disorders, the development of emotional or behavioural symptoms occurs in response to an identifiable stressor. Predominant symptoms could be depressed or anxious mood, which can occur individually or can be mixed, depending

on the subtype. There can also be disturbance of conduct, which is manifested by behavioural changes. In this case both the affective and the behavioural components can be misinterpreted with NBS. Symptoms usually occur within 3 months of the onset of head trauma, which is similar to what happens in NBS.

The major question clinicians confront is when patients are treated with antidepressants for depressed mood or anxious mood even if these symptoms are not secondary to major depression but are in the context of the psychosocial stressors often encountered after a TBI, would there be a change in outcomes. The evidence is insufficient to answer this question. Future studies must try to determine the relative contributions of central nervous system lesions, physical disabilities, and environmental stressors on the manifestation of NBS. The question is very important: there are risks of pharmacotherapy especially when a patient is cognitively compromised after a TBI. Antidepressants can interfere with cognitive function, especially with attention and memory, and can cause sleep disturbances. Also, headaches can be associated with antidepressant therapy.

Creating a differential diagnosis and management plan:

Determining cause of a neurobehavioral complaint requires a systematic and comprehensive evaluation. NBS of TBI are nonspecific and clinicians must avoid drawing a false conclusion before a proper assessment has been made. For example, a TBI patient who has depressed mood may have hypothyroidism, a mesial frontal region lesion, a major depressive disorder, an adjustment disorder or injury to the basal ganglia. An adjustment disorder might not require pharmacotherapy but would require psychotherapy. A person with major depression disorder requires antidepressants. Depression from a mesial frontal lesion likely would have minimal or no benefit from antidepressants. If thyroxin is not given, depression is not going to lift

in a person with hypothyroidism. The clinician must also remember the possibility of the depression being an expression of an existing condition and not directly due to the TBI.

Cognitive deficit of attention plays a major role in NBS and recognizing them may be the key to a successful management plan. The differential diagnosis of dysfunction of attention includes a structural lesion, any underlying medical condition, a primary psychiatric disorder, an environmental cause or drug side effect. Drug side effects are to be considered if compounds with high anticholinergic properties or antihistaminergic properties are being administered.

Sleep problems and pain issues can interfere with attention. Attention can be adversely affected by lesions in the orbitofrontal region. This leads to high level of distractibility. A lesion in the dorsolateral prefrontal region, leads to inability to switch cognitive sets and impairs multitasking. Primary psychiatric disorders like psychotic disorders, mood disorders, anxiety disorders and personality disorders can also interfere with attention. So does fatigue secondary to TBI or to a medical problem. Bizarre behavior after TBI can be due to organic structural lesions, primary psychiatric disorders, adverse effects due to drugs, metabolic derangements and frontal lobe seizures. Special mention of frontal lobe seizures needs to be made because their dramatic clinical presentation which can be quite bizarre behavior like repeated motor activity or complex automatisms, such as running, trashing repetitive tapping or kicking,. Such episodes can be associated with unpredictable awareness, nonspecific auras, no loss of consciousness and variable post-ictal confusion. These closely mimic psychiatric disorders and presentation can be associated with a normal interictal or ictal EEG increasing the diagnostic confusion.

Complaints of NBS after TBI are best addressed by a multidisciplinary team. Family involvement is important to promote an understanding and support system needed for successful management. The literature on mild TBI demonstrates that education can decrease the severity and duration of NBS, partially by normalizing the situation and providing the reassurance needed to patiently allow recovery to occur. Ponsford and colleagues studied 202 mild TBI patients and found that the patients who were given a booklet with information on mild TBI and how to cope with symptoms were significantly less symptomatic a quarter year after. This was in comparison to those who were not provided any such education *(Ponsford et al., 2002).* Borg and colleagues showed in their review on early intervention after mild TBI that early sharing of information and education reduces long-term complaints *(Borg et al., 2004).*

Indian work:

In India, research has been done in NIMHANS on the epidemiology of injuries shows that TBIs are a leading cause of disability morbidity, mortality and socio-economic losses in India. This should be true for other developing countries as well. In India it can be estimated that nearly 15 to 20 lakh people are injured and 10 lakh die every year due to TBI. About 60% of the injuries caused are related to Road traffic Accidents. Falls (20%-25%) and violence (10%) are the causes that follow Road Accidents. Alcohol involvement is known to be present among 15%-20% of TBIs at the time of injury. The need for rehabilitation of persons with TBI is not only high but is increasing every year *(Gururaj, 2002).*

Sabhesan et al studied 141 patients with head injuries for a period of 18 months. They measured neurological, behavioural, neuropsychiatric and psychosocial parameters and came up with many papers from this study. They found only 22.7 % of the

patients did not suffer from any behavioural changes. They presented data showing sub optimal restoration of occupational function, worsening marital relationships, worse neuropsychological and behavioural morbidity compared to neurological morbidity *(Sabhesan and Natarajan, 1993).*

Sabhesan and his collegeues also found 22.67% of the patients with closed head injury had delusions. They discussed the variation in psychopathology at various times *(Sabhesan et al 1998).* They also discussed hallucinosis following head injury. They also contributed to the field of psychopathology by describing confabulations after head injury and their clinical correlates. They also described the change in sexual behaviour in men and wormen following head injury. They discussed this from both neuro-anatomical and cultural perspective.

Chatterjee et al studied 37 patients with psychiatric disabilities resulting from brain trauma. They studied the patients with neurological clinical examination, neurological investigations, psychiatric examination and psychological testing. They found that psychiatric examination and psychological testing combined give better insight into disability of the patient compared to combination of neurological examination and investigations. The psychiatric clinical picture conformed to the categories of chronic amnestic state, dementia, psychosis and personality disorder. They also pointed that the overall prognosis may not be bad as 90% of the patients were retained in service meaning good recovery *(Chatterjee, 1979).*

Keshavan et al followed up 60 cases of closed civilian head injuries for 3 months since the time of injury. They found 80 % had neuropsychiatric disturbances at 1 ½ month. They also found that social disability was related to severity of head injury and subjective symptoms related to pre-trauamatic neuroticism *(Keshavan et al., 1981).* Bhat et al reported a case of partial Kluver Bucy Syndrome presenting as a

delayed manifestation of traumatic brain injury, which they treated with carbamazipine and antipsychotics *(Bhat et al., 2009).* Sudersanan et al reviewed psychiatric aspects of traumatic brain injury and recommend that treatment of patients with TBI should involve a multidisciplinary approach. There should be close collaboration between the patient, family, neurologist/neurosurgeon, psychologist, social worker and the psychiatrist *(Sudersanan S, 2007).*

Summarizing, from the studies cited above, it can be argued that TBI acts as a flood-gate for the development of psychiatric disorders and neuropsychiatric symptoms. There is a suggestion of reciprocal interaction due to the finding that people with TBI have higher base rates of psychopathology. This could mean psychopathology increases risk for TBI, and TBI increases risk for development of psychiatric disorders.

The presence of psychiatric disorder impedes the treatment and rehabilitation of a patient by interfering in compliance, reducing motivation, increasing suicidal risk and integration to normal community life even after physical recovery. Information regarding psychiatric illness following TBI in India would be essential to planning for services required as well as in the area of education and training of rehabilitation personnel.

Aims and Objectives

Aim: To study of neuropsychiatric problems in patients with traumatic brain injury treated in a tertiary care rehabilitation center.

Objectives:

1. To measure and describe the nature and prevalence of neuropsychiatric problems and psychiatric disorder after Traumatic Brain Injury (TBI).
2. To measure disability consequent to TBI.
3. To study the association if any between socio-demographic variables, trauma related variables, cognitive status, presence of psychiatric illness prior to TBI and co-morbidities with the occurrence of neuropsychiatric problems and disability.

Methodology

Study area:

The study was conducted in Rehabilitation Institute of the Christian Medical College Vellore. CMC, Vellore The department runs a weekly clinic called the Brain Injury Clinic in CMC hospital. It served 1981 outpatient in year 2011. The Rehabilitation institute has 85 beds and had treated 658 inpatients in year 2011. Patients with traumatic brain injury are admitted in Rehabilitation Institute for neuro-rehabilitation. The patients here are treated by a multidisciplinary team including physiatrist, psychiatrist, psychologist, occupational, speech and physical therapist.

Study population:

Patients who have suffered traumatic brain injury and were admitted in Rehabilitation Institute are the population in which the study was conducted. The study subjects were recruited using the following criteria for inclusion and exclusion.

Inclusion criteria

- Age 18-60 years
- History of TBI
- Patient or caregiver consenting for study

Exclusion Criteria

- Extremes of age [<18 and >60 years]
- Severe injury interfering with participation with interview. Current GCS being < 9T/15
- Moderate to severe mental retardation existing prior to TBI
- Not consenting for being part of the study

Recruitment will continue till sample size is met.

Study design

The study follows a cross sectional study design

Study period

The recruitment of patients began on 1st March 2012 and is ongoing. For the purpose of completion of the study cases seen till 15th November 2012 were taken for analysis.

Sample size calculation

Previous studies show a prevalence of around 50%. *(Gould et al.)* Assuming that prevalence of psychiatric morbidity in TBI patients to be around 50% and with precision at 10%, and a Type 1 error of 5 %, the sample size obtained was 100 patients.

$$\text{Sample size} = \frac{[Z\alpha]^2 \times P \times Q}{d^2}$$

Where

Zα is 1.96, when Type1 error α is fixed at 0.05

P is prevalence; assumed to be 0.5

Q is 1-P; 1-0.5 = 0.5

d is absolute precision; fixed at 0.1

$$\text{So Sample size} = \frac{1.96 \times 1.96 \times 0.5 \times 0.5}{0.1 \times 0.1} = 96$$

= 100 [approximately]

Data collection

The variables which could be associated with neuropsychiatric problems like severity and location of traumatic brain injury, associated physical disease, cognitive status, pre-existing psychiatric illness, socio-demographic background of the patient.

I Socio-demographic information

Age,

Gender,

Marital status,

Religion,

Socio-economic status,

Number of years of education,

Residence

Work done unemployed/employed

Unskilled/skilled/ Professional/ Self employed

Monthly income

II Details of TBI

Severity of trauma

GCS at presentation

Length of hospital admission during acute care

Nature of injury

Duration between trauma and assessment

Treatment given

III Neuropsychiatric information

Neuropsychiatric symptom

Psychiatric Diagnosis

Premorbid psychiatric illness

Family history of psychiatric illness

Drug and alcohol use

IV Degree of disability following brain injury

V Cognitive status of the patient

VI Physical deficits and disease

Monoplegia/Monoparesis

Hemiplegia/Hemiparesis

Quadriplegia/Quadriparesis

Fractures

Pre-existing Diabetes Mellitus, Systemic Hypertension, Ischemic Heart

Disease, Hypothyroidism

Epilepsy

Any other

D Data Sources/measurement:

Data	Source	Collected by
Socio-demographic information Age, gender, marital status, religion, socio-economic status, number of years of education, residence	Interview / medical records	PI
Trauma related information Severity GCS at presentation Length of hospital stay ICU Ward Rehabilitation Nature of Injury Location of Injury Treatment given	Medical Records & Interview	PI
Cognitive status of the patient	Addenbrooke's Cognitive Examination-Revised Score [ACE-R] Ranchos Los Amigos Level of Cognitive functioning scale	Occupational Therapist
Psychopathology Premorbid state Family history of psychiatric illness Drug and alcohol use Current psychiatric diagnosis	Interview from caregiver and patients	PI
Current Neurospychiatric Symptoms	Neuropsychiatric Inventory [NPI]	PI
Degree of disability following brain injury	Rappaport Disability Rating Scale [DRS]	PI
Physical deficits and disease Monoplegia/monoparesis Hemiplegia/hemiparesis Quadriplegia/quadriparesis Fractures Pre-existing Diabetes Mellitus, Hypertension, Ischaemic Heart Disease, Hypothyroidism Epilepsy, others	Interview with patient and caregiver Review of medical records	PI

Socio-demographic data will be obtained from the patient and the caregiver [See Appendix C].

Socio-Economic Status:

The socio-economic status was measured using modified Kuppusamy scale. It is a scale that uses educational achievement, income and employment to classify people in to five classes of Upper, Upper Middle, Lower Middle, Upper Lower and Lower [See Appendix D] The data related to trauma and the treatments received by the subject will be extracted from medical records.

The Ranchos Los Amigos Levels of Cognitive Functioning

It is a tool generally used by rehabilitation teams for evaluating cognitive functioning. It describes eight levels. Each level corresponds to a stage of recovery or pattern seen typically after a TBI. This is of immense help in the team's understanding to focus on the patient's strengths and for appropriate design of a treatment regime. Progress of every individual happens at his/her own rate. This usually depends on the severity of the damage caused to brain, site of the brain injury and period of time elapsed since the brain injury. [See appendix F]

The following are its levels:

1st Level - No Response

Person seems to appear being in deep sleep. He/she is not responsive at all to any stimuli.

2nd Level - Generalized Response

Patient shows inconsistent, unspecific and non-purposeful reactions to stimuli. There is a limited set of responses. They are usually the same reactions to a myriad of stimuli presented. The responses may be seen as vocalizations, changes in

physiological responses' and gross movements of the body. It is observed that the first response is to deep pain. Sometimes responses are delayed.

3rd Level- Localized Response

There are specific but inconsistent reactions, to stimuli. The presenting stimulus elicits a related response. For example patient may turn head towards a sound. A painful stimulus might make the patient withdraw or vocalize with a sound. Patients can follow simple commands. Their responses would be in an inconsistent and slow manner. For example they may close their eyes, squeeze their eye or extend a limb. Patient may lie quietly, once the stimuli are removed. Patients could also show some awareness of their own self. They respond to discomfort. This is seen in them pulling the Ryle's tube or Foley's catheter. They sometimes show a bias by responding to few people and not others.

4th Level – Agitated/ Confused

Patients are in a state of increased activity but with marked decrease in information processing ability. They are detached from the immediate present. They respond to their own internal confusion. Their behavior often bizarre and is not purposed to the context of immediate environment. They may cry or scream loudly, clearly out of proportion to triggering stimulus. They may show aggressive behavior even after the stimulus is removed. They don't discriminate among people or things. They are unable to cooperate properly with treatment team. Frequently their verbalizations are incoherent and inappropriate to the context. They might confabulate. They may inappropriately be hostile or elated. Their gross attention to surrounding is very short. They lack selective attention.

As patients are not aware of events happening at present, they lack short-term memory. They cannot do self-care activities like feeding or dressing without requiring

maximal assistance. If they are not physically disabled, they may sit, reach and move about. Due to agitated state they may not be as purposeful and may not act on request.

5th Level - Inappropriate Non-Agitated, Confused,

These patients look to be alert. They can also respond consistently to simple commands. Their responses become non purposeful and random, if more complex commands are given or if an external structure does not exist. They might demonstrate agitated behavior. However this is not due to internal stimuli as in previous level, but is due to external stimuli. These reactions are many a time out of proportion to the trigger. They have gross attention to the surrounding. However they are highly distractable. They also lack ability to concentrate attention on to a task. They require frequent redirection to tasks they are engaged in. The patients might converse at a social automatic level for brief periods of time.

Their verbalizations are frequently inappropriate. They confabulate memories from past events. Their memory is severely impaired. They get confused with past and present. They lack ability to initiate functional tasks and frequently show improper use of things when external direction is not given. They have ability to do tasks which were previously learnt, if the tasks are structured for them. They have inability to learn new information. They respond in best possible ways to themselves, their body, comfort, and, also the members of their family. These patients can perform their self-care activities especially with some assistance. They may even feed with maximal supervision. These patients are not easy to manage in the ward, if they are ambulant. There would remain a fear that patient may wander away randomly thinking he/she is only going home!

6th Level– Appropriate, Confused

These patients can perform goal-directed behavior. However they are dependent on inputs from outside. Their responses to discomforting stimuli are appropriate. They are able to tolerate few unpleasant stimuli if they are explained well about the reason for the same. For example they can tolerate passing of Ryle's tube. They are able to consistently follow simple directions. They also show carry-over for tasks they had relearned during rehabilitation. They can be functional with least level of supervision is tasks which were learnt previously. They are unable to learn new things with any meaningful carry-over even with maximal assistance. Their responses may be wrong due to amnesia, however they are appropriate contextually. They have lowered ability for information processing. They have difficulties in anticipating and predicting events. Their past memories have more clarity and detail compared to recently acquired memories.

Patients might start showing some signs of immediate awareness of the context by realizing ignorance of an answer. They do not wander and are at times oriented to time and place. Impairment to selective attention may persist, more so with difficult tasks especially in settings that are not structured. They might vaguely recognize members of treating team. Their awareness of themselves, relatives and needs like food would have improved as compared to those in level five.

7th Level – Appropriate, Automatic

In this level patients appear oriented and appropriate in settings of home and hospital. They go through routine activities automatically. However they are like robots with very minimal confusion. They have shallow recall of acts they had been doing. They show more awareness of themselves, people, food and the surrounding. They have

awareness but lack full insight in to their problems with less adequate judgement, lacking realistic planning and problem-solving skills. They do show carry-over effect for new learning. However this is at a slower rate. They require minimal supervision for their safety and teaching. They are independent in activities of self-care. They can be at home and community with minimal supervision for safety. They can initiate activities of social and recreational value in areas of their interest when provided with structure. Their judgement continues to remain impaired. They may not be able to drive a car. They can be advised prevocational or vocational counseling after evaluation.

8 th Level – Appropriate, Purposeful

These patients are alert and oriented. They are able to recall memories from past. They also can integrate memories of past and present. They show cultural awareness and are appropriately responsive. They show carry-over for any new learning especially if they like and accept the newly learnt things as useful. They would not require any supervision once they are learnt. They are independent in their homes and communities, within the range of their physical capabilities. They need vocational rehabilitation. This is to check their ability to return to work force. This might mean working even at a different capacity. They may continue to show a lower level of ability in comparison to their premorbid level in various domains like tolerating stress, emergency judgement and abstract reasoning. Their emotional, intellectual and social capacities may continue at a lower level but they can function in a society.

There is also a revision of the scale with up to 10 levels of functioning. However the 8 level scale was used in the study being in line with the clinical practice of the department.

Addenbroke's Cognitive Examination –Revised Score [ACE-R]

It would be used for measuring Cognitive functioning. ACE-R is a short, sensitive, and inexpensive cognitive test used worldwide in all the five continents. The ACE-R takes an average of 16 minutes to administer and score for any patient. The scale tests five domains. There are sub-scores for each cognitive domain. Attention/orientation domain carries18 points, memory domain carries 26 points, fluency domain carries 14 points, language domain carries 26 points and visuo-spatial domain carries 16 points. Maximum score possible in ACE-R is 100. This is obtained by addition of the all domain scores. Many patients would have difficulties in performing the tests due to non-cognitive reasons. So while scoring patients ability or disability is not assumed. Patient is scored on what tests he could complete. [See Appendix E]

Neuropsychiatric Inventory (NPI)

It is a psychometric tool. It measures psychopathology in people with brain dysfunction. Originally NPI was developed for the purpose of applying to Alzheimer's disease patients and possibly in other dementias. It has been found to be useful in the assessing behavioural problems in other conditions as well. There are Ten behavioral and two neurovegetative areas that are included in the NPI. They are agitation/aggression, delusions, hallucinations, depression/dysphoria, apathy/indifference, disinhibition, anxiety, elation/ euphoria, irritability/ lability and aberrant motor behavior are the behavioural domains. Change in sleep and night-time behaviours and appetite and eating change are the neurovegetative areas.. Each of these symptoms is scored for frequency, severity and distress [Appendix F].

The questions are regarding changes observed in the behaviour of patient that have appeared after the onset of the illness. Abnormal behaviours that could have been present before the onset the illness is not marked. This is so even if it is present at

assessment, as only changes are being studied. Core abnormalities like anxiety or depression present premorbidly would get missed if NPI is used to screen and treat long standing problems. This does pick new onset problems well for this very reasom.. However behaviours that have always been present in life but have recently changed since the onset of illness are scored appropriately. For example if a person had always been an irritable person but after a TBI it has been observed that there is an increase in irritability in the period of inquiry, it is scored.

Typically the NPI is used to assess any change in a person's behavior that has happened in a defined time period. Some studies have pointed that the NPI could be used to study changes as a response to given treatment or intervention. There should be a pragmatic revision in understanding 'time frame' in this context.

A question is asked for screening purpose, if change in behaviour is actually present or not. If the caregiver answers negatively, "no" is marked. The question to screen for the second problem is asked without probing the first problem with sub-questions. If the caregiver answered positively to the screening question or is ambiguous regarding the problem then the rater marks "yes" and explores the problem in depth by asking the sub-questions. Consider for example, a caregiver responded negatively to the screening question on euphoria but on examination the patient appears euphoric to the doctor, then it is clarified by asking the sub-questions and after finally confirming the issue the symptom is marked "yes".

When the sub-questions are confirmatory of the screening question then the severity and frequency of the behavior are explored. They are determined in accordance with the criteria that are provided for each behavior. There are some occasion when a caregiver responds positively for a screening question but later gives negative answers to all the confirmatory sub-questions. When this situation arises the caregiver is asked

to explain the reason behind his/her initial ‘yes’ response. On many occasions they provide information which is relevant to the domain under discussion but is not captured in the sub-questions. It is from the described behaviour that clinician should score for the severity and frequency. It is also possible that the initial ‘yes’ response was an error due to misunderstanding. In that case behaviour response is changed to ‘no’.

For the assessment of the severity and frequency of the behaviours are being determined it is advised that the sub-questions that were identified as most aberrant be selected for assessment. Consider for example, caregivers share that resistive behavior is the most problematic behaviour, when the agitation section sub-questions were asked, then it is best to use frequency and severity of resistive behavior to measure the frequency and severity of agitation. There are times when two behaviours are considered to be problematic. In these cases the use of severity and frequency of both behaviours is measured to score the domain. For example, if the patient has two or more types of hallucinations, then frequency and severity of all hallucinatory behaviours are asked about.

The frequency assessment is done by asking if the behaviour related to problem under consideration every day, several times in a week but not on all days, about once in a week or less than once in a week. Few behaviours like for example ‘apathy’ end up being present continuously. They can be rated as present every day.

While severity of symptoms is assessed, the individual being interviewed is asked about how disabling or disturbing the symptom under consideration is for the patient. It is rated mild, moderate, or severe. In each case it is ensured that care giver does clearly state the frequency and severity of the problem behaviours. Their responses are not assumed of guessed.

There are patients who are very impaired patients. There are also a set of patients who have comorbid medical problems. In this group of patients few questions might not be applicable. Consider for example, patients who are bound to the bed patients may exhibit delusions or hallucinations but cannot have aberrant motor behavior. The section can be marked “NA” meaning not applicable, if the rating clinician or the caregiver think it is appropriate. In these cases no more data is recorded in that particular section. Similarly, if responses are considered invalid by the rating clinician then also “NA” can be marked. This would be typically a situation when caregiver does not understand a set of queries and gives random contradictory responses.

Items number 11 of sleep and item no 12 of appetite were added to the original after NPI’s original publication of the NPI. These items have been included because NPI was being used of assessment of people with dementias including Alzheimer’s disease. These two are commonly encountered problems in patients with those conditions. These symptoms are also seen in depressive syndrome. Therefore to not create an imbalance in total score in patients with depression, their scores are not included in total NPI in most protocols.

After completion of each domain in severity and frequency domains, the caregiver is asked the distress question for each domain. If it is present they are asked to rate it in a likert scale of 5.

The development of distress scale of the NPI instrument is attributed to Daniel Kaufer and his colleagues.

Frequency is rated in the following way:

1 - Occasionally – occurring less than once in a week

2 - Often – occurring around once in a week

3 - Frequently – occurring many times in a week but not on a daily basis

4 - Very frequently – occurring daily or continuously present

Severity is rated in the following way:

1 - Mild – producing little distress to the patient

2 - Moderate –disturbing the patient more but the caregiver can redirect it

3 - Severe – disturbing the patient very much and is difficult for caregiver to redirect

The score for each domain is: frequency x severity

Distress is scored is scored in the following way::

0 - no distress

1- minimal

2 - mild

3 - moderate

4 - moderately severe

5 - very severe or extreme

Overall there are four scores in each behavioural domain:

• Severity score

• Frequency score

• Total Score (which is a product of frequency and severity)

• Caregiver distress score

Disability:

Disability was measured using the Rappaport Disability Rating Scale [DRS]. It is used in physical medicine and rehabilitation settings while treating patients with moderate and severe TBI. It was tested for reliability and validity in adolescents and adults. It can capture recovery occurring over a wide range. It contains items which address the categories of impairment, disability and handicap as described by the

World Health Organization. The top three items of DRS "Communication Ability", “Eye Opening," and "Motor Response" are modified expanded versions of the Glasgow Coma Scale. They measure and reflect impairments. The items of "Toileting", "Feeding" and "Grooming" that follow measure individual’s cognitive ability. The indication the level of disability is obtained by the item "Level of Functioning" The last item measured is that of "Employability". It reflects handicap. [See Appendix G]

Quantitative variables:

Age, GCS at presentation, duration of post traumatic amnesia, duration of stay in hospital, duration between trauma and assessment, Addenbrooke’s cognitive evaluation-revised score, Ranchos Los Amigos Level of cognitive functioning score and disability rating scale score are the quantitative variables which will be seen in the study.

Statistical Analysis

Data will be entered in Epi-Info 2002 and analyzed using SPSS version 15.0. Descriptive analysis will be done to meet the objective of finding the prevalence of neuropsychiatric problems and psychiatric disorders in the TBI individuals. The prevalence of individual neuropsychiatric symptom and psychiatric disorder occurring as a syndrome would also be found.

To meet the second objective of measuring the disability following TBI the measures of central tendency for the disability scores and its dispersion would be looked at.

To study the association if any between the socio-demographic variables [like age, sex, socioeconomic status], trauma related variables [like GCS at presentation, duration of stay in ICU], cognitive status and co-morbidities with psychiatric disorders univariate logistic regression analysis will be done. The variables significant at P=0.20 level will then be considered for the multivariate analysis. Univariate and multivariable linear regression analysis will be done to assess the relationship between disability score and other covariates.

Results

In the study 54 patients who met the inclusion criteria were interviewed. Their socio-demographic details, information relating to injury, neuropsychiatric symptomatology, cognitive status and disability rating were analysed.

Age and Gender:

There were 46 males and 8 females in the population studied i.e. 85.19% were male and 14.81% were female. Their median age was 28.5 years with inter-quartile range ranging from 24 to 46 years. There was a bimodal age distribution with peak in third decade and sixth decade of life.

Education:

Only 2 of the population studied [3.7%] had no formal education. One patient [1.85%] had studied till primary school. 16 patients [29.63%] had studied till secondary school. 10 patients [10.52%] had studied upto higher secondary. 11 patients [20.37%] had studied up to graduation. 6 patients [11.11%] had studied up to post graduation. 8 patients [14.81%] had trained as professionals.

Employment status:

Before TBI

About four patients [7.41%] were unemployed before the trauma occurred. Three patients [5.56%] were engaged in unskilled labour. 16 patients [29.63%] were employed as skilled labourers and another 16 patients [29.63%] were employed as professionals. Six patients [11.11%] were self employed. Nine patients [16.67%] were registered as students.

After TBI

After the traumatic brain injury 40 patients [70.07%] were unemployed. Six patients [11.11%] were employed as skilled labour. Two patients [3.70%] were self employed and six patients [11.11%] were still pursing studies.

Residence:

28 patients [51.85%] were living in a rural area whereas 26 patients [48.15%] were living in urban area.

Religion:

Majority of the patients were Hindus by religion, 36 patients [67.2%] in all. 10 patients [18.82%] were Muslims and seven patients [13.21%] were Christians.

Marital status:

23 patients [42.59%] were single and 31 patients [57.41%] were single.

Socio Economic Status [SES]:

The following results were obtained using the Modified Kuppusamy's Scale. The Upper and Upper Middle were clubbed and considered as high SES. Lower Middle, Upper Lower and Lower were clubbed and were considered as low SES. This was for the simplifying the analysis while looking for associations with SES. Table 6.1 summarizes the distribution of people across the socio economic class.

Table 6.1: Socio Economic Class

Sl no	Socio Economic Class	Number of patients	Percent
1	Upper	12	22.2
2	Upper Middle	17	31.48
3	Lower Middle	10	18.52
4	Upper Lower	14	25.93
5	Lower Lower	1	1.85

Monthly income was skewed .Median monthly income was Rs 16,500/-.

Severity of Injury:

A vast majority 50 [92.6%] of the patients had a severe traumatic injury in comparison to 4 [7.40%], who had sustained TBI of moderate intensity.

History of Alcohol consumption at the time of TBI:

There was record of Alcohol consumption in 10 patients [18.84%].

Number of days of hospital admission:

The distribution of number of days of admission was skewed. Therefore median was chosen as a measure of central tendency. Median number of days of admission in ICU was 16.5 days with inter-quartile range between 14 and 30 days. . Median number of days of admission in non-rehabilitation ward was 25 days with inter-quartile range between 14 and 45 days. Median number of days of admission in rehabilitation ward was 35 days with inter-quartile range between 21 and 65 days. This was not associated with any of the outcomes of psychiatric disorders, neuropsychiatric morbidity or disability.

Time from trauma to the study assessment:

The median time from trauma to assessment during study was 295 days with inter-quartile range between 110 and 480 days. This was not associated with any of the outcomes of psychiatric disorders, neuropsychiatric morbidity or disability.

Nature of head injury:

50 patients [92.6%] had closed head injury, whereas four patients had penetrating head injury. 23 patients [42.59%] had operation performed on them. Only one patient [1.85%] had history of head injury in the past.

Past History of Seizures:

17 patients [31.48%] had history of seizures, all of which were following the TBI with no patient with history of seizure history prior to trauma. Three patients [5.56%] had family history of psychiatric illness.

Past Psychiatric Morbidity [before TBI]:

51 patients [94.44%] had no history of known psychiatric illness prior to the TBI. Three patients [5.56%] had history of past psychiatric disorder. One had Obsessive Compulsive Disorder [OCD] and two others had Alcohol Dependence Syndrome. Only one patient [1.85%] gave history of past treatment with psychotropic drugs i.e. even before the TBI. He was the patient with 49 patients [90.74%] gave history of no prior treatment with antipsychotics or antidepressants. On objective assessment of medical records it was found that 16 patients [29.63%] were currently on Anti Depressant Drugs and 9 patients [16.67%] were on Anti Psychotic Drugs. 23 patients [42.5%] were on any of the Psychotropic drugs.

Current Psychiatric Disorders:

In the 54 patients evaluated for psychiatric disorders, 16 patients [30%] had a current psychiatric diagnosis. The 95% confidence intervals were 17% and 42.2%. Of these Alcohol dependence syndrome was diagnosed in two, Severe depression without psychotic symptoms in six, Generalized Anxiety disorder in one, Hypomania in two, Dysthymia in one, OCD in one and Unspecified Psychosis in five patients. Of these the patient with OCD and two patients with Alcohol dependence had these psychiatric diagnoses prior to TBI. These are summarized in the Table 6.2.

Table 6.2 : Psychiatric Diagnosis Frequencies

Sl No	Psychiatric Diagnosis	Frequency
1	Alcohol Dependence Syndrome	2
2	Obsessive Compulsive Disorder	1
3	Severe Depression without Psychotic Symptoms	6
4	Unspecified Psychosis	5
5	Generalized Anxiety Disorder	1
6	Dysthymia	1
7	Hypomania	2

Patients with psychiatric disorders and the ones without psychiatric disorders were compared with each other. Univariate analysis was done, looking for association with various variables. Table 6.3 summarizes the obtained results.

Table 6.3: Factors associated with Psychiatric Disorder [Univariate Analysis]

Sl no	Variable	Odds ratio (95% CI)	p value
1	Age less than or equal to 30	0.9 (0.27 -2.89)	0.86
2	Male Gender	0.35 (0.07 -1.63)	0.18
3	High Socio Economic Status	0.84 (0.26-2.79)	0.80
4	Rural Residence	0.9 (0.27-2.89)	0.86
5	Single Marital Status	1.06 (0.32 -3.47)	0.91
6	Alcohol consumption at the time of injury	1.77 (0.42 - 7.41)	0.43
7	Penetrating form of Injury	8.53 (0.81 - 89)	0.07
8	Operation being performed	4.76 (0.81 - 89)	0.01
9	Family history of Psychiatric Disorder	1.2 (0.10 - 14.2)	0.88
10	History of Seizures associated with Injury	1.47 (0.0.42 - 5.02)	0.53
11	High Glasgow Coma Scale score at Presentation	1.25 (0.95 -1.64)	0.09
12	Ranchos Los Amigos Level of Cognitive functioning	1.24 (0.88-1.75)	0.2

Multivariate analysis was performed and the results that were obtained with adjustment for other variables are summarized in Table 6.4.

Table 6.4 : Factors associated with Psychiatric Disorder [Multivariate analysis]

Sl no	Variable	Adjusted Odds ratio (95% CI)	p Value
1	Age less than or equal to 30	1.15 (0.25-5.44)	0.85
2	Male Gender	0.35 (0.05-2.29)	0.28
3	Alcohol consumption at the time of injury	3.63 (0.55-23.95)	0.18
4	Operation been performed	5.05 (1.20-21.21)	0.03
5	High Glasgow Coma Scale score at Presentation	1.2 (0.87-1.75)	0.23
6	Ranchos Los Amigos Score	1.19(0.76-1.88)	0.43

Neuropsychiatric Symptoms:

Neuropsychiatric symptoms were studied using the Neuropsychiatric Inventory. 51 patients out of the 54 who were studied had at least one neuropsychiatric symptom. It means the prevalence of neuropsychiatric symptoms was 94.44%. The 95% confidence intervals were 88.13% and 100%.

On studying the number of patients who had neuropsychiatric symptoms in the Neuropsychiatric Inventory, the commonest symptom found was Irritabilty/Lability seen in 30 patients [55.56%]. The prevalence of other symptoms was as follows: Agitation/aggression seen in 27 patients [50%], Depression seen in 23 patients [53.7%], Anxiety seen in 17 patients [31.48%], Apathy/ Indifference seen in 15 patients [27.78%], Appetite/eating change seen in 14 patients [25.93%], Disinhibition seen in 12 patients [22.22%], Night time behaviour problems seen in nine patients [16.67%], Aberrant motor behaviour seen in seven patients [12.96%],

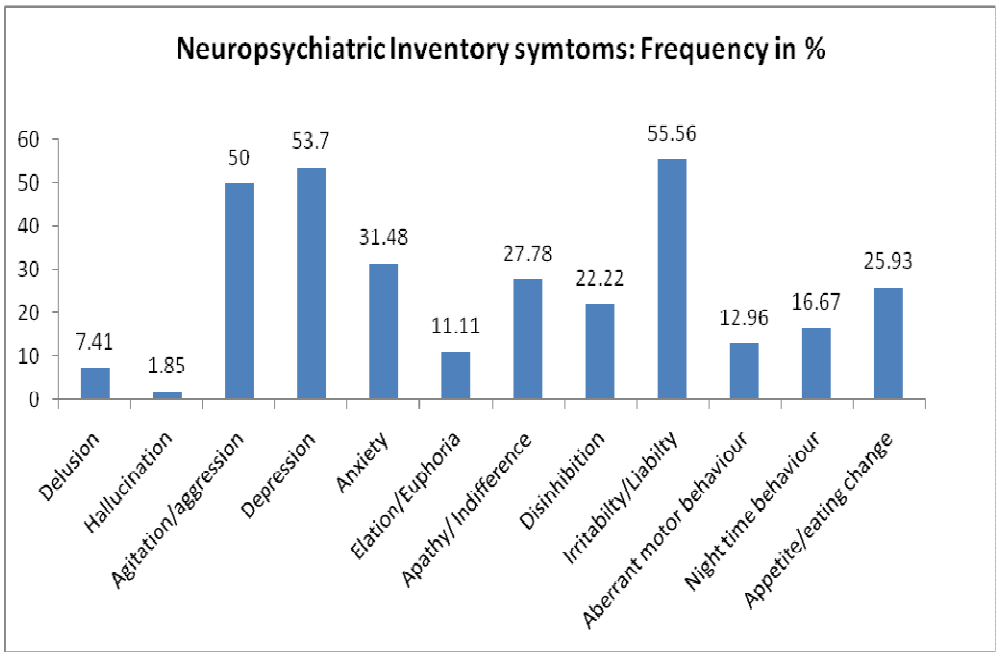
Elation/Euphoria seen in six patients [11.11%], Delusions seen in four patients [7.41%] and Hallucinations seen in one patient[1.85%]. These have been summarized in Table 6.5.

Table 6.5 : Frequency of Neuropsychiatric Symptoms

Neuropsychiatric Symptom	Frequency	%
Delusion	4	7.41
Hallucination	1	1.85
Agitation/aggression	27	50
Depression	23	53.7
Anxiety	17	31.48
Elation/Euphoria	6	11.11
Apathy/ Indifference	15	27.78
Disinhibition	12	22.22
Irritabilty/Liabilty	30	55.56
Aberrant motor behaviour	7	12.96
Night time behaviour	9	16.67
Appetite/eating change	14	25.93

The following bar graph [Figure 6.1] shows the relative prevalence of each of the symptoms given in percentages.

Figure 6.1 : Neuropsychiatric Inventory symptoms frequency



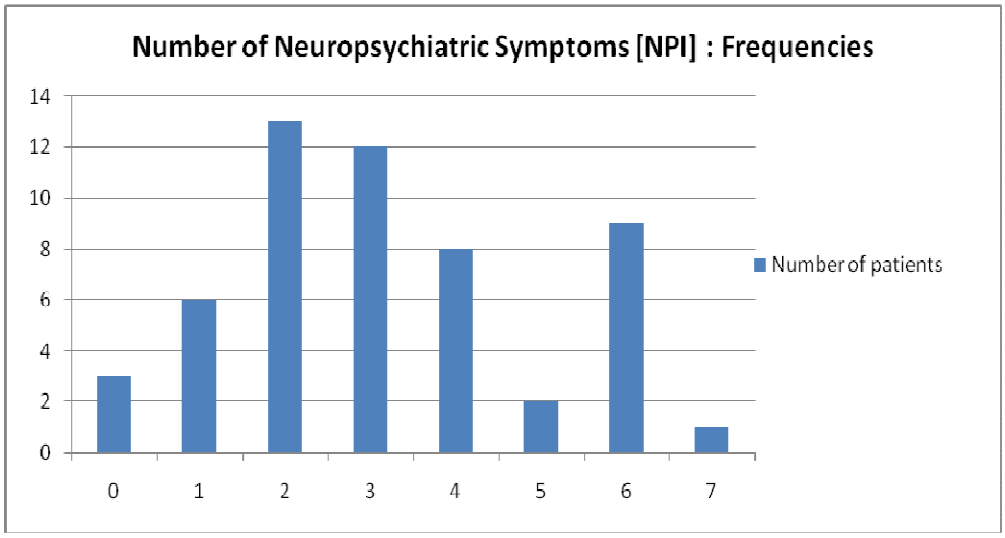
The frequency of the number of neuropsychiatric symptoms was also studied. The Table 6.6 that follows summarizes the findings.

Table 6.6 : Frequency of number of neuropsychiatric symptoms

Number of Symptoms	No of subjects	Percentage
None	3	5.56%
One	6	11.11%
Two	13	24.07%
Three	12	22.22%
Four	8	14.81%
Five	2	3.70%
six	9	16.67%
seven	1	1.85%
Total	54	100%

This can be graphically seen in the Figure 6.2.

Figure 6.2: Frequency of number of Neuropsychiatric Symptoms



In neuropsychiatric inventory, each symptom is scored in domains of frequency and severity. The product of frequency score and severity score, gives the burden score. This is indicative of the burden of the symptom in a given patient. Not every patient

would have burden from every symptom. The burden scores of each symptom were summed up in the entire study population. This score obtained for each symptom is indicative of the overall burden caused due to the symptom in the entire population.

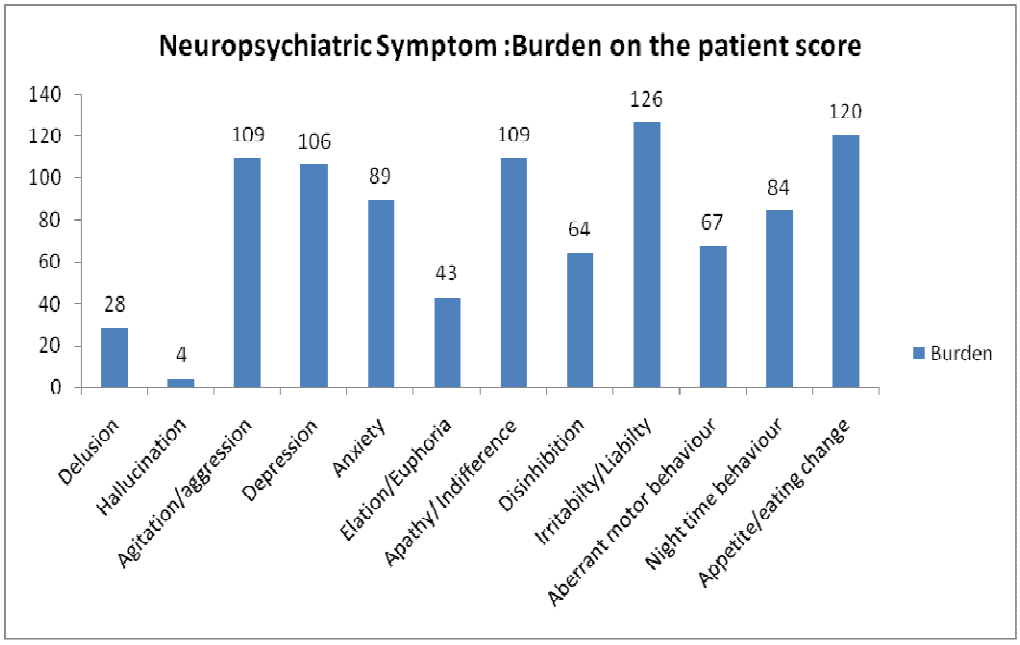
In this irritabilty/lability scored high with 126 points. The other symptoms in descending order of burden caused were appetite/eating change with 120 points, agitation/aggression with 109 points, apathy/ indifference with 109 points, depression with 106 points, anxiety with 89 points, problematic night time behaviour with 84 points, aberrant motor behaviour with 67 points, disinhibition with 64 points, elation/euphoria with 43 points, delusion with 28 points and hallucination with 4 points. These are summarized in the Table 6.7

Table 6.7: Burden due to neuropsychiatric symptoms

Neuropsychiatric Symptom	**Burden on the patient [Sum of the burden scores of entire study population]**
Delusion	28
Hallucination	4
Agitation/aggression	109
Depression	106
Anxiety	89
Elation/Euphoria	43
Apathy/ Indifference	109
Disinhibition	64
Irritabilty/Liabilty	126
Aberrant motor behaviour	67
Night time behaviour	84
Appetite/eating change	120

This is also shown as a bar chart graphically [Figure 6.3]

Figure 6.3: Neuropsychiatric symptom burden scores



In the NPI there is a distress of care giver score for each symptom. The symptoms which are absent in a given patient would obviously have no distress score. Each symptom is present in a different set of patients studied. The distress scores of each symptom were summed up. These scores reflect the distress experienced from caregiver perspective regarding each of the neuropsychiatric symptom. These scores are tabulated in Table 6.8.

Table 6.8 : Neuropsychiatric symptom caregiver distress scores

Neuropsychiatric symptom	Caregiver Distress [Sum of the caregiver distress scores of the entire study population
Delusion	11
Hallucination	5
Agitation/aggression	55
Depression	63
Anxiety	38
Elation/Euphoria	6
Apathy/ Indifference	36
Disinhibition	30
Irritabilty/Liabilty	48
Aberrant motor behaviour	19
Night time behaviour	37
Appetite/eating change	40

It was found that depression as a symptom in the patient scored high with score of 63 points. This was followed by agitation/aggression with a score of 55. These were followed by other symptoms. In the descending order they are Irritabilty/Labilty with 48 points, Appetite/eating change with 40 points, Anxiety with 38 points, Night time behaviour with 37 points, Apathy/ Indifference with 36 points, Disinhibition with 30 points, Aberrant motor behaviour with 19 points, Delusion with 11 points, Elation/Euphoria with 6 points, Hallucination with 5 points.

This is represented as a bar graph shown below [Figure 6.4].

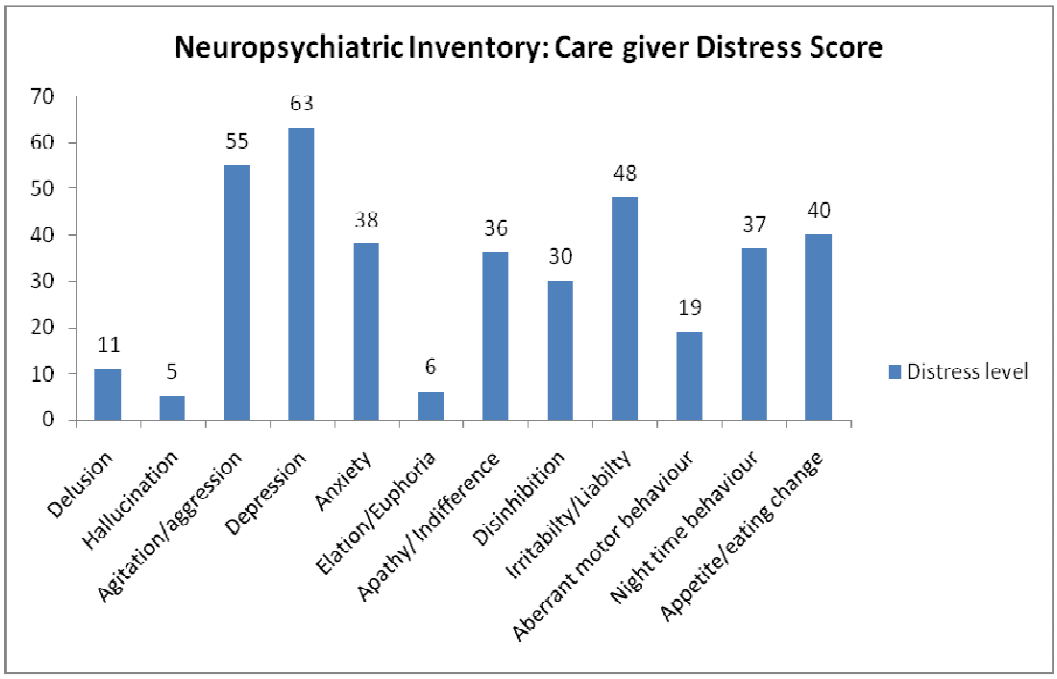


Figure 6.4 : Neuropsychiatric symptom caregiver distress score

Neuropsychiatric Inventory score is obtained for each patient summing the burden scores for each of the neuropsychiatric symptoms except the scores for night time behaviour and appetite and eating change items.

The distribution of NPI scores was skewed to the right. The median score was 11.5. The interquartile range was 5 to 8. The study population was divided into two groups using the median NPI score as cut off. The groups were studied for any possible association with variables using univariate analysis. The results obtained are summarized in Table 6.9.

Table 6.9: Factors associated with high neuropsychiatric morbidity [Univariate Analysis]

Sl no	Variable	Odds ratio (95% CI)	p value
1	Age less than or equal to 30	1.34 (0.46 -3.92)	0.58
2	Male Gender	1	
3	High Socio Economic Status	1.77(0.15-20.86)	0.64
4	Rural Residence	1.81 (0.61 - 5.35)	0.27
5	Single Marital Status	1.16 (0.39 - 3.42)	0.78
6	Alcohol consumption at the time of injury	1.64 (0.40 - 6.63)	0.48
7	Penetrating form of Injury	1	
8	Operation been performed	2.96 (1 -9.11)	0.05
9	Family history of Psychiatric Disorder	0.48 (0.04 -5.64)	0.55
10	History of Seizures associated with Injury	1.87 (0.37 - 3.75)	0.77
11	Hypothyroidism	3.25 (0.31 -33.4)	0.29
12	High Glasgow Coma Scale score at Presentation	0.83(0.51-1.37)	0.48
13	Fractures	1.42 (0.44 -4.62)	0.55
14	Hemiparesis/ Hemiplegia	1.56 (0.53 - 4.57)	0.41

The multivariate analysis done while adjusting for other variables in the group revealed results which are tabulated in Table 6.10

Table 6.10: Factors associated with high neuropsychiatric morbidity [Multivariate Analysis]

Sl No	Variable	Adjusted Odds ratio (95% CI)	p Value
1	Male Gender	2.21 (0.37-12.12)	0.38
2	Family history of Psychiatric Disorder	0.93 (0.06-14.80)	0.96
3	Rural residence	2.93 (0.8-10.69)	0.10
4	Operation been performed	5.79 (1.36-24.68)	0.02
5	History of Seizures associated with Injury	0.60 (0.15-2.43)	0.47
6	Hemiplegia/Hemiparesis	1.88 (0.57-6.15)	0.30

Cognitive Functioning:

Patients' overall cognitive level of functioning was studied using the Ranchos Los Amigos Level of Functioning Scale. Detailed assessment of each cognitive domain was done using Addenbrooke's Cognitive Examination Revised Scale. Analysis using both systems is presented in the following.

Ranchos Los Amigos Scores:

It was decided to divide the patients into two groups based on the Ranchos Los Amigos Level of Functioning scores. The patients with scores of 6 and above were considered as the higher functioning group. The patients with score of 5 and below

were considered as the lower functioning group, as they required supervision of an attendant most of the time.

The results that were obtained in the univariate analysis are tabulated in Table 6.11

Table 6.11: Factors associated with low Ranchos Los Amigos Scores [Univariate analysis]

Sl No	Variable	Odds ratio (95% CI)	p value
1	Age less than or equal to 30	1.22 (0.40 - 3.7)	0.72
2	Male Gender	0.98 (0.17 - 6.01)	0.63
3	High Socio Economic Status	0.47(0.15-1.49)	0.20
4	Rural Residence	1.22 (0.40 - 3.70)	0.72
5	Single Marital Status	0.84 (0.27 - 2.5)	0.78
6	Alcohol consumption at the time of injury	3.2 (0.78 - 13.2)	0.09
7	Operation been performed	0.60 (0.19 -1.89)	0.38
8	Family history of Psychiatric Disorder	3.66 (0.31 -43.2)	0.30
9	History of Seizures associated with Injury	1.29 (0.39 - 4.19)	0.66
10	Hemiplegia/ Hemiparesis	2.65 (0.84 - 8.33)	0.09
11	High Glasgow Coma Scale score	0.73 (0.54 – 0.99)	0.04

In the multivariate analysis the results which were obtained are tabulated in Table 6.12

Table 6.12 : Factors associated with low Ranchos Los Amigos scores [Multivariate Analysis]

Sl no	Variable	Adjusted Odds ratio (95% CI)	p Value
1	Alcohol consumption at the time of injury	4.03 (0.77-20.84)	0.09
2	Hemiplegia/Hemiparesis	1.86 (0.54-6.39)	0.32
3	High Glasgow Coma Scale score	0.71(0.51-0.99)	0.04

Addenbrooke's Cognitive Examination Revises Scale:[ACE-R]

Using the ACE-R scale the cognitive functions were tested in various domains. If a test was not performable due to a specific reason the denominator was adjusted.

In the patients who performed ACE-R the mean ACE-R score was 70.1% with a standard deviation of 20.48.

The mean scores in each domain are tabulated below in Table 6.13.

Table 6.13: Addenbrooke's Cognitive Examination- Revised scale scores

Domain	Mean Score [%]	Range [%]
Attention/ Concentration	81	11-100
Memory	72	7.7-100
Fluency	29	0-100
Language	82.1	30.7-100
Visuo-Spatial	71.3	6.2 -100

15 could not be tested due to various reasons reflecting a worse status than other on whom testing was at least possible. The differences in two groups was analysed with univariate analysis. This revealed the following results.

Results obtained are tabulated below in Table 6.14

Table 6.14: Factors associated with patients who could not be tested with ACE-R [Univariate Analysis]

Sl no	Variable	Odds ratio (95% CI)	p value
1	Age less than or equal to 30	0.75(0.23-2.47)	0.63
2	Male Gender	1.18(0.21-6.62)	0.85
3	High Socio Economic Status	1.47(0.44-4.88)	0.52
4	Rural Residence	2.33 (0.67-8.09)	0.18
5	Single Marital Status	0.58(0.16-2.02)	0.39
6	Alcohol consumption at the time of injury	5.83(1.35-25.16)	0.01
7	Operation been performed	0.38(0.10-1.41)	0.15
8	Family history of Psychiatric Disorder	1.32(0.11-15.74)	0.82
9	History of Seizures associated with Injury	1.69(0.48-5.90)	.40
10	Hypothyroidism	2.84(0.36-22.31)	0.32
11	High Glasgow Coma Scale score at Presentation	0.66(0.46-0.95)	0.02

Multivariate analysis was performed and the obtained results with adjustment for other variables is tabulated in Table 6.15.

Table 6.15 : Factors associated with patients who could not be tested with ACE-R [Multivariate Analysis]

Sl No	Variable	Adjusted Odds ratio (95% CI)	p Value
1	Alcohol consumption at the time of injury	13.38 (1.75-102.11)	0.01
2	Operation been performed	0.35(0.07-1.61)	0.18
3	High Glasgow Coma Scale score at Presentation	0.54(0.34-0.87)	0.01

Disability Scores:

The level of disability was measured using a score obtained from Disability Rating Scale. Median Disability score was 7.25 with inter-quartile range between 4 and 17. The patient population was divided in to two using the median score as a cut off. Univariate analysis revealed results which are tabulated in Table 6.16.

Table 6.16: Factors associated with high disability score [Univariate Analysis]

Sl No	Variable	Odds ratio (95% CI)	p value
1	Age less than or equal to 30	1	
2	Male Gender	1.81(0.38-8.51)	0.44
3	High Socio Economic Status	0.86 (0.29-2.51)	0.78
4	Rural Residence	0.74(0.25-2.16)	0.58
5	Single Marital Status	0.63(0.21-1.87)	0.41
6	Alcohol consumption at the time of injury	5.26(1-27)	0.05
7	Operation been performed	1.16(0.39-3.42)	0.78
8	Family history of Psychiatric Disorder	2.08 (0.17-24.40)	0.56
9	History of Seizures associated with Injury	1.18(0.37-3.75)	0.77
10	Hypothyroidism	1	
11	High Glasgow Coma Scale score at Presentation	0.75(0.57-0.98)	0.03
12	Hemiplegia	4(1.29-12.40)	0.01
13	Quadriplegia	3.57 (0.65-19.5)	0.14

Multivariate analysis was performed after adjusting for the other variables in the group. Results obtained are tabulated in Table 6.17

Table 6.17 : Factors associated with high disability score [Multivariate Analysis]

Sl No	Variable	Adjusted Odds ratio (95% CI)	p Value
1	Alcohol consumption at the time of injury	7.39(0.90-60.61)	0.06
2	High Glasgow Coma Scale score at Presentation	0.79(0.56-1.12)	0.19
3	Quadriplegia/Quadriparesis [Present or Not]	11.33(1.30-98.51)	0.02
4	Hemiplegia/ Hemiparesis [Present or Not]	7.69(1.60-36.83)	0.01

Discussion

Design:

The study done was using a cross sectional study design. Any cross-sectional study measures the prevalence of outcomes of health and/or its determinants in a specified population in a specific time period. This kind of information is useful to explore causality. It is the first kind of study to give such clues. Consider the example of relation between depression and severe TBI can be explored in cross sectional study.

One has to careful interpreting associations found in cross-sectional studies. Bias may easily arise due to selection or non selection of subjects, who are to be drawn from population under study. This is likely in our study as it is being conducted in a tertiary care institution. Bias can also arise due to observations being carried out by the same investigator on outcomes and also risk factors. To exclude the possibility of bias in psychiatric diagnosis the PI would be blind to details of the nature of injury at the time of assessment while collecting data regarding neuropsychiatic symptoms, psychiatric disorders and disability.

A cross sectional survey of socioeconomic status in severe TBI would underestimate prevalence of low socioeconomic status as many in that group could have got excluded from the study due to different survival rates linked to affordability of treatments. A cross sectional design poses problems by making it difficult to establish the direction of causality. For example if depression is associated with TBI, is that because TBI caused depression, or because depression gave vulnerabilities leading to a TBI? These difficulties make cross sectional studies exploring causation, best suited to the group of diseases that do not produce severe disability and to those that are associated with a identifiable phases before the symptom onset in case of serious

disorders. The other utility of cross sectional studies lies in planning health care. Consider example of a psychiatrist who wishes to know the prevalence of different risk factors for suicide in patients with TBI. It would help him plan strategies to avert suicidal behaviours in such patients.

Gender:

There were 46 males and 8 females in the population studied i.e. 85.19% were male and 14.81% were female. This is consistent with other literature which state that men are more likely than women to suffer with a TBI *(Bruns and Hauser, 2003).* There are other possibilities as well. Males having higher survival than females following TBI, is one such option. Neglect of female by non treatment in rehabilitation facilities is another. These are studied by looking at follow up of the TBI cases which come to Trauma facilities.

Age:

Their median age was 28.5 years with inter-quartile range ranging from 24 to 46 years. There was a bimodal age distribution with peak in third decade and sixth decade of life. This is consistent with available literature. There are many studies which suggest that people have highest incidence rates for TBI in the second and third decade of life. They also suggest an increase in TBI in the geriatric age group, which are usually due to falls *(Bruns and Hauser, 2003).*

Socio Economic Status [SES]

Although a variety of ways exist for measurement of socioeconomic status, Kuppusamy scale has been widely used in the urban population. Pareek has proposed one for rural populations. The effect of inflation and frequent devaluation of rupee requires frequent modification of any socioeconomic assessment scale. Modified

Kuppusamy scale continues to be used as a reliable scale for socioeconomic status measurement in studies done in India. The 2012 revision was used to calculate SES. This is an important aspect of evaluation of SES. The value of Rupee devalues quite rapidly during times of inflation. Old scales would over estimate SES. In this study however, latest version was used.

In absolute terms, distribution of monthly income was skewed. Median monthly income was Rs 16,500/-. SES was classified into five categories in the Kuppusamy Scale. During analysis they were clubbed with adjacent groups to form two groups. This was for ease of analysis and also to increase the power of analysis.

SES was not associated with any of the outcome variables. This could be due to disability, neuropsychiatric symptom burden and psychiatric disorders being truly independent of the SES or that the study was not powered to capture the effect. The difference in SES before and after trauma was not measured. Only the current SES was measured. It would be interesting to look at the difference in future studies. The difference would point to economic burden due to TBI. It is likely to be significant considering the fact that on many occasions, employment does get affected after TBI, as indicated in discussion below.

Employment status:

About four patients [7.41%] were unemployed before the trauma occurred. After trauma, at the time of assessment After the traumatic brain injury 40 patients [70.07%] were unemployed. Nine patients [16.67%] were registered as students before trauma. Six patients [11.11%] continued to be registered as students, even though few of them were not actively pursuing studies. The numbers available were small for comparison.

Area of residence:

28 patients [51.85%] were living in a rural area whereas 26 patients [48.15%] were living in urban area.

Religion:

Majority of the patients were Hindus by religion, 36 patients [67.2%] in all. 10 patients [18.82%] were Muslims and seven patients [13.21%] were Christians.

Severity of Trauma:

A vast majority 50 [92.6%] of the patients had a severe traumatic injury in comparison to 4 [7.40%], who had sustained TBI of moderate intensity. Severity of trauma is associated with more morbidity and need for rehabilitation. *(van Reekum et al., 2000)* Therefore the finding is understandable. The study being conducted in a tertiary care hospital is likely to recruit more serious cases. The predominance of severe injury in most of the study subjects has decreased the power of the study to identify association with disability, neuropsychiatric morbidity and psychiatric disorders.

Alcohol use:

In the 54 patients who were studied, two patients had diagnosis of Alcohol Dependence Syndrome before the trauma. They were all abstinent at the time of assessment. This is consistent with a systematic review of the literature, which found limited evidence of an association between TBI and decreased drug and alcohol use up to 3 years post-injury. However a 30-year longitudinal study conducted in Finland showed around 70% of patients with TBI, who currently use drugs also had used drugs and alcohol even before they got TBI*(Koponen et al., 2002)*

The short term decrease in Alcohol and drug use can be reasoned as due to learning that accidents are usually associated with Alcohol and drug use and also due to inability to procure the substances due to physical reasons. The long term study findings probably indicate return to previous states due to increased vulnerability due to personality changes, disabilities or the natural course of substance use being unaltered.

Literature shows that alcohol consumption is an important risk factor for occurrence of TBI. It also affects severity and outcomes. It is found to be present in 15 -20 % of all cases with TBI. *(Gururaj, 2002)* Our study finding is consistent with literature. There was record of Alcohol consumption at the time of the injury in 10 patients [18.84%]. However alcohol use at the time of trauma may be unreliable. Usually it is obtained through history, when it is unreliable due to amnesia in patients or through smell at the time of examination, when it is quite subjective.

Number of days of admission:

The distribution of number of days of admission was skewed. Therefore median was chosen as a measure of central tendency rather than the usual mean. None of these correlated with any of the measures like psychiatric disorder, neuropsychiatric morbidity or disability. This could be due to various factors. The assessment done for study purpose is not done at the time of discharge. Many patients would have stayed in rehabilitation ward for more days after the study was done. Therefore the number of days of admission in rehabilitation was an underestimate of truth. It probably also indicates that admission, discharge and duration of admission are dependent on resources of time and money and not just clinical picture alone.

Time from trauma to assessment:

The median time from trauma to assessment during study was 295 days with inter-quartile range between 110 and 480 days. This wide variation shows the bottleneck in services available at tertiary care and willingness of families to seek rehabilitation long after the initial trauma.

Head injury details:

50 patients [92.6%] had closed head injury, whereas four patients had penetrating head injury. 23 patients [42.59%] had operation performed on them. Only one patient [1.85%] had history of head injury in the past. 50 patients [92.6%] had severe head injury as indicated by Glasgow Coma Scale [GCS] score of less than or equal to 8. Four patients [7.4%] had moderate head injury with GCS score ranging between 9 and 12. There were no patients with mild head injury. This is understandable as people with mild injury may not be morbid enough to require rehabilitation services.

Psychiatric Disorders:

51 patients [94.44%] had no history of known psychiatric illness prior to the TBI, but three patients [5.56%] had history of past psychiatric disorder. Of those who had past history of psychiatric disorder one had Obsessive Compulsive Disorder [OCD] and two others had Alcohol Dependence Syndrome. Only one patient [1.85%] gave history of past treatment with psychotropic drugs i.e. even before the TBI. He was the patient with OCD.

49 patients [90.74%] gave history of no prior treatment with antipsychotics or antidepressants but medical records delete showed that 16 patients [29.63%] were currently on Anti Depressant Drugs and 9 patients [16.67%] were on Anti Psychotic Drugs. In all 23 patients [42.5%] were on any of the Psychotropic drugs. This

discrepancy may be due to ignorance of why the drugs are being given or were reluctant to reveal due to stigma.

Current Psychiatric Disorders:

In the 54 patients evaluated for psychiatric disorders, 16 patients [30%] had at least a current psychiatric diagnosis. Of these Alcohol dependence syndrome was diagnosed in two, Severe depression without psychotic symptoms in six [11.11%], Generalized Anxiety disorder in one [1.85%], Hypomania in two [3.7%], Dysthymia in one [1.85%], OCD in one [1.85%] and Unspecified Psychosis in five patients [9.25%]. The numbers in each disorder group are so few that no meaningful statistical comparisons can be made with each other.

11.11% prevalence of depression is lesser than 25% to 50% prevalence found in other studies. This could be due to differences in methodologies used for measurement of depression. In this study the prevalence of 11.11% was for of severe depression without psychosis. The sub-syndromal forms were captured as neuropsychiatric symptom of depression. This is discussed later.

The literature on anxiety Disorders following TBI is dominated by discussions on post-traumatic stress disorder [PTSD]. Literature also reveals anxiety disorders are reported after mild TBI, most commonly in those who sustained a limb injury. In this study no case of PTSD was found. The one patient who had generalized anxiety disorder did not have any limb injuries at least in form of fractures.

The two patients with Alcohol Dependence had been dependent on alcohol even before TBI. There were no cases of alcohol dependence emerging after TBI. The issues regarding alcohol are discussed in the section on alcohol use.

The patients with psychiatric disorders and those without psychiatric disorders were compared for differences in association with variables using univariate logistic regression and later with multivariate logistic regression backward elimination.

The presence of psychiatric disorder was associated with a neurosurgical operation being performed on the patient after TBI. There was a 5 times increased risk of developing psychiatric disorder in patients who underwent a neurosurgery compared to those who did not. The confidence intervals for the adjusted odds ratio were 1.20 and 21.21 at a p value of 0.03. . It is likely that the effect found would remain significant and that confidence intervals would narrow if the sample size is larger. Neurosurgery being performed is a proxy indicator of a severe injury. This is consistent with literature that psychiatric disorders are associated with more severe head injuries.

Neuropsychiatric Symptoms:

Neuropsychiatric symptoms were studied using the Neuropsychiatric Inventory. 51 patients out of the 54 had at least one neuropsychiatric symptom meaning the prevalence of neuropsychiatric symptoms was 94.44%. The 95% confidence intervals were 88.13% and 100%. It suggests very high neuropsychiatric morbidity.

The frequency of the number symptoms was studied. It showed around 63% had 3 symptoms or lesser but about 37% of patients had more than 4 symptoms. This too is suggestive of high neuropsychiatric morbidity.

On studying the number of patients who had neuropsychiatric symptoms in the Neuropsychiatric Inventory, the commonest symptom found was Irritabilty/Lability. It was seen in 30 patients [55.56%]. The prevalence of other symptoms was as follows: Agitation/aggression seen in 27 patients [50%], Depression seen in 23 patients [53.7%], Anxiety seen in 17 patients [31.48%], Apathy/ Indifference seen in 15

patients [27.78%], Appetite/eating change seen in 14 patients [25.93%], Disinhibition seen in 12 patients [22.22%], Night time behaviour problems seen in nine patients [16.67%], Aberrant motor behaviour seen in seven patients [12.96%], Elation/Euphoria seen in six patients [11.11%], Delusions seen in four patients [7.41%] and Hallucinations seen in one patient[1.85%].

Presence of a symptom is marker for a problem, but it does not tell the entire story. For example a symptom like sleep disturbance may be present in large proportion of study population but it would not matter if it just meant one extra awakening compared to normal population. In other words the frequency of the symptom is an important dimension in the measurement of a symptom. If a person were to assault a person without provocation, even if it is rare event, it would amount to being a significant problem. This suggests severity of the problem being another important dimension in measurement of a symptom.

The Neuropsychiatric Inventory measures both severity and frequency of each symptom when it occurs. In it each symptom is scored in domains of frequency and severity. The frequency score is multiplied with severity score. The product thus obtained is the burden score. This is an objective indicator of the burden of the symptom in a given patient. Not every patient would have burden from every symptom.

To study the burden caused by each symptom, the burden scores of each symptom were summed up in the entire study population. This score obtained for each symptom is indicative of the overall burden caused due to the symptom in the entire population. In this irritabilty/lability scored high with 126 points. The other symptoms in descending order of burden caused were appetite/eating change with 120 points, agitation/aggression with 109 points, apathy/ indifference with 109 points, depression

with 106 points, anxiety with 89 points, problematic night time behaviour with 84 points, aberrant motor behaviour with 67 points, disinhibition with 64 points, elation/euphoria with 43 points, delusion with 28 points and hallucination with 4 points.

In the NPI there is a distress of care giver score for each symptom. The symptoms which are absent in a given patient would obviously have no distress score. The distress scores of each symptom were summed up. These scores reflect the distress experienced from caregiver perspective regarding each of the neuropsychiatric symptom.

It was found that depression as a symptom in the patient scored high with score of 63 points. This was followed by agitation/aggression with a score of 55. These were followed by other symptoms. In the descending order they are Irritabilty/Labilty with 48 points, Appetite/eating change with 40 points, Anxiety with 38 points, Night time behaviour with 37 points, Apathy/ Indifference with 36 points, Disinhibition with 30 points, Aberrant motor behaviour with 19 points, Delusion with 11 points, Elation/Euphoria with 6 points, Hallucination with 5 points.

It is interesting to find that what is subjectively a more important problem is objectively lower in the order of morbidity as in case of depression. Otherwise the symptoms of agitation/aggression, irritability and weight/ appetite change were burdensome both subjectively and objectively. It is also interesting to note that traditional markers of psychopathology delusions and hallucinations are low in both the lists reinforcing the fact that TBI related psychiatric morbidity is quite atypical.

Castano et al used the same Neuropsychiatric Inventory to 53 patients with severe TBI and found that 92.5% of them have neuropsychiatric symptoms. In their study they found that most common symptoms were irritability/lability, apathy and

depression/dysphoria. They found that presence of symptoms of agitation/aggression, apathy and disinhibition was correlated with more disability. (Castano Monsalve et al, 2012) This could reveal a sample to sample variation. It could also be due to cultural differences. For example apathy may be taken more seriously in the west and disinhibition tolerated more in the east.

Total NPI score was obtained by taking sum of burden scores of all neuropsychiatric symptoms except night time behaviours and weight/ appetite change. The median was used to divide the study population into high morbid and low morbid groups.

Using univariate analysis and later with multivariate logistic regression backward elimination, the following associations were found.

Being operated upon was a significant risk factor for developing higher neuropsychiatric morbidity. It was about 5 times increased risk. The confidence intervals of the odds ration ranged from 1.36 to 24.68. The p value was 0.02. The confidence interval was wide. It is likely that the effect found would remain significant and that confidence intervals would narrow if the sample size is larger.

Cognitive problems:

The overall level of cognitive functioning was assessed using Ranchos Los Amigos Level of Functioning score. The study population was divided into groups based on their score. The patients with score 5 and below were compared with those with score 6 and above. There was 20 patients in the low functioning group and 34 in the high functioning group. Using univariate analysis and later with multivariate logistic regression backward elimination, it was found that higher GCS score at presentation was associated with protection against low functioning. The odds ratio obtained was 0.71. The confidence intervals were 0.51 and 0.99. Conversely, it means patients with

higher GCS score at presentation were at greater risk of lower level of cognitive functioning.

Addenbrooke's cognitive examination was also used to measure different dimensions of cognitive functioning like attention/concentration, fluency, memory etc. The patients who could not perform the tests were not part of the denominator while calculating the mean scores.

The scores were Attention/ Concentration 81% [11%-100%], Memory 72%[7.7-100%], Fluency 29% [0-100], Language 82.1% [30.7-100] and Visuo-Spatial 71.3%[6.2 -100]. On observation the range of values is very wide showing the heterogeneity of cognitive function in the study population.

Literature supports the view that cognitive deficits are common presenting complaints after TBI. *(Lovell M, 1994).* They hinder the reintegration of patients back to normal life. This they do by affecting family life, adaptive skills of social functioning, job related dysfunction and instrumental skills of daily living *(McAllister, 2008).* Many domains of cognition are impaired. Cognitive domains that are predictably impaired are:

1. Attention *(Mathias and Wheaton, 2007)*
2. Frontal executive functions (impulse control, self-monitoring, problem solving) *(Lehtonen et al., 2005, Freedman et al., 1987)*
3. Short-term memory and learning *(Levin et al., 1988, Vakil, 2005)*
4. Emotion processing *(Jackson and Moffat, 1987)*
5. Speed of information processing *(Rassovsky et al., 2006, O'Jile et al., 2006)*
6. Speech and language functions.*(Weintraub et al., 1981)*

These aren't completely independent domains, as anyone can understand. Clearly there are a mixture of deficits across domains in varying degrees. This is indirectly evidenced with the wide range of scores of cognitive functioning in our study population.

There were 15 patients on whom ACE-R could not be done due to various factors like irritability, non-cooperativeness etc. Univariate analysis followed by multivariate logistic regression backward elimination was done to see if these groups were different. The following associations were found.

Alcohol consumption at the time of Injury and lower GCS scores at presentation was associated with patient not being assessable with ACE-R. Alcohol consumption at the time of injury was associated with more than 13 times the risk. The confidence limits were 1.75 and 102.11 with a p value of 0.01. GCS score was associated with protective effect with odds ratio of 0.54. The confidence limits were 0.34 and 0.87. This can also be stated as there is a 1.85 times risk with more severe head injury as indicated by low GCS score. Interpretation of these result needs caution. Are these outcomes of non-cooperation and alcohol consumption both related to personality factors of low frustration tolerance or is the current non-cooperativeness a result of alcohol related head injuries? These questions cannot be answered in a cross-sectional study like this but are interesting to be followed up in future studies.

Disability:

The disability was measured using Disability Rating Scale. The distribution of scores was skewed to right. Median disability score was 7.25 with inter-quartile range between 4 and 17. This is consistent with other studies. Idresel J et al compared DRS scores at admission and at discharge for 30 patients who were undergoing an in-patient rehabilitation programme. They found the mean DRS score at admission was

8.67 with standard deviation of 0.77. The mean DRS score at discharge was 5.7 with standard deviation of 2.77. Our study being done during the in-patient stay has values right in between the ranges they obtained *(Irdesel et al., 2007).*

The median score was used as a cut off for dividing the study population in to two groups. Using univariate analysis and later with multivariate logistic regression backward elimination, the following associations were found.

Having quadriplegia/quadriparesis or hemiplegia/ hemiparesis was identified as a significant risk factor for developing higher disability. It was more than 11 times increased risk with quadriplegia/quadriparesis. The confidence intervals of the odds ration ranged from 1.30 to 98.51. The p value was 0.02. It was more than 7 times increased risk with hemiplegia/hemiparesis. The confidence intervals of the odds ration ranged from 1.60 to 36.83. The p value was 0.01.The confidence interval was wide in both cases. It is likely that the effect found would remain significant and that confidence intervals would narrow if the sample size is larger.

Limitations

The study being carried out in a tertiary care hospital may lead to bias. The patients with TBI admitted in the rehabilitation ward are a special group of patients. Their findings may not be generalizable to all patients with TBI.

The calculated sample size is 100 patients. During the study period only 54 patients could get recruited. This decreases the power of the study, especially to identify associated factors.

Conclusions

The prevalence of psychiatric disorder in patients with traumatic brain injury admitted in the tertiary care Physical Medicine and Rehabilitation facility was 30 % [95% CI 17-42.2%].

The prevalence of neuropsychiatric symptoms in patients with traumatic brain injury admitted in the tertiary care Physical Medicine and Rehabilitation facility was 94.44% [95% CI 88.13-100%].

The level of disability was measured using Disability Rating Scale. Median Disability score was 7.25 with inter-quartile range between 4 and 17.

Cognitive functioning tested in the patients who performed ACE-R showed the mean ACE-R score was 70.1% with a standard deviation of 20.48.

Presence of hemiplegia/ hemiparesis, quadriplegia/quadriparesis and consumption of alcohol at the time of injury was significantly associated with higher disability.

Patients who had neurosurgical operation performed on them had significantly higher risk for developing psychiatric disorders and neuropsychiatric symptoms. This can be seen as an association with severity of injury.

The neuropsychiatric symptoms of agitation/aggression, irritability and weight/ appetite change were burdensome to patients objectively and caregivers subjectively.

It can be concluded that TBI is strongly associated with psychiatric morbidity. Therefore treatment of patients with TBI should involve a multidisciplinary approach, in which there is a close collaboration between neurologist/neurosurgeon, physiatrist, family physician, social worker, psychologist, family members, patient and the psychiatrist.

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ஆய்வு பற்றிய விவரம் (Information sheet)

என் பெயர் தீரஜ் கட்டுலா. நான் கிருஷ்ணா மருத்துவ கல்லூரியின் மனநல மருத்துவ மேல்நிலைப் படிப்பு மேற்கொண்டு வருகிறேன். நான் செய்யப் போகும் ஆராய்ச்சியில் தலைக்காயம் ஏற்பட்டவர்களின் ஏற்படும் மனநிலை மாற்றங்கள் குறித்தாகும். இந்த ஆய்வின் ஒரு பகுதியாக நோயாளியைப் பற்றிய விவரங்கள், தலைக்காயம் குறித்தும் அதற்கான சிகிச்சை முறைகள் குறித்தும் கேள்விகள் கேட்கப்படும்.

இந்த ஆய்வில் [redacted] பங்கெடுப்பதன் மூலம், உங்களுக்கு அளிக்கப்படும் சிகிச்சை முறையில் எந்தவித இடர்பாடும் ஏற்படாது. தங்களை பற்றிய தகவல்கள் ஆய்விற்கு மட்டுமே உபயோகப்படுத்தப்படும் என்பதையும் தெரிவித்துக் கொள்கிறேன். ஆய்வாளர் தேவையானவை[redacted] மட்டுமே தங்களிடம் கேட்கப்படும் என்பதையும் தங்களின் பெயர் மற்றும் முகவரி வெளியிடப்படாது என்பதை உறுதி செய்து கொள்ள விரும்புகிறேன்.

தங்களின் சுய விருப்பத்தின் பேரில் இந்த ஆராய்ச்சியில் பங்கு கொள்வதில் அவசியமில்லை என்பதையும், ஆய்வின் எந்த ஒரு நிலையிலும், தங்களுக்கு விருப்பமில்லையென்றால் விலகிக்

இந்த ஆய்வு பற்றிய சந்தேகங்கள்

எதுவாக இருப்பினும் கீழ்கண்ட நபரிடம்

கேட்டு தெரிந்து கொள்ளலாம்.

டாக்டர்
அ. தீரஜ் கட்டலா

டாக்டர் அண்ணா
துரியன்

மனநல மருத்துவ பிரி
யாகாயம், வேலூர் -

ஒப்புதல் படிவம் (Consent)

நான் இப்படிவத்தில் கையொப்பம் வைப்பதன் மூலம் நான் டாக்டர் தீரஜ் கட்டுலா அவர்களின் ஆய்வில் பங்கெடுப்பதற்கு சம்மதம் தெரிவிக்கிறேன். இந்த ஆராய்ச்சியின் பகுதியாக சில கேள்விகள் எனது மனநல ஆரோக்கியம் குறித்து கேட்கப்படும் என்பதை அறிவேன்.

நான் இந்த ஆய்வில் பங்கெடுப்பது எனது சுய விருப்பத்தின் அடிப்படையில் மட்டுமே என்பதையும், இதில் பங்கெடுப்பதினாலோ இல்லையென்றாலோ எனது ~~[illegible]~~சிகிச்சையில் எந்தவித இடர்பாடும் ஏற்படாது என்பதை தெளிவாக அறிந்து கொண்டேன்.

கையொப்பம்.

நோயாளியின் உறவினர்

தேதி

...యం.స. వెల్లూరు పోస్టుగ్రాడియేటు విద్యార్థి ...పత్రము.
డాక్టరు కత్తుల ధీరజ్ చే ఇంటర్వ్యూ చెయ్యబడడానికి, నేను ఒప్పుకుంటూ ఈ పత్రము మీద సంతకము చేస్తున్నాను.

'తలకు అయిన గాయాల మూలమున వచ్చిన మానసిక రోగాల' గురించి జరిగే పరిశోధనలో నేనూ భాగం తీసుకొంటున్నాను.

నా ఆరోగ్యము గురించి కొన్ని ప్రశ్నలు అడుగుతారని నాకు తెలుసు. ఎవరి వత్తిడి లేకుండా, నా అంతట నేనే ఇందులో పాల్గొంటున్నాను. ఇందులో నేనిచ్చే జవాబుల వలన నాకు, నా కుటుంబానికి దొరికే వైద్య, సేవా సదుపాయల్లో ఏ విధమైన మార్పు ఉండదు.

నేను చెప్పేవి పరిశోధనకు మాత్రమే వాడుతారు. చెప్పినవి రహస్యంగా ఉంచబడతాయి.

ఈ పరిశోధనవల్ల 'తలకు తగిలిన గాయాల వలన కలిగే మానసిక రోగాలు' పై ఎక్కువ తెలుసుకోబడుతుంది. అది వారి చికిత్సకు సహాయపడుతుంది. లేక ఉపయోగపడ్తుంది.

...ాల్గొనే వ్యక్తి బంధువు

...తకము.

పాల్గొనే వ్యక్తి

సంతకము.

అంగీకార ధృవీకరణ పత్రము.

సి.యం.సి వెల్లూరు పోస్టుగ్రాడియేటు విద్యార్థి అయిన డా॥ కతుల ధీరజ్ కి ఇంటర్న్ షిప్ (ట్రైనింగ్) చెయ్యుటకు అంగీకారము తెలియచేయు ఈ పత్రము మీద సంతకము చేసి, నా సమ్మతిని తెలియచేయుచున్నాను.

దీనిని బట్టి నేను, 'తలకు తగిలిన గాయముల వలన కలిగిన మానసిక రుగ్మతలు' మీద జరుగు పరిశోధనలో పాలుపంచుకొనుచున్నానని నాకు అవగాహన ఉన్నది. నా అభిప్రాయాలను గురించి కొన్ని ప్రశ్నలు అడుగుతారని కూడా నాకు తెలుసు. నా అంతట నేనే స్వేచ్ఛాపూర్వకముగా ఇందులో పాలుపంచుకొనుచున్నాను.

ప్రశ్నలకు ఇచ్చే సమాధానాలవల్ల నాకుగాని, నా కుటుంబానికి గాని చెడ్డ సేవా పదుపాయాలలో ఏ విధమైన మార్పు ఉండదని నా వంటి సేకరించిన విషయాలను పరిశోధనకు మాత్రమే ఉపయోగపడుతుందని, గుప్తంగా ఉంచబడతాయని నాకు రూఢిగా చెప్పబడినది.

ఈ పరిశోధన వలన తలకు తగిలిన గాయాల వలన కలిగే మానసిక రుగ్మతలపై ఎక్కువ అవగాహన పెరుగుతుందని నాకు తెలిసినది.

పాల్గొన్న వారి బంధువు పేరు

సంతకము

పాల్గొనే వ్యక్తి

సంతకము.

నా పేరు కల్తేల ధీరజ్, నేను క్రైస్తవ వైద్యకళాశాల, వెల్లూ
లో మానసిక విభాగములో పి.జి. విద్యార్థిని. నా పైచదువుల
నిమిత్తము నేనొక ప్రాజెక్ట్ చేస్తున్నాను. తలమీద దెబ్బ తో
మెదడు కూడు దెబ్బ, తగిలిన వారి నాడీవ్యూహ మానసికంగ
ఎలా పరివర్తన చెందుతుందో అన్న అంశం మీద నేను
చెస్తున్న ప్రాజెక్ట్ ఇది. ఈ ప్రాజెక్ట్ లో భాగంగా నీవు,
నిన్ను చూచుకొనే వారికి ఇదొక ఇంటర్వ్యూ అన్నమాట
నిన్ను, నిన్ను చూసుకొనే వారిని కొన్ని ప్రశ్నలు అడుగుతాను
నీకు ఎట్లా తల మీద దెబ్బ తగిలింది, దానికి ఏమేమి
మందులు వాడావు మరియు ఇప్పుడున్న సమస్యలు మరియు
మీ కుటుంబం గురించి. ఇట్లా కొన్ని ప్రశ్నలు అడుగుతాను.

నిన్ను ఈ ప్రాజెక్ట్ లోకి ఆహ్వానిస్తున్నాను. నీవు
నీకిచ్చిన కర పత్రమును జాగ్రత్తగా చదివి, అర్థం చేసు
కోవాలి. మేము ఈ కర పత్రము నీకు ఇస్తాము. నేను నీకొచ్చిన
సందేహాలు సంతోషంగా తీరుస్తాను. ఈ ప్రాజెక్ట్ లో నీవు
పాల్గొనటము అంతా నీకు నచ్చితేనే. ఈ ప్రాజెక్ట్ లో
పాల్గొనటము బట్టి నీకు రోజు వారిగా ఇచ్చే మందులలో
ఏమీ తేడా వుండదు. నీవు ఈ ప్రాజెక్ట్ లో పాల్గొనకపోతే
కూడా నీకు రోజు వాడే మందులు మంచిగానే దొరుకుతాయి
నీవు ఈ ప్రాజెక్ట్ లో పాల్గొనలుగుంటానని చెప్పి తరువాత
మనస్సు మార్చుకుంటే నీవు మానుకోవచ్చు. ఈలాగ
చేసిన నీ చికిత్సా విధానములో ఎటు వంటి మార్పు వుండదు
వీలయినంత ఇటువంటి రోగులు పాల్గొనాలని నా
విన్నపము.

[illegible]

పత్రము మీద సంతకం పెట్టమంటాను లేదా ఒక పత్రంమీ
మీ వేలి ముద్రలు తీసుకుంటాను. ఎందుకంటే నేను మీకు
ఈ ప్రాజెక్ట్ విషయంలో అన్ని తెలియచేసానని చెప్పు
డానికి మరియు మీరు మీ ఇష్టానుసారమే దీనిలో పాల్గొన్నార
చెప్పడానికి ఈ పత్రం మీద సంతకం చేసిన తరువాత
కూడా మీరు మీ మనస్సు మార్చుకొని తరువాత
ఈ ప్రాజెక్ట్ మానుకోవచ్చు.

మీ స్వంత విషయాలు గుప్తంగా వుంచబడతాయి.
కాని మీ వ్యాధికి సంభంధించిన కాగితాలు ఈ ప్రాజెక్ట్ లో
పాల్గొంటున్న వారు చూస్తారు. దానికి మరల మీ అనుమతి
తీసుకోరు. ఈ ప్రాజెక్ట్ ఫలితాలు తరువాత మెడికల్
జర్నల్ లో ప్రచురించబడతాయి కాని దానిలో మీ పేరు,
ఊరు తో మిమ్మల్ని ఎవరు గుర్తు పట్టలేరు.
క్రైస్తవ వైద్యకళాశాల, వెల్లూరు పరిశోధనా విభాగము
వారు ఈ ప్రాజెక్ట్ చేయడానికి అంగీకరించారు. ఏమి
టంటే కొంతమంది వైద్యులు ఈ ప్రణాళికను చదివి
నన్ను ఈ పరిశోధన చేయుటకు అంగీకరించారు

మీకు మరి ఏమైన సందేహాలు వుంటే, మరి
ఏమైన ఇలంటి విషయాలు ఎక్కువగా తెలుసుకోవాలంటే
మీరు ఈ క్రింద ఇచ్చిన వారిని ఎవరినైన సంప్రదించ
వచ్చు

మిమ్మల్ని ఈ క్రింద చిరునామ లో సంప్రదించవచ్చు.

డా. కల్తుల థెరజ్

డా. అన్న తరియన్
ప్రొఫసర్
మానసిక వైద్య విభాగము
క్రైస్తవ వైద్య కళాశాల
బాగాయమ్, వెల్లూరు.
632002.

APPENDIX A

STUDY INFORMATION SHEET:

TITLE OF THE STUDY: A cross sectional study of neuropsychiatric problems in patients with traumatic brain injury in a tertiary care rehabilitation center

I am Dr.Kattula Dheeraj. I am a post graduate student of Psychiatry Department in Christian Medical College, Vellore. I am now doing a project as a part of my higher studies. The project is about looking at Psychiatric morbidity in patients with recent traumatic brain injury. During this project you and your caregiver have to undergo an interview. You and your caregiver will be asked a few questions about your background, your injury, treatments you received and also your current problems.

You are invited to participate in this project. You have to read this information leaflet very carefully and understand what is written. We will give you a copy of this information for you to keep. I will be happy to answer any doubts or questions you have. Your participation in this study is entirely voluntary. Taking part in this study will not affect your regular treatment in any way. If you do not wish to take part, you will continue with regular treatment as usual. Even if you agree to take part, you can change your mind at any time and leave the study. This will not affect your treatment in any way. I will request totally around 100 patients to participate in this project.

If you wish to take part, I will ask you to sign a form or give your thumb impression, saying that I have explained all the details to you and that you are willing to take part. Even after signing, you may change your mind and cancel it at any time.

Your personal details will be kept anonymous and confidential. However, your medical notes may be reviewed by people involved in the study, without your additional permission. The results of this study may be published in a medical journal in future but you will not be identified by name in any publication or presentation of results.

The research committee and the ethics committee of the Christian Medical College, Vellore, have approved this study. This means that a group of doctors of this hospital have studied this plan and have given permission for me to do this study.

If you have any doubts, or want additional information, contact any of the following in this hospital. We can be contacted at the following address:

Dr.Kattula Dheeraj

Post graduate Registrar

Dr. Anna Tharyan

Professor,
Department of Psychiatry,
Christian Medical College, Vellore 632002

APPENDIX B

CONSENT FORM

In signing this document I am giving consent to be interviewed by Dr. Kattula Dheeraj, Post graduate student from CMC, Vellore. I understand that I will be part of the research study that will focus on psychiatric disorders in people with traumatic brain injury.

I further understand that I will be asked a few questions regarding my health status. My participation will be voluntary and granted freely. The answers will have no effect on the health or social services provided to me and my family.

I am assured that the information that will be collected from me will be used only for this study purpose and it will be kept completely confidential.

I understand that this study will develop a better understanding about psychiatric problems in people with traumatic brain injury

Date: Respondent's Signature

Witness -

Relationship -

Sociodemographic Data

Name : Mr/Mrs/Ms

Age [in years]:

Gender: Male/ Female

Hospital Number:

Informant:

Education **:** No Formal Schooling / Primary / Secondary/ Higher Secondary/ Graduation/ Post Graduation/ Professional

Years of education:

Occupation

Current : Unemployed/ Unskilled/skilled/ Professional/ Self employed

Pre injury: Unemployed/ Unskilled/skilled/ Professional/ Self employed

Residence: rural/ urban

Telephone:

Religion: Hindu/Muslim/Christian/Others

Marital Status: Single/Married/Divorced/Widowed/Separated

SE Status: High / middle/ low [scale is available in appendix D]

Income:

Other Data related to trauma and psychiatric problems

GCS at presentation

TBI: Moderate/ Severe

History of pre injury alcohol consumption

Admitted for how long

In ICU

In ward

In Rehab

When did trauma occur:

Time from trauma till current assessment:

Nature of Injury: Closed / Penetrating

Operation

Done /not done

What operation

h/o previous head injury: Yes/ no

Imaging findings:

Psychiatric history

h/o previous psych illness: Yes/ no

h/o psych meds: yes/ no

h/o seizures: yes /no

- Asso with Trauma
- Before trauma
- Last seizure

h/o family members with psychiatric illness: Yes/ no

if yes what...

h/o family members with Seizures

Patient's Current neuropsychiatric problems: [from NPI]

Patient's current psychiatric disorder:

Patient's Past Psychiatric diagnosis:

Cognitive Problems:

Current cognitive score on ACE-R [Addenbrooke Cognitive Examination Revised]

Attention/orientation: /18 points,

Memory: /26 points,

Ffluency: / 14 points

Language: / 26 points and

Visio-spatial: / 16 points

Rancho Los Amigos Level of cognitive functioning score

Physical Problems:

Any associated physical problems:

- Monoplegia/Monoparesis
- Hemiplegia/Hemiparesis
- Quadriplgia/ Quadriparesis
- Fractures
- Preexisting DM, HT, IHD, Hypothyroidism
- Others

Disability:

Rappaport Disabiity Rating score

Total

Eye Opening

Communication Ability

Motor Response

Feeding

Toileting

Grooming

Level of Functioning

Employability

Any Complaints:

[patients and caregivers]

Modified Kuppusamy Scale [2012 revision]

Education

1. Profession or Honors.....7
2. Graduate or Post Graduate.....6
3. Intermediate or post high school diploma.....5
4. High school certificate.....4
5. Middle school certificate.....3
6. Primary school certificate.....2
7. Illiterate.....1

Occupation

1. Professional.....10
2. Semi Professional.....6
3. Clerical shop/ Farmer.....5
4. Skilled worker.....4
5. Semi skilled worker.....3
6. Unskilled worker.....2
7. Unemployed.....1

Family Income per month

1. > Rs 30,375.....12
2. Rs 15,188-30,374.....8
3. Rs 11.362-15,187.....6
4. Rs 7,594-11,361.....4
5. Rs 4,556-7,593.....3
6. Rs 1521-4,555.....2
7. < Rs 1520.....1

	SOCIO ECONOMIC CLASS	**SCORE**
1	Upper	26-29
2	Upper Middle	16-25
3	Lower Middle	11-15
4	Upper Lower	5-10
5	Lower	<5

ADDENBROOKE'S COGNITIVE EXAMINATION - ACE-R

Tamil Version

Name / Age /Sex/ Hospital No:

Dates of testing: ..... / ..... / ..... / .....

Handedness:

Tester's names: .....
Education: .....
Occupation: .....

ORIENTATION

Ask: What is the

DAY NAAL நாள்	DATE(+/-2) THEDHI தேதி	MONTH MASAM மாதம்	YEAR VARUSHAM வருடம்	SEASON PARUVAM பருவம்

[Score 0-5]

Ask: Which

BUILDING KATTIDAM கட்டிடம்	FLOOR MAADI தளம் /மாடி	TOWN OOR ஊர்	STATE MAANILAM மாநிலம்	COUNTRY NAADU தேசம்

[Score 0-5]

REGISTRATION

[Score 0-3]

Tell: 'I'm going to give you three words and I'd like you to repeat after me: lemon, key and ball'. After subject repeats, say 'Try to remember them because i'm going to ask you later'. Score only the first trial (repeat 3 times if necessary). **எலுமிச் சை, சாவி, பந்து** (Elumichai, Saavi, Pandhu)

Register number of trials ……..

ATTENTION& C ONCENTRATION

[Score 0-5]

Ask the subject: ' could you take 7 away from a 100? After the subject responds, ask him or her to take away another 7 to a total of 5 subtractions. If subject make a mistake, carry on and check the subsequent answer (i.e. 93, 84, 77, 70, 63 -score 4) Stop after five subtractions (93, 86, 79, 72, 65). (Score for the best performed task)……

Ask: 'Could you please spell **WORLD (மத்தளம்)** Mathalam. Then ask him/her to spell it backwards:

MEMORY - Recall

[Score 0-3]

Ask: 'Which 3 words did I ask you to repeat and remember?'……

MEMORY - Anterograde Memory

[Score 0-7]

- Tell: ' I'm going to give you a name and address and I'd like you to repeat after me. We'll be doing that 3 times, so you have a chance to learn it. I'll be asking you later'
  Score only the third trial

	1st Trial	2nd Trial	3rd Trial
Selva Kumar 42, Nehru Street Gandhinagar Vellore			

MEMORY - Retrograde Memory

[Score 0 -4]

- Name of current Prime Minister/Chief Minister of your state……..
- Name of the woman who was Prime Minister/Any Sports personality .....
- Name of the Indian president/Local municipal officer/VAO .....
- Name of the Indian Prime minister who was killed in bomb blast in 1991 .....

ATTENTION&ORIENTATION

MEMORY

VERBAL FLUENCY - Letter 'P' and animals

➢ **Letters**

Say: 'I'm going to give you a letter of the alphabet and I'd like you to generate as many words As you can beginning with that letter, but not names of people or places. Are you ready? You've got a minute and the letter is '**ப**(Pa)' , '**P'**

[Score 0 - 7]

				>17	7
				14-17	6
				11-13	5
				8-10	4
				6-7	3
				4-5	2
				2-3	1
				<2	0
				total	correct

➢ **Animals**

Say: 'Now can you name as many animals as possible, beginning with any letter? You've got a minute

[Score 0 - 7]

				>21	7
				17-21	6
				14-16	5
				11-13	4
				9-10	3
				7-8	2
				5-6	1
				<5	0
				total	correct

FLUENCY

LANGUAGE - Comprehension

➢ Show written instruction: (Kanngalai Moodavaum)

[Score 0-1]

Close your eyes

கண்களை மூடவும்

➢ 3 stage command: (Score 1 for each command)

'Take the paper in your right hand. Fold the paper in half. Put the paper on the floor'

Score 0-3]

LANGUAGE - Writing

➢ Ask the subject to make up a sentence and write it in the space below: Score 1 if sentence contains a subject and a verb and meaning. (Give a pen with closed cap)

[Score 0-1]

LANGUAGE

LANGUAGE - Repetition

[Score 0-2]

➢ Ask the subject to repeat:**' Hippopotamus'; 'Eccentricity; 'Unintelligible'; 'Statistician'**
Score 2 if all correct; 1 if 3 correct; 0 if 2 or less. **(வண்டு கரங்கள் குரல்வளை வளையல்)**
(Vandu, Karangal, Kuralvalai, Valayal)

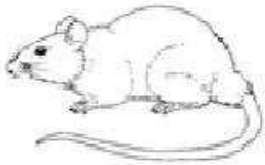
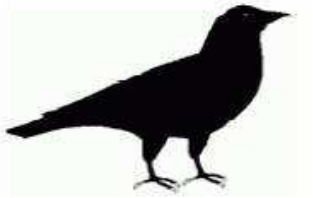
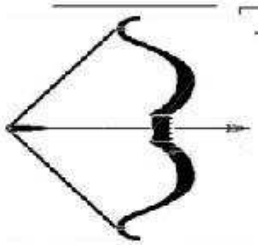
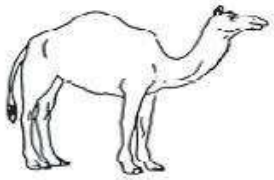
➢ Ask the subject to repeat: **'Above, beyond and below'** [Score 0-1]
'கற்க கசடற கற்பவை'(Karka, Kasadara, Karpavai)

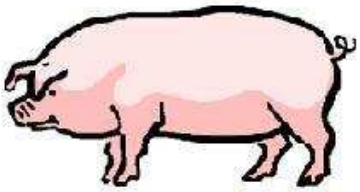
➢ Ask the subject to repeat: **'No ifs, ands or buts'** [Score 0-1]
'வானில் வானவில் தெரியும்' (Vaanil Vaanavil Theriyum)

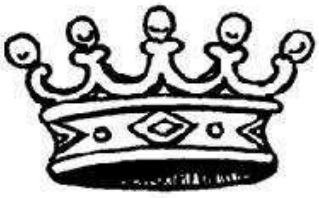
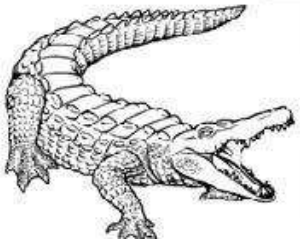
LANGUAGE - Naming

➢ Ask the subject to name the following pictures: [Score 0-2]
Pencil
+Watch






[Score 0-10]

LANGUAGE - Comprehension

➢ Using the pictures above, ask the subject to: [Score 0-4]

- Point to the one which is found in desert (paalaivanam) .....
- Point to the one which can fly .....
- Point to the one which is used by warriors(pourveerargal) .....
- Point to the one which is worn by king/Queen .....

LANGUAGE - Reading

[Score 0-1]

- **Ask the subject to read the following words: [Score 1 only if all correct]**

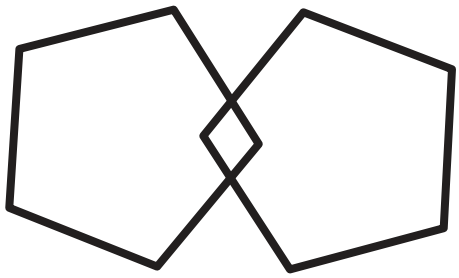
sew	மரம் (Maram)
pint	ஆறு (Aaru)
soot	வேஷம் (Vesham)
dough	சாஸ்திரம் (Sasthram)
height	நிறம் (Niram)

LANGUAGE

VISUOSPATIAL ABILITIES

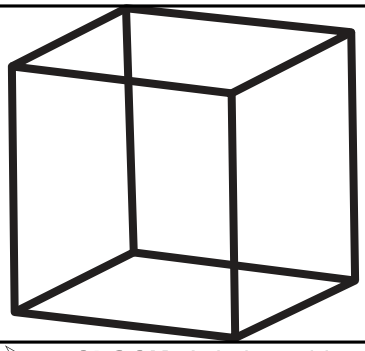
[Score 0-1]

- **Overlapping pentagons:** Ask the subject to copy this diagram:
  (Pentagon should show 5 corners)



[Score 0-2]

- **Wire cube:** Ask the subject to copy this drawing (if cube has 12 lines =2, less than 12 lines =1)



[Score 0-5]

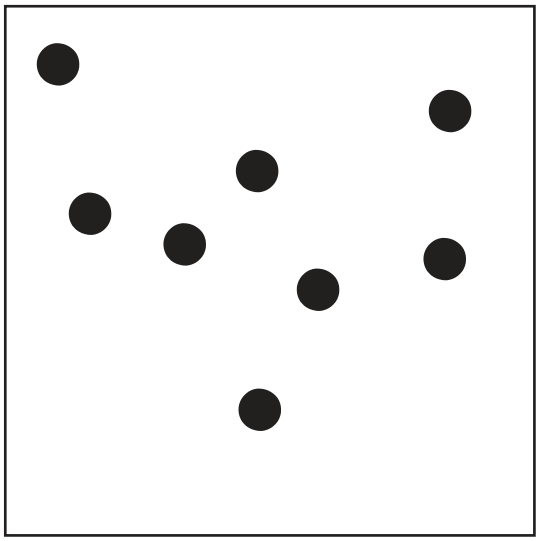
- **CLOCK:** Ask the subject to draw a clock face with numbers and the hands at ten past five. (For scoring circle = 1, numbers = 2, hands = 2 if all correct)

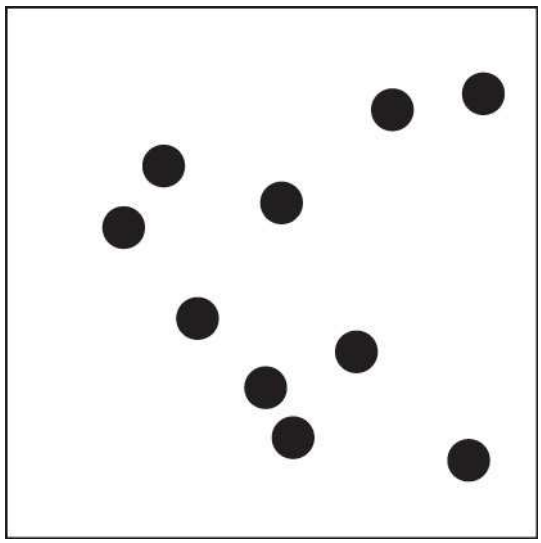
VISUOSPATIAL

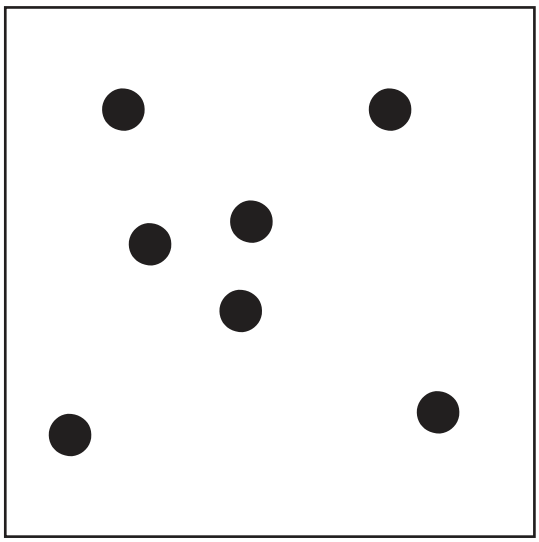
PERCEPTUAL ABILITIES

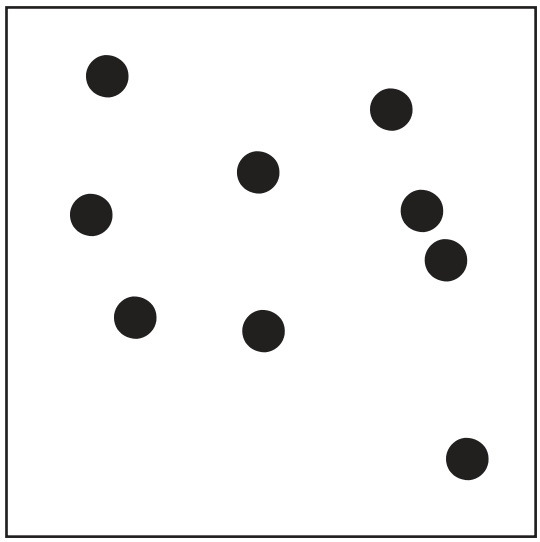
➢ Ask the subject to count the dots without pointing them (Mask the other pictures)

[Score 0-4]









VISUOSPATIAL

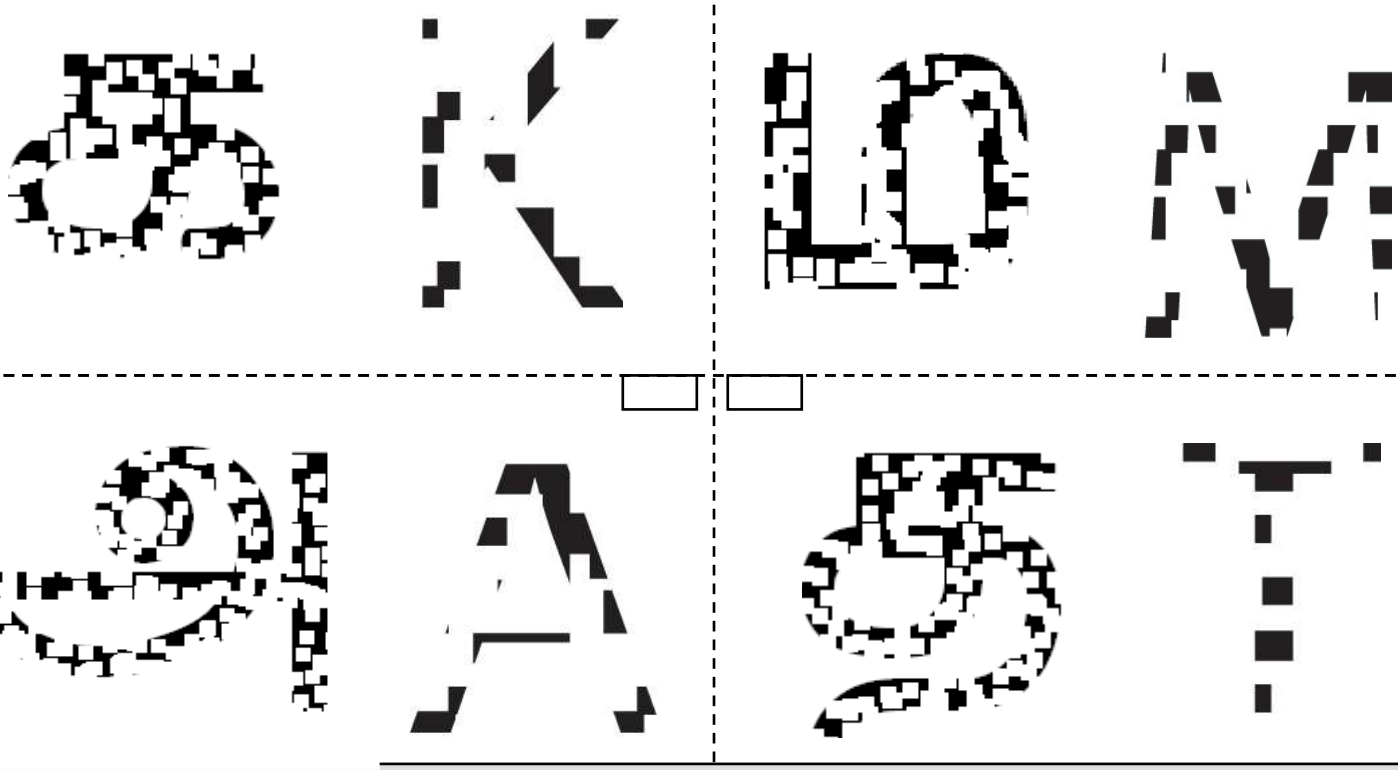
PERCEPTUAL ABILITIES

VISUOSPATIAL

➢ Ask the subject to identify the letters (Mask the other pictures)

[Score 0-4] ☐

☐ ☐



☐ ☐

RECALL

MEMORY

➢ Ask "now tell me what you remember of that name and address we were repeating at the beginning'"

Selva **Kumar** ------
42 Nehru Street -------
Gandhinagar ------
Vellore ------

[Score 0-7] ☐

RECOGNITION

[Score 0-5] ☐

➢ This test should be done if subject failed to recall one or more items. If all items were recalled, skip the test and score 5. If only part is recalled start by ticking items recalled in the shadowed column on the right hand side. Then test not recalled items by telling "ok, I'll give you some hints: was the name X, Y or Z?" and so on. Each recognised item scores one point which is added to the point gained by recalling.

Nalla Kumar		**Selva Kumar**		Selva Krishna		recalled	
43		**42**		49		recalled	
Nehru Road		Patel road		**Nehru Street**		recalled	
Virudhunagar		**Gandhinagar**		Chrompet		recalled	
Nellore		Nagpur		**Vellore**		recalled	

General Scores

SCORE

MMSE	/30
ACE-R	/100

Subscores		Date	Date	Date	Date
Attention and Orientation	/18				
Memory	/26				
Fluency	/14				
Language	/26				
Visuospatial	/16				
Total					

Rancho Los Amigos Levels of Cognitive Functioning:

The Rancho Los Amigos Levels of Cognitive Functioning (RLA) were designed to measure and track an individual's progress early in the recovery period. They have been used as a means to develop "level-specific" treatment interventions and strategies designed to facilitate movement from one level to another. A RLA level is determined based on behavioral observations. The RLA scale designates eight levels of function:

1. No Response
The individual appears to be in deep sleep and is completely unresponsive to any stimuli.

2. Generalized Response
The individual reacts inconsistently and non-purposefully to stimuli. Responses are limited in nature and often the same regardless of the stimuli presented. Responses may include gross motor movements, vocalization, and physiologic changes. Response time is likely to be delayed. Deep pain evokes the earliest response.

3. Localized Response
The individual responds specifically but inconsistently to stimulus. Responses are directly related to the type of stimuli presented. For example, an individual's head will turn toward a sound or his/her eyes will focus on an object when presented. The individual may follow simple commands and may respond better to some people (i.e. family and friends) than others.

4. Confused - Agitated
The individual is in a heightened state of activity with severely decreased ability to process information. Behavior is non-purposeful relative to the immediate environment. Attempts to climb out of bed, remove restraints, and hostility are common. The individual requires maximum assistance to perform self-care activities. An individual may sit, reach, or walk, but will not necessarily perform these activities upon request.

5. Confused - Inappropriate
The individual appears alert and responds to simple commands fairly consistently. Agitation, which is out of proportion, (but directly related) to stimuli may be evident. Lack of external structure results in random or non-purposeful responses. Inappropriate verbalizations and high distractibility are common. Memory is severely impaired, but the individual may self-feed with supervision and requires only assistance for self-care activities.

6. Confused - Appropriate
The individual shows goal-oriented behavior, but is dependent upon external input for direction. Response to discomfort is appropriate. Responses are incorrect due to memory problems, but are appropriate to the situation. Simple commands are followed consistently and carry-over for relearned activities is evident. Orientation is inconsistent but awareness of self, family, and basic needs is increased.

7. Automatic - Appropriate
The individual appears appropriate within hospital and home settings, goes through daily routine automatically but is robot-like, with shallow recall of activities performed. Has absent-to-minimal confusion and lacks insight. The individual frequently demonstrates poor

judgment and problem solving and expresses unrealistic future plans. With structure the individual is able to initiate tasks or social and recreational activities.

8. Purposeful - Appropriate
The individual is alert and oriented, able to recall and integrate past and recent events and is aware of and responsive to the environment. Independence in the home and community has returned. Carry-over for new learning is present, and the need for supervision is absent once activities have been learned. Social, emotional and cognitive abilities may still be decreased.

Patient Name: _____ **Date of Rating:**_____

Name of Person Completing Form: _____

DISABILITY RATING SCALE:

A. EYE OPENING:

- ☐ (0) Spontaneous
- ☐ (1) To Speech
- ☐ (2) To Pain
- ☐ (3) None

0-SPONTANEOUS: eyes open with sleep/wake rhythms indicating active arousal mechanisms, does not assume awareness.
1-TO SPEECH AND/OR SENSORY STIMULATION: a response to any verbal approach, whether spoken or shouted, not necessarily the command to open the eyes. Also, response to touch, mild pressure.
2-TO PAIN: tested by a painful stimulus.
3-NONE: no eye opening even to painful stimulation.

B. COMMUNICATION ABILITY:

- ☐ (0) Oriented
- ☐ (1) Confused
- ☐ (2) Inappropriate
- ☐ (3) Incomprehensible
- ☐ (4) None

0-ORIENTED: implies awareness of self and the environment. Patient able to tell you a) who he is; b) where he is; c) why he is there; d) year; e) season; f) month; g) day; h) time of day.
1-CONFUSED: attention can be held and patient responds to questions but responses are delayed and/or indicate varying degrees of disorientation and confusion.
2-INAPPROPRIATE: intelligible articulation but speech is used only in an exclamatory or random way (such as shouting and swearing); no sustained communication exchange is possible.
3-INCOMPREHENSIBLE: moaning, groaning or sounds without recognizable words, no consistent communication signs.
4-NONE: no sounds or communications signs from patient.

C. MOTOR RESPONSE:

- ☐ (0) Obeying
- ☐ (1) Localizing
- ☐ (2) Withdrawing
- ☐ (3) Flexing
- ☐ (4) Extending
- ☐ (5) None

0-OBEYING: obeying command to move finger on best side. If no response or not suitable try another command such as “move lips,” “blink eyes,” etc. Do not include grasp or other reflex responses.
1-LOCALIZING: a painful stimulus at more than one site causes limb to move (even slightly) in an attempt to remove it. It is a deliberate motor act to move away from or remove the source of noxious stimulation. If there is doubt as to whether withdrawal or localization has occurred after 3 or 4 painful stimulations, rate as localization.
2-WITHDRAWING: any generalized movement away from a noxious stimulus that is more than a simple reflex response
3-FLEXING: painful stimulation results in either flexion at the elbow, rapid withdrawal with abduction of the shoulder or a slow withdrawal with adduction of the shoulder. If there is confusion between flexing and withdrawing, then use pinprick on hands.
4-EXTENDING: painful stimulation results in extension of the limb.
5-NONE: no response can be elicited. Usually associated with hypotonia. Exclude spinal transection as an explanation of lack of response; be satisfied that an adequate stimulus has been applied.

D.FEEDING (COGNITIVE ABILITY ONLY)

- ☐ (0.0) Complete
- ☐ (0.5) Btw.Compl/partial
- ☐ (1.0) Partial
- ☐ (1.5) Btw.partial / minimal
- ☐ (2.0) Minimal
- ☐ (2.5) Btw.min/none
- ☐ (3.0) None

Does the patient show awareness of how and when to perform this activity? Ignore motor disabilities that interfere with carrying out this function. (This is rated under Level of Functioning described below.)
0-COMPLETE: continuously shows awareness that he knows how to feed and can convey unambiguous information that he knows when this activity should occur.
1-PARTIAL: intermittently shows awareness that he knows how to feed and/or can intermittently convey reasonably clearly information that he knows when the activity should occur.
2-MINIMAL: shows questionable or infrequent awareness that he knows in a primitive way how to feed and/or shows infrequently by certain signs, sounds, or activities that he is vaguely aware when the activity should occur.
3-NONE: shows virtually no awareness at any time that he knows how to feed and cannot convey information by signs, sounds, or activity that he knows when the activity should occur.

E.TOILETING (COGNITIVE ABILITY ONLY)

- ☐ (0.0) Complete
- ☐ (0.5) Btw.Complete/partial
- ☐ (1.0) Partial
- ☐ (1.5) Btw.partial / minimal
- ☐ (2.0) Minimal
- ☐ (2.5) Btw.minimal / none
- ☐ (3.0) None

Does the patient show awareness of how and when to perform this activity? Ignore motor disabilities that interfere with carrying out this function. (This is rated under Level of Functioning described below.) Rate best response for toileting based on bowel and bladder behavior
0-COMPLETE: continuously shows awareness that he knows how to toilet and can convey unambiguous information that he knows when this activity should occur.
1-PARTIAL: intermittently shows awareness that he knows how to toilet and/or can intermittently convey reasonably clearly information that he knows when the activity should occur.
2-MINIMAL: shows questionable or infrequent awareness that he knows in a primitive way how to toilet and/or shows infrequently by certain signs, sounds, or activities that he is vaguely aware when the activity should occur.
3-NONE: shows virtually no awareness at any time that he knows how to toilet and cannot convey information by signs, sounds, or activity that he knows when the activity should occur.

F.GROOMING (COGNITIVE ABILITY ONLY)

- ☐ (0.0) Complete
- ☐ (0.5) Btw.Complete / partial
- ☐ (1.0) Partial
- ☐ (1.5) Btw.partial / minimal
- ☐ (2.0) Minimal
- ☐ (2.5) Btw.minimal/none
- ☐ (3.0) None

Does the patient show awareness of how and when to perform this activity? Ignore motor disabilities that interfere with carrying out this function. (This is rated under Level of Functioning described below.) Grooming refers to bathing, washing, brushing of teeth, shaving, combing or brushing of hair and dressing.
0-COMPLETE: continuously shows awareness that he knows how to groom self and can convey unambiguous information that he knows when this activity should occur.
1-PARTIAL: intermittently shows awareness that he knows how to groom self and/or can intermittently convey reasonably clearly information that he knows when the activity should occur.
2-MINIMAL: shows questionable or infrequent awareness that he knows in a primitive way how to groom self and/or shows infrequently by certain signs, sounds, or activities that he is vaguely aware when the activity should occur.
3-NONE: shows virtually no awareness at any time that he knows how to groom self and cannot convey information by signs, sounds, or activity that he knows when the activity should occur.

G.LEVEL OF FUNCTIONING (PHYSICAL, MENTAL, EMOTIONAL OR SOCIAL FUNCTION))

- ☐ (0.0) Completely Independent
- ☐ (0.5) Between Comp indep/indep in special environ.
- ☐ (1.0) Independent in special environment
- ☐ (1.5) Between indep in special environ/mildly dependent.
- ☐ (2.0) Mildly Dependent-Limited assistance(non-resid - helper)
- ☐ (2.5) Between mildly dependent/moderately dependent
- ☐ (3.0) Moderately Dependent-moderate assist(person in home)
- ☐ (3.5) Between moderately depend / markedly dependent.
- ☐ (4.0) Markedly Dependent-assist all major activities, all times
- ☐ (4.5) Between markedly dependent / totally dependent.
- ☐ (5.0) Totally Dependent-24 hour nursing care.

0-COMPLETELY INDEPENDENT: able to live as he wishes, requiring no restriction due to physical, mental, emotional or social problems.
1-INDEPENDENT IN SPECIAL ENVIRONMENT: capable of functioning independently when needed requirements are met (mechanical aids)
2-MILDLY DEPENDENT: able to care for most of own needs but requires limited assistance due to physical, cognitive and/or emotional problems (e.g., needs non-resident helper).
3-MODERATELY DEPENDENT: able to care for self partially but needs another person at all times.
4-MARKEDLY DEPENDENT: needs help with all major activities and the assistance of another person at all times.
5-TOTALLY DEPENDENT: not able to assist in own care and requires 24-hour nursing care.

H."EMPLOYABILITY"(AS A FULL TIME WORKER, HOMEMAKER, OR STUDENT)

- ☐ (0.0) Not Restricted
- ☐ (0.5) Btw.not restricted/selective jobs, competitive
- ☐ (1.0) Selected jobs, competitive
- ☐ (1.5) Btw.selected jobs/sheltered workshop
- ☐ (2.0) Sheltered workshop, Non-competitive
- ☐ (2.5) Btw.sheltered workshop/not employable
- ☐ (3.0) Not Employable

0-NOT RESTRICTED: can compete in the open market for a relatively wide range of jobs commensurate with existing skills; or can initiate, plan execute and assume responsibilities associated with homemaking; or can understand and carry out most age relevant school assignments.
1-SELECTED JOBS, COMPETITIVE: can compete in a limited job market for a relatively narrow range of jobs because of limitations of the type described above and/or because of some physical limitations; or can initiate, plan, execute and assume many but not all responsibilities associated with homemaking; or can understand and carry out many but not all school assignments.
2-SHELTERED WORKSHOP, NON-COMPETITIVE: cannot compete successfully in a job market because of limitations described above and/or because of moderate or severe physical limitations; or cannot without major assistance initiate, plan, execute and assume responsibilities for homemaking; or cannot understand and carry out even relatively simple school assignments without assistance.
3-NOT EMPLOYABLE: completely unemployable because of extreme psychosocial limitations of the type described above, or completely unable to initiate, plan, execute and assume any responsibilities associated with homemaking; or cannot understand or carry out any school assignments.

The psychosocial adaptability or “employability” item takes into account overall cognitive and physical ability to be an employee, homemaker or student. This determination should take into account considerations such as the following:

1. Able to understand, remember and follow instructions.
2. Can plan and carry out tasks at least at the level of an office clerk or in simple routine, repetitive industrial situation or can do school assignments.
3. Ability to remain oriented, relevant and appropriate in work and other psychosocial situations.
4. Ability to get to and from work or shopping centers using private or public transportation effectively.
5. Ability to deal with number concepts.
6. Ability to make purchases and handle simple money exchange problems
7. Ability to keep track of time and appointments

NPI Neuropsychiatric Inventory (NPI):
INSTRUCTIONS FOR USE AND ADMINISTRATION

I. Purpose of the NPI

The purpose of the Neuropsychiatric Inventory (NPI) is to obtain information on the presence of psychopathology in patients with brain disorders. The NPI was developed for application to patients with Alzheimer's disease and other dementias, but it may be useful in the assessment of behavioral changes in other conditions. Ten behavioral and two neurovegetative areas are included in the NPI:

Delusions
Hallucinations
Agitation/Aggression
Depression/Dysphoria
Anxiety
Elation/Euphoria
Apathy/Indifference
Disinhibition
Irritability/Lability
Aberrant Motor Behavior

Sleep and Nighttime Behavior Disorders
Appetite and Eating Disorders

II. Administration of the NPI

A. NPI Interview

The NPI is based on responses from an informed caregiver, preferably one living with the patient. If an informed observer is not available, this instrument cannot be used or must be modified. The interview is best conducted with the caregiver in the absence of the patient to facilitate an open discussion of behaviors that may be difficult to describe with the patient present. Several points should be made when you introduce the NPI interview to the caregiver:

- Purpose of the interview
- Ratings - frequency, severity, distress (described below)
- Answers apply to behaviors that are new since the onset of the disease and have been present for the past four weeks or other defined period
- Questions can usually be answered with "yes" or "no" and responses should be brief

When beginning the inventory, say to the caregiver "These questions are designed to evaluate your [husband's/wife's/etc] behavior. They can usually be answered "yes" or "no" so please try to be brief in your responses." If the caregiver lapses into elaborate responses that provide little useful information, he/she may be reminded of the need to be brief. Some of the issues raised with this scale are very emotionally disturbing to caregivers and the interviewer should reassure the caregiver that they will discuss the problems in more detail after completion of the inventory.

Questions should be asked exactly as written. Clarification should be provided if the caregiver does not understand the question. Acceptable clarifications are restatements of the questions in alternate terms.

B. Changes in Behavior

The questions pertain to changes in the patient's behavior that have appeared since the onset of the illness. Behaviors that have been present throughout the patient's life and have not changed in the course of the illness are not scored even if they are abnormal (e.g., anxiety, depression). Behaviors that have been present throughout life but have changed since the illness are scored (e.g., the patient has always been apathetic but there has been a notable increase in apathy during the period of inquiry).

The NPI is typically used to assess changes in the patient's behavior that have appeared in a defined period of time (e.g., in the past four weeks or other defined interval). In some studies, the NPI may be used to address changes occurring in response to treatment or that have changed since the last clinic visit. The time frame of the question would then be revised to reflect this interest in recent changes. Emphasize to the caregiver that the questions pertain to behaviors that have appeared or changed since the onset of the illness. For example, the questions might be phrased "Since he/she began treatment with the new medications..." or "Since the dosage of _____ was increased ...."

C. Screening Questions and Subquestions

The screening question is asked to determine if the behavioral change is present or absent. If the answer to the screening question is negative, mark "NO" and proceed to the next screening question without asking the subquestions. If the answer to the screening question is positive or if there are any uncertainties in the caregiver's response or any inconsistencies between the response and other information known by the clinician (e.g., the caregiver responds negatively to the euphoria screening question but the patient appears euphoric to the clinician), the category is marked "YES" and is explored in more depth with the subquestions. If the subquestions confirm the screening question, the severity and frequency of the behavior are determined according to the criteria provided with each behavior (below).

In some cases, the caregiver will provide a positive response to the screening question and a negative reply to all subquestions. If this happens, ask the caregiver to expand on why he/she responded affirmatively to the screen. If he/she provides information relevant to the behavioral domain but in different terms, the behavior should be scored for severity and frequency as usual. If the original affirmative response was erroneous, leading to a failure to endorse any subquestions, then the behavior is changed to "NO" on the screen.

Some sections such as the questions pertaining to appetite are framed so as to capture whether there is an increase or decrease in the behavior (increased or decreased appetite or weight). If the caregiver answers "yes" to the first member of the paired questions (such as has the patient's weight decreased?), do not ask the second question (has the patient's weight increased?) since the answer to the second question is contained in the answer to the first. If the caregiver answers "no" to the first member of the pair of questions, then the second question must be asked.

D. Frequency and Severity Ratings

When determining frequency and severity, use the behaviors identified by the subquestions as most aberrant. For example, if the caregiver indicates that resistive behavior is particularly problematic when you are asking the subquestions of the agitation section, then use resistive behavior to prompt judgments regarding the frequency and severity of agitation. If two behaviors are very problematic, use the frequency and severity of both behaviors to score the item. For example, if the patient has two or more types of delusions, then use the severity and the frequency of all delusional behaviors to phrase the questions regarding severity and frequency.

When assessing frequency, say to the person being interviewed "Now I want to find out how often these things [define using the description of the behaviors noted as most problematic on the subquestions] occur. Would you say that they occur less than once per week, about once per week, several times per week but not every day, or every day?" Some behaviors such as apathy eventually become continuously present, and then "are constantly present" can be substituted for "every day."

When determining severity, tell the person being interviewed "Now I would like to find out how severe these behaviors are. By severity, I mean how disturbing or disabling they are for the patient. Would you say that [the behaviors] are mild, moderate, or severe?" Additional descriptors are provided in each section that may be used to help the interviewer clarify each grade of severity. In each case, be sure that the caregiver provides you with a definite answer as to the frequency and severity of the behaviors. Do not guess what you think the caregiver would say based on your discussion.

We have found it helpful to provide the caregiver with a piece of paper on which is written the frequency and severity descriptions (less than once per week, about once per week, several times per week, and daily or continuously for frequency; and mild, moderate, and severe for severity) to allow him/her to visualize the response alternatives. This also saves the examiner from reiterating the alternatives with each question.

E. Not Applicable Designations

In very impaired patients or in patients with special medical circumstances, a set of questions may not be applicable. For example, bed-bound patients may exhibit hallucinations or agitation but are unable to exhibit aberrant motor behavior. If the clinician or the caregiver believes that the questions are inappropriate, then the section should be marked "NA" (upper right corner of each section), and no further data are recorded for that section. Likewise, if the clinician feels that the responses are invalid (e.g., the caregiver did not seem to understand the particular set of questions asked), "NA" should be marked.

F. Neurovegetative Changes

Items 11 (sleep) and 12 (appetite) were added after the original publication of the NPI (Cummings et al, 1994). They were included because they are common problem areas in Alzheimer's disease and other dementias. They form part of the depression syndrome in some patients and were specifically excluded from the dysphoria subscale of the NPI in order to allow that subscale to focus on mood symptoms. These two symptoms are usually not included in the total NPI score and may not be included in all protocols.

G. Caregiver Distress (NPI-D)

When each domain is completed and the caregiver has completed the frequency and severity rating, ask the associated caregiver distress question if your protocol includes the distress assessment. To do this, ask the caregiver how much, if any, "emotional or psychological" distress the behavior he/she just discussed causes him/her (the caregiver). The caregiver must rate his/her own distress on a five point scale from 0 - no distress, 1- minimal, 2 - mild, 3 - moderate, 4 - moderately severe, 5 - very severe or extreme. The distress scale of this instrument was developed by Daniel Kaufer, M.D. (Kaufer et al., 1998).

III. Scoring the NPI

Frequency is rated as:

1 - Occasionally – less than once per week
2 - Often – about once per week
3 - Frequently – several times per week but less than every day
4 - Very frequently – daily or essentially continuously present

Severity is rated as:

1 - Mild – produces little distress in the patient
2 - Moderate – more disturbing to the patient but can be redirected by the caregiver
3 - Severe – very disturbing to the patient and difficult to redirect

The score for each domain is: frequency x severity

Distress is scored as:
0 - no distress
1- minimal
2 - mild
3 - moderate
4 - moderately severe
5 - very severe or extreme

Thus, for each behavioral domain there are four scores:
- Frequency
- Severity
- Total (frequency x severity)
- Caregiver distress

A total NPI score can be calculated by adding the scores of the first 10 domain scores together. In most cases, the two neurovegetative items are not included in the NPI total score. If they are included, specify that the 12 item score is being used rather than the 10 item score. The distress score is not included in the total NPI score.

The total distress score is generated by adding together the scores of the individual NPI distress questions; specify whether the 10 or 12 item score is being used.

IV. NPI-NH and NPI-Q

A nursing home version of the NPI (the NPI-NH) has been developed for use with professional caregivers in institutional settings. The instrument is identical to the original NPI but the questions have been rephrased to reflect the fact that the professional caregiver will not have known the patient prior to the onset of the illness and cannot know if the current behaviors represent changes from premorbid behaviors. The caregiver distress questions have been rephrased to assess the "occupational disruptiveness" of the behaviors. The NPI-Q version of the NPI has been developed and cross-validated with the standard NPI to provide a brief assessment of neuropsychiatric symptomatology in clinical practice settings. The NPI-NH and NPI-Q are available through the UCLA Alzheimer's Disease Center at the address shown below (section VIII).

V. Instructional Videotapes

Instructional videotapes (English language) demonstrating the use of the NPI (for interviewers) and the NPI-NH (one for interviewers and one for interviewees) are available through the UCLA Alzheimer's Disease Center at the address shown below (section VIII). The cost of each videotape is $25.00 (USD) (subject to change). Use of the videotapes to train users and achieve uniform application of the NPI or NPI-NH is strongly encouraged if the instruments are to be used for research purposes.

VI. Translations

The NPI is available in a variety of languages for Asia, Europe, and the Americas and more translated versions are currently being developed. Please correspond with Dr. Cummings at the address shown below (section VIII) regarding the availability of these translations. All translations went through a process of translation and back translation by a bilingual clinician-scientist whose first language was that of the translation. The translator is identified for correspondence when the translation is provided.

VII. Electronic Versions

The NPI, NPI-NH and NPI-Q are available on disc (no electronically scored or administered version is available) for MacIntosh computers. The disc version can be obtained by contacting Dr. Cummings at the address shown below (section VIII).

VIII. Copyright and Use of the NPI

IX. Key References

Cummings JL, Mega M, Gray K, Rosenberg-Thompson S, Carusi DA, Gornbein J. The Neuropsychiatric Inventory: comprehensive assessment of psychopathology in dementia. *Neurology* 1994; 44: 2308-2314.

Cummings JL. The Neuropsychiatric Inventory: Assessing psychopathology in dementia patients. *Neurology* 1997; 48 (Suppl.6): S10-S16.

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Neuropsychiatric Inventory Questions

A. DELUSIONS (NA)

Does the patient have beliefs that you know are not true (for example, insisting that people are trying to harm him/her or steal from him/her)? Has he/she said that family members are not who they say they are or that the house is not their home? I'm not asking about mere suspiciousness; I am interested if the patient is convinced that these things are happening to him/her.

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient believe that he/she is in danger - that others are planning to hurt him/her? _____
2. Does the patient believe that others are stealing from him/her? _____
3. Does the patient believe that his/her spouse is having an affair? _____
4. Does the patient believe that unwelcome guests are living in his/her house? _____
5. Does the patient believe that his/her spouse or others are not who they claim to be? _____
6. Does the patient believe that his/her house is not his/her home? _____
7. Does the patient believe that family members plan to abandon him/her? _____
8. Does the patient believe that television or magazine figures are actually present in the home? [Does he/she try to talk or interact with them?] _____
9. Does the patient believe any other unusual things that I haven't asked about? _____

If the screening question is confirmed, determine the frequency and severity of the delusions.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – once or more per day.

Severity:
1. Mild – delusions present but seem harmless and produce little distress in the patient.
2. Moderate – delusions are distressing and disruptive.
3. Marked – delusions are very disruptive and are a major source of behavioral disruption. [If PRN medications are prescribed, their use signals that the delusions are of marked severity.]

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

B. HALLUCINATIONS (NA)

Does the patient have hallucinations such as seeing false visions or hearing false voices? Does he/she seem to see, hear or experience things that are not present? By this question we do not mean just mistaken beliefs such as stating that someone who has died is still alive; rather we are asking if the patient actually has abnormal experiences of sounds or visions.

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient describe hearing voices or act as if he/she hears voices? _____
2. Does the patient talk to people who are not there? _____
3. Does the patient describe seeing things not seen by others or behave as if he/she is seeing things not seen by others (people, animals, lights, etc)? _____
4. Does the patient report smelling odors not smelled by others? _____
5. Does the patient describe feeling things on his/her skin or otherwise appear to be feeling things crawling or touching him/her? _____
6. Does the patient describe tastes that are without any known cause? _____
7. Does the patient describe any other unusual sensory experiences? _____

If the screening question is confirmed, determine the frequency and severity of the hallucinations.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – once or more per day.

Severity:
1. Mild – hallucinations are present but harmless and cause little distress for the patient.
2. Moderate – hallucinations are distressing and are disruptive to the patient.
3. Marked – hallucinations are very disruptive and are a major source of behavioral disturbance. PRN medications may be required to control them.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

C. AGITATION/AGGRESSION (NA)

Does the patient have periods when he/she refuses to cooperate or won't let people help him/her? Is he/she hard to handle?

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient get upset with those trying to care for him/her or resist activities such as bathing or changing clothes? _____
2. Is the patient stubborn, having to have things his/her way? _____
3. Is the patient uncooperative, resistive to help from others? _____
4. Does the patient have any other behaviors that make him/her hard to handle? _____
5. Does the patient shout or curse angrily? _____
6. Does the patient slam doors, kick furniture, throw things? _____
7. Does the patient attempt to hurt or hit others? _____
8. Does the patient have any other aggressive or agitated behaviors? _____

If the screening question is confirmed, determine the frequency and severity of the agitation/aggression.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than daily.
4. Very frequently – once or more per day.

Severity:
1. Mild – agitation is disruptive but can be managed with redirection or reassurance.
2. Moderate – agitation is disruptive and difficult to redirect or control.
3. Marked – agitation is very disruptive and a major source of difficulty; there may be a threat of personal harm. Medications are often required.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

D. DEPRESSION/DYSPHORIA (NA)

Does the patient seem sad or depressed? Does he/she say that he/she feels sad or depressed?

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient have periods of tearfulness or sobbing that seem to indicate sadness? _____
2. Does the patient say, or act as if, he/she is sad or in low spirits? _____
3. Does the patient put him/herself down or say that he/she feels like a failure? _____
4. Does the patient say that he/she is a bad person or deserves to be punished? _____
5. Does the patient seem very discouraged or say that he/she has no future? _____
6. Does the patient say he/she is a burden to the family or that the family would be better off without him/her? _____
7. Does the patient express a wish for death or talk about killing himself/herself? _____
8. Does the patient show any other signs of depression or sadness? _____

If the screening question is confirmed, determine the frequency and severity of the depression/dysphoria.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – essentially continuously present.

Severity:
1. Mild – depression is distressing but usually responds to redirection or reassurance.
2. Moderate – depression is distressing; depressive symptoms are spontaneously voiced by the patient and difficult to alleviate.
3. Marked – depression is very distressing and a major source of suffering for the patient.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

E. ANXIETY (NA)

Is the patient very nervous, worried, or frightened for no apparent reason? Does he/she seem very tense or fidgety? Is the patient afraid to be apart from you?

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient say that he/she is worried about planned events? _____
2. Does the patient have periods of feeling shaky, unable to relax, or feeling excessively tense? _____
3. Does the patient have periods of [or complain of] shortness of breath, gasping, or sighing for no apparent reason other than nervousness? _____
4. Does the patient complain of butterflies in his/her stomach, or of racing or pounding of the heart in association with nervousness? [Symptoms not explained by ill health] _____
5. Does the patient avoid certain places or situations that make him/her more nervous such as riding in the car, meeting with friends, or being in crowds? _____
6. Does the patient become nervous and upset when separated from you [or his/her caregiver]? [Does he/she cling to you to keep from being separated?] _____
7. Does the patient show any other signs of anxiety? _____

If the screening question is confirmed, determine the frequency and severity of the anxiety.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – once or more per day.

Severity:
1. Mild –anxiety is distressing but usually responds to redirection or reassurance.
2. Moderate – anxiety is distressing, anxiety symptoms are spontaneously voiced by the patient and difficult to alleviate.
3. Marked – anxiety is very distressing and a major source of suffering for the patient.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

F. ELATION/EUPHORIA (NA)

Does the patient seem too cheerful or too happy for no reason? I don't mean the normal happiness that comes from seeing friends, receiving presents, or spending time with family members. I am asking if the patient has a persistent and abnormally good mood or finds humor where others do not.

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient appear to feel too good or to be too happy, different from his/her usual self? _____
2. Does the patient find humor and laugh at things that others do not find funny? _____
3. Does the patient seem to have a childish sense of humor with a tendency to giggle or laugh inappropriately (such as when something unfortunate happens to others)? _____
4. Does the patient tell jokes or make remarks that are not funny to others but seem funny to him/her? _____
5. Does he/she play childish pranks such as pinching or playing "keep away" for the fun of it? _____
6. Does the patient "talk big" or claim to have more abilities or wealth than is true?
7. Does the patient show any other signs of feeling too good or being too happy? _____

If the screening question is confirmed, determine the frequency and severity of the elation/euphoria.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – essentially continuously present.

Severity:
1. Mild – elation is notable to friends and family but is not disruptive.
2. Moderate – elation is notably abnormal.
3. Marked – elation is very pronounced; patient is euphoric and finds nearly everything to be humorous.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

G. APATHY/INDIFFERENCE (NA)

Has the patient lost interest in the world around him/her? Has he/she lost interest in doing things or does he/she lack motivation for starting new activities? Is he/she more difficult to engage in conversation or in doing chores? Is the patient apathetic or indifferent?

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient seem less spontaneous and less active than usual? _____
2. Is the patient less likely to initiate a conversation? _____
3. Is the patient less affectionate or lacking in emotions when compared to his/her usual self? _____
4. Does the patient contribute less to household chores? _____
5. Does the patient seem less interested in the activities and plans of others? _____
6. Has the patient lost interest in friends and family members? _____
7. Is the patient less enthusiastic about his/her usual interests? _____
8. Does the patient show any other signs that he/she doesn't care about doing new things? _____

If the screening question is confirmed, determine the frequency and severity of the apathy/indifference.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – nearly always present.

Severity:
1. Mild – apathy is notable but produces little interference with daily routines; only mildly different from patient's usual behavior; patient responds to suggestions to engage in activities.
2. Moderate – apathy is very evident; may be overcome by the caregiver with coaxing and encouragement; responds spontaneously only to powerful events such as visits from close relatives or family members.
3. Marked – apathy is very evident and usually fails to respond to any encouragement or external events.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

H. DISINHIBITION (NA)

Does the patient seem to act impulsively without thinking? Does he/she do or say things that are not usually done or said in public? Does he/she do things that are embarrassing to you or others?

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient act impulsively without appearing to consider the consequences? _____
2. Does the patient talk to total strangers as if he/she knew them? _____
3. Does the patient say things to people that are insensitive or hurt their feelings? _____
4. Does the patient say crude things or make sexual remarks that he/she would not usually have said? _____
5. Does the patient talk openly about very personal or private matters not usually discussed in public? _____
6. Does the patient take liberties or touch or hug others in way that is out of character for him/her? _____
7. Does the patient show any other signs of loss of control of his/her impulses? _____

If the screening question is confirmed, determine the frequency and severity of the disinhibition.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – essentially continuously present.

Severity:
1. Mild – disinhibition is notable but usually responds to redirection and guidance.
2. Moderate – disinhibition is very evident and difficult to overcome by the caregiver.
3. Marked – disinhibition usually fails to respond to any intervention by the caregiver, and is a source of embarrassment or social distress.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

I. IRRITABILITY/LABILITY (NA)

Does the patient get irritated and easily disturbed? Are his/her moods very changeable? Is he/she abnormally impatient? We do not mean frustration over memory loss or inability to perform usual tasks; we are interested to know if the patient has abnormal irritability, impatience, or rapid emotional changes different from his/her usual self.

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient have a bad temper, "flying off the handle" easily over little things? _____
2. Does the patient rapidly change moods from one to another, being fine one minute and angry the next? _____
3. Does the patient have sudden flashes of anger? _____
4. Is the patient impatient, having trouble coping with delays or waiting for planned activities? _____
5. Is the patient cranky and irritable? _____
6. Is the patient argumentative and difficult to get along with? _____
7. Does the patient show any other signs of irritability? _____

If the screening question is confirmed, determine the frequency and severity of the irritability/lability.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – essentially continuously present.

Severity:
1. Mild – irritability or lability is notable but usually responds to redirection and reassurance.
2. Moderate – irritability and lability are very evident and difficult to overcome by the caregiver.
3. Marked – irritability and lability are very evident; they usually fail to respond to any intervention by the caregiver, and they are a major source of distress.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

J. ABERRANT MOTOR BEHAVIOR (NA)

Does the patient pace, do things over and over such as opening closets or drawers, or repeatedly pick at things or wind string or threads?

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient pace around the house without apparent purpose? _____
2. Does the patient rummage around opening and unpacking drawers or closets? _____
3. Does the patient repeatedly put on and take off clothing? _____
4. Does the patient have repetitive activities or "habits" that he/she performs over and over? _____
5. Does the patient engage in repetitive activities such as handling buttons, picking, wrapping string, etc?
6. Does the patient fidget excessively, seem unable to sit still, or bounce his/her feet or tap his/her fingers a lot? _____
7. Does the patient do any other activities over and over? _____

If the screening question is confirmed, determine the frequency and severity of the aberrant motor activity:

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – essentially continuously present.

Severity:
1. Mild – abnormal motor activity is notable but produces little interference with daily routines.
2. Moderate – abnormal motor activity is very evident; can be overcome by the caregiver.
3. Marked – abnormal motor activity is very evident, usually fails to respond to any intervention by the caregiver and is a major source of distress.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

K. SLEEP AND NIGHTTIME BEHAVIOR DISORDERS (NA)

Does the patient have difficulty sleeping (do not count as present if the patient simply gets up once or twice per night only to go to the bathroom and falls back asleep immediately)? Is he/she up at night? Does he/she wander at night, get dressed, or disturb your sleep?

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Does the patient have difficulty falling asleep? _____
2. Does the patient get up during the night (do not count if the patient gets up once or twice per night only to go to the bathroom and falls back asleep immediately)? _____
3. Does the patient wander, pace, or get involved in inappropriate activities at night? _____
4. Does the patient awaken you during the night?
5. Does the patient wake up at night, dress, and plan to go out, thinking that it is morning and time to start the day? _____
6. Does the patient awaken too early in the morning (earlier than was his/her habit)? _____
7. Does the patient sleep excessively during the day? _____
8. Does the patient have any other nighttime behaviors that bother you that we haven't talked about? _____

If the screening question is confirmed, determine the frequency and severity of the nighttime behavior.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – once or more per day (every night).

Severity:
1. Mild – nighttime behaviors occur but they are not particularly disruptive.
2. Moderate – nighttime behaviors occur and disturb the patient and the sleep of the caregiver; more than one type of nighttime behavior may be present.
3. Marked – nighttime behaviors occur; several types of nighttime behavior may be present; the patient is very distressed during the night and the caregiver's sleep is markedly disturbed.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

L. APPETITE AND EATING DISORDERS (NA)

Has he/she had any change in appetite, weight, or eating habits (count as NA if the patient is incapacitated and has to be fed)? Has there been any change in type of food he/she prefers?

NO (If no, proceed to next screening question). **YES** (If yes, proceed to subquestions).

1. Has he/she had a loss of appetite? _____
2. Has he/she had an increase in appetite? _____
3. Has he/she had a loss of weight? _____
4. Has he/she gained weight? _____
5. Has he/she had a change in eating behavior such as putting too much food in his/her mouth at once? _____
6. Has he/she had a change in the kind of food he/she likes such as eating too many sweets or other specific types of food? _____
7. Has he/she developed eating behaviors such as eating exactly the same types of food each day or eating the food in exactly the same order? _____
8. Have there been any other changes in appetite or eating that I haven't asked about? _____

If the screening question is confirmed, determine the frequency and severity of the changes in eating habits or appetite.

Frequency:
1. Occasionally – less than once per week.
2. Often – about once per week.
3. Frequently – several times per week but less than every day.
4. Very frequently – once or more per day or continuously.

Severity:
1. Mild – changes in appetite or eating are present but have not led to changes in weight and are not disturbing.
2. Moderate – changes in appetite or eating are present and cause minor fluctuations in weight.
3. Marked – obvious changes in appetite or eating are present and cause fluctuations in weight, are embarrassing, or otherwise disturb the patient.

Distress: How emotionally distressing do you find this behavior?
0. Not at all
1. Minimally
2. Mildly
3. Moderately
4. Severely
5. Very severely or extremely

[09/6/02: JLC]

NPI Neuropsychiatric Inventory Scoring Summary

CENTER NUMBER	SCREENING NUMBER	PATIENT NUMBER	PATIENT INITIALS	VISIT	DATE
☐☐☐	☐☐☐☐☐	☐☐☐☐	☐☐☐ (F M L)	☐☐	☐☐☐ (M D Y)

Please transcribe appropriate categories from the NPI Worksheet into the boxes provided.

For each domain:
- If symptoms of a domain did not apply, check the "N/A" box.
- If symptoms of a domain were absent, check the "0" box.
- If symptoms of a domain were present, check one score each for Frequency and Severity.
- Multiply Frequency score x Severity score and enter the product in the space provided.
- Total all Frequency x Severity scores and record the Total Score below.
- If symptoms of a domain were present, check one score for Distress; total all distress scores for a summary score.

Rater's Initials: ☐☐☐

DOMAIN	N/A	ABSENT	FREQUENCY	SEVERITY	FREQUENCY X SEVERITY	OCCUPATIONAL DISRUPTION
A. Delusions	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
B. Hallucinations	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
C. Agitation/Aggression	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
D. Depression	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
E. Anxiety	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
F. Elation/Euphoria	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
G. Apathy/Indifference	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
H. Disinhibition	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
I. Irritability/Liability	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
J. Aberrant Motor Behavior	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
TOTAL SCORE:					☐☐☐	☐☐
K. Nighttime Behavior	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5
L. Appetite/Eating Change	☐	0	1 2 3 4	1 2 3	☐☐	0 1 2 3 4 5

NPI Neuropsychiatric Inventory Worksheet

Directions: Read all items from the NPI "Instructions for Administration of the NPI". Mark Caregiver's responses on this worksheet before scoring the Frequency, Severity, and Caregiver Distress for each item.

A. DELUSIONS: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Fear of harm
____ ☐ 2. Fear of theft
____ ☐ 3. Spousal affair
____ ☐ 4. Phantom boarder
____ ☐ 5. Spouse imposter
____ ☐ 6. House not home
____ ☐ 7. Fear of abandonment
____ ☐ 8. Talks to TV, etc.
____ ☐ 9. Other _____

B. HALLUCINATIONS: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Hears voices
____ ☐ 2. Talks to people not there
____ ☐ 3. Sees things not there
____ ☐ 4. Smells things not there
____ ☐ 5. Feels things not there
____ ☐ 6. Unusual taste sensations
____ ☐ 7. Other _____

C. AGITATION/AGGRESSION: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Upset with caregiver; resists ADL's
____ ☐ 2. Stubbornness
____ ☐ 3. Uncooperative; resists help
____ ☐ 4. Hard to handle
____ ☐ 5. Cursing or shouting angrily
____ ☐ 6. Slams doors; kicks, throws things
____ ☐ 7. Hits, harms others
____ ☐ 8. Other _____

D. DEPRESSION/DYSPHORIA: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Tearful and sobbing
____ ☐ 2. States, acts as if sad
____ ☐ 3. Puts self down, feels like failure
____ ☐ 4. "Bad person", deserves punishment
____ ☐ 5. Discouraged, no future
____ ☐ 6. Burden to family
____ ☐ 7. Talks about dying, killing self
____ ☐ 8. Other _____

E. ANXIETY: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Worries about planned events
____ ☐ 2. Feels shaky, tense
____ ☐ 3. Sobs, sighs, gasps
____ ☐ 4. Racing heart, "butterflies"
____ ☐ 5. Phobic avoidance
____ ☐ 6. Separation anxiety
____ ☐ 7. Other _____

F. ELATION/EUPHORIA: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Feels too good, too happy
____ ☐ 2. Abnormal humor
____ ☐ 3. Childish, laughs inappropriately
____ ☐ 4. Jokes or remarks not funny to others
____ ☐ 5. Childish pranks
____ ☐ 6. Talks "big", grandiose
____ ☐ 7. Other _____

CONTINUES ON REVERSE

NPI

Neuropsychiatric Inventory Worksheet

G. APATHY/INDIFFERENCE: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Less spontaneous or active
____ ☐ 2. Less likely to initiate conversation
____ ☐ 3. Less affectionate, lacking emotions
____ ☐ 4. Contributes less to household chores
____ ☐ 5. Less interested in others
____ ☐ 6. Lost interest in friends or family
____ ☐ 7. Less enthusiastic about interests
____ ☐ 8. Other _____

H. DISINHIBITION: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Acts impulsively
____ ☐ 2. Excessively familiar with strangers
____ ☐ 3. Insensitive or hurtful remarks
____ ☐ 4. Crude or sexual remarks
____ ☐ 5. Talks openly of private matters
____ ☐ 6. Inappropriate touching of others
____ ☐ 7. Other _____

I. IRRITABILITY: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Bad temper, "flies off handle" easily
____ ☐ 2. Rapid changes in mood
____ ☐ 3. Sudden flashes of anger
____ ☐ 4. Impatient, trouble coping with delays
____ ☐ 5. Cranky, irritable
____ ☐ 6. Argues, difficult to get along with
____ ☐ 7. Other _____

J. ABERRANT MOTOR BEHAVIOR: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Paces without purpose
____ ☐ 2. Opens or unpacks closets or drawers
____ ☐ 3. Repeatedly dresses and undresses
____ ☐ 4. Repetitive activities or "habits"
____ ☐ 5. Handling, picking, wrapping behavior
____ ☐ 6. Excessively fidgety
____ ☐ 7. Other _____

K. NIGHTTIME BEHAVIORS: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Difficulty falling asleep
____ ☐ 2. Up during the night
____ ☐ 3. Wanders, paces, inappropriate activity
____ ☐ 4. Awakens others at night
____ ☐ 5. Wakes and dresses to go out at night
____ ☐ 6. Early morning awakening
____ ☐ 7. Sleeps excessively during the day
____ ☐ 8. Other _____

L. APPETITE/EATING BEHAVIORS: Y N N/A

Frequency_____ **Severity**_____
Distress _____

____ ☐ 1. Loss of appetite
____ ☐ 2. Increased appetite
____ ☐ 3. Weight loss
____ ☐ 4. Weight gain
____ ☐ 5. Change in eating habits
____ ☐ 6. Change in food preferences
____ ☐ 7. Eating rituals
____ ☐ 8. Other _____

INSTITUTIONAL REVIEW BOARD (IRB)
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VELLORE 632 002, INDIA

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Principal

Dr. Nihal Thomas
MD, MNAMS, DNB(Endo), FRACP(Endo), FRCP(Edin)
Secretary, Ethics Committee, IRB
Additional Vice Principal (Research)

December 21, 2012

Dr. Kattula Dheeraj
PG Registrar
Department of Psychiatry
Christian Medical College
Vellore 632 002

Sub: **FLUID Research grant project NEW PROPOSAL:**
A cross sectional study of neuropsychiatric problems in patients with traumatic brain injury treated in a tertiary care rehabilitation center
Dr. Kattula Dheeraj, PG Registrar, Psychiatry, Dr. Anna Tharyan, Dr. Geeta Soohinda, Psychiatry, Dr. Bobeena Rachel Chandy, Dr. Suhany BT, Dr. Judy Ann John, PMR.

Ref: IRB Min. No. 7821 dated 18.04.2012

Dear Dr. Kattula Dheeraj,

The Institutional Review Board (Blue, Research and Ethics Committee) of the Christian Medical College, Vellore, reviewed and discussed your project entitled "A cross sectional study of neuropsychiatric problems in patients with traumatic brain injury treated in a tertiary care rehabilitation center" on April 18, 2012.

The Committees reviewed the following documents:

1. Format for application to IRB submission
2. Patient Information Sheet and Consent Form (English, Tamil and Telugu)
3. Addenbrooke's cognitive examination - ACE – R
4. Sociodemographic Data
5. Neuropsychiatric Inventory Scoring Summary
6. Cvs of Drs. Kattual Dheeraj, Anna Tharyan, Bobeena Rachel Chandy, Geeta S Soohinida, Judy Ann John, Suhany.
7. A CD containing documents 1 – 6

TEL : 0416 - 2284294, 2284202 FAX : 0416 - 2262788, 2284481 E-mail : research@cmcvellore.ac.in

INSTITUTIONAL REVIEW BOARD (IRB)
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Secretary, Ethics Committee, IRB
Additional Vice Principal (Research)

The following Institutional Review Board (Ethics Committee) members were present at the meeting held on April 18, 2012 in the CREST/SACN Conference Room, Christian Medical College, Bagayam, Vellore- 632002.

Name	Qualification	Designation	Other Affiliations
Dr.B.J.Prashantham	MA (Counseling), MA (Theology), Dr Min(Clinical)	Chairperson(IRB)& Director, Christian Counselling Centre	External, Scientist
Mrs. S. Pattabiraman	BSc, DSSA	Social Worker, Vellore	Lay Person
Mrs. Ellen Ebenezer Benjamin	M.Sc. (Nursing), Ph.D.	Deputy Nursing Superintendent, CMC.	Nurse
Dr. Vathsala Sadan	M.Sc, Ph.D	Addl. Deputy Dean, College o Nursing, CMC.	Nurse
Mr. Samuel Abraham	MA, PGDBA, PGDPM, M.Phil, BL.	Legal Advisor, CMC.	Internal, Legal Expert
Mr. Joseph Devaraj	BSc, BD	Chaplain, CMC	Social Scientist
Dr. Nihal Thomas	MD MNAMS DNB(Endo FRACP(Endo) FRCP(Edi	Secretary IRB (EC)& Dy. Chairperson (IRB), Professor of Endocrinology & Addl. Vice Principal (Research), CMC.	Clinician

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Secretary, Ethics Committee, IRB
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We approve the project to be conducted as presented.

The Institutional Ethics Committee expects to be informed about the progress of the project, any serious adverse events occurring in the course of the project, any changes in the protocol and the patient information/informed consent and requires a copy of the final report

A sum of Rs. Rs 4750/- (Rupees Four Thousand Seven Hundred and Fifty only) will be granted for 8 months

Yours sincerely,

Dr. Alfred Job Daniel
Principal & Chairperson (Research committee)
Institutional Review Board

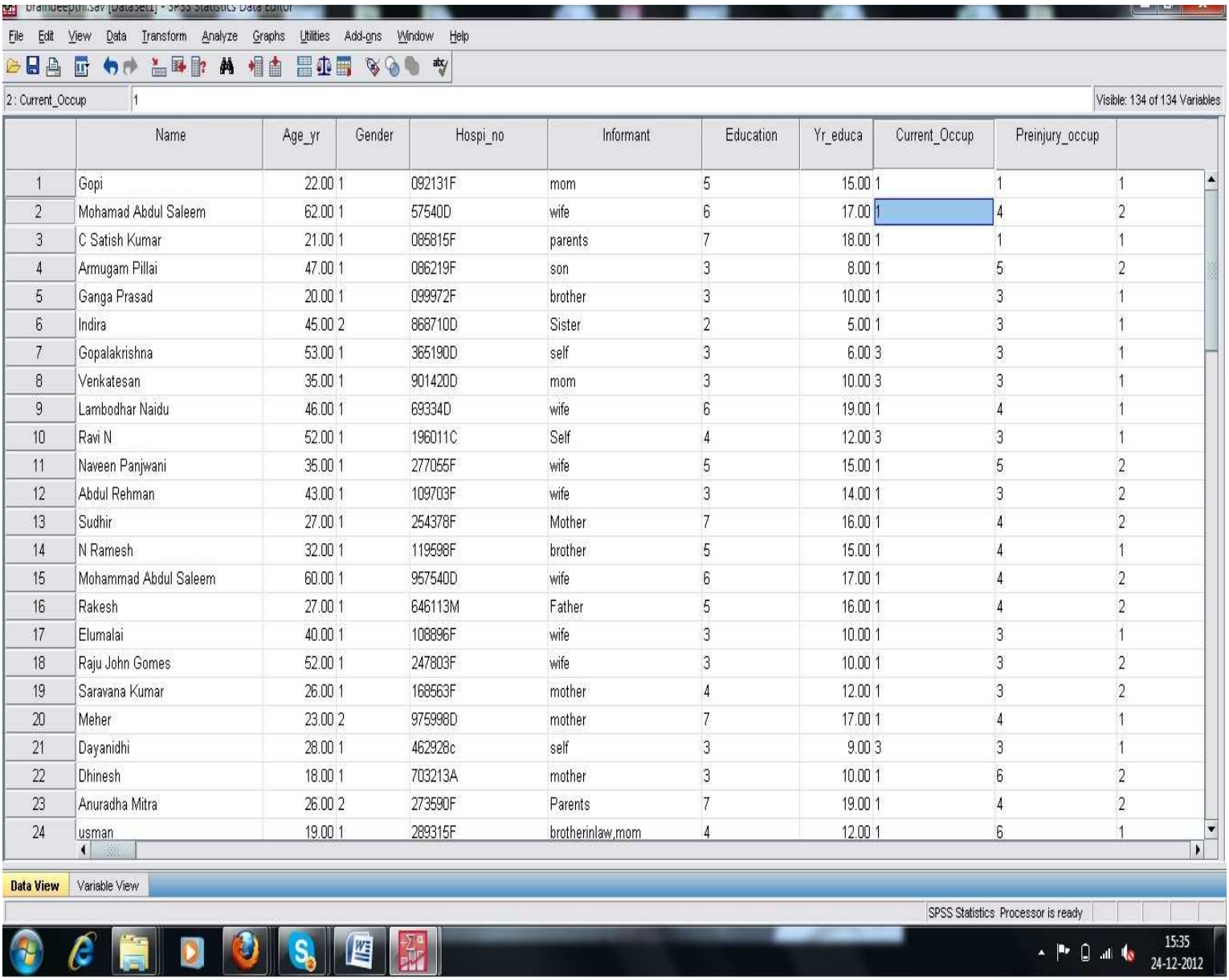
Chairperson (Research Committee) &
Principal
Christian Medical College
Vellore - 632 002, Tamil Nadu, India

CC: Dr. Anna Tharyan, Department of Psychiatry

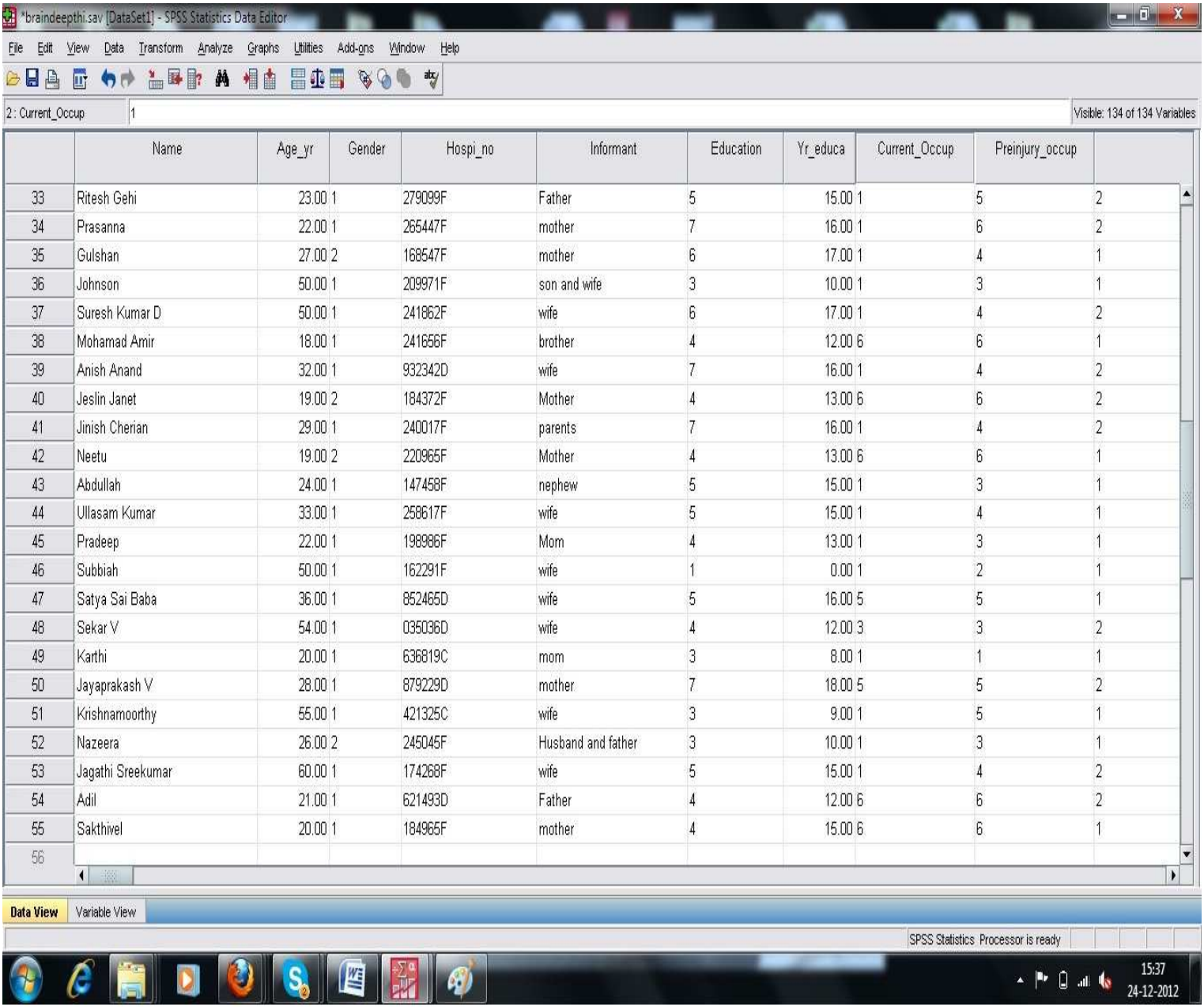
TEL : 0416 - 2284294, 2284202 FAX : 0416 - 2262788, 2284481 E-mail : research@cmcvellore.ac.in

Introduction:

Traumatic Brain Injury [TBI] can be defined as an externally inflicted blow to the brain with a cause that is not of a degenerative, vascular, infectious or congenital nature. Most commonly TBI occurs following a fall, road traffic accidents, assaults and accidents related to sports. Worldwide TBI is acknowledged as a significant problem. A review of epidemiological studies done in Europe suggested an incidence of 235 hospitalized cases per 100,000 populations (Tagliaferi F et al, 2006). This had included fatalities as well. In the other side of Atlantic in United States of America, incidence is estimated at 150 per 100,000



	Name	Age_yr	Gender	Hospi_no	Informant	Education	Yr_educa	Current_Occup	Preinjury_occup	
1	Gopi	22.00	1	092131F	mom	5	15.00	1	1	1
2	Mohamad Abdul Saleem	62.00	1	57540D	wife	6	17.00	1	4	2
3	C Satish Kumar	21.00	1	085815F	parents	7	18.00	1	1	1
4	Armugam Pillai	47.00	1	086219F	son	3	8.00	1	5	2
5	Ganga Prasad	20.00	1	099972F	brother	3	10.00	1	3	1
6	Indira	45.00	2	868710D	Sister	2	5.00	1	3	1
7	Gopalakrishna	53.00	1	365190D	self	3	6.00	3	3	1
8	Venkatesan	35.00	1	901420D	mom	3	10.00	3	3	1
9	Lambodhar Naidu	46.00	1	69334D	wife	6	19.00	1	4	1
10	Ravi N	52.00	1	196011C	Self	4	12.00	3	3	1
11	Naveen Panjwani	35.00	1	277055F	wife	5	15.00	1	5	2
12	Abdul Rehman	43.00	1	109703F	wife	3	14.00	1	3	2
13	Sudhir	27.00	1	254378F	Mother	7	16.00	1	4	2
14	N Ramesh	32.00	1	119598F	brother	5	15.00	1	4	1
15	Mohammad Abdul Saleem	60.00	1	957540D	wife	6	17.00	1	4	2
16	Rakesh	27.00	1	646113M	Father	5	16.00	1	4	2
17	Elumalai	40.00	1	108896F	wife	3	10.00	1	3	1
18	Raju John Gomes	52.00	1	247803F	wife	3	10.00	1	3	2
19	Saravana Kumar	26.00	1	168563F	mother	4	12.00	1	3	2
20	Meher	23.00	2	975998D	mother	7	17.00	1	4	1
21	Dayanidhi	28.00	1	462928c	self	3	9.00	3	3	1
22	Dhinesh	18.00	1	703213A	mother	3	10.00	1	6	2
23	Anuradha Mitra	26.00	2	273590F	Parents	7	19.00	1	4	2
24	usman	19.00	1	289315F	brotherinlaw,mom	4	12.00	1	6	1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File Edit View Data Transform Analyze Graphs Utilities Add-ons Window Help
2 : Current_Occup
1
Visible: 134 of 134 Variables
Name Age_yr Gender Hospi_no Informant Education Yr_educa Current_Occup Preinjury_occup
33 Ritesh Gehi 23.00 1 279099F Father 5 15.00 1 5 2
34 Prasanna 22.00 1 265447F mother 7 16.00 1 6 2
35 Gulshan 27.00 2 168547F mother 6 17.00 1 4 1
36 Johnson 50.00 1 209971F son and wife 3 10.00 1 3 1
37 Suresh Kumar D 50.00 1 241862F wife 6 17.00 1 4 2
38 Mohamad Amir 18.00 1 241656F brother 4 12.00 6 6 1
39 Anish Anand 32.00 1 932342D wife 7 16.00 1 4 2
40 Jeslin Janet 19.00 2 184372F Mother 4 13.00 6 6 2
41 Jinish Cherian 29.00 1 240017F parents 7 16.00 1 4 2
42 Neetu 19.00 2 220965F Mother 4 13.00 6 6 1
43 Abdullah 24.00 1 147458F nephew 5 15.00 1 3 1
44 Ullasam Kumar 33.00 1 258617F wife 5 15.00 1 4 1
45 Pradeep 22.00 1 198986F Mom 4 13.00 1 3 1
46 Subbiah 50.00 1 162291F wife 1 0.00 1 2 1
47 Satya Sai Baba 36.00 1 852465D wife 5 16.00 5 5 1
48 Sekar V 54.00 1 035036D wife 4 12.00 3 3 2
49 Karthi 20.00 1 636819C mom 3 8.00 1 1 1
50 Jayaprakash V 28.00 1 879229D mother 7 18.00 5 5 2
51 Krishnamoorthy 55.00 1 421325C wife 3 9.00 1 5 1
52 Nazeera 26.00 2 245045F Husband and father 3 10.00 1 3 1
53 Jagathi Sreekumar 60.00 1 174268F wife 5 15.00 1 4 2
54 Adil 21.00 1 621493D Father 4 12.00 6 6 2
55 Sakthivel 20.00 1 184965F mother 4 15.00 6 6 1
56
Data View
Variable View
SPSS Statistics Processor is ready
15:37
24-12-2012