# NEUROPSYCHOLOGY TODAY

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## Traumatic Brain Injury: Definition, Statistics, and Types

Traumatic Brain Injury (TBI) is a form of acquired cerebral injury, which compromises the integrity of the brain on a structural and functional levels. Among adults, males under the age of 24 and the elderly of both sexes 75+ years are at the highest risk of TBIs. In the US, about 1.4 million people experience a TBI, 50,000 die from a TBI, and about 1 million people visit emergency rooms because of a head injury. Nearly 50% of all TBIs result from auto-accidents, and nearly 50% involve alcohol use. Falls cause most of the TBIs among the elderly over 75.[1]

Mild TBI is characterized by confusion, disorientation, dizziness, *with or without brief loss of consciousness*. Moderate and severe TBI involves the same symptoms, but may also be associated with repeated vomiting and nausea, prolonged headaches, loss of consciousness or coma, slurred speech, impaired coordination, and numbness in the extremities.[1]

TBIs are also classified according to the type of brain damage. Among the most common types is *contusion*, which occurs when an area of the brain is swollen and mixed with blood released from broken blood vessels. *Hematoma* is a heavy bleeding into or around the brain, which may require immediate surgery. Contusions and hematomas often result from falls, blows to the head and from hitting the head against a hard

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### *Inside:*



## Diagnosis and Symptoms of Mild TBI

Mild TBIs, or concussions, account for over 75% of all TBIs. Concussion is defined as a "trauma-induced alteration in mental status that may or may not involve loss of consciousness." Post-traumatic amnesia of up to 24 hours is also observed in mild TBIs. Concussions are usually caused by a blow to the head or rapid acceleration, deceleration or rotation of the head. This may occur during a fall, physical attack, or a whiplash in a auto-accident. Researchers believe that concussions are under-diagnosed because many individuals do not take their symptoms seriously and do not seek medical attention when their symptoms are mild and/or short-lived.[1,2]

There is a wide range of symptoms associated with mild TBI that may or may not resolve shortly after the injury. Also, some symptoms may not surface until hours or days after the injury. Somatic symptoms of mild TBI include brief loss of consciousness, headache, dizziness, blurred vision, ringing in ears, fatigue or lethargy, and changes in sleep. Cognitive symptoms involve confusion, memory loss, decreased

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## Neurological Alterations and Long-Term Cognitive Sequelae of mild TBI

Research studies have demonstrated that mild TBI can lead to mild, but measurable long-standing neurocognitive symptoms that can affect daily functioning. These neuropsychological symptoms are produced by subtle damage to the brain caused by the TBI. For instance, concussion may result in diffuse axonal injury, which affects cerebral perfusion and metabolism. This can undermine the patients' executive functions, speed of information processing, working memory, attention, and inhibition. Fronto-temporal regions are particularly susceptible to focal damage and may lead to attention, executive, and emotional control difficulties. Executive functions include planning, reasoning, decision making, and problem solving, and are essential to the individuals' professional, academic, social, and personal functioning.[2,3,4,6]

Frequently reported cognitive difficulties include impaired divided attention, processing speed, working memory, mental flexibility , abstraction, learning and delayed recall. These cognitive symptoms may be exacerbated by the co-occurring and/or pre-existing medical illnesses and emotional distress, which can also lead to slower recovery of cognitive functioning.[2]

Cognitive symptoms may appear subtle and be dismissed by the individuals with a mild TBI, their caregivers, and even health care providers. However, different neurocognitive deficits may affect different areas of the patients' lives. For this reason, objective neuropsychological assessment is necessary to identify and measure cognitive symptoms and outline treatment options.[2,3]

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surface. *Anoxia* and *hypoxia* occur when the supply of oxygen to the brain is discontinued or reduced, respectively, which may result from a significant blood loss during an operation, drowning, birth trauma, or choking. *Concussion* is the mildest and the most common type of TBI.[1]

### Neuropsychological Exam and Cognitive Rehab After Mild TBI

TBI survivors with persisting cognitive symptoms are often referred for a comprehensive neuropsychological exam by their physicians. This exam is performed only by a certain specialist- Neuropsychologist- and involves an objective, diagnostic assessment of the nature and extent of cognitive deficits. The exam determines which specific neurocognitive functions were affected by the TBI and which functions remained adequate for the age norm. In other words, neuropsychologist can estimate the pre-TBI level of functioning and distinguish cognitive deficits from the normal age-related decline. Sensory and motor functions are also examined.[3,6]

It is critical to objectively measure post-TBI cognitive symptoms using objective, standardized neuropsychological tests for proper diagnosis and treatment planning. This is particularly relevant when it comes to the elderly, who may attribute their post-TBI cognitive symptoms to the effects of aging or may not be aware of their symptoms due to age-related cognitive decline or dementia. Based on the test results, neuropsychologist concludes with a diagnosis and makes treatment recommendations. [2,3,5]

Cognitive rehabilitation (CR), a treatment of choice for post-TBI cognitive symptoms, is recommended to alleviate cognitive deficits and the associated functional difficulties in daily life. This type of non-pharmacological treatment was developed to address cognitive deficits among the patients with a history of TBI or stroke, and is now increasingly used to treat patients with other neurological, neurodevelopmental, and psychiatric conditions.[3,6]

Cognitive rehabilitation (CR) is also provided by a neuropsychologist. The goal of this treatment is to improve patients' cognitive symptoms and their ability to perform activities of daily living through the repeated use of exercises of increasing difficulty. Restorative cognitive training involves re-training of the cognitive skills that were affected by the injury. Compensatory training involves teaching the patients various strategies to use their intact cognitive skills in order to compensate for their lost or impaired cognitive functions.[3,6] In combination, these exercises rehabilitate post-TBI cognitive deficits and help patients to regain their independence and employability.

Cognitive rehabilitation can be individual or group-based, and may or may not involve the use of computers and other assistive technology. Individual cognitive rehabilitation is an individually tailored structured treatment program that consists of various exercises to systematically train the specific impaired cognitive functions. According to the National Institutes of Health (NIH), the most effective cognitive rehabilitation interventions for TBIs are those that are structured, systematic, goal-directed, and individualized.[1,3,6]

The majority of the existing studies on cognitive rehabilitation in TBI targeted memory, attention, and executive functions. Research shows that cognitive rehabilitation improves cognitive, psychosocial and occupational functioning and often preserves independence and employment. Additionally, cognitive rehabilitation has been found to be linked to faster re-integration into community and re-assuming of family-related and leisure activities.[1,3,6]

Timely assessment and treatment of post-TBI cognitive symptoms expedites patients' cognitive recovery after TBI and the attainment of their pre-injury level of professional and psychosocial functioning. It has been found that cognitive rehabilitation is effective in treating post-injury cognitive and psychosocial symptoms regardless of the injury severity and time post-TBI.[3,6]

In other words, treatment of cognitive symptoms weeks or months after the injury still significantly improves neurocognitive functioning among the patients with mild TBI. Thus, the residual symptoms of concussion need to be evaluated and addressed even when substantial period of time has passed since the injury.[1,3,6]

To conclude, research findings point to the importance of neuropsychological assessment and to the fact that the effects of cognitive rehabilitation are not limited to neurocognitive functioning and performance of daily living activities, but also improve patients' overall well-being and quality of life. This, together with occupational re-entry, reduces caregiver burden as well as personal and national economic toll of TBIs.[1,3,6]

### About Dr. Rimma Danov

Dr. Rimma Danov received her PhD in clinical psychology from Adelphi University in NY. She completed her internship in clinical psychology and neuropsychology at Harvard Medical School and postdoctoral fellowship in pediatric and adult neuropsychology in a private clinic affiliated with NJ Medical School and the Robert Wood Johnson Medical Center. She is an assistant clinical professor at Penn State University, Dept. of Kinesiology, and has served as an assistant clinical professor at NYU School of Medicine, Dept. of Neurology, and Adelphi University, Derner Institute. In the past, she worked as a neuropsychologist for the NJ Devils Hockey Team and was engaged as a co-investigator of TBI in boxers at the NYS Athletic Commission.

Presently, Dr. Danov maintains a full-time private neuropsychology practice where she examines neurocognitive and neurobehavioral functioning of patients 2-90 years of age with various neurological and neuropsychiatric disorders, such as MS, TBI, CVA, Parkinson's, Alzheimer's, dementia, ADHD, PDD, Autism, learning disabilities, seizures, and many others, using state-of-the-art neuropsychological techniques. Dr. Danov also conducts and publishes research in these areas. She is available for medico-legal consultations and testimony.

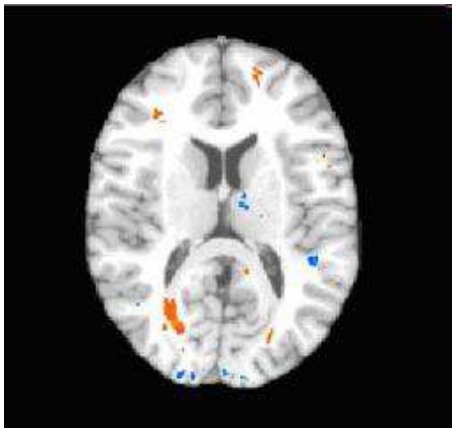
*("Diagnosis and Symptoms of Mild TBI," cont. from p.1)*

concentration, and slow thinking. Mild TBI patients may also experience behavioral and mood changes.[1,2]

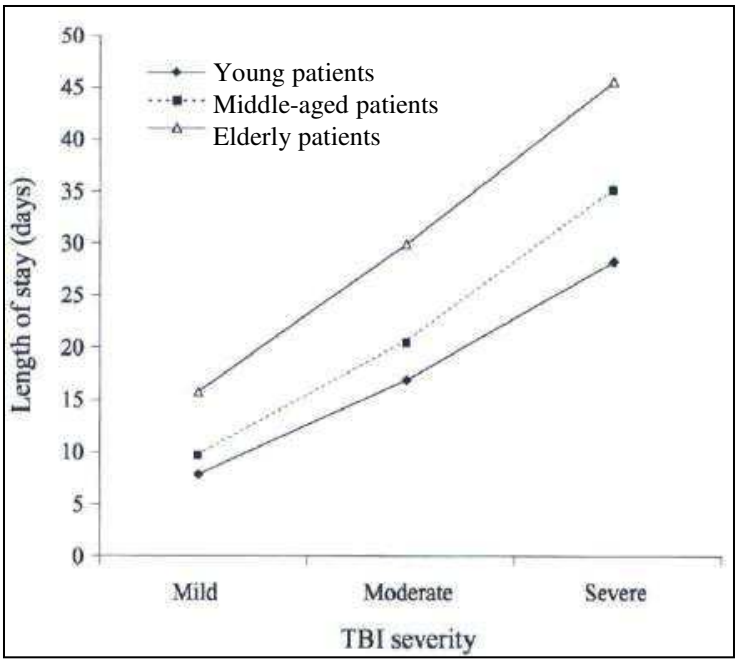
About 20% of mild TBI patients continue to experience post-injury symptoms that affect their daily functioning 12 months or longer after the injury. This condition, referred to as Post-Concussive Syndrome, can be attributed to functional abnormalities and micro-lesions in the brain caused by TBI. Conventional neuroimaging techniques such as MRI and CT scans, however, usually do not detect these subtle brain alterations, and a comprehensive neuropsychological exam is necessary to objectively assess cognitive changes and point to the underlying brain damage following mild TBI.[1,2,3]

In a recent study, a new technique called Diffusion Tensor Imaging (DTI), which measures the diffusion of water in the brain's white matter was used to evaluate brain functioning of concussed patients within 2 weeks of mild TBI. Even though conventional neuro-imaging techniques did not reveal any group differences, DTI data showed significant alterations in water diffusion among the concussed participants, pointing to some structural brain damage. These abnormalities were mostly found in the patients' prefrontal cortex (see image below), which is highly involved in executive functions (reasoning, planning, problem solving, decision making, working memory, selective attention, etc.).[4]

In addition, the concussed group scored significantly lower on the objective tests of executive functions than healthy controls. Further, their executive functions scores were related to their post-TBI brain damage as indicated by DTI data, which provided solid evidence of the direct link between the location of brain injury and the resulting worsening of the specific cognitive functions.[4]



*The Diffusion Tensor Imaging (DTI) scan above shows the areas of brain damage after mild TBI. The most pronounced abnormalities were seen in the prefrontal cortex, which plays a central role in executive functions.[4]*




*The graph is based on 2,327 adults seen in hospitals due to TBIs. The results showed that elderly patients (60+ yrs) had more severe post-injury symptoms compared to younger patients, which resulted in longer duration of hospital stay at all TBI severity levels. Among the elderly, 72% were diagnosed with mild TBI. 58% of the TBIs among the elderly were due to falls, 36% were caused by auto-accidents, and 6% were due to other reasons.*

## TBI and the Elderly

Individuals over the age of 65 are at an increased risk for injuries, including TBI. Elderly 85+ years are at the greatest risk for TBI, which is a growing public health problem. Most of the injuries among the elderly are due to unintentional falls, followed by auto-accidents. TBI is the 3rd most common type of injury among the elderly who fall. An increased incidence of falls and auto-accidents among the elderly can be partially explained by cognitive decline, dementia, and weak sensorimotor skills. Winter months are worse, since the roads are slippery because of ice and snow.[1,5]

Research shows that the elderly experience more severe and extensive cognitive symptoms and poorer recovery from TBI, both immediately and several months post-injury (see image above). Elderly also have higher mortality and morbidity rates and higher likelihood of late post-TBI seizures and dementia. Thus, it is critical to identify elderly with mild TBI, assess their cognitive symptoms, and treat to prevent further cognitive decline, dementia, and disability.[5]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1. Background image (pp.1,4): Jeff Johnson Biolog. & Medic. Visuals
2. TBI mage (p.1). bryanking.net/traumatic-brain-injury/
3. Graph (p.2). From Leblanc et al. (2006). Comparison of functional outcomes… *Brain Injury* 20: 779-790.
4. Pet scan (p.3). Newswise.com/articles/strong-link-found-between-concussions-and-brain-tissue-injury222222


**Editor**

Dr. Rimma Danov, Ph.D.

**Layout:**

Natalia Shtompel, M. A.
Research Coordinator


**Next Issue-** Feb'10: Premature Children; Mar'10: Mild Cognitive Impairment (MCI)

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Each insurance carrier determines the medical necessity of every requested neuropsychological exam differently. Our billing staff determines whether the exam will be covered by the insurance before the exam begins and works very hard to obtain an authorization, if needed. If you have questions about a plan that is not listed here, contact our office to find out whether we can obtain an authorization or have recently joined that plan.

**Languages**

We are very much open to diverse cultures in this practice and value the quality of a bilingual neuropsychological exam performed in the patient's native language. Dr. Danov is a native Russian speaker. Her current clinical staff include native ***Russian***, ***Spanish*** and ***Hebrew*** speakers.



**For ALL appointments and questions call:** 718-667-5530

**Office Locations:**

Staten Island: (main office, forward **all** correspondence)
65 Kelvin Avenue
Staten Island, NY 10306

Brooklyn:
95-11 Shore Road, Suite C
Brooklyn, NY 11209

Manhattan:

139 Fulton Street, Suite 215
New York, NY 10038

Queens:

76-13 113 Street, Suite 1F
Forest Hills, NY 11375

Long Island:
2900 Hempstead Tpke, Suite 217
Levittown, NY 11756



## Dr. DANOV NEUROPSYCHOLOGIST, P.C.

65 Kelvin Avenue
Staten Island, NY 10306

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