

## **FATIGUE FOLLOWING BRAIN INJURY**

- **The brain uses more energy than any organ in the body.**
- **When the brain is injured nearly all of your energy is required to perform basic life functions**
- **43-73% of survivors of mTBI complain of mental fatigue.**
- **Mental fatigue can last for years following traumatic brain injury and it can be profoundly disabling and affect working capacity and social abilities**
- **Fatigue affects the quality of individuals lives**
- **Fatigue is related to the mental effort necessary to overcome attentional deficits and slowed processing**
- **CONATION: Problems with conation represent difficulties expending intellectual energy. When individuals attempt to think and perform a task that is somewhat complex, they may become very fatigued mentally and physically. The brain fatigues**
- **Cognitive/mental fatigue has been shown to be one of the most debilitating symptoms after a traumatic brain injury**
- **Individuals oftentimes say, “I am so exhausted.” “I don’t want to get out of bed.” “I can’t make myself think or process information.”**
- **There are 3 types of fatigue: Physical, Cognitive and Emotional**

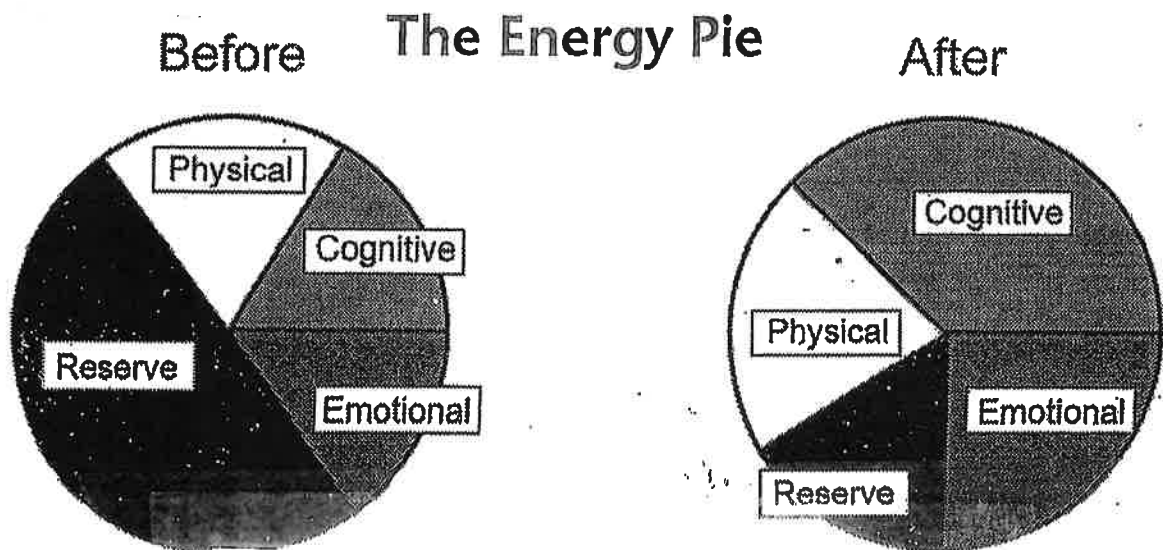
- **Physical Fatigue** occurs when you do physical tasks such as house cleaning, gardening, etc. and this type of fatigue usually becomes worse over the day
- **Mental or Cognitive fatigue** becomes worse when you think, concentrate, read, try to solve problems, etc. You may find that your efficiency and accuracy are less, and thinking takes more effort
- **Emotional or Psychological Fatigue** is related to stress and/or depression; and this type of fatigue is oftentimes worse when you awaken in the morning.
- **Causes of Fatigue After Brain Injury:**
  - **Molecular Mechanisms** such as abnormal protein markers, abnormal pituitary functions, or hormonal deficiencies.
  - **25-50%** of individuals with TBI have pituitary deficiencies.

#### **RECENT RESEARCH ON COGNITIVE FATIGUE:**

- The Kessler Foundation recently discovered that cognitive fatigue in traumatic brain injury is associated with activation changes in the caudate nucleus and the basal ganglia
- Both hemispheres have a caudate nucleus and it is deep in the brain and near the basal ganglia
- Researchers believe that this may lead to a clinical intervention to help alleviate fatigue in brain injury and other neurological disorders

## ENERGY ALLOCATION:

- **Energy Pie:** Before an injury you can perform physical, cognitive and emotional tasks and still have a reserve near the end of the day. But when you have a brain injury, your reserve is much less because the brain takes most of your energy to function.



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- **You must compensate for the decreased energy by doing the following:**
  - Consider using morning blue-light therapy (BLT)
  - Sleeping more and taking naps during the day
  - Pace yourself throughout the day—do a little bit, rest a little bit, and follow this model throughout the day.
  - Analyze tasks by how much energy they take and how much time they take rather than just the time required to accomplish the task

## ENERGY ALLOCATION



Fatigue is a common symptom following a brain injury. The brain needs a great deal of rest throughout the day to heal. One important strategy is called PACING.

When pacing, you do a little task of activity and then rest and repeat this through out the day. This will help you conserve your energy.

This means that you need to think about your daily activities differently than before because some tasks take more energy than others. For example, going to the grocery store may take much more energy because of all of the visual and auditory stimulation, lights, sound, etc., than going to the library where it is quiet. Having to drive somewhere may take more energy that walking somewhere near your home.

You can think about each day as having 100% of the energy for you to use. However, some days you may feel tired when you get out of bed and feel that you have less energy. One good exercise is to make a list of your activities and assign how much energy you think those activities take. Plan you day based on 1) how much energy you feel like you have and 2) how much energy each activity takes.

ACTIVITY	%AGE OF ENERGY
1. Example: Grocery shopping	60%
2. _____	_____
3. _____	_____
4. _____	_____
5. _____	_____
6. _____	_____

## **SLEEP/FATIGUE AND TRAUMATIC BRAIN INJURY**

- **3 out of 4 individuals hospitalized with TBI developed sleep-wake disturbance by 6 months postinjury**
- **40% of mild TBI cases; 20% moderate; and 40% severe had sleep disturbance. 25% complained of insomnia.**
- **A study of 87 individuals with mild to severe TBI found that individuals with mild TBI met the criteria of sleep disturbance more than severe TBI**
- **2 types of brain injury that can negatively impact sleep are: acceleration/deceleration injuries which are more generalized; and contact injuries.**
- **Individuals with TBI had less REM sleep; decreased sleep efficiency; more time awake after sleep onset.**
- **At 3 years post injury 67% of individuals continue to complain of sleep/wake disturbances and hypersomnia and fatigue.**

### **CAUSES OF SLEEP PROBLEMS IN TBI:**

- **Insomnia in TBI can be caused by circadian rhythm disorders –such as delayed sleep-wake phase; or irregular sleep-wake rhythm disorder.**
- **Headaches and centralized pain can have effects on sleep-quality.**
- **Problems with Neurotransmitters can cause sleep problems; including dopamine, serotonin, GABA, etc. Too much or too little of these neurotransmitters can cause wakefulness or induce sleep**
- **Melatonin production was 42% less overnight in individuals with TBI; and melatonin was delayed by approximately 1.5 hours in patients with TBI. Altered melatonin synthesis in TBI may disrupt circadian rhythms, possibly causing sleep disturbance**
- **Sleep apnea, narcolepsy, and periodic limb movement disorder (restless leg syndrome) can be caused by and/or accompany a TBI**

**Brainwave patterns and sleep issues:**

- Delta is the primary brainwave produced during sleep (2-4 Hz). Theta is 4-7 Hz and is a state between wakefulness and sleep and is where many individuals reside following their injury (feeling foggy, confused, etc). Beta and Gamma EEG activity is found to be dominant in all sleep stages over the frontal, central, occipital regions in post-traumatic patients with pain. By altering brainwaves through EEG Neurofeedback you may be able to change sleep cycles.

#### **DIAGNOSIS OF SLEEP PROBLEMS:**

- Polysomnography, also called a sleep study, is a test used to diagnose sleep disorders. Polysomnography records your brain waves, the oxygen level in your blood, heart rate and breathing, as well as eye and leg movements during the study.

#### **TREATMENT OF SLEEP PROBLEMS FOLLOWING TBI:**

- Treatments can include: Behavior modifications, medications; positive airway pressure; etc.
- Behavior Modifications:
  - Relaxation training (biofeedback): The use of machines to measure muscle tension, temperature, skin conductance and breathing can teach body relaxation. Daily practice of progressive muscle relaxation, visual imagery, use of automatic phrases to condition responses improved sleep.
  - Mindfulness/meditation practice and yoga: This study found that breathing, gentle flow body postures, and learning techniques to control thoughts and mindful breathing, self-talk and loving kindness helped prepare individuals to move into sleep patterns more easily.
  - Warm Foot-Bath Improve sleep in chronic phase of TBI—looked at patients 1 year or more post injury—looked at sleep onset latency, and sleep efficiency and waking after sleep onset. Had participants use warm footbaths 41 °Celsius (105 °F), soak feet to above ankle for 30 minutes 1-2 hours before lights off.
  - Found that this decreased sleep Latency Onset; possibly due to the warm sensitive neurons in the POAH (skin temperature warming

activates the hypothalamus and insula). It spontaneously increases firing rate at sleep onset and by increase in skin temperature it increases the firing rate of warm sensitive neurons, which facilitates sleep. This also decreased the waking after sleep times.

- **Acupuncture**
- **Phototherapy or Bright Light Therapy: 10,000 lux white light or alternative short- wavelength (blue light) for 45 minutes early morning has been shown to be most effective due to key role in circadian rhythms. This is believed to reduce daytime fatigue, and sleepiness and improve mood and help with sleep/wake cycles.**
- **Sleep hygiene education: going to bed at the same time—awakening at the same time; no TV's or lights in the room; no computer time or TV time before bed. No heavy meals before bed, no alcohol consumption before bed, avoid daytime naps, or schedule them (no longer than 30-45 minutes)**
- **Psychotherapy: such as cognitive behavioral therapy, particularly if you have nightmares following your injury.**

#### **Medications/Supplements:**

- **Medications: Literature says to avoid benzodiazepines due to cognitive side effects, which may be compounded in TBI. Trazadone (nonaddictive), Ambien, Lunesta, etc. are often used for sleep. Some people use low dose (5 mg. of amitriptyline) to relax muscles and help sleep.**
- **Over the Counter medications and supplements: Anti-histamines such as Benadryl; may be used to aid sleep**
- **Herbal Supplements: Melatonin; valerian; individuals with TBI had lower levels of Melatonin production, which is correlated with REM sleep. Neuroreplete improves serotonin production. Ask your doctor about dosages**
- **Caution should be made not to drive or drink alcohol with these supplements.**

**TABLE 4****Key elements of sleep hygiene**

- Maintain a regular and strict sleep schedule of going to bed and awakening around the same time every day ( $\pm 30$  minutes), including holidays and weekends
- Avoid daytime naps; if very tired, schedule naps, but keep them short (no longer than 30 to 45 minutes)
- If unable to fall asleep within 10 to 20 minutes of lying in bed, get out of bed and do something relaxing; once you feel sleepy, go back to bed; if not sleeping within 10 to 20 minutes, repeat the process, and keep repeating until asleep
- Avoid seeing what time it is at night—this could cause anxiety and worsen sleep
- Minimize consumption of alcohol: it is best to avoid in the first 1 to 2 years of injury
- Avoid alcohol, coffee, and sodas late in the day because they may be too stimulating and delay sleep
- Stop smoking
- Avoid stimulating activities and heavy meals before bedtime; light stretching can help
- Maintain comfortable bedroom ambience: quiet, dark, and cool
- Avoid bright lights, loud noise, and using anything with a screen (television, tablets, smartphones, laptops) in the bedroom

*TABLE 4: Key elements of sleep hygiene*