Fatigue in workers with traumatic brain injury

Researcher: Tatyana Mollayeva, MD, PhD Candidate
Research Supervisor: Prof. Angela Colantonio
Research Committee: Prof. Colin M Shapiro, Prof. David J Cassidy
Disclosure

- There is no conflict of interest to disclose
Presentation outline

- Three-component model – sleep, fatigue and performance
- Sleep after traumatic brain injury (TBI)
- Fatigue after TBI: chicken or egg? Or both?
- How sleep and fatigue modulate performance after TBI – gap in knowledge
- Study: Disorders of sleep and wakefulness in Ontario workers with head injury: preliminary results
- Conclusions
Fatigue in workers with TBI: a three-component model

Mollayeva et al, 2014
Sleep disorders in the TBI population

TBI vs. general population:

- **Insomnia:** 30%¹, >3 times the rate in gen. pop.²
- **Sleep-related breathing disorder:** 25%-35%³ vs. 6%⁴
- **Hypersomnia:** 30%⁵ vs. 0.05%⁶
- **Circadian rhythm sleep disorder:** 36%⁴ vs. 6.6%⁷
- **Periodic leg movements syndrome:** 17%⁸ vs. 4%-11%⁹⁻¹

Fatigue: primary complaint in the TBI population

Difficult to elucidate – many plausible biological causes of the symptom acting independently or together

Fatigue is burdensome and associated with poor outcomes

Negatively impacts social, physical and cognitive functioning; participation in daily activities; results in increased work-related and other disabilities

Recognized when activity results in diminished capacity to carry out a function

Cited as factor in occupational disasters Chernobyl nuclear reactor, Exxon Valdez oil spill, Challenger space shuttle

Growing evidence supporting association – sleepiness, fatigue and probability of involvement in accident

As such, fatigue can be a proximate cause of TBI at the workplace (chicken)

Fatigue can also be a result of the TBI (egg)
National:

- 1.4 million persons living with TBI-related disability\(^1\)
- Affected persons usually young-mid age → financial cost to society due to loss of productive activity\(^1\), unemployment\(^2\)
- Therefore, return to work (RTW)/productive activity is an important endpoint of rehabilitation


Returning to work after TBI

- After TBI rate of RTW: 10-70\%\(^1\)
- Highest in first six months after injury\(^2\)
- Factors affecting RTW: demographic, injury severity, rehabilitation, workplace accommodations, etc.\(^3\)
- Fatigue is a predictor of number of days from injury to RTW\(^4\)
- Sleep complaints two years post injury associated with lower rates of employment\(^5\)

Sleep problems are common after TBI, linked to employment rates post-TBI.

Fatigue frequently cited post-TBI; symptom implicated in occupational errors.

Both sleep and fatigue appear as components relevant to performance after TBI, specifically of occupational duties.

The gap – study of sleep and fatigue and their relationship to work performance and disability after TBI.
Disorders of sleep and wakefulness in Ontario workers with TBI
Objectives and methods

- **Objectives relevant to today’s topic:**
  - Prevalence: fatigue and sleep disorders in Ontario workers with TBI
  - Association between fatigue, sleep dysfunction, disability
  - Review correlations between variables by sex

- **Methods:**
  - Cross-sectional, prospective recruitment
  - TRI-UHN Neurology Services, WSIB Clinic
**Measures used**

- **Sleep assessment**: standardized scales, in accordance with ICSD-2\(^1\)
- **Psychological status**: PHQ-9\(^2\), HADS-A\(^3\)
- **Pain**: Pain Analogue Scale\(^4\)
- **Other items**: medications, other med disorders, shift work, pre-morbid sleep condition, etc.
- **Disability**: Sheehan Disability Scale\(^5\)

---

Preliminary results

- Median time since injury = 531 days
- Mild TBI/concussion = 95%

<table>
<thead>
<tr>
<th></th>
<th>Females</th>
<th>Males</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>32</td>
<td>52</td>
</tr>
<tr>
<td>Mean age (y)</td>
<td>47±10.3</td>
<td>45±10.5</td>
</tr>
<tr>
<td>Pre-morbid shift work (%)</td>
<td>31</td>
<td>57</td>
</tr>
</tbody>
</table>
## Preliminary results

<table>
<thead>
<tr>
<th>Work status</th>
<th>Disability</th>
<th>Part-time</th>
<th>Full-time</th>
<th>Laid-off</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>66.7%</td>
<td>20.4%</td>
<td>11.1%</td>
<td>1.9%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shift-work</th>
<th>47.8%</th>
<th>Rotating</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>80%</td>
<td>20%</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>#work-related injuries in past 5 years</th>
<th>1</th>
<th>75.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>17%</td>
</tr>
<tr>
<td></td>
<td>≥3</td>
<td>7.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Accident involvement due to sleepiness</th>
<th>Yes</th>
<th>5.6%</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Pre-morbid sleep disorders</th>
<th>SA</th>
<th>13.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated?</td>
<td>Yes</td>
<td>83%; 67% not compliant</td>
</tr>
</tbody>
</table>
## Most disabling symptoms

<table>
<thead>
<tr>
<th>Order</th>
<th>Symptom</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pain</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Insomnia/other sleep-related</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>Dizziness</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Fatigue</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>Fatigue</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Pain</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Insomnia/other sleep-related</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Anxiety/depression</td>
<td>11</td>
</tr>
<tr>
<td>3</td>
<td>Dizziness</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Insomnia/other sleep-related</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Fatigue</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Poor memory</td>
<td>9</td>
</tr>
</tbody>
</table>

Sleep-related = 38%
Fatigue = 33%
Comorbid conditions

- Fibromyalgia
- COPD
- Seizure disorder
- Diabetes
- Heart disease
- Sleep apnea
- Arthritis
- Depression
Frequencies: fatigue
Measure: fatigue severity scale

Normal (<36)  Excessive (>=36)
Frequencies: insomnia
Measure: insomnia severity scale

<table>
<thead>
<tr>
<th>Severity Level</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>None/subthres (&lt;15)</td>
<td>20%</td>
</tr>
<tr>
<td>Moderate (15-21)</td>
<td>50%</td>
</tr>
<tr>
<td>Severe (22-28)</td>
<td>30%</td>
</tr>
</tbody>
</table>
Insomnia, by sex

Mod-sev insomnia

Mod-sev insomnia in shift-workers

Male
Female
Frequencies: daytime sleepiness

Measure: Epworth sleepiness scale

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal (0-9)</td>
<td>% 49.5</td>
</tr>
<tr>
<td>Excessive (&gt;=10)</td>
<td>% 51.0</td>
</tr>
</tbody>
</table>
Frequencies: sleep apnea
Measure: STOP-BANG
Frequencies: restless leg’s
Measure: RLQ

Recurrent unpleasant sensation, tingling in legs while sitting, lying down

If present, worse in evening or night?
Three-component model based on correlations

- Insomnia
  - Disability: $r=0.42, p<0.0018$
  - Fatigue: $r=0.43, p<0.0001$

- Disability
  - Insomnia: $r=0.55, p<0.0001$
  - Fatigue

- Fatigue
  - Insomnia
  - Disability
Three-component model based on correlations

- **Insomnia**
  - $r = 0.52$, $p < 0.0001$

- **Disability**
  - $r = 0.54$, $p < 0.0001$

- **Fatigue**
  - $r = 0.50$, $p < 0.0002$
Three-component model based on correlations

- **Insomnia**
  - $r=0.42, \ p<0.0018$
  - $r=0.20, \ p<0.1$

- **Disability**
  - $r=0.67, \ p<0.0001$

- **Fatigue**
Important to note

Alertness \( r=-0.6, p<0.0001 \) Fatigue
Conclusions

- Fatigue was found to be strongly associated with insomnia and disability, with some variability between sexes.
- A strong negative association between fatigue and alertness may indicate workers’ inability to return to duties requiring sustained attention.
- Future research on the effects of circadian displacement due to shift work as a determinant of post-morbid fatigue, alertness and performance is warranted.
Acknowledgements

- Ontario workers with head injury
- Neurology services, WSIB clinic, Toronto Rehab-UHN
- Research sleep facility, Toronto Western Hospital-UHN

Funding:
- MITACS Accelerate
- Canadian Institutes of Health Research
- Toronto Rehabilitation Institute, UHN
Thank you!