Traumatic Brain Injury among the Homeless: Current State of the Science and Clinical Implications

Lisa Brenner, Ph.D., ABPP
VISN 19 MIRECC
University of Colorado Denver
School of Medicine
The VISN 19 MIRECC Research Team

Sean Barnes PhD
Marie Devore MS
Joe Huggins MSW MSCIS
Leah Russell MA
David Weitzenkamp PhD
TBI 101
• Traumatic Brain Injury - A bolt or jolt to the head or a penetrating head injury that disrupts the function of the brain. Not all blows or jolts to the head result in a TBI. The severity of such an injury may range from “mild” (a brief change in mental status or consciousness) to “severe” (an extended period of unconsciousness or amnesia) after the injury.

• A TBI can result in short- or long-term problems with independent function.
The Scope of the Problem

- 1.7 million injuries per year (approximately 200 per 100,000 persons per year)
  - Vast majority ~80%, are graded as mild, with 100% survival
  - ~10% are moderate, with 93% survival
  - ~10% are severe, with only 42% survival
Bimodal Distribution and Highest Risk Age

Ages: 15 - 24

Ages: 65 - 75

Elderly adults – higher mortality rates
TBI and Gender

- Traumatic brain injury is more than twice as likely in males than in females
Alcohol/Drugs and TBI Acquisition

The greatest risk factors for traumatic brain injury:

- Alcohol/drug use
- An alcohol/drug disorder
Studies suggest that between 1/3 to slightly over 1/2 of persons with TBI are intoxicated at the time of injury and/or show a pre-injury history of alcohol abuse.
Risk Factors for Sustaining a TBI

- Alcohol/drugs
- Familial discord
- Low SES
- Unemployment
- Low educational status
- Psychiatric symptoms
- Antisocial/Aggressive behavior
- Previous TBI
Leading Causes of TBI

- Falls (28%)
- Motor Vehicle – Traffic Crashes (20%)
- Assaults (11%) Langolis et al. 2004
- Blasts are the leading cause of TBI for active duty military personnel in war zones DVBIC 2005

http://www.cdc.gov/ncipc/tbi/TBI.htm
Mechanism of Injury (Traditional)
Blast Injury

- **Primary** – Barotrauma
- **Secondary** – Objects being put into motion
- **Tertiary** – Individuals being put into motion
Mild TBI Definition – American Congress of Rehabilitation Medicine

“Traumatically induced disruption of brain function that results in loss of consciousness of less than 30 minutes’ duration or in an alteration of consciousness manifested by an incomplete memory of the event or being dazed and confused.”
Mild TBI
Short- and Long-Term Effects
Common Mild TBI/Postconcussive Symptoms

- Headache
- Poor concentration
- Memory difficulty
- Irritability
- Fatigue
- Depression
- Anxiety
- Dizziness
- Light sensitivity
- Sound sensitivity

Immediately post-injury 80% to 100% describe one or more symptoms

Most individuals return to baseline functioning within a year

Ferguson et al. 1999, Carroll et al. 2004; Levin et al. 1987
7% to 33% have persistent symptoms
TBI and Homelessness
Substance abuse and homeless – 1,966 publications

Traumatic brain injury and homeless – 12 publications
Cognitive Function and Duration of Rooflessness in Entrants to a Hostel for Homeless Men

ALEXANDER J. BREMNER, PETER J. DUKE, HAZEL E. NELSON, CHRISTOS PANTELIS and THOMAS R. E. BARNES

Background. Four previous studies of homeless adults have yielded conflicting results regarding the presence of cognitive impairment.

Method. A consecutive series of 80 roofless entrants to a hostel for homeless men were sampled, and 82 (76%) completed a range of assessments, including measures of mental status, cognitive functions and substance use.

Results. Estimated premorbid IQ (mean=96), current IQ (mean=84) and cognitive speed were significantly lower than the norm. There was a significant IQ drop in all diagnostic groups. IQ dropped, but not current IQ, correlated with duration of rooflessness. Those with schizophrenia or alcohol problems were roofless for longest. Alcohol misuse did not correlate with IQ drop, excepting alcohol withdrawal symptoms in those with schizophrenia.

Conclusion. The hypothesis that low IQ is a risk factor for rooflessness is supported. However, length of rooflessness was more closely related to IQ drop than to current IQ, suggesting that some third factor may be affecting both rooflessness and intellectual functioning. Roofless men with schizophrenia or alcohol problems may be especially at risk of long-term rooflessness.
Neurological deficits in the homeless: a downward spiral

Recent research has uncovered high rates of traumatic brain injury and cognitive dysfunction in the homeless. Might these problems contribute to their plight? Norra MacReady investigates.
# Traumatic Brain Injury and Homelessness: A Review

Jane Topolovec-Vranic, Naomi Ennis
St. Michael’s Hospital, Toronto, Canada

## Table 1: Published Research Studies

<table>
<thead>
<tr>
<th>Research Study</th>
<th>Setting</th>
<th>Population (Sample size; n males; age (SD); duration homelessness in days (SD))</th>
<th>How was TBI Measured</th>
<th>Prevalence of TBI among homeless sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hwang et al., (2008).</td>
<td>Toronto Shelters and Meal Programs</td>
<td>904; 601 males; 37.4 (12.9); 1606 days (2153.5)</td>
<td>Self-Report: “Have you ever had an injury to the head which knocked you out or at least left you dazed, confused or disoriented?”</td>
<td>53%</td>
</tr>
<tr>
<td>Solliday- McRoy et al. (2004)</td>
<td>Large Homeless shelter in Milwaukee, Wisconsin (USA)</td>
<td>90; 90 males; 40.96 (NR); 87.68 days (NR)</td>
<td>Self-Report</td>
<td>47%</td>
</tr>
<tr>
<td>Cotman &amp; Sandman (1997)</td>
<td>Homeless residents of an 18 month residential program (Orange County, California)</td>
<td>24; 13 males; 30.6 (6.5); Mean days homeless NR</td>
<td>Self-report</td>
<td>8.3%</td>
</tr>
<tr>
<td>Hux et al. (2009)</td>
<td>Separate samples from a homeless shelter, vocational rehabilitation centre, mental health facility &amp; domestic abuse facility (Midwest, USA)</td>
<td>N = 1999 all sites, (Homeless shelter n = 240); 33 males; 35.56 (NR); Mean days homeless NR</td>
<td>HELPS screening Tool</td>
<td>20%</td>
</tr>
<tr>
<td>Bremner et al. (1996)</td>
<td>Hostel in London, England</td>
<td>62; 62 men; age NR; duration of homelessness NR</td>
<td>Detailed semi-structured questionnaire to assess health history</td>
<td>46%</td>
</tr>
<tr>
<td>Gonzalez et al. (2001)</td>
<td>Health Care for the Homeless Clinic in Miami, Florida</td>
<td>60; 36 males; 39.8 (11.4); duration of homelessness NR</td>
<td>Documented instance of concussion or loss of consciousness or the patient's self-report</td>
<td>38.3%</td>
</tr>
</tbody>
</table>
• 53% for any TBI
  – 12% for moderate to severe TBI
The effect of traumatic brain injury on the health of homeless people

Stephen W. Hwang MD MPH, Angela Colantonio PhD OT Reg, Shirley Chiu MA, George Tolomiczenko PhD MPH, Alex Kiss PhD, Laura Cowan BScN, Donald A. Redelmeier MD MSHSR, Wendy Levinson MD

- Increased likelihood of
  - Seizures
  - Mental health problems
  - Drug problems
- Poorer
  - Physical health
  - Mental health status
## Characteristics of 904 Homeless Individuals

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Total no. (%)* of participants n = 904</th>
<th>Traumatic brain injury; no. (%) of participants*</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Present n = 475</td>
<td>Absent n = 429</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age at first episode of homelessness, yr, mean (SD)</td>
<td>28.5 (13.8)</td>
<td>27.5 (13.3)</td>
<td>0.02</td>
</tr>
<tr>
<td>Lifetime years of homelessness, mean (SD)</td>
<td>4.4 (5.9)</td>
<td>4.9 (6.3)</td>
<td>0.006</td>
</tr>
<tr>
<td>Seizures (ever experienced in lifetime)</td>
<td>139 (15)</td>
<td>103 (22)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Mental health problems in the last 30 days</td>
<td>344 (38)</td>
<td>204 (43)</td>
<td>0.001</td>
</tr>
<tr>
<td>Alcohol problems in the last 30 days</td>
<td>322 (36)</td>
<td>201 (42)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Drug problems in the last 30 days</td>
<td>442 (49)</td>
<td>269 (57)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Mental component subscale score‡, mean (SD)</td>
<td>41.3 (13.2)</td>
<td>39.0 (12.7)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Physical component subscale score‡, mean (SD)</td>
<td>45.9 (11.1)</td>
<td>43.9 (11.4)</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Note: SD = standard deviation.
*Unless otherwise indicated.
†Ethnic background was self-identified by participants.
‡Measured using the SF-12 health survey.

Hwang et al 2008
For 70% of respondents – 1st TBI occurred prior to onset of homelessness

Hwang et al 2008
Risk Factors for TBI in a Homeless Population

• Homeless at an increased risk for injury including head injury, secondary to falls (Morbidity and Mortality Weekly Report, 1991)

• Increased risk of being the victim of violent assaults (Geissler, et al., 1995)

• Elevated rates of substance abuse (Koegel et al., 1988)
  – 58% - 68% -- 6 to 7 times the general population (Fischer and Breakey, 1991)
Homelessness and Risk Factors For Acquiring TBI

- Increased risk for injury & trauma
- Elevated substance abuse

TBI and Risk Factors for Becoming Homeless

- Decreased Income
- Decreased Social Support

Brain Injury

Homelessness
Do Veterans seeking mental health services really have a history of TBI?
### TBI in a MH Setting TBI – 4 (n=1,810)

<table>
<thead>
<tr>
<th>Question</th>
<th># Yes</th>
<th>% Yes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1. Veteran has been treated in an emergency room following an injury</td>
<td>741</td>
<td>41%</td>
</tr>
<tr>
<td>Q2. Veteran has been knocked out or unconscious following an accident or injury</td>
<td>813</td>
<td>45%</td>
</tr>
<tr>
<td>Q3. Veteran has injured head or neck in a car accident or from some other moving vehicle accident</td>
<td>632</td>
<td>35%</td>
</tr>
<tr>
<td>Q4. Veteran has injured head or neck in a fight or fall</td>
<td>728</td>
<td>40%</td>
</tr>
</tbody>
</table>

**Any Question (n=1,810, 63%)**
Why else might I need to know that the Veteran I am working with has a history of TBI?
Individuals who received care between FY 01 and 06

Analyses included all patients with a history of TBI (n = 49,626) plus a 5% random sample of patients without TBI (n = 389,053)

Suicide - National Death Index (NDI) compiles death record data for all US residents from state vital statistics offices

TBI diagnoses of interest were similar to those used by Teasdale and Engberg
Suicide by TBI Severity – VHA Users FY 01-06

• 12,159 with concussion or cranial fracture, of which 33 died by suicide
• 39,545 with cerebral contusion/traumatic intracranial hemorrhage of which 78 died by suicide
• Of those with a history of TBI, 105 died by suicide

Challenges associated with this type of research and need for collaboration (~8 million records reviewed)
Cox proportional hazards survival models for time to suicide, with time-dependent covariates, were utilized. Covariance sandwich estimators were used to adjust for the clustered nature of the data, with patients nested within VHA facilities.

ICD-9 codes:
1) concussion (850), cranial fracture—fracture of vault of skull (800), fracture of base of skull (801), and other and unqualified skull fractures (803)
2) cerebral laceration and contusion (851); subarachnoid, subdural, and extradural hemorrhage after injury (852); other and unspecified intracranial hemorrhage after injury (853); and intracranial injury of other and unspecified nature (854).
<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>All</th>
<th>All</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Col%</td>
<td>N</td>
</tr>
<tr>
<td>VHA users with any TBI (combined)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>49626</td>
<td>100</td>
<td>105</td>
</tr>
<tr>
<td>Substance abuse</td>
<td>8368</td>
<td>16.86</td>
<td>32</td>
</tr>
<tr>
<td>Bipolar I/II</td>
<td>2265</td>
<td>4.56</td>
<td>10</td>
</tr>
<tr>
<td>MDD</td>
<td>4464</td>
<td>9</td>
<td>24</td>
</tr>
<tr>
<td>Other depression, no MDD</td>
<td>7616</td>
<td>15.35</td>
<td>23</td>
</tr>
<tr>
<td>Other anxiety</td>
<td>4326</td>
<td>8.72</td>
<td>16</td>
</tr>
<tr>
<td>PTSD</td>
<td>4880</td>
<td>9.83</td>
<td>23</td>
</tr>
<tr>
<td>Schizophrenia/schizoaffective disorder</td>
<td>2287</td>
<td>4.61</td>
<td>6</td>
</tr>
<tr>
<td>VHA users with concussion/fracture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>12159</td>
<td>100</td>
<td>33</td>
</tr>
<tr>
<td>Substance abuse</td>
<td>2087</td>
<td>17.16</td>
<td>9</td>
</tr>
<tr>
<td>Bipolar I/II</td>
<td>588</td>
<td>4.84</td>
<td>2</td>
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<tr>
<td>MDD</td>
<td>1198</td>
<td>9.85</td>
<td>10</td>
</tr>
<tr>
<td>Other depression, no MDD</td>
<td>1831</td>
<td>15.06</td>
<td>7</td>
</tr>
<tr>
<td>Other anxiety</td>
<td>1148</td>
<td>9.44</td>
<td>7</td>
</tr>
<tr>
<td>PTSD</td>
<td>1376</td>
<td>11.32</td>
<td>7</td>
</tr>
<tr>
<td>Schizophrenia/schizoaffective disorder</td>
<td>519</td>
<td>4.27</td>
<td>1</td>
</tr>
<tr>
<td>VHA users with cerebral contusion/traumatic intracranial hemorrhage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>39545</td>
<td>100</td>
<td>78</td>
</tr>
<tr>
<td>Substance abuse</td>
<td>6728</td>
<td>17.01</td>
<td>25</td>
</tr>
<tr>
<td>Bipolar I/II</td>
<td>1802</td>
<td>4.56</td>
<td>8</td>
</tr>
<tr>
<td>MDD</td>
<td>3490</td>
<td>8.83</td>
<td>17</td>
</tr>
<tr>
<td>Other depression, no MDD</td>
<td>6142</td>
<td>15.53</td>
<td>17</td>
</tr>
<tr>
<td>Other anxiety</td>
<td>3377</td>
<td>8.54</td>
<td>11</td>
</tr>
<tr>
<td>PTSD</td>
<td>3757</td>
<td>9.5</td>
<td>17</td>
</tr>
<tr>
<td>Schizophrenia/schizoaffective disorder</td>
<td>1869</td>
<td>4.73</td>
<td>5</td>
</tr>
</tbody>
</table>
Veterans are disproportionately represented in the homeless population.

Homeless veterans report histories of mental health complaints.

Veterans seeking mental health services are reporting high rates of TBI and this history appears to be related to negative psychiatric outcomes.

Rosenheck 1994 from Adams et al., 2007
Homelessness among Veterans

– U.S. population in 2009 consisted of nearly 23 million Veterans

– On a single night in January 2009 75,609 Veterans were homeless (~ 33 for every 10,000)

– Between October 1, 2008 and September 30, 2009 136,334 Veterans spent at least one night homeless (~ 60 out of every 10,000)
Homelessness among Veterans

– In 1996, the National Survey of Homeless Assistance providers and Clients estimated that 23% of the homeless population were Veterans
– VA facilities have reported an increase of 24% in homeless Veteran families seeking care
– The percentage of homeless female Veterans is expected to increase dramatically as the female Veteran population has increased in recent years

Balshem, H., Christensen, V., & Tuepker, A. 2011
Psychiatric illness, substance abuse, and chronic medical illness among homeless veterans?

– 2009 Veteran AHAR estimates ~ 53% of homeless Veterans have some kind of disability

– Homeless shelters in Santa Clara County, CA (1989-1990) found that of Veterans admitted 17% were for psychiatric problems, 29% alcohol abuse, & 22% illegal drug use

– Of homeless adults in Pittsburgh & Philadelphia, 61.4% reported psychiatric problems, 79.5% substance abuse, and 66.1% at least one chronic medical condition

Balshem, H., Chrisetensen, V., & Tuepker, A. 2011
Risk and Protective Factors

– Some risk factors consistent across Veteran & non-Veterans are inadequate care by parents, foster care or group placement, prolonged periods of running away from home, low or unstable income, low social support, & history of incarceration

– Differ in terms of protective factors: homeless Veterans tend to be older & better educated, have had better early family cohesion, & more likely to have been married

– Veterans may possess unique experiences associated with post-deployment readjustment

Balshem, H., Chrisetensen, V., & Tuepker, A. 2011
Factors specific to military service?

– Prolonged or intense combat exposure negatively impacts mental health, employment, income & social support, thus indirectly increasing the risk of homelessness among Veterans.

– The frequency and disruptive nature of readjustment/post-deployment periods increase risk factors such as alcohol use, substance use and/or low social support and the likelihood of negative outcomes for both substance use and social support.

– In a small study, MST has been associated with increased risk among female Veterans.

Balshem, H., Chrsetensen, V., & Tuepker, A. 2011
TBI Among Homeless Veterans  
Three Sites

• Denver VAMC (data collection)  
  – Lisa Brenner, Ph.D. (PI)  
  – Kim Arne, MSW  
  – Maria Devore, MS  
  – Leah Russell, MA

• Philadelphia VAMC (IRB Approval)  
  – Vince Kane, LCSW  
  – Ann Elizabeth Montgomery, Ph.D.

• Tampa VAMC (IRB Approval)  
  – Roger Casey, Ph.D. (PI)  
  – John Schinka, Ph.D.
Study Methods

- All Veterans seeking VA homeless services
- Ages 18 to 89
- Participation includes completing several measures administered by Research Team Member
- 1 to 2 visits – $20 compensation
TBI-4 Questions

1) Have you ever been hospitalized or treated in an emergency room following a head or neck injury?

2) Have you ever been knocked out or unconscious following an accident or injury?

3) Have you ever injured your head or neck in a car accident or from some other moving vehicle accident?

4) Have you ever injured your head or neck in a fight or a fall?
Measures - Data

• MINI International Neuropsychiatric Interview
• Ohio State University TBI Identification Method
• Demographic Questionnaire
• VA Medical Records
Risk Factors for Veteran Homelessness: Conceptual Model

Veteran-unique exposures associate with several general homelessness risk exposures; understanding these pathways may be critically important to intervention.

Shared early life exposures:
- Psychiatric illness
- Abuse
- Family dysfunction
- Foster/institutional care

Shared exposures
- Readjustment Difficulties
- Physical/Cognitive Disability
- PTSD/ Depression/Anxiety
- Alcohol/Drug Abuse

Shared immediate exposures:
- Low social support
- Low/unstable income
- Incarceration

HOMELESSNESS

Time →
Pre-Service
Military Service
Post-Deployment
Long Term Post-Service

(solid arrow) = strong association shown by two or more studies reviewed
(dashed arrow) = weak association only shown by one study reviewed, or evidence is mixed

Balshem, H., Chrisetensen, V., & Tuepker, A. 2011
Next Steps - Homelessness + TBI

• Complete data collection – 3 sites
• Explore outcomes
  – Increased likelihood of
    • Seizures
    • Mental health problems
    • Drug problems
  – Poorer
    • Physical health
    • Mental health status

Hwang et al 2008
Use Your Smartphone to Visit the VISN 19 MIRECC Website

Requirements:
1. Smartphone with a camera
2. QR scanning software (available for free download just look at your phone’s marketplace)

www.mirecc.va.gov/visn19