UNITED STATES
DEPARTMENT OF VETERANS AFFAIRS

Traumatic Brain Injury and Post Traumatic Stress Disorder: Current State of the Science, Diagnostic Challenges, and Best Clinical Practices

Lisa A. Brenner, PhD, ABPP (Rp)
VISN 19 Mental Illness Research Education and Clinical Center
Departments of Psychiatry, Neurology,
& Physical Medicine and Rehabilitation
University of Colorado, Denver,
School of Medicine

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VISN 19 ROCKY MOUNTAIN NETWORK

Fort Carson 2011 - Oct

PTSD – A Review

DSM-IV Criteria – PTSD Traumatic Event

The person has been exposed to a traumatic event in which both of the following have been present:

- (1) the person experienced, witnessed, or was confronted with an event or events that involved actual or threatened death or serious injury, or a threat to the physical integrity of self or others (2) the person's response involved intense fear, helplessness, or horror.

APA 2000

DSM-IV Criteria - PTSD

B. Re-experiencing symptoms

(nightmares, intrusive thoughts)

C. Avoidance of trauma cues and Numbing/detachment from others

D. Hyperarousal (increased startle, hypervigilance)

Duration of the disturbance (symptoms in Criteria B, C, and D) is more than one month.

The disturbance causes clinically significant distress or impairment in social, occupational, or other important areas of functioning.

APA 2000

PTSD and OEF/OIF Seminal Study

- Exposure to combat greater among those deployed to Iraq
- The percentage of study subjects who met screening criteria for major depression, generalized anxiety disorder, or PTSD
  - Iraq 15.6%-17.1%
  - Afghanistan 11.2%

Hoge et al. 2004

Rates of PTSD Vary

- Military
  - From 4%-5% to 30%-31%
- Civilian
  - National Co-Morbidity Sample – 21% of women and 8% of men
  - Interpersonal vs. Impersonal
    - 55% of rape victims develop PTSD and only 7.5% of accident victims develop PTSD

Why?

- More severe trauma results in more severe PTSD
- Contextual factors (e.g., combat environment)
- Time
- Nature of symptom presentation or acknowledgement

Bryant 2011, Milliken,Auchterlonie, and Hoge, 2007, Martin, 2007; Lapierre, Schwegler, and LaBauve, 2007)

How it PTSD Diagnosed?

Screening vs. Assessment

Objective Marker vs. Self-Report

PTSD
What Can We Expect?

- If we apply the range of prevalence estimates for PTSD (5 to 15 percent) and depression (2 to 10 percent) to the 1.64 million service members who have already been deployed, we can estimate that the number of service members returning home with PTSD will range from 75,000 to 225,000 and with depression, from 30,000 to 50,000.

Potential Consequences of PTSD

Social and Interpersonal Problems:

- Relationship issues
- Low self-esteem
- Alcohol and substance abuse
- Employment problems
- Homelessness
- Trouble with the law
- Isolation

Mild TBI – A Review

TBI – Definition

- 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.

CDC 2005

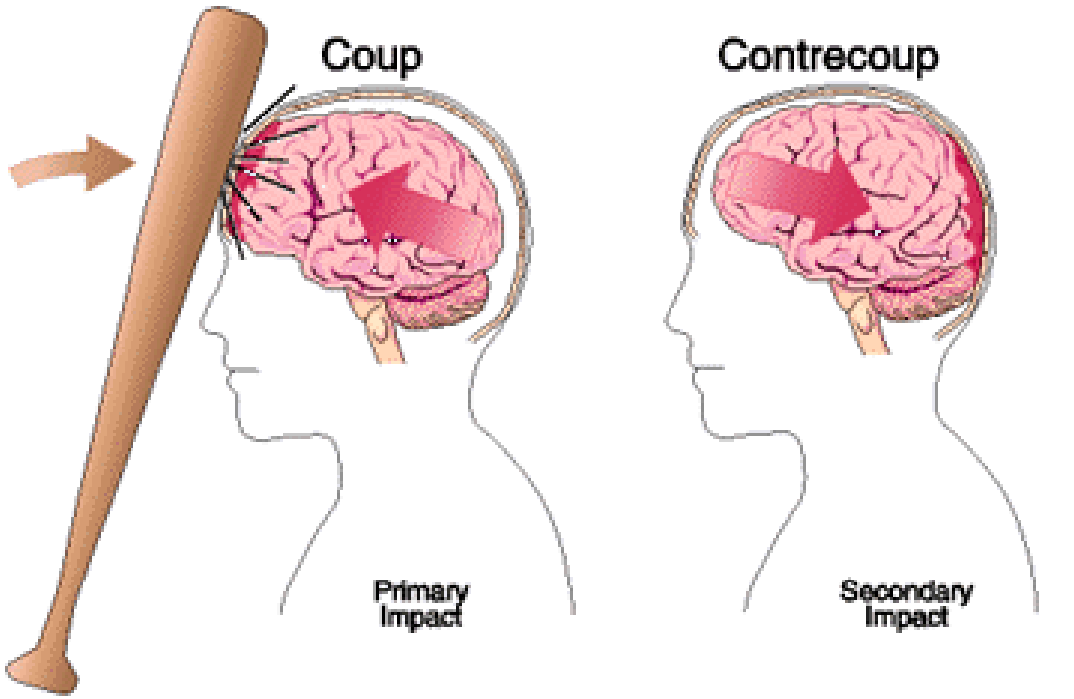
Mild TBI Definition – American Congress of Rehabilitation Medicine

"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."

McCallister 2005

TBI – Mechanism of Injury

Mechanism of Injury – Acceleration/Deceleration



John Kirk, Ph.D.

Thanks John Kirk, Ph.D.

Blast Injury

- Blast injuries are injuries that result from the complex pressure wave generated by an explosion.
  - The explosion causes an instantaneous rise in pressure over atmospheric pressure that creates a blast overpressurization wave

- Air-filled organs such as the ear, lung, and gastrointenstinal tract and organs surrounded by fluid-filled cavities such as the brain and spinal are especially susceptible to primary blast injury

Blast Injury

- Primary – Barotrauma
- Secondary – Objects being put into motion
- Tertiary – Individuals being put into motion

TBI –Severity of Injury

Injury Severity

Mild	**Moderate**	**Severe**
Altered or LOC<30 minutes with normal CT and/or MRI	LOC<6 hours with abnormal CT and/or MRI	LOC>6 hours with abnormal CT and/or MRI
GCS 13-15	GCS 9-12	GCS<9
PTA<24 hours	PTA<7 days	PTA>7days

Common Mild TBI Symptoms

NOT to be confused with the injury itself

TBI is a historical event

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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

Belanger et al., 2005

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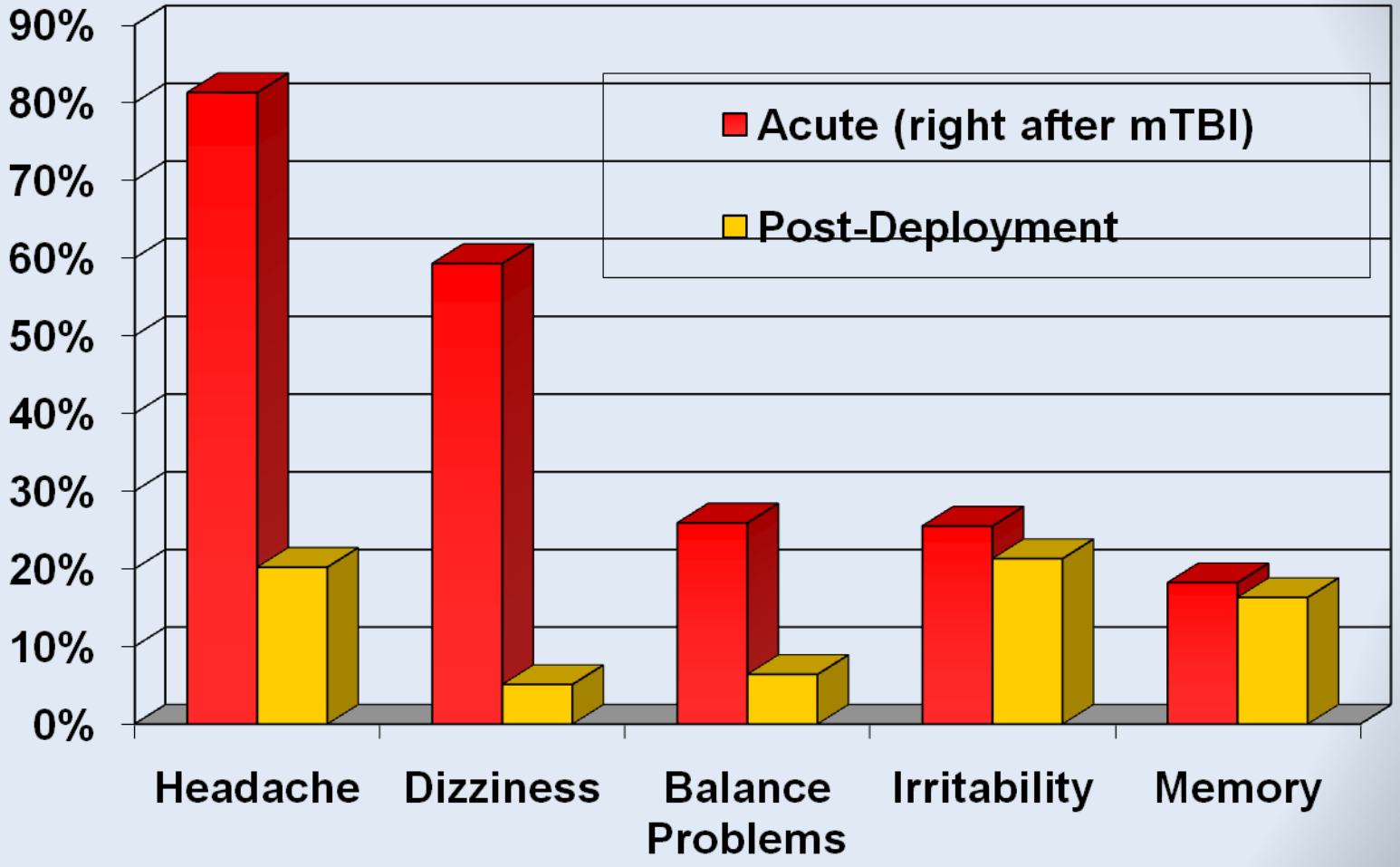
Screening Results: n=3,973

Injury Status	N (%)
Injured with TBI	907 (22.8)
Injured without TBI	385 (9.7)
Not injured	2,681 (67.5)
Total Screened	**3,973 (100)**
Injury Characteristics for Soldiers with TBI‡	
Dazed or confused only	572 (63.1)
Had LOC* or could not remember the injury	335 (36.9)
Total with TBI	**907 (100)**

‡ TBI is defined by an alteration in consciousness, such as being dazed or confused, not remembering the injury event, and/or losing consciousness in the context of an injury
* LOC=loss of consciousness

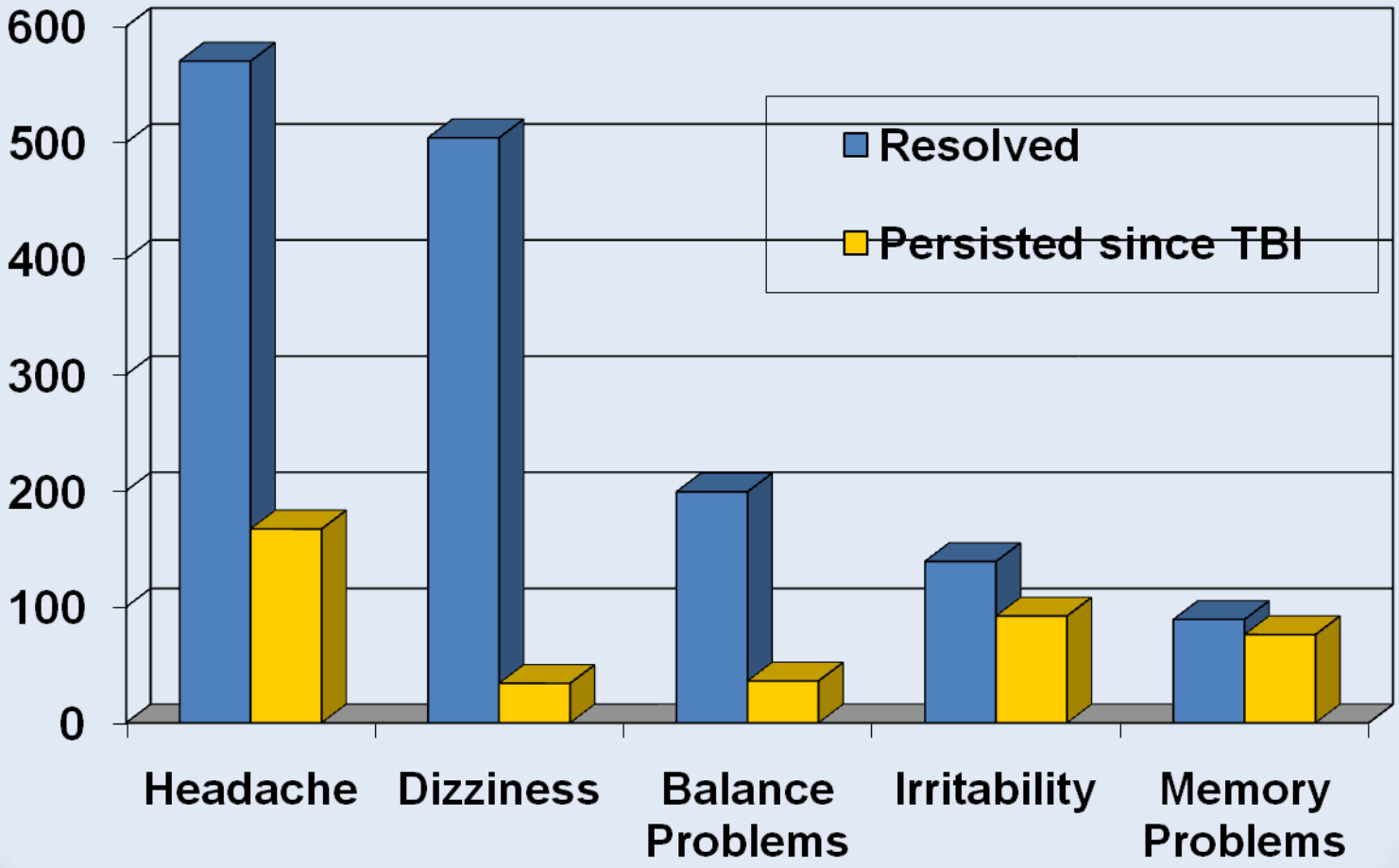
Terrio et al., 2009

Ft. Carson: Post-Deployment Data (n = 907)



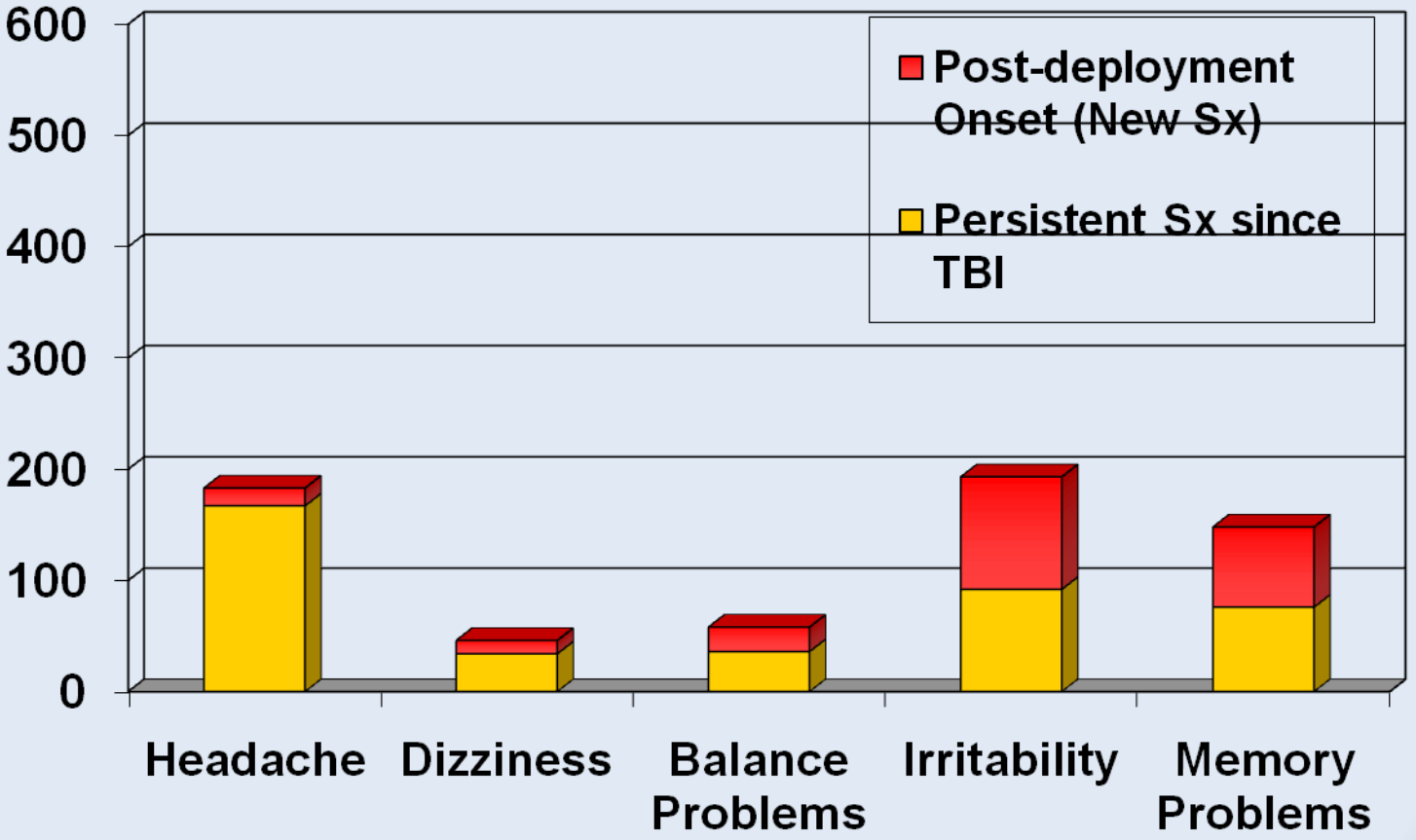
Terrio H, Brenner LA, Ivins B, Cho JM, Helmick K, Schwab K, et al. Traumatic brain injury screening: Preliminary findings regarding prevalence and sequelae in a US Army Brigade Combat Team. Journal of Head Trauma Rehabilitation. 2009; 24(1):14-23.

Symptoms Beginning at TBI Event: Course of Symptoms (n = 844)



Terrio H, **Brenner LA,** Ivins B, Cho JM, Helmick K, Schwab K, et al. Traumatic brain injury screening: Preliminary findings regarding prevalence and sequelae in a US Army Brigade Combat Team. Journal of Head Trauma Rehabilitation. 2009; 24(1):14-23.

Currently Symptomatic: Onset of Symptoms (n = 844)



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Potential Consequences of mTBI

Social and Interpersonal Problems:

- Relationship issues
- Low self-esteem
- Alcohol and substance abuse
- Employment problems
- Homelessness
- Trouble with the law
- Isolation

TBI
What Can We Expect?

- 320,000 veterans may have experienced a probable TBI during deployment

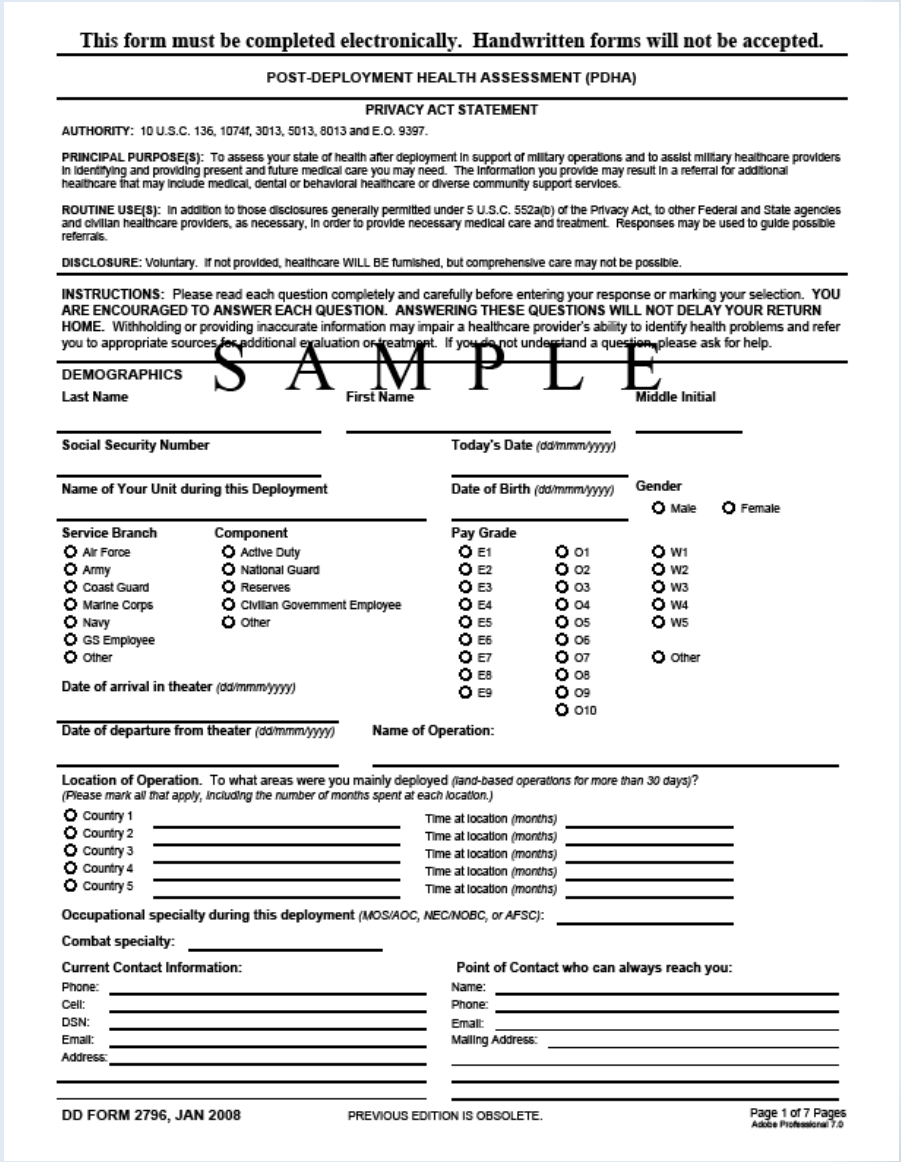
Rand Report 2008

How it mTBI Diagnosed?

Screening vs. Assessment

Objective Marker vs. Self-Report

Screening – PTSD and TBI – PDHA, DD FORM 2796, JAN 2008



This form must be completed electronically. Handwritten forms will not be accepted.

POST-DEPLOYMENT HEALTH ASSESSMENT (PDHA)

PRIVACY ACT STATEMENT

AUTHORITY: 10 U.S.C. 136, 1074f, 3013, 5013, 8013 and E.O. 9397.

PRINCIPAL PURPOSE(S): To assess your state of health after deployment in support of military operations and to assist military healthcare providers in identifying and providing present and future medical care you may need. The information you provide may result in a referral for additional healthcare that may include medical, dental or behavioral healthcare or diverse community support services.

ROUTINE USE(S): In addition to those disclosures generally permitted under 5 U.S.C. 552a(b) of the Privacy Act, to other Federal and State agencies and civilian healthcare providers, as necessary, in order to provide necessary medical care and treatment. Responses may be used to guide possible referrals.

DISCLOSURE: Voluntary. If not provided, healthcare WILL BE furnished, but comprehensive care may not be possible.

INSTRUCTIONS: Please read each question completely and carefully before entering your response or marking your selection. **YOU ARE ENCOURAGED TO ANSWER EACH QUESTION. ANSWERING THESE QUESTIONS WILL NOT DELAY YOUR RETURN HOME.** Withholding or providing inaccurate information may impair a healthcare provider's ability to identify health problems and refer you to appropriate sources for additional evaluation or treatment. If you do not understand a question, please ask for help.

SAMPLE

DEMOGRAPHICS

Last Name | **First Name** | **Middle Initial**

Social Security Number | **Today's Date** *(dd/mmm/yyyy)*

Name of Your Unit during this Deployment | **Date of Birth** *(dd/mmm/yyyy)* | **Gender** ○ Male ○ Female

Service Branch
- ○ Air Force
- ○ Army
- ○ Coast Guard
- ○ Marine Corps
- ○ Navy
- ○ GS Employee
- ○ Other

Component
- ○ Active Duty
- ○ National Guard
- ○ Reserves
- ○ Civilian Government Employee
- ○ Other

Pay Grade
- ○ E1 ○ E2 ○ E3 ○ E4 ○ E5 ○ E6 ○ E7 ○ E8 ○ E9
- ○ O1 ○ O2 ○ O3 ○ O4 ○ O5 ○ O6 ○ O7 ○ O8 ○ O9 ○ O10
- ○ W1 ○ W2 ○ W3 ○ W4 ○ W5
- ○ Other

Date of arrival in theater *(dd/mmm/yyyy)*

Date of departure from theater *(dd/mmm/yyyy)* | **Name of Operation:**

Location of Operation. To what areas were you mainly deployed *(land-based operations for more than 30 days)*? *(Please mark all that apply, including the number of months spent at each location.)*

- ○ Country 1 — Time at location *(months)*
- ○ Country 2 — Time at location *(months)*
- ○ Country 3 — Time at location *(months)*
- ○ Country 4 — Time at location *(months)*
- ○ Country 5 — Time at location *(months)*

Occupational specialty during this deployment *(MOS/AOC, NEC/NOBC, or AFSC)*:

Combat specialty:

Current Contact Information:
Phone:
Cell:
DSN:
Email:
Address:

Point of Contact who can always reach you:
Name:
Phone:
Email:
Mailing Address:

PTSD – Challenges Associated With Screening

PTSD - Screen

13. Have you ever had any experience that was so frightening, horrible, or upsetting that, IN THE PAST MONTH, you ....

a. Have had nightmares about it or thought about it when you did not want to?

b. Tried hard not to think about it or went out of your way to avoid situations that remind you of it?

c. Were constantly on guard, watchful, or easily startled?

d. Felt numb or detached from others, activities, or your surroundings?

PTSD Checklist – Civilian Version (PCL-C)

Patient's Name: _____

Instruction to patient: Below is a list of problems and complaints that veterans sometimes have in response to stressful life experiences. Please read each one carefully, put an "X" in the box to indicate how much you have been bothered by that problem *in the last month*.

No.	Response:	Not at all (1)	A little bit (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
1.	Repeated, disturbing *memories*, *thoughts*, or *images* of a stressful experience from the past?					
2.	Repeated, disturbing *dreams* of a stressful experience from the past?					
3.	Suddenly *acting* or *feeling* as if a stressful experience *were happening again* (as if you were reliving it)?					
4.	Feeling *very upset* when *something reminded* you of a stressful experience from the past?					
5.	Having *physical reactions* (e.g., heart pounding, trouble breathing, or sweating) when *something reminded* you of a stressful experience from the past?					
6.	Avoid *thinking about* or *talking about* a stressful experience from the past or avoid *having feelings* related to it?					
7.	Avoid *activities* or *situations* because *they remind you* of a stressful experience from the past?					
8.	Trouble *remembering important parts* of a stressful experience from the past?					
9.	Loss of *interest in things that you used to enjoy?*					
10.	Feeling *distant* or *cut off* from other people?					
11.	Feeling *emotionally numb* or being unable to have loving feelings for those close to you?					
12.	Feeling as if your *future* will somehow be *cut short*?					
13.	Trouble *falling* or *staying asleep*?					
14.	Feeling *irritable* or having *angry outbursts*?					
15.	Having *difficulty concentrating*?					

Posttraumatic Stress Disorder Checklist (PCL)

The PCL is a 17-item self-report measure of the 17 DSM-IV symptoms of PTSD. Respondents rate how much they were "bothered by that problem in the past month". Items are rated on a 5-point scale ranging from 1 ("not at all") to 5 ("extremely").

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Clinical Psychology Review

The diagnostic accuracy of the PTSD Checklist: A critical review☆

Scott D. McDonald [a,b,c,d,*], Patrick S. Calhoun [e,f,g]

[a] Defense and Veterans Brain Injury Center, Richmond VA Medical Center, 1201 Broad Rock Boulevard, Richmond, VA 23249, USA
[b] The Henry M. Jackson Foundation for the Advancement of Military Medicine, USA
[c] Hunter Holmes McGuire Richmond VA Medical Center, USA
[d] Department of Physical Medicine and Rehabilitation, Virginia Commonwealth University, USA
[e] Durham VA Medical Center, Durham VA Medical Center, 508 Fulton Street, Durham, NC 27705, USA
[f] VA Mid-Atlantic Region Mental Illness Research, Education and Clinical Center (MIRECC), USA
[g] Department of Psychiatry and Behavioral Sciences, Duke University Medical Center, USA

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ABSTRACT

The PTSD Checklist (PCL) is the most frequently used self-report measure of PTSD symptoms. Although the PCL has been in use for nearly 20 years and over a dozen validation studies have been conducted, this paper provides the first comprehensive review of its diagnostic utility. Eighteen diagnostic accuracy studies of the PCL are presented, followed by an examination of the potential roles of spectrum effects, bias, and prevalence in understanding the variation in sensitivity, specificity, and other operating characteristics across these studies. Two related issues as to the interchangeability of the PCL's three versions (civilian, military, and specific) and various scoring methods are also discussed. Findings indicate that the PCL has several strengths as a PTSD screening test and suggest that it can be a useful tool when followed by a second-tier diagnostic test such as a standardized interview. However, the PCL's operating characteristics demonstrate significant variation across populations, settings, and research methods and few studies have examined such factors that may moderate the PCL's utility. Recommendations and cautions regarding the use of the PCL as a clinical screening test, a diagnostic tool in research, and as an estimator of PTSD population prevalence are provided.
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Contents

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* Corresponding author. Defense and Veterans Brain Injury Center, Research Service (151), Richmond VA Medical Center, 1201 Broad Rock Boulevard, Richmond, VA 23249, USA. Tel.: +1 804 675 5000x3633; fax: +1 804 675 6627.
E-mail addresses: Scott.McDonald@va.gov (S.D. McDonald), Patrick.Calhoun2@va.gov (P.S. Calhoun).

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Table 3
Studies of the PTSD Checklist's diagnostic accuracy: Recruitment, participant characteristics, and setting.

Study	N	Gender (% Female)	Population	Diagnostic reference standard	Observed PTSD prevalence	Recruiting	Administration date of reference standard	Setting for PCL administration
PCL-Civilian								
Bollinger, Cuevas, Vielhauer, Morgan, and Keane (2008)	57	30%	HIV-seropositive patients	CAPS	12%	Participants in a research study on HIV/AIDS treatment who also met criteria for past year substance abuse/dependence and another Axis I disorder, Antisocial Personality Disorder, or Borderline Personality Disorder	Not reported	Not reported
Dobie et al. (2002)	282	100%	VA primary care patients	CAPS	36%	Mailings to eligible veterans	Same day	Research session
Grubaugh, Elhai, Cusack, Wells, and Frueh (2007)	44	66%	Patients with psychotic disorders	CAPS	59%	Patients screened for a CBT treatment trial for co-morbid PTSD and serious mental illness	Not reported	Research session (oral administration)
Harrington and Newman (2007)	44	100%	Residents of a women's substance use disorder treatment facility	CAPS	39%	Approached by on-site clinicians	Same day is inferred	Research session
Hudson, Beckford, Jackson, and Philpot (2008)	100	58%	Inpatient or day-patients aged 65 years or older receiving inpatient or day treatment for medical and/or psychiatric conditions	CAPS	10%	Approached in a clinical setting (e.g., while hospitalized)	CAPS administered no more than 2 weeks after PCL	Research session
Keen et al. (2008)	114	0%	Community-dwelling veterans	CAPS	22%	Participants in a research study on trauma and community advertisements	Within 1 week after PCL	Research session
Lang and Stein (2005)	154	52%	VA and academic medical center primary care	CIDI	16%	Approached patients in primary care clinics	Not reported	Mail
Lang, Laffaye, Satz, Dresselhaus, and Stein (2003)	49	100%	VA primary care patients	CIDI	31%	Mailings to all female VA primary care patients	Within 1 month after PCL	Telephone
Manne et al. (1998)	65	100%	Mothers of pediatric cancer survivors	SCID	6%	Mailing to participants of another study	Not reported	Mail
Prins et al. (2003, 2004)	167	66%	VA primary care patients	CAPS	26%	Approached veterans in a VA primary care clinic	Same day	Research session
Walker et al. (2002)	261	100%	HMO patients	CAPS	11%	Mailings to patients of an HMO	Invited for CAPS within 2 months of receiving PCL	Mail
Widows, Jacobsen, and Fields (2000)	102	77%	Bone marrow transplant recipients	SCID	5%	Bone marrow patient registry	One week	Mail
PCL-Military								
Weathers et al. (1993)	123	0%	Vietnam veterans	SCID (DSM-III-R)	54%	Clinical contact and advertisements	Not reported	Research session
Yeager, Magruder, Knapp, Nicholas, and Frueh (2007)	840	21%	VA primary care patients	CAPS	11%	Mailings and clinic follow-up	Within 2 months after PCL	During primary care visit. Setting not reported
PCL-Specific								
Andrykowski et al. (1998)	82	100%	Women with breast cancer	SCID	6%	Mailings to participants of another study	Same day	Telephone
Blanchard et al. (1996)	40	92%	Various research volunteers	CAPS	45%	Community advertisements and clinician referral	Not reported	Mail
Bliese et al. (2008)	724	3%	U.S. Army soldiers postdeployment	MINI (modified)	6%	Asked permission to use military mental health screening data for research purposes	Same day	Administered to Army units in an aircraft hanger
McDevitt-Murphy et al. (2005)	50	100%	Community-dwelling women	CAPS	25%	Community advertisements	Generally within 2 weeks after PCL	Research session

Notes. CAPS = Clinician-Administered PTSD Scale. CIDI = Composite International Diagnostic Interview. SCID = Structured Clinical Interview for DSM Disorders. MINI = Mini-International Neuropsychiatric Interview.

Table 4
Comparison across studies of the PTSD Checklist at a cut point of 50 and PTSD prevalence set at .50.

Study	Population	Sensitivity	Specificity	PPP	NPP	Efficiency	Kappa	Estimated prevalence
PCL-C								
Bollinger et al. (2008)	HIV-seropositive patients	.86 (.74–.93)	.79 (.67–.88)	.80 (.68–.89)	.85 (.73–.92)	.83 (.70–.90)	.58 (.45–.70)	.54 (.41–.66)
Dobie et al. (2002)	VA primary care patients	.58 (.52–.64)	.92 (.88–.95)	.88 (.84–.91)	.69 (.63–.74)	.75 (.70–.80)	.53 (.47–.59)	.33 (.28–.39)
Grubaugh et al. (2007)	Patients with psychotic disorders	.69 (.54–.81)	.67 (.52–.79)	.68 (.53–.80)	.68 (.54–.80)	.68 (.53–.80)	.36 (.23–.51)	.51 (.37–.65)
Hudson et al. (2008)	Inpatient or day-patients aged 65 years or older receiving inpatient or day treatment for medical and/or psychiatric conditions	.40 (.31–.50)	.97 (.91–.99)	.93 (.86–.97)	.62 (.52–.71)	.69 (.59–.77)	.40 (.31–.50)	.22 (.15–.31)
Keen et al. (2008)	Community-dwelling veterans	.56 (.47–.65)	.72 (.63–.79)	.67 (.58–.75)	.62 (.53–.70)	.64 (.55–.72)	.27 (.20–.36)	.42 (.33–.51)
Prins and Ouimette (2004)	VA and academic medical center primary care	.54 (.46–.62)	.94 (.89–.97)	.90 (.84–.94)	.67 (.59–.74)	.74 (.67–.80)	.50 (.42–.58)	.30 (.23–.38)
Lang et al. (2003)	VA primary care patients	.39 (.27–.53)	.94 (.83–.99)	.87 (.74–.94)	.61 (.47–.73)	.67 (.52–.78)	.38 (.25–.52)	.23 (.13–.36)
Manne et al. (1998)	Mothers of pediatric cancer survivors	.75 (.63–.84)	.89 (.79–.95)	.87 (.77–.94)	.78 (.66–.87)	.82 (.71–.90)	.55 (.43–.67)	.43 (.32–.55)
Walker et al. (2002)	HMO patients	.21 (.16–.26)	.98 (.95–.99)	.91 (.87–.94)	.55 (.49–.61)	.60 (.53–.65)	.22 (.18–.28)	.12 (.08–.16)
Widows et al. (2000)	Bone marrow transplant recipients	.20 (.13–.29)	.95 (.89–.98)	.80 (.71–.87)	.54 (.45–.64)	.58 (.48–.67)	.15 (.09–.23)	.13 (.07–.20)
PCL-M								
Weathers et al. (1993)	Vietnam veterans	.82 (.74–.88)	.83 (.75–.89)	.83 (.75–.89)	.82 (.74–.88)	.83 (.75–.88)	.65 (.56–.73)	.50 (.41–.58)
Yeager et al. (2007)	VA primary care patients	.53 (.50–.56)	.95 (.93–.96)	.91 (.89–.93)	.67 (.64–.70)	.74 (.71–.77)	.49 (.45–.52)	.29 (.26–.32)
PCL-S								
Andrykowski et al. (1998)	Women with breast cancer	.60 (.49–.70)	.99 (.93–1.01)	.98 (.92–1.00)	.71 (.61–.80)	.80 (.69–.87)	.65 (.54–.74)	.31 (.22–.41)
Blanchard et al. (1996)	Various research volunteers	.78 (.63–.88)	.86 (.72–.94)	.85 (.70–.93)	.80 (.65–.89)	.82 (.67–.91)	.64 (.49–.77)	.46 (.32–.61)

Notes. PPP = positive predictive power. NPP = negative predictive power. Kappa is a measure of efficiency adjusted for chance. Values in parentheses are 95% adjusted Wald confidence intervals. Rounding during calculation of PPP, NPP, efficiency and kappa may have resulted in slightly different values from those reported by the authors.

Sensitivity – Proportion of those with the disorder who are correctly identified by the test

Specificity – Proportion of those without the disorder who are correctly identified by the test

Conclusions

- “When a screening tool is used as a clinical screen or to populate groups in research, the population prevalence must be known in order to in order to determine the appropriate cut score”
- As a clinical screening tool
  - Consider existing research
- As a diagnostic tool for group assignment – use to “narrow the field”

McDonald and Calhoun, 2010

mTBI – Challenges Associated With Screening

TBI Screen – Injury Event

9.a. During this deployment, did you experience any of the following events? *(Mark all that apply)*

(1) Blast or explosion *(IED, RPG, land mine, grenade, etc.)*

(2) Vehicular accident/crash *(any vehicle, including aircraft)*

(3) Fragment wound or bullet wound above your shoulders

(4) Fall

(5) Other event *(for example, a sports injury to your head)*. Describe:

TBI Screen – Alteration in Consciousness

9.b. Did any of the following happen to you, or were you told happened to you, IMMEDIATELY after any of the event(s) you just noted in question 9.a.?

(Mark all that apply)

(1) Lost consciousness or got "knocked out"

(2) Felt dazed, confused, or "saw stars"

(3) Didn't remember the event

(4) Had a concussion

(5) Had a head injury

Symptoms - Acute

9.c. Did any of the following problems begin or get worse after the event(s) you noted in question 9.a.? *(Mark all that apply)*

(1) Memory problems or lapses

(2) Balance problems or dizziness

(3) Ringing in the ears

(4) Sensitivity to bright light

(5) Irritability

(6) Headaches

(7) Sleep problems

Symptoms - Persistent

9.d. In the past week, have you had any of the symptoms you indicated in 9.c.? *(Mark all that apply)*

(1) Memory problems or lapses

(2) Balance problems or dizziness

(3) Ringing in the ears

(4) Sensitivity to bright light

(5) Irritability

(6) Headaches

(7) Sleep problems

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CHALLENGES ASSOCIATED WITH POST-DEPLOYMENT SCREENING FOR MILD TRAUMATIC BRAIN INJURY IN MILITARY PERSONNEL

Grant L. Iverson[1], Jean A. Langlois[2], Michael A. McCrea[3,4], and James P. Kelly[5,6]

[1]University of British Columbia & British Columbia Mental Health & Addiction Services, Vancouver, BC, Canada, [2]Office of Research and Development, US Department of Veterans Affairs, Washington, DC, [3]Neuroscience Center, Waukesha Memorial Hospital, Waukesha, Wisconsin, [4]Department of Neurology, Medical College of Wisconsin, Milwaukee, Wisconsin, [5]Departments of Neurosurgery and Physical Medicine and Rehabilitation, University of Colorado Denver School of Medicine, Denver, Colorado, and [6]National Intrepid Center of Excellence, Defense Centers of Excellence for Psychological Health and TBI, US Department of Defense, Washington, DC, USA

There is ongoing debate regarding the epidemiology of mild traumatic brain injury (MTBI) in military personnel. Accurate and timely estimates of the incidence of brain injury and the prevalence of long-term problems associated with brain injuries among active duty service members and veterans are essential for (a) operational planning, and (b) to allocate sufficient resources for rehabilitation and ongoing services and supports. The purpose of this article is to discuss challenges associated with post-deployment screening for MTBI. Multiple screening methods have been used in military, Veterans Affairs, and independent studies, which complicate cross-study comparisons of the resulting epidemiological data. We believe that post-deployment screening is important and necessary—but no screening methodology will be flawless, and false positives and false negatives are inevitable. Additional research is necessary to refine the sequential screening methodology, with the goal of minimizing false negatives during initial post-deployment screening and minimizing false positives during follow-up evaluations.

Keywords: Mild Traumatic Brain Injury; Military; Screening; Epidemiology.

INTRODUCTION

Traumatic brain injuries (TBI) among service members deployed to war zones (Drazen, 2005; Okie, 2005; Tanielian & Jaycox, 2008) are of widespread concern because of their potential to result in long-term disability. At the same time there is ongoing debate regarding the true epidemiology of TBI associated with military

Address correspondence to: Grant Iverson, Ph.D., Department of Psychiatry, University of British Columbia, 2255 Wesbrook Mall, Vancouver, BC, Canada V6T 2A1. E-mail: giverson@interchange.ubc.ca

6 primary concerns about TBI screening measures

6 Concerns

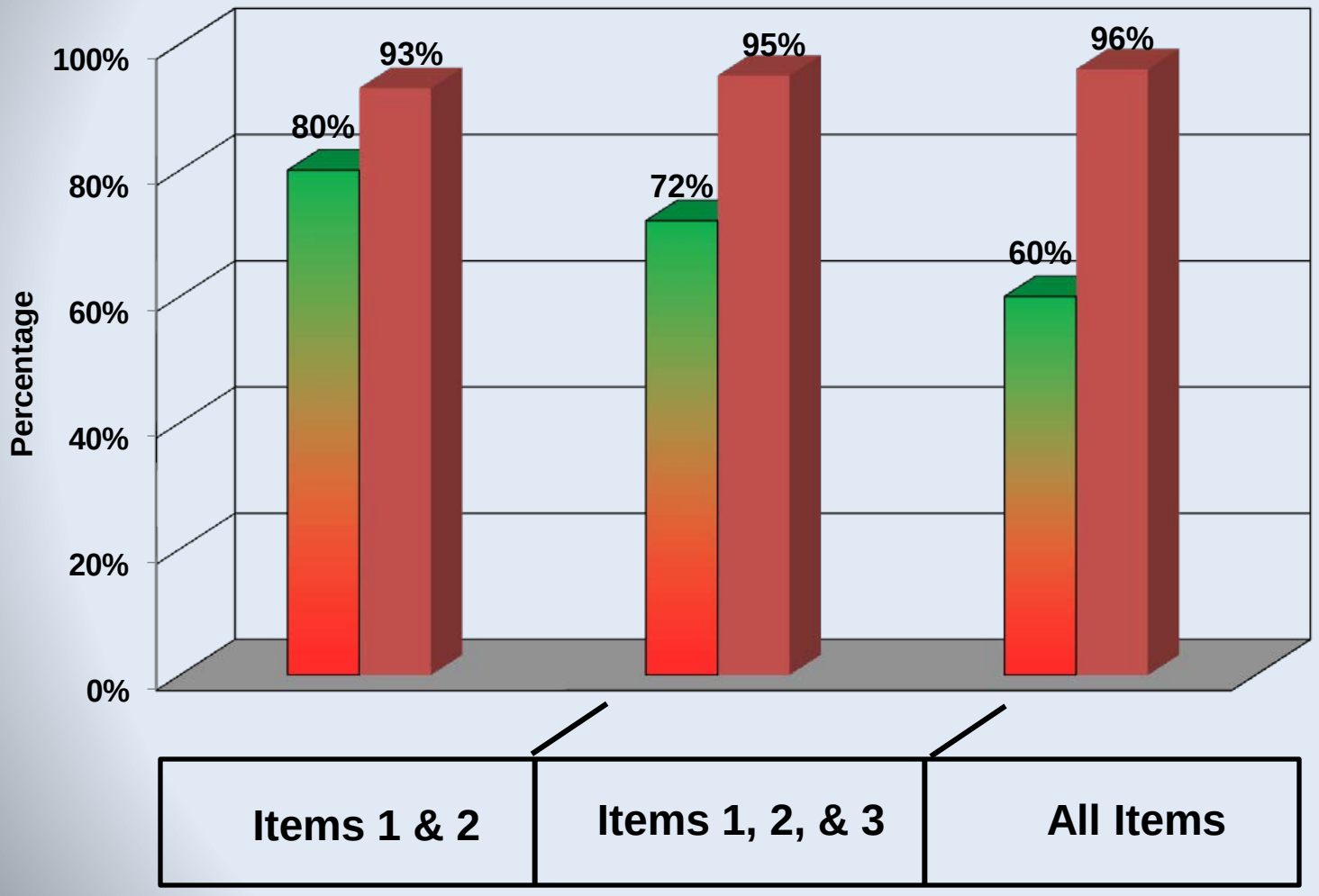
- Not all OEF/OIF service members have been screened (DoD – 2008/VA 2007)
- Post-deployment screening focuses exclusively on most recent deployment
- Most screening measures focus on a single injury

6 Concerns

- Implemented in group setting – desire to get home
- Blast exposure confused as blast injury
- “The screening tools used by the DoD and the VA are likely to lead to misidentification of residual symptoms of mild TBI in some service members…logic and flow of the questions …establish an expectation of causation”

Iverson, Langlois, McCrea, and Kellly, 2009

Diagnostic Performance of the DoD TBI Screen



Sensitivity – Proportion of those with the disorder who are correctly identified by the test

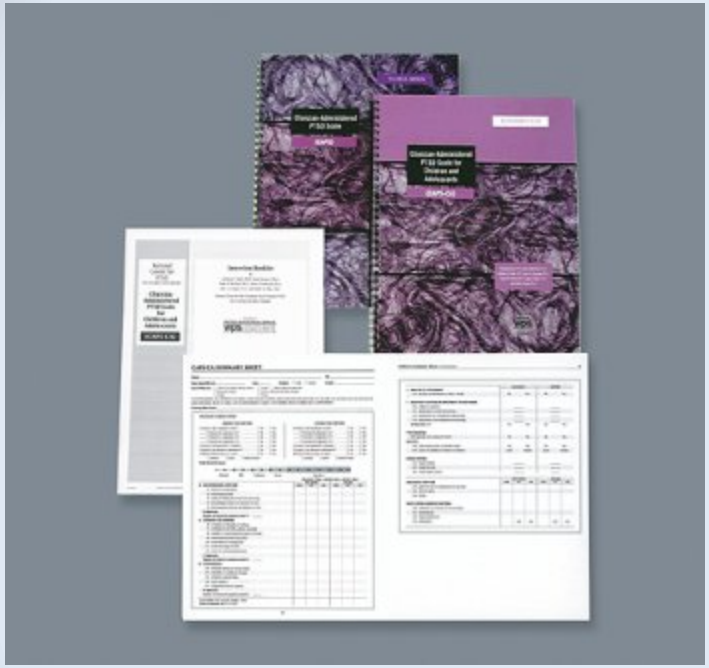
Specificity – Proportion of those without the disorder who are correctly identified by the

Terrio et al, Under Review

How many psychometric studies on self-report measures (PTSD and/or mTB) have been conducted with OEF/OIF Veterans?

What continues to be the “gold standard” for TBI and/or PTSD diagnostic assessment?

OSU TBI-ID



Clinician-Administered PTSD Scale (CAPS)

- Structured interview designed to elicit lifetime history of TBI
- Uses multiple probes to stimulate memory
- Avoids misunderstanding about what a TBI is by first eliciting *injuries*, then determining if altered consciousness occurred as a result
- Provides richer information about history than simple "yes/no" (e.g., number, severity, effects, timing, etc.)

Can a person develop PTSD following a TBI with loss of consciousness?

Vasterling, Verfaille, & Sullivan, 2009

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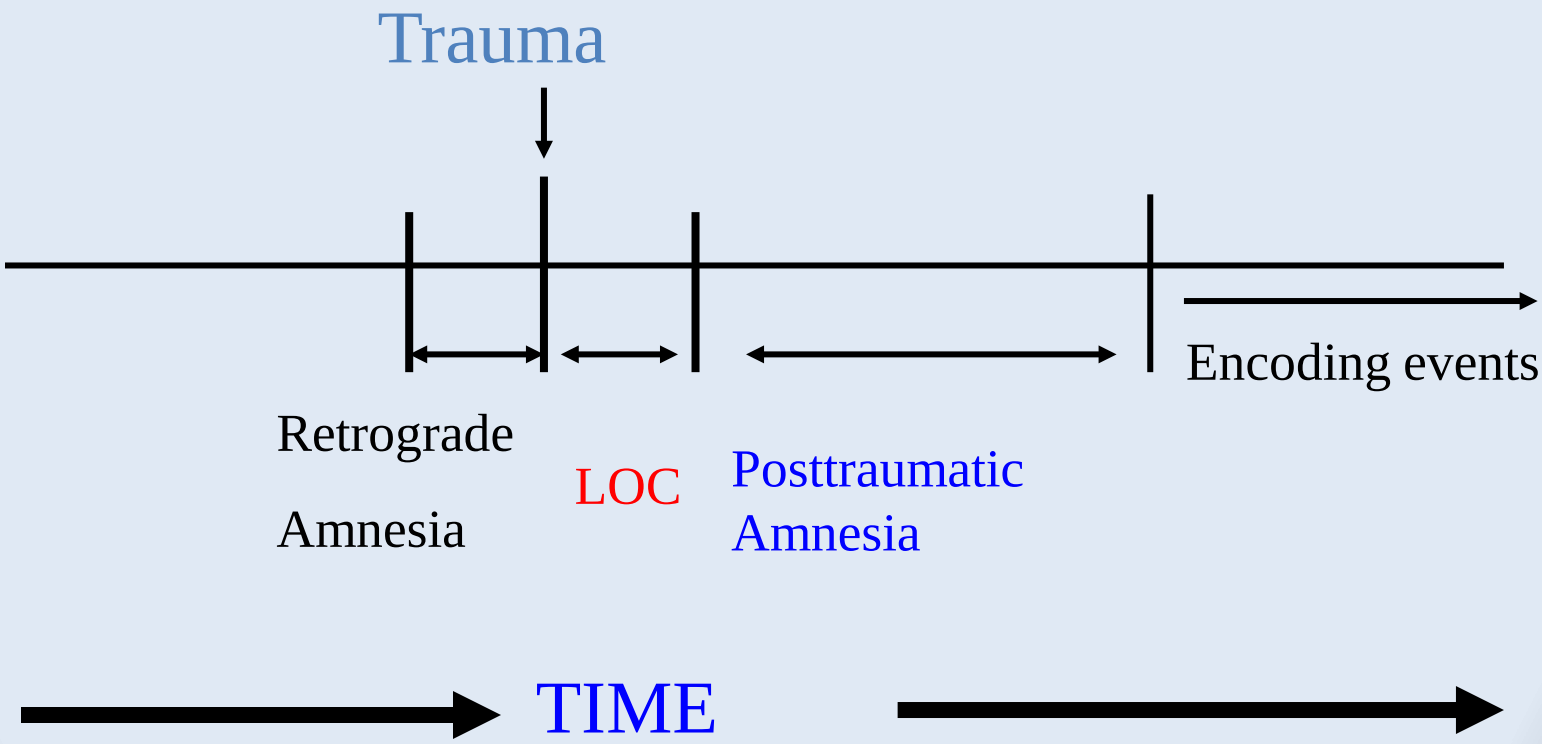
PTSD with Amnesia?

Why the controversy?



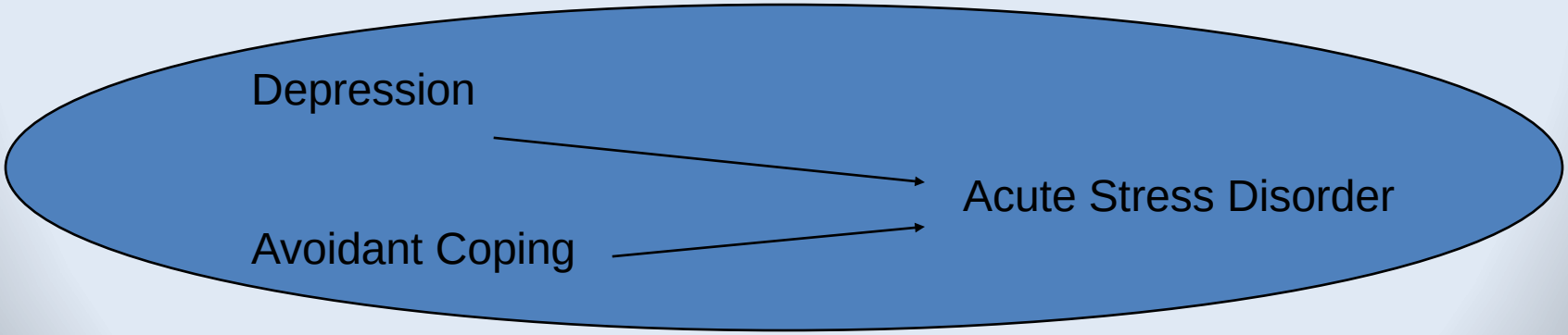
Thanks John Kirk, Ph.D.

TBI and Stress Disorders
Factors that Seem to Matter

- Comorbid Psychological Conditions
- Coping Styles
- Memories for the Traumatic Event
  - Length of Post Traumatic Amnesia
    - Severity of Injury

Predictors of Acute Stress Disorder following Mild TBI

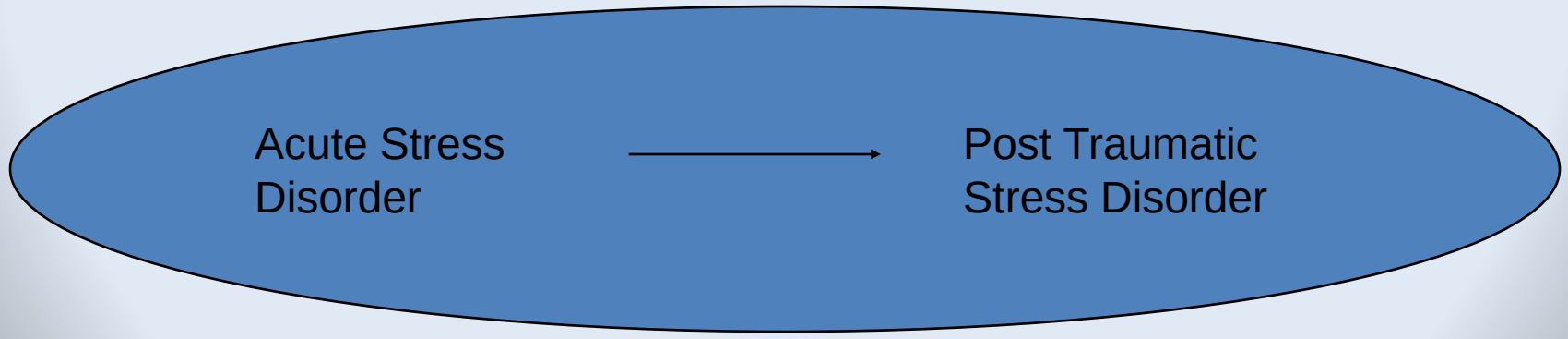
- 48 patients sustained mild TBIs secondary to motor vehicle accidents (MVA)
  - Assessed within 18 days of trauma for Acute Stress Disorder (ASD)
- 14.6% diagnosed with ASD
- 4.2% diagnosed with-sub syndromal ASD
- Higher scores on the Beck Depression Inventory and "avoidant coping" were significant predictors of ASD and acute stress severity.



Harvey and Bryant 1998

Acute Stress Disorder as a Predictor of PTSD

- Survivors of MVA with mild TBI assessed at the following intervals
  - 1 month (n=79) for ASD
  - 6 months (n=63) for PTSD
  - 2 years (n=50) for PTSD
- Of the total initial group, 73% diagnosed with ASD had PTSD at 2 years.



Harvey and Bryant 2000

mTBI and PTSD

- Prospective study of the relationship between TBI and PTSD
  - 120 subjects with mild TBI who were hospitalized for observation
  - Assessed immediately after accident, and at 1 week, 3 months, and 6 months
  - 17 subjects (14%) meet criteria at 6 months
    - Subjects with memory of the event were more likely to develop PTSD than those with no memory – Differences between the groups primarily resulted from the re-experiencing cluster

Analysis revealed that memory of the traumatic event within the first 24 hours was a strong predictor of PTSD at 6 months

Gil et al. 2005

Can individuals with moderate to severe TBI develop PTSD?

- Memory Reconsolidation – those with TBI reconstruct memories
- Post-amnesia resolution – experiencing traumatic events post-amnesia

Bryant 2011

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Period of Unconsciousness

- 46 patients - questionnaires and structured interviews
  - 27% of the sub-sample who were not unconscious for an extended period were diagnosed with PTSD
  - 3% of the sub-sample (1 patient) with a loss of consciousness greater than 12 hours was diagnosed with PTSD

Relationship between period of unconsciousness and meeting criteria for PTSD

Glaesser et al. 2004

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Frequency and Quality of Intrusions Depending on Consciousness

	conscious (N = 10)		unconscious (N = 8)		
	Mean	Rank sum	Mean	Rank sum	U
Frequency of intrusions during the last week	5.95	120	3.25	51	15*
Intrusions of the accident itself	3.3	115.5	2	55.5	19.5*
Visual intrusions	3.3	104.5	2.75	66.5	30.5
Acoustic intrusions	2.7	113.5	1.38	57.5	21.5
Olfactory intrusions	1	95	1	76	40
Bodily sensations during intrusions	2.7	119	1	52	16**
Same feelings as during the event	2.9	123	1	48	12**
Impression that event is happening at this moment	2.3	115	1	56	20*
Internal narrative about the sequence of events	1	67.5	1.63	85.5	22.5*
Intrusions of the space of time before the accident	1.7	97.5	1.5	73.5	37.5
Intrusions of the space of time after the accident	2.4	86.5	2.57	66.5	31.5
Intrusions about reports by others	1.3	79.5	2.38	91.5	24.5
Intrusions based on imaginations	1.4	97.5	1.38	73.5	37.5
Ruminations without an image of the event	1.78	90.5	1.38	62.5	26.5

Only those were included in the analysis. * $p \leq 0.05$; ** $p < 0.01$. Note: "Frequency" is the number of intrusions during the last week. Only patients with intrusions were included in the analyses.

Glaesser et al. 2004

PTSD after Severe TBI

- Patients with severe TBI (n=96) were assessed for PTSD at 6 months

PTSD diagnosed in 27.1% (n=26)

Bryant et al. 2000

Rates of PTSD Symptoms in Patients With and Without PTSD 6 Months After Severe Traumatic Brain Injury

	PTSD					
	Patients With (N=26)		Patients Without (N=70)		Predictive Power	
Symptom	N	%	N	%	Positive[a]	Negative[b]
Intrusive memories	5	19.2	0	0.0	1.00	0.77
Nightmares	6	23.1	0	0.0	1.00	0.78
Sense of reliving trauma	8	30.8	3	4.3	0.73	0.79
Emotional reactivity	25	96.2	4	5.7	0.86	0.98
Physiological reactivity	13	50.0	6	8.6	0.68	0.83
Avoidance of thoughts	17	65.4	15	21.4	0.53	0.86
Avoidance of places	17	65.4	14	20.0	0.55	0.86
Diminished interest	19	73.1	23	32.9	0.45	0.87
Detachment	19	73.1	24	34.3	0.44	0.91
Restricted affect	17	65.4	19	27.1	0.47	0.85
Sense of foreshortened future	19	73.1	23	32.9	0.45	0.87
Insomnia	18	69.2	17	24.3	0.51	0.87
Irritability	22	84.6	22	31.4	0.50	0.92
Concentration deficits	24	92.3	32	45.7	0.43	0.95
Hypervigilance	19	73.1	19	27.1	0.50	0.88
Startle response	19	73.1	11	15.7	0.63	0.89

[a] Probability of PTSD when symptom is present.
[b] Probability of absence of PTSD when symptom is absent.

Bryant et al. 2000

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SYMPOSIUM

Post-traumatic amnesia and the nature of post-traumatic stress disorder after mild traumatic brain injury

RICHARD A. BRYANT,[1] MARK CREAMER,[2] MEAGHAN O'DONNELL,[2] DERRICK SILOVE,[3] C. RICHARD CLARK,[4] AND ALEXANDER C. MCFARLANE[5]

[1]School of Psychology, University of New South Wales, Sydney, New South Wales, Australia
[2]Department of Psychiatry, University of Melbourne, Melbourne, Victoria, Australia
[3]School of Psychiatry, University of New South Wales, Sydney, New South Wales, Australia
[4]Department of Psychology, Flinders University, Adelaide, South Australia, Australia
[5]Department of Psychiatry, University of Adelaide, Adelaide, South Australia, Australia

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Abstract

The prevalence and nature of post-traumatic stress disorder (PTSD) following mild traumatic brain injury (MTBI) is controversial because of the apparent paradox of suffering PTSD with impaired memory for the traumatic event. In this study, 1167 survivors of traumatic injury (MTBI: 459, No TBI: 708) were assessed for PTSD symptoms and post-traumatic amnesia during hospitalization, and were subsequently assessed for PTSD 3 months later (N=920). At the follow-up assessment, 90 (9.4%) patients met criteria for PTSD (MTBI: 50, 11.8%; No-TBI: 40, 7.5%); MTBI patients were more likely to develop PTSD than no-TBI patients, after controlling for injury severity (adjusted odds ratio: 1.86; 95% confidence interval, 1.78–2.94). Longer post-traumatic amnesia was associated with less severe intrusive memories at the acute assessment. These findings indicate that PTSD may be more likely following MTBI, however, longer post-traumatic amnesia appears to be protective against selected re-experiencing symptoms. (*JINS*, 2009, *15*, 862–867.)

Keywords: Trauma, Memory, Stress, Risk, Intrusions, Anxiety

INTRODUCTION

There has been unprecedented attention in recent years to the interplay between mild traumatic brain injury (MTBI) and posttraumatic stress disorder (PTSD) (Bryant, 2001b; Moore, Terryberry-Spohr, & Hope, 2006). Much of the debate has focused on the extent to which PTSD can develop after MTBI. Some commentators have argued that people who sustain a MTBI are unlikely to develop PTSD, because they suffer impaired consciousness secondary to the brain injury, and accordingly, do not encode the necessary mental representations of the traumatic experience to cause fear reactions (Sbordone & Liter, 1995). In contrast, others have argued that PTSD can occur after MTBI, because following MTBI, people can still have islands of memory for the traumatic experience, and some fear conditioning can occur despite impaired consciousness, and much trauma can occur following resolution of posttraumatic amnesia. For example, once cognitive processing has resumed normal functioning, patients can suffer traumatic experiences as a result of extraction from the site of traumatic injury, medical procedures, or extreme pain (Bryant, 2001a).

There is increasing evidence that PTSD can develop after MTBI (Bryant & Harvey, 1998a; Castro & Gaylord, 2008; Greenspan, Stringer, Phillips, Hammond, & Goldstein, 2006; Harvey & Bryant, 2000; Hoge et al., 2008; Levin et al., 2001). Intriguingly, there is increasing evidence that MTBI may be associated with increased risk for PTSD; two recent studies of combat troops returning from Iraq or Afghanistan found that sustaining a MTBI (typically as a result of explosions) was associated with increased rates of PTSD (Hoge et al., 2008; Schneiderman, Braver, & Kang, 2008). Several explanations have been suggested to explain the increased occurrence of PTSD after MTBI. First, prevailing models of PTSD posit that it develops as a result of impaired functioning of the medial prefrontal cortex, which limits regulation of

Correspondence and reprint requests to: Richard A. Bryant, School of Psychology, University of New South Wales, New South Wales 2052, Australia. E-mail: r.bryant@unsw.edu.au

mTBI patients were more likely to develop PTSD than non-mTBI patients

In the acute phase longer PTA was inversely associated with intrusive memories

The association between PTA and re-experiencing symptoms was weaker at follow-up – reconstructive memory?

Can individuals with moderate to severe TBI develop PTSD?

- Fear Conditioning – fear elicited during a traumatic event results in conditioning in which subsequent reminders of the trauma elicit anxiety
  - Extreme sympathetic arousal at time of TBI results in a release of neurochemicals –
    - Mediating an over consolidation of trauma memories

Bryant 2011

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Fear Conditioning

- Patients (n=68) with severe TBI
  - Resting heart rate assessed at one week and one month after injury
  - Assessed for PTSD at 6 months
- 23% of the sample met criteria for PTSD
- Those with PTSD had higher heart rates at 1 week (but not 1 month) after trauma

Researchers propose that “fear conditioning” can occur outside the level of awareness and contribute to the development of PTSD

Bryant et al. 2004

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"Does TBI confer additional risk of PTSD development or symptom exacerbation following psychological trauma exposure?"

If so, why?

Vasterling, Verfaille, & Sullivan, 2009

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Increased Rates of PTSD in those with Mild TBI

Article

The Psychiatric Sequelae of Traumatic Injury

Richard A. Bryant, Ph.D.
Meaghan L. O'Donnell, Ph.D.
Mark Creamer, Ph.D.
Alexander C. McFarlane, M.D.
C. Richard Clark, Ph.D.
Derrick Silove, M.D.

Objective: Traumatic injury affects millions of people each year. There is little understanding of the extent of psychiatric illness that develops after traumatic injury or of the impact of mild traumatic brain injury (TBI) on psychiatric illness. The authors sought to determine the range of new psychiatric disorders occurring after traumatic injury and the influence of mild TBI on psychiatric status.

Method: In this prospective cohort study, patients were drawn from recent admissions to four major trauma hospitals across Australia. A total of 1,084 traumatically injured patients were initially assessed during hospital admission and followed up 3 months (N=932, 86%) and 12 months (N=817, 75%) after injury. Lifetime psychiatric diagnoses were assessed in hospital. The prevalence of psychiatric disorders, levels of quality of life, and mental health service use were assessed at the follow-ups. The main outcome measures were 3- and 12-month prevalence of axis I psychiatric disorders, levels of quality of life, and mental health service use and lifetime axis I psychiatric disorders.

Results: Twelve months after injury, 31% of patients reported a psychiatric disorder, and 22% developed a psychiatric disorder that they had never experienced before. The most common new psychiatric disorders were depression (9%), generalized anxiety disorder (9%), posttraumatic stress disorder (6%), and agoraphobia (6%). Patients were more likely to develop posttraumatic stress disorder (odds ratio=1.92, 95% CI=1.08–3.40), panic disorder (odds ratio=2.01, 95% CI=1.03–4.14), social phobia (odds ratio=2.07, 95% CI=1.03–4.16), and agoraphobia (odds ratio=1.94, 95% CI=1.11–3.39) if they had sustained a mild TBI. Functional impairment, rather than mild TBI, was associated with psychiatric illness.

Conclusions: A significant range of psychiatric disorders occur after traumatic injury. The identification and treatment of a range of psychiatric disorders are important for optimal adaptation after traumatic injury.

(Am J Psychiatry 2010; 167:312–320)

Traumatic injury is a common occurrence, with over 2 million people hospitalized in the United States each year following nonfatal injuries (1). Traumatic injury has been shown to be the leading cause of trauma-related psychiatric disorders and hence represents a major public health issue (2, 3). Most attention has focused on the incidence of posttraumatic stress disorder (PTSD) and depression after traumatic injury. Studies indicate that 10%–20% of traumatic injury survivors develop PTSD (4, 5) and 9%–19% develop major depressive disorder (4, 6). Our understanding of the psychiatric impact of traumatic injury has been limited by several factors, however. The focus on PTSD and depression has resulted in a relative neglect of the broad range of psychiatric disorders that can arise after traumatic injury. Some small studies suggest increased rates of anxiety and substance use disorders after traumatic injury (4, 7, 8), but most studies indicate that psychiatric disorders after trauma are typically comorbid with PTSD (9). There remains an outstanding need to evaluate the full range of psychiatric sequelae to traumatic injury.

Another critical issue in the study of traumatic injury has to do with the potential role of mild traumatic brain injury (TBI), which involves transient diminished consciousness following an insult to the brain. Mild TBI represents a major public health issue; the incidence of hospitalized adult patients with mild TBI ranges from 100 to 300/100,000 per year (10). The role of TBI in posttraumatic psychiatric illness has been controversial. Although there is some evidence of comparable rates of PTSD in mild TBI and non-TBI samples (11), some commentators have suggested that impaired consciousness after TBI limits awareness of the traumatic nature of the injury and thus is protective against subsequent PTSD (12). Consistent with this proposal, there is evidence that poorer memory of the traumatic injury after mild TBI is protective against PTSD (13, 14). Several large-scale studies of psychiatric illness associated with TBI have been reported (15–17). For example, based on a large-scale study of 939 health plan members, Fann and colleagues (15) reported that patients with mild TBI were 2.8 times more likely to develop a psychiatric disorder than patients with no TBI. These studies

This article is featured in this month's AJP Audio and is the subject of a CME course (p. 359).

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Mild Traumatic Brain Injury in U.S. Soldiers Returning from Iraq

Charles W. Hoge, M.D., Dennis McGurk, Ph.D., Jeffrey L. Thomas, Ph.D., Anthony L. Cox, M.S.W., Charles C. Engel, M.D., M.P.H., and Carl A. Castro, Ph.D.

ABSTRACT

BACKGROUND

An important medical concern of the Iraq war is the potential long-term effect of mild traumatic brain injury, or concussion, particularly from blast explosions. However, the epidemiology of combat-related mild traumatic brain injury is poorly understood.

METHODS

We surveyed 2525 U.S. Army infantry soldiers 3 to 4 months after their return from a year-long deployment to Iraq. Validated clinical instruments were used to compare soldiers reporting mild traumatic brain injury, defined as an injury with loss of consciousness or altered mental status (e.g., dazed or confused), with soldiers who reported other injuries.

RESULTS

Of 2525 soldiers, 124 (4.9%) reported injuries with loss of consciousness, 260 (10.3%) reported injuries with altered mental status, and 435 (17.2%) reported other injuries during deployment. Of those reporting loss of consciousness, 43.9% met criteria for post-traumatic stress disorder (PTSD), as compared with 27.3% of those reporting altered mental status, 16.2% with other injuries, and 9.3% with no injury. Soldiers with mild traumatic brain injury, primarily those who had loss of consciousness, were significantly more likely to report poor general health, missed workdays, medical visits, and a high number of somatic and postconcussive symptoms than were soldiers with other injuries. However, after adjustment for PTSD and depression, mild traumatic brain injury was no longer significantly associated with these physical health outcomes or symptoms, except for headache.

CONCLUSIONS

Mild traumatic brain injury (i.e., concussion) occurring among soldiers deployed in Iraq is strongly associated with PTSD and physical health problems 3 to 4 months after the soldiers return home. PTSD and depression are important mediators of the relationship between mild traumatic brain injury and physical health problems.

From the Division of Psychiatry and Neuroscience, Walter Reed Army Institute of Research, U.S. Army Medical Research and Material Command, Silver Spring, MD (C.W.H., D.M., J.L.T., A.L.C., C.A.C.); and the Deployment Health Clinical Center and Uniformed Services University of Health Sciences, Washington, DC (C.C.E.). Address reprint requests to Dr. Hoge at the Division of Psychiatry and Neuroscience, Walter Reed Army Institute of Research, 503 Robert Grant Ave., Silver Spring, MD 20910, or at charles.hoge@us.army.mil.

N Engl J Med 2008;358:453-63.

"Patients with mild TBI were twice as likely to develop PTSD [or other anxiety disorders]…"

"Mild traumatic brain injury (i.e., concussion) occurring among soldiers deployed in Iraq is strongly associated with PTSD…"

Why?

- Impaired emotional regulation resulting from damage to the medial pre-frontal cortex
- Impaired cognitive strategies that limit management of emotional stress
- Additional stressors that occur after mTBI

Bryant, Creamer, O'Donnell, Silove, Clark, and McFarlane, 2009

PTSD and mTBI – Challenges Associated With Differential Diagnosis

Does more (TBI plus PTSD) = more symptoms?

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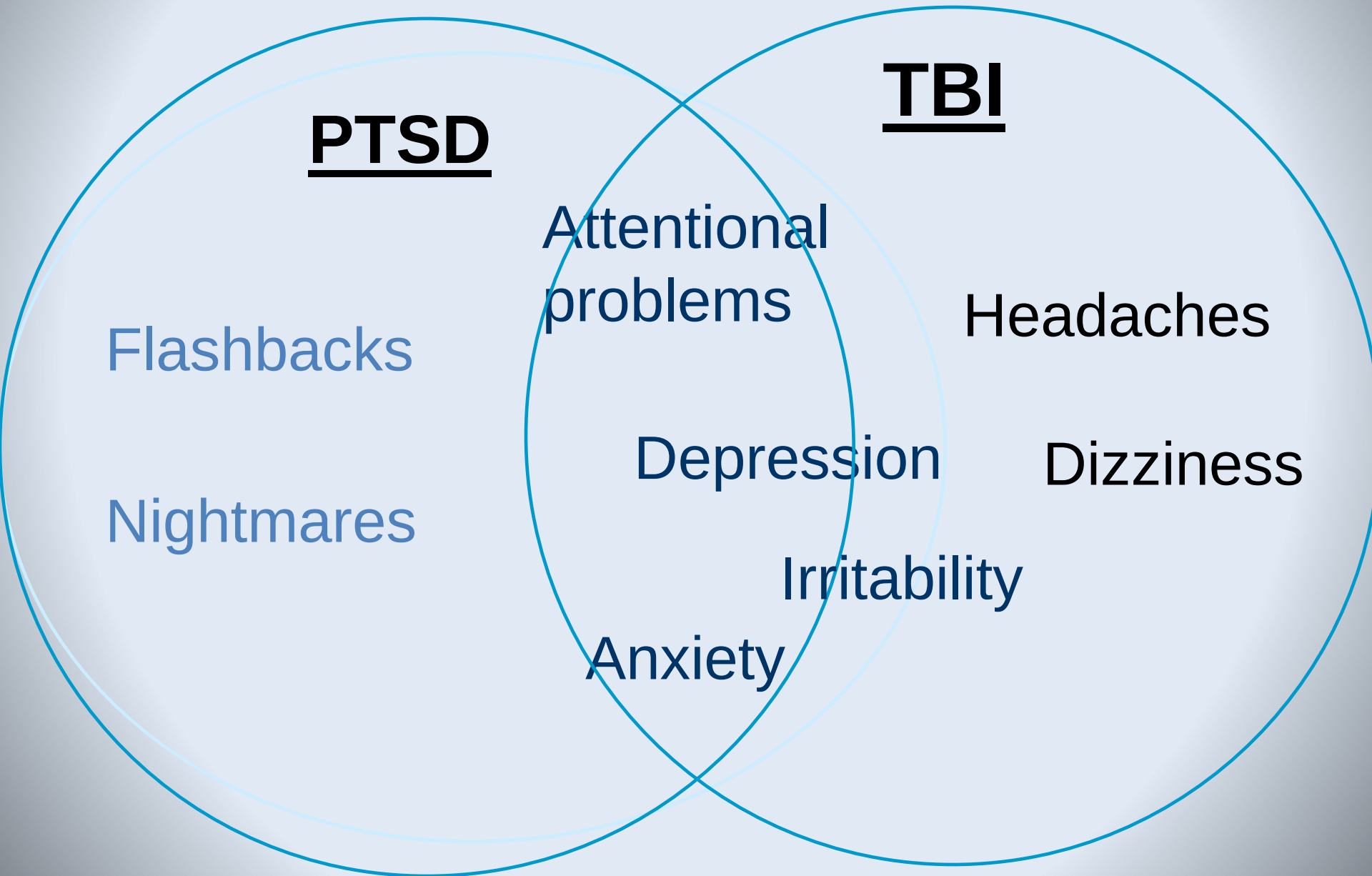
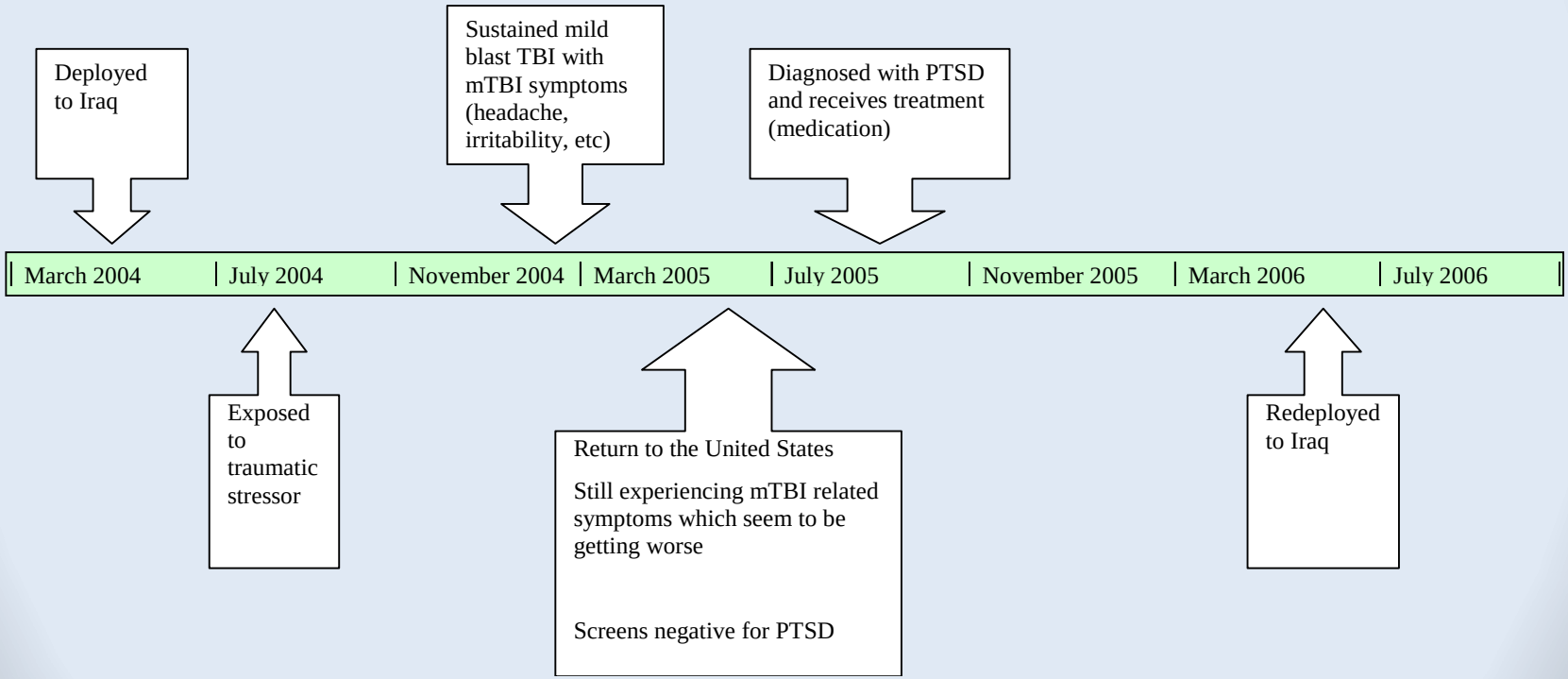
Mild TBI and PTSD: Overlapping Symptoms and Diagnostic Clarification

- PTSD
  - Insomnia
  - Impaired memory
  - Poor concentration
  - Depression
  - Anxiety
  - Irritability
  - Emotional Numbing
  - Hypervigilance
  - Flashbacks/Nightmares
  - Avoidance
- Mild TBI
  - Insomnia
  - Impaired memory
  - Poor concentration
  - Depression
  - Anxiety
  - Irritability
  - Fatigue
  - Headache
  - Dizziness
  - Noise/Light intolerance

Potential Clinical Presentation



Case Example:
Co-Occurring PTSD and mTBI



Headaches

Dizziness

Feeling Tired/Having Little Energy

Brief Report

Association of Posttraumatic Stress Disorder With Somatic Symptoms, Health Care Visits, and Absenteeism Among Iraq War Veterans

Charles W. Hoge, M.D.
Artin Terhakopian, M.D.
Carl A. Castro, Ph.D.
Stephen C. Messer, Ph.D.
Charles C. Engel, M.D., M.P.H.

Objective: Studies of soldiers from prior wars conducted many years after combat have shown associations between combat-related posttraumatic stress disorder (PTSD) and physical health problems. The current Iraq war has posed a considerable PTSD risk, but the association with physical health has not been well studied.

Method: The authors studied 2,863 soldiers using standardized self-administered screening instruments 1 year after their return from combat duty in Iraq.

Results: Among all participants, 16.6% met screening criteria for PTSD. PTSD was significantly associated with lower ratings of general health, more sick call visits, more missed workdays, more physical symptoms, and high somatic symptom severity. These results remained significant after control for being wounded or injured.

Conclusions: The high prevalence of PTSD and its strong association with physical health problems among Iraq war veterans have important implications for delivery of medical services. The medical burden of PTSD includes physical health problems; combat veterans with serious somatic concerns should be evaluated for PTSD.

(Am J Psychiatry 2007; 164:150–153)

Research has established a strong relationship between combat-related posttraumatic stress disorder (PTSD) and physical health measures (1–16). This association was observed in veterans from the 1991 Gulf War who experienced increased rates of physical symptoms in all domains in the years after returning from deployment (1, 4–7, 12, 16). Compared to military personnel who were not stationed in the war zone, 1991 Gulf War veterans showed significantly higher rates of somatic symptoms, more psychological distress, worse general health status, and greater health-related physical and psychosocial functional impairment (1). The major limitations of these studies were that they were conducted many years after the veterans returned from combat, were based largely on clinical populations, and did not control for wartime injuries.

Research conducted on veterans from the current war in Iraq has already established the presence of a high prevalence of PTSD (12%–13%) during the first 3–4 months after their return home (17). One study conducted among seriously injured hospitalized veterans showed that PTSD was strongly correlated with the level of injury (18). However, to date the relationship between PTSD and physical health has not been explored among healthy noninjured veterans. This study evaluated the association of PTSD with physical health measures among Iraq war veterans 1 year after their return from deployment with control for combat injury.

Method

This study was based on self-report survey data obtained from 2,863 soldiers from four Army combat infantry brigades surveyed 1 year after their return from deployment to Iraq. This is part of a larger study looking at the effect of combat on the mental health of soldiers (17).

Recruitment and survey collection methods have been described previously (17). Briefly, the soldiers were administered the survey at their duty site with written informed consent under a protocol approved by the institutional review board of the Walter Reed Army Institute of Research. All surveys were anonymous. Approximately half of the soldiers from the selected units were available for the survey, with most of those not available because of work or training duties. Over 98% of the available soldiers consented to participate; the rates of missing values for individual items in this study ranged from 2% to 9%; 2% did not complete the PTSD measure.

The study outcomes included past month symptoms of PTSD, depression, alcohol misuse, self-rated health status, sick call visits, missed work days, and somatic symptoms. PTSD was assessed with the well-validated 17-item National Center for PTSD Checklist (19, 20). PTSD scoring criteria have been described previously (17) and required at least one intrusion symptom, three avoidance symptoms, and two hyperarousal symptoms that were at least at the moderate level of severity. In addition, the total score had to be at least 50 on a scale that ranged from 17 to 85. Comorbidity of depression or alcohol misuse with PTSD was measured with the Patient Health Questionnaire Depression Scale—9 and a two-item alcohol screening instrument, respectively, with previously described criteria (21, 22).

The soldiers were asked to rate their overall health (excellent, very good, good, fair, or poor), and their responses were dichotomized ("fair" and "poor" were considered worse health). The soldiers were also asked to report the number of sick call (primary care) visits and the number of missed workdays in the past month, both dichotomized at two or more.

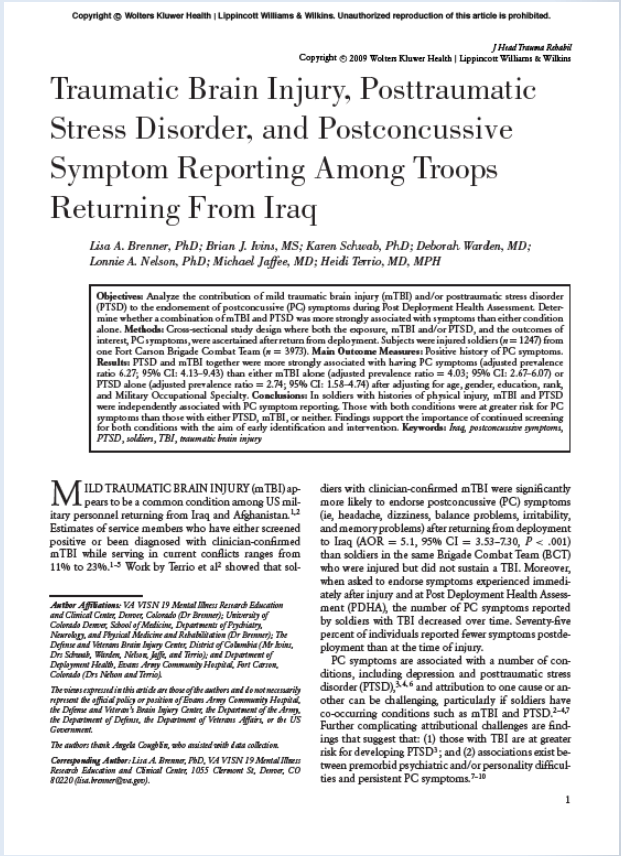
Somatic symptoms were measured with the 15-item Patient Health Questionnaire—15 (23). The symptoms were scored, per established criteria (23), as 0 (not bothered at all), 1 (bothered a

"Among all participants, 16.6% met screening criteria
or PTSD. PTSD was significantly associated with lower ratings of
general health, more sick call visits, more missed workdays,
more physical symptoms, and high somatic symptom severity.
These results remained significant after control for being
wounded or injured."

Hoge et al. 2007

Increased Symptoms with TBI + PTSD

"In Soldiers with histories of physical injury, mTBI and PTSD were independently associated with PC symptom reporting. Those with both conditions were at greater risk for PC symptoms than those with either PTSD, mTBI, or neither."



J Head Trauma Rehabil

Traumatic Brain Injury, Posttraumatic Stress Disorder, and Postconcussive Symptom Reporting Among Troops Returning From Iraq

Lisa A. Brenner, PhD; Brian J. Ivins, MS; Karen Schwab, PhD; Deborah Warden, MD; Lonnie A. Nelson, PhD; Michael Jaffee, MD; Heidi Terrio, MD, MPH

Objectives: Analyze the contribution of mild traumatic brain injury (mTBI) and/or posttraumatic stress disorder (PTSD) to the endorsement of postconcussive (PC) symptoms during Post Deployment Health Assessment. Determine whether a combination of mTBI and PTSD was more strongly associated with symptoms than either condition alone. **Methods:** Cross-sectional study design where both the exposure, mTBI and/or PTSD, and the outcomes of interest, PC symptoms, were ascertained after return from deployment. Subjects were injured soldiers (n = 1247) from one Fort Carson Brigade Combat Team (n = 3972). **Main Outcome Measures:** Positive history of PC symptoms. **Results:** PTSD and mTBI together were more strongly associated with having PC symptoms (adjusted prevalence ratio 6.27; 95% CI: 4.13–9.43) than either mTBI alone (adjusted prevalence ratio = 4.03; 95% CI: 2.67–6.07) or PTSD alone (adjusted prevalence ratio = 2.74; 95% CI: 1.58–4.74) after adjusting for age, gender, education, rank, and Military Occupational Specialty. **Conclusions:** In soldiers with histories of physical injury, mTBI and PTSD were independently associated with PC symptom reporting. Those with both conditions were at greater risk for PC symptoms than those with either PTSD, mTBI, or neither. Findings support the importance of continued screening for both conditions with the aim of early identification and intervention. **Keywords:** *Iraq, postconcussive symptoms, PTSD, soldiers, TBI, traumatic brain injury*

MILD TRAUMATIC BRAIN INJURY (mTBI) appears to be a common condition among US military personnel returning from Iraq and Afghanistan.[1,2] Estimates of service members who have either screened positive or been diagnosed with clinician-confirmed mTBI while serving in current conflicts ranges from 11% to 23%.[1–5] Work by Terrio et al[2] showed that soldiers with clinician-confirmed mTBI were significantly more likely to endorse postconcussive (PC) symptoms (ie, headache, dizziness, balance problems, irritability, and memory problems) after returning from deployment to Iraq (AOR = 5.1, 95% CI = 3.53–7.30, $P < .001$) than soldiers in the same Brigade Combat Team (BCT) who were injured but did not sustain a TBI. Moreover, when asked to endorse symptoms experienced immediately after injury and at Post Deployment Health Assessment (PDHA), the number of PC symptoms reported by soldiers with TBI decreased over time. Seventy-five percent of individuals reported fewer symptoms postdeployment than at the time of injury.

PC symptoms are associated with a number of conditions, including depression and posttraumatic stress disorder (PTSD),[3,4,6] and attribution to one cause or another can be challenging, particularly if soldiers have co-occurring conditions such as mTBI and PTSD.[2,47] Further complicating attributional challenges are findings that suggest that: (1) those with TBI are at greater risk for developing PTSD[3]; and (2) associations exist between premorbid psychiatric and/or personality difficulties and persistent PC symptoms.[7–10]

Author Affiliations: VA VISN 19 Mental Illness Research Education and Clinical Center, Denver, Colorado (Dr Brenner); University of Colorado Denver, School of Medicine, Departments of Psychiatry, Neurology, and Physical Medicine and Rehabilitation (Dr Brenner); The Defense and Veterans Brain Injury Center, District of Columbia (Mr Ivins, Drs Schwab, Warden, Nelson, Jaffe, and Terrio); and Department of Deployment Health, Evans Army Community Hospital, Fort Carson, Colorado (Drs Nelson and Terrio).

The views expressed in this article are those of the authors and do not necessarily represent the official policy or position of Evans Army Community Hospital, the Defense and Veteran's Brain Injury Center, the Department of the Army, the Department of Defense, the Department of Veterans Affairs, or the US Government.

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Corresponding Author: Lisa A. Brenner, PhD, VA VISN 19 Mental Illness Research Education and Clinical Center, 1055 Clermont St, Denver, CO 80220 (lisa.brenner@va.gov).

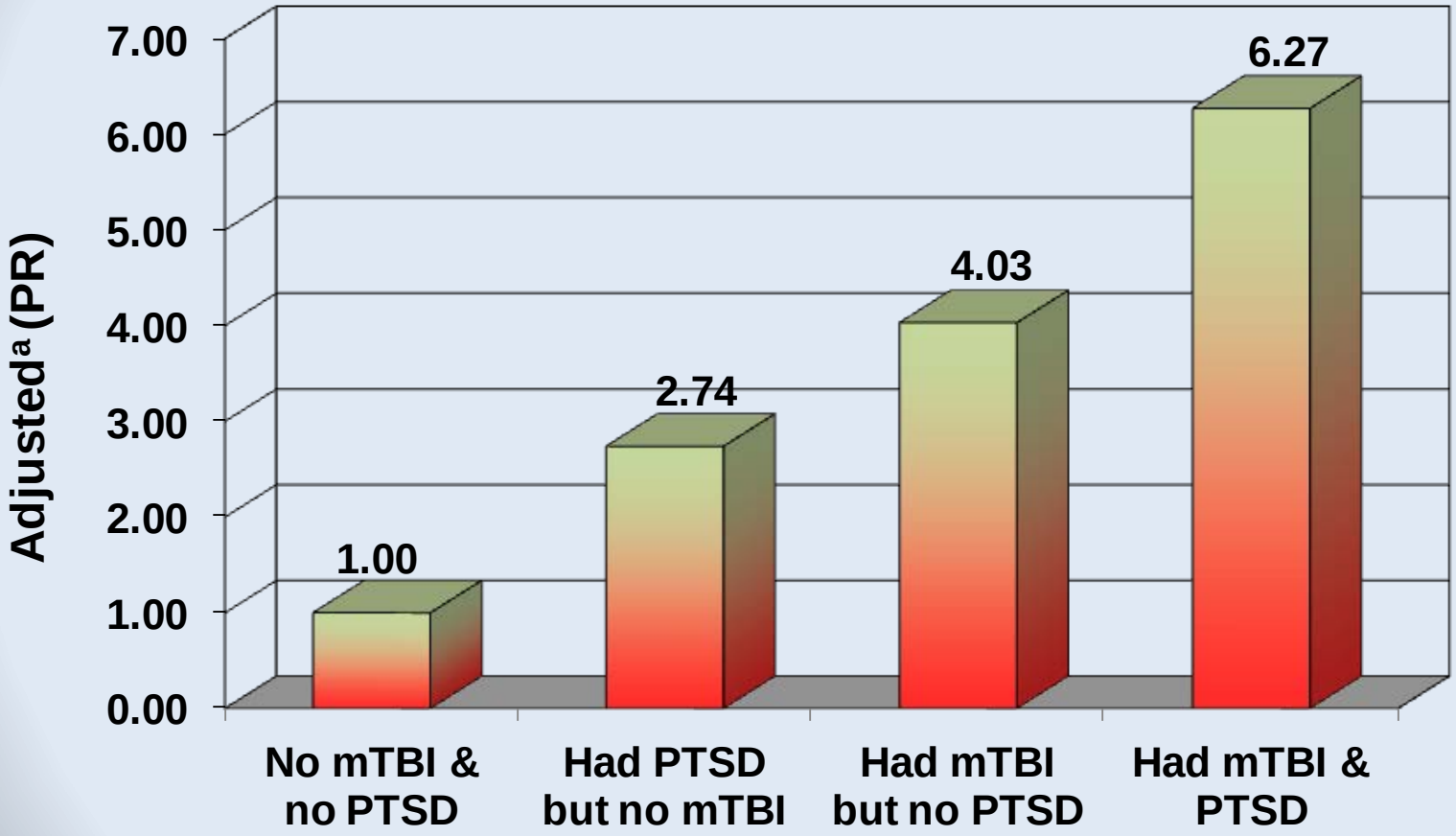
Total No. of Soldiers: N = 1,247

TBI & PTSD Status	n	(%)
Total w/ mTBI	878	
Total w/ PTSD	405	
No PTSD and no mTBI	287	23
Had PTSD but no mTBI	82	7
Had mTBI but no PTSD	555	45
Had mTBI and PTSD	323	26
Total	**1247**	**100**

Brenner et al., 2009

Symptom-Exposure:

Any Symptoms (n = 389)

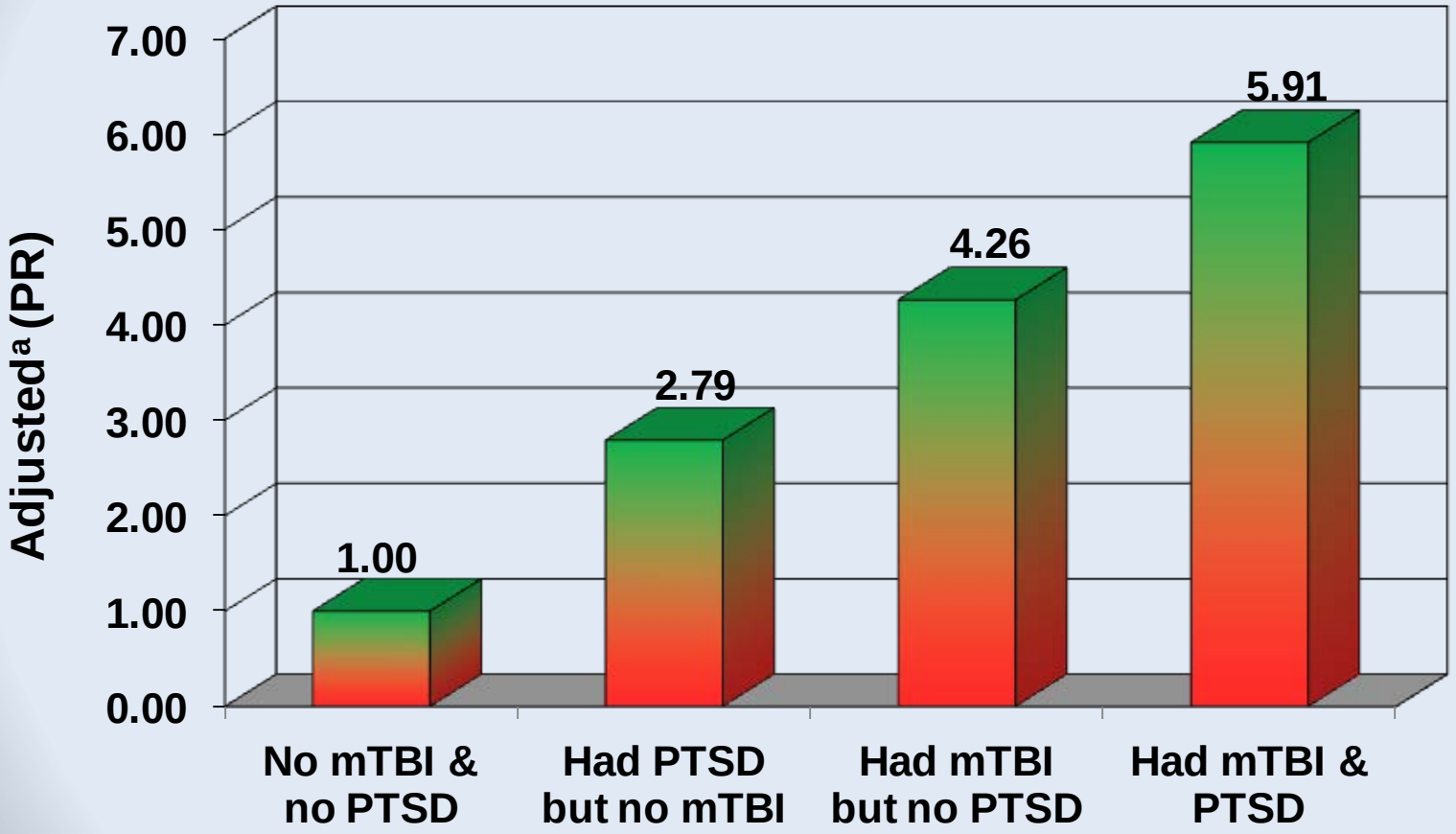


[a]Adjusted for age, gender, education, rank, and MOS

Brenner et al., 2009

Symptom-Exposure:

Headache (n = 204)



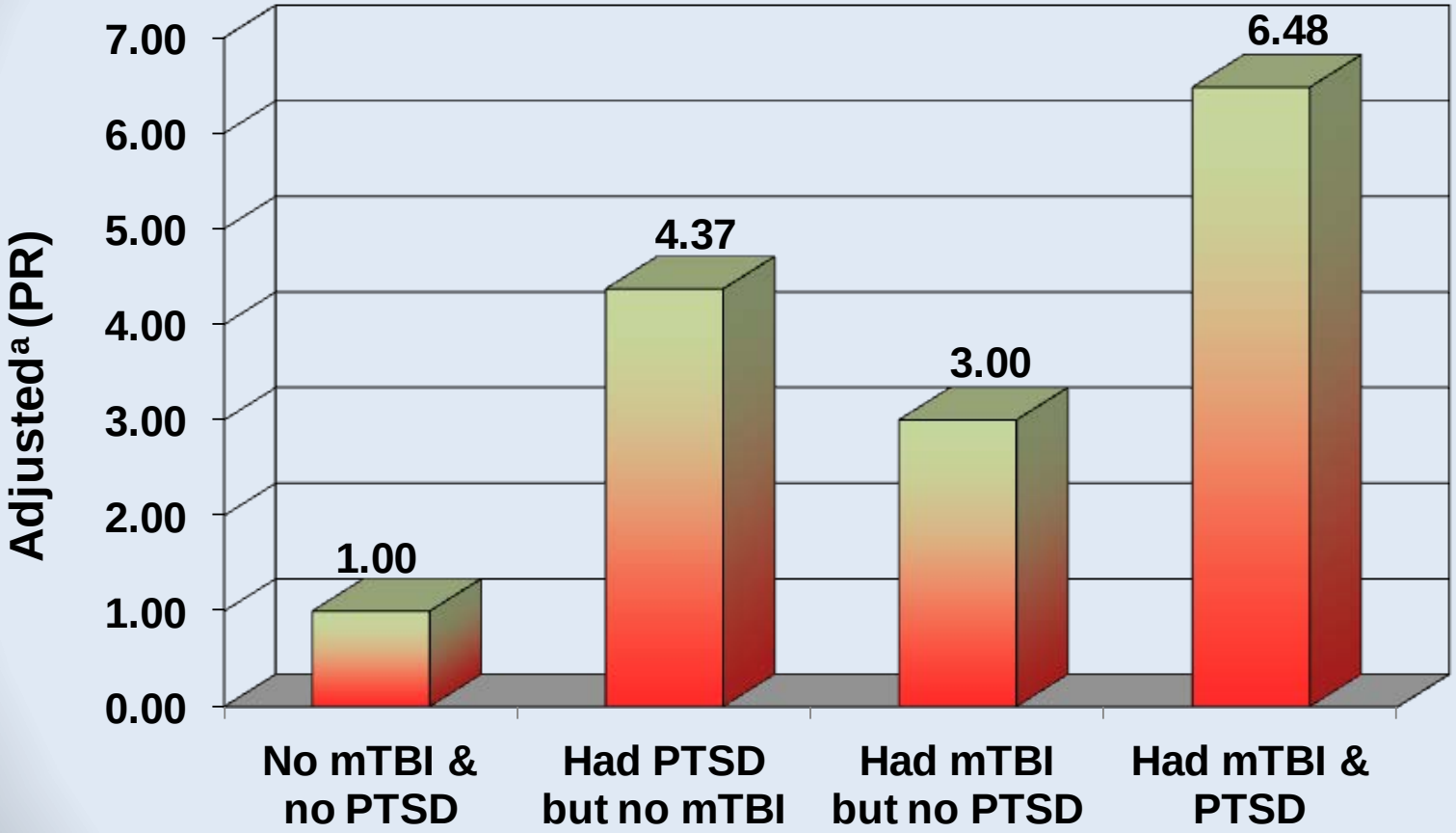
[a]Adjusted for age, gender, education, rank, and MOS

Total no. of soldiers (N = 1247)

Brenner et al., 2009

Symptom-Exposure:

Dizziness (n = 51)



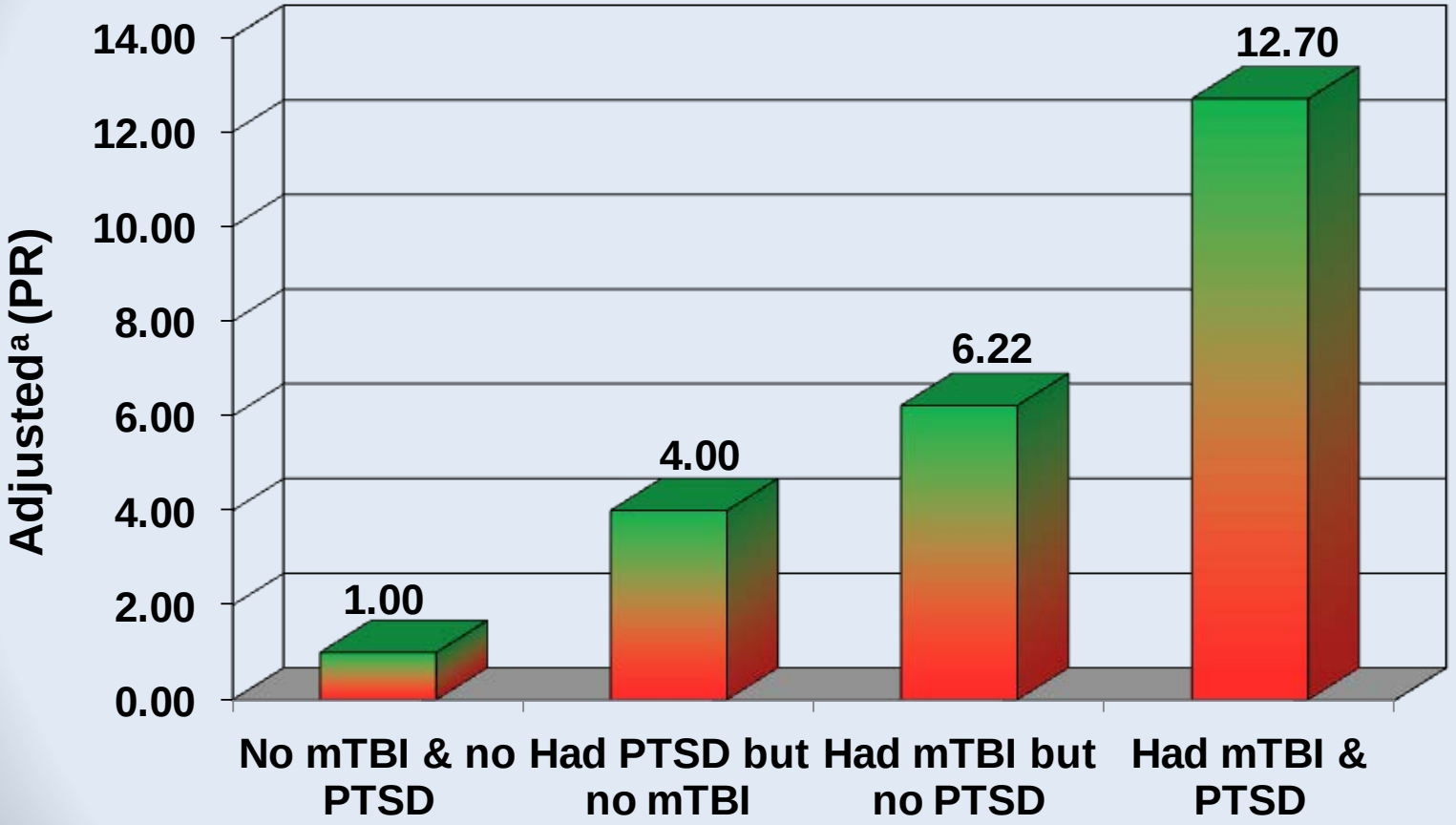
[a]Adjusted for age, gender, education, rank, and MOS

Total no. of soldiers (N = 1247)

Brenner et al., 2009

Symptom-Exposure:

Memory Problems (n = 154)

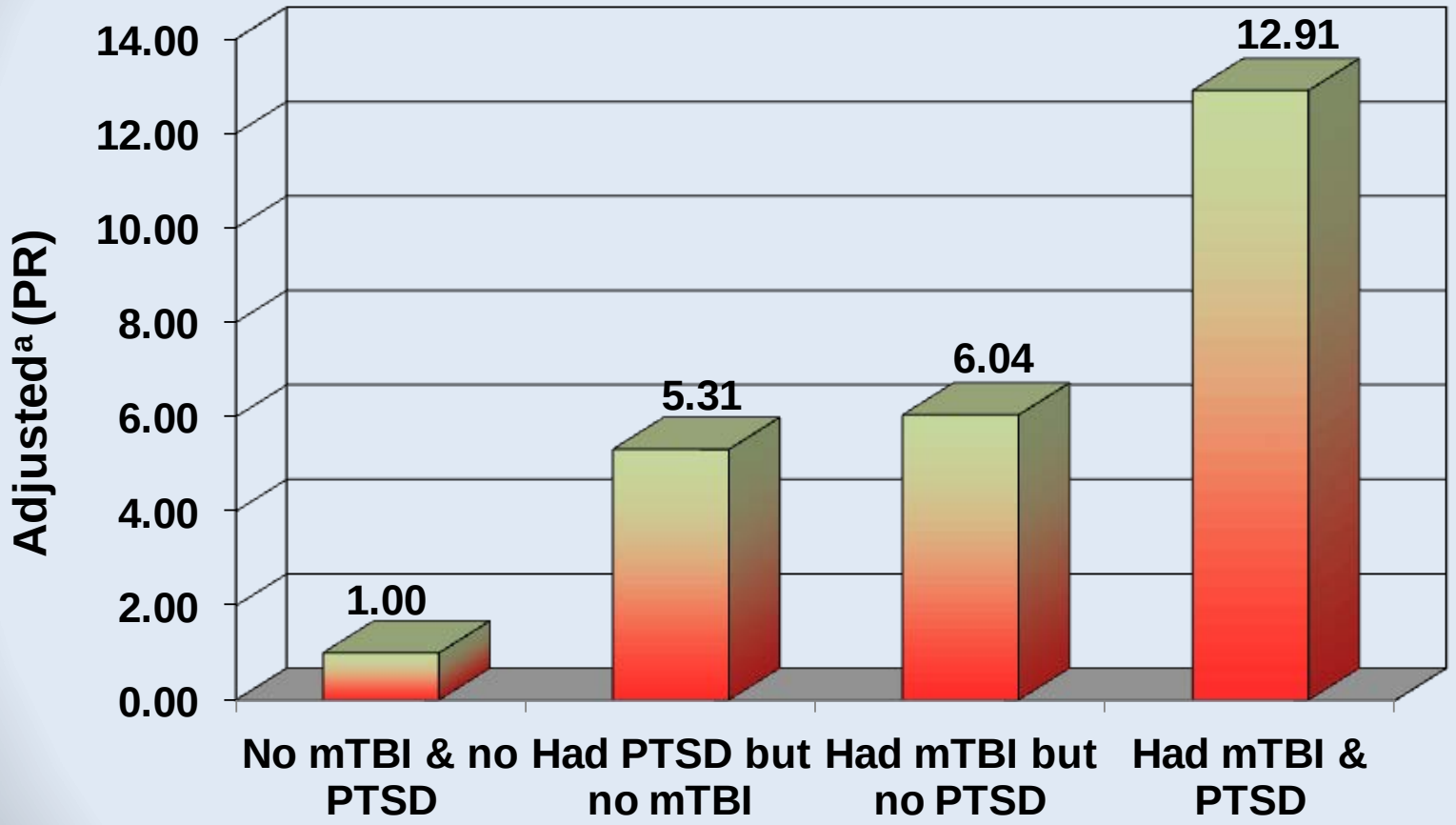


[a]Adjusted for age, gender, education, rank, and MOS

Total no. of soldiers (N = 1247)

Brenner et al., 2009

Symptom-Exposure:
Balance Problems (n = 62)

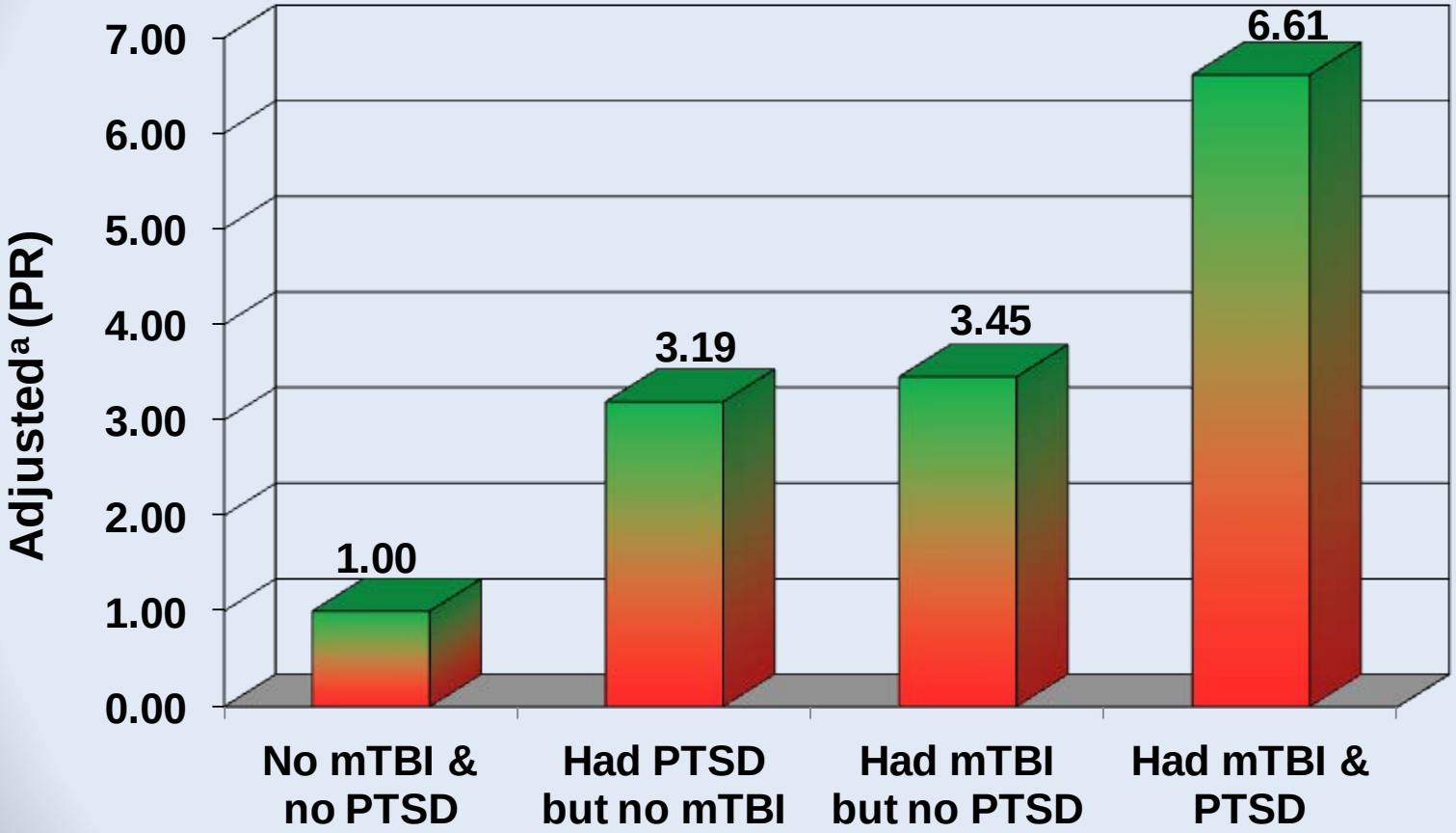


[a]Adjusted for age, gender, education, rank, and MOS

Brenner et al., 2009

Symptom-Exposure:

Irritability (n = 215)



[a]Adjusted for age, gender, education, rank, and MOS

Total no. of soldiers (N = 1247)

Brenner et al., 2009

Factors that Can Influence Symptom Reporting

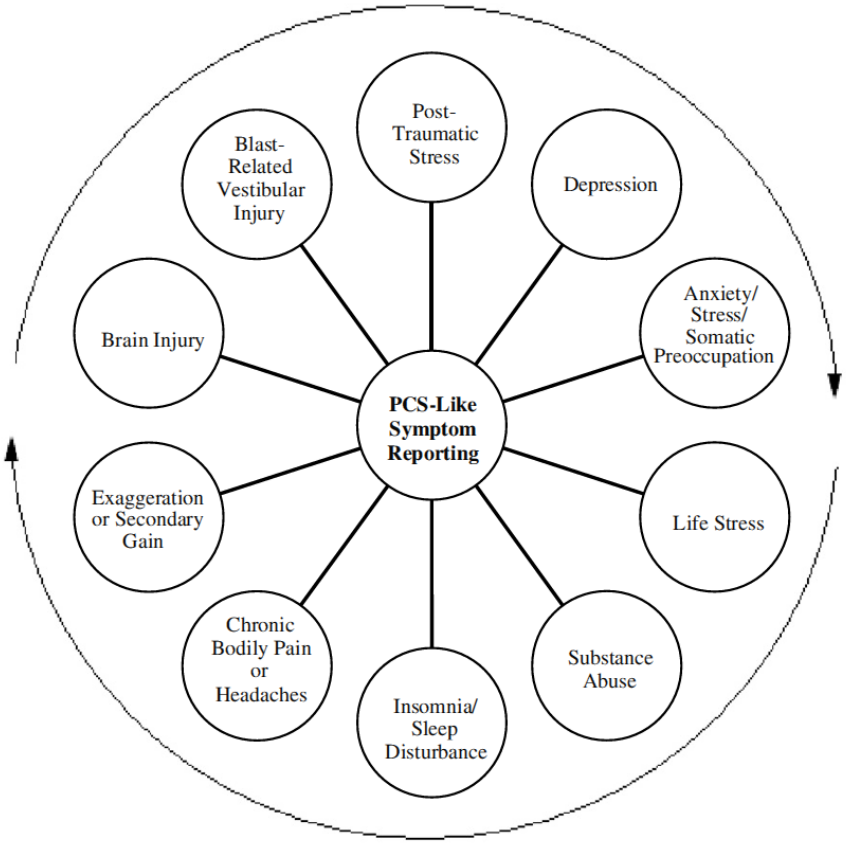
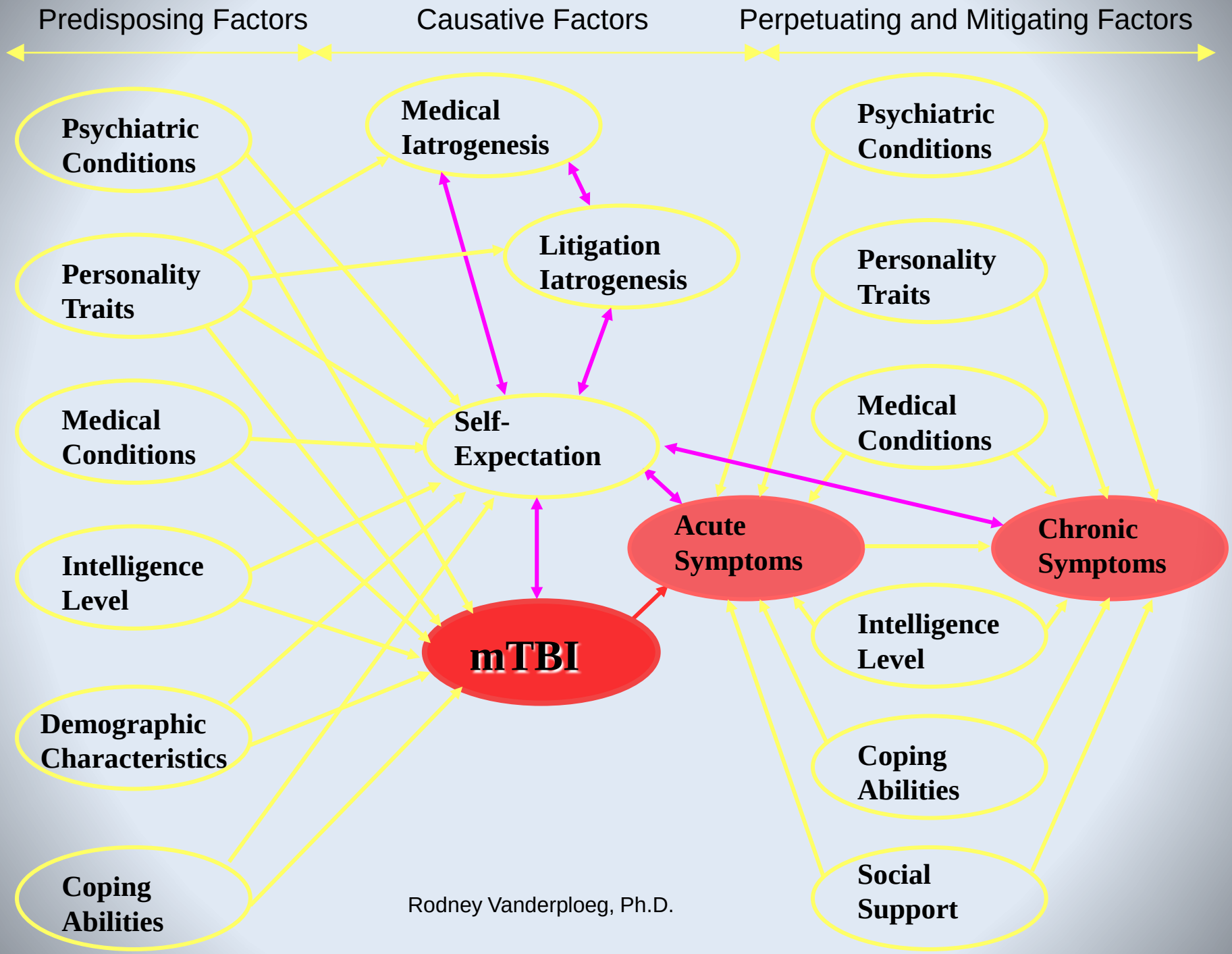


Figure 3 Factors that can influence post-concussion-like symptom reporting post-acutely or long after a mild traumatic brain injury in service members.

Iverson, Langlois, McCrea, Kelly, 2009


Predisposing Factors
Causative Factors
Perpetuating and Mitigating Factors
Psychiatric Conditions
Personality Traits
Medical Conditions
Intelligence Level
Demographic Characteristics
Coping Abilities
Medical Iatrogenesis
Litigation Iatrogenesis
Self-Expectation
mTBI
Acute Symptoms
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Chronic Symptoms
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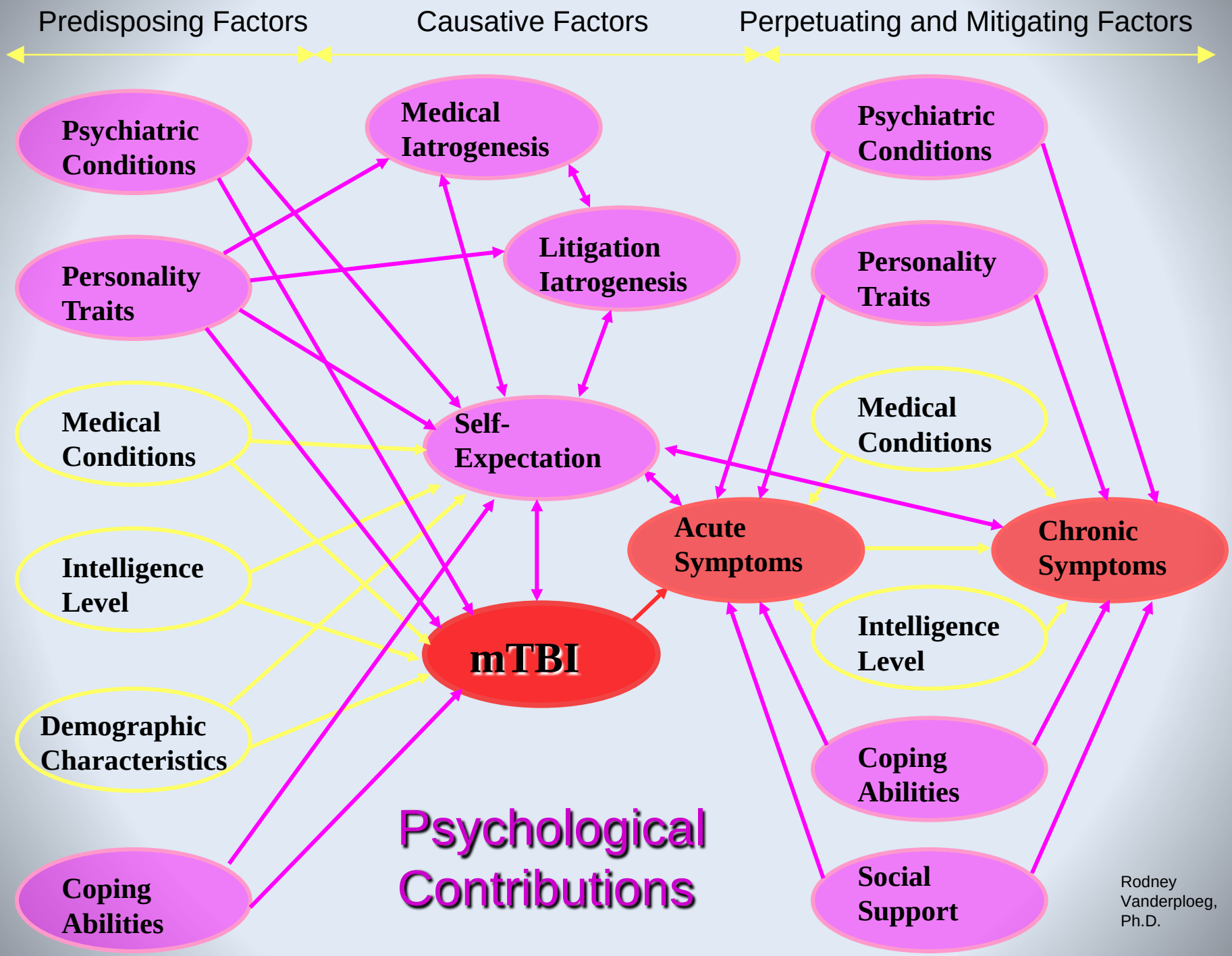
Social Support
Rodney Vanderploeg, Ph.D.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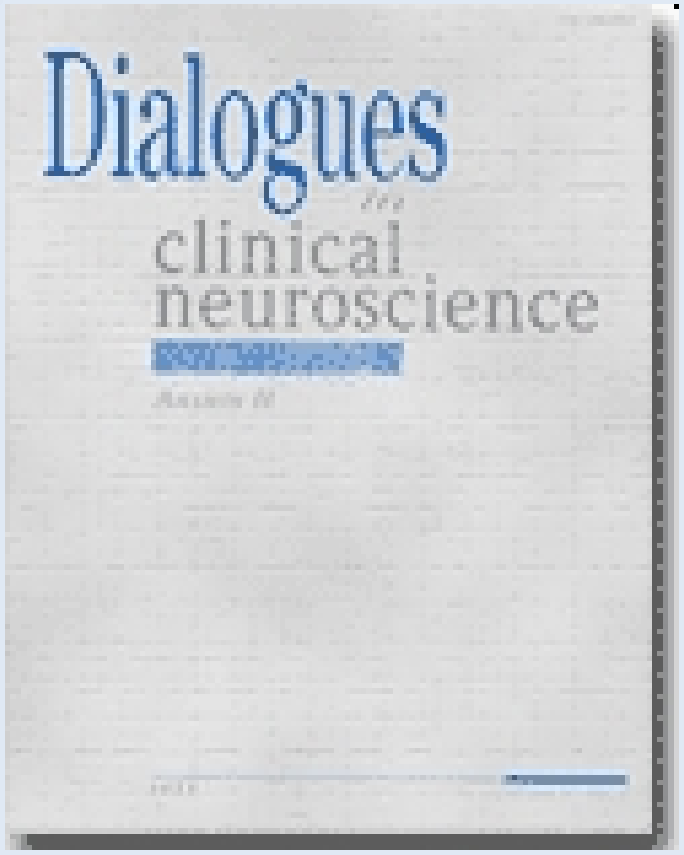


Current Issue:
Trauma, Brain Injury, and Post-traumatic Stress Disorder

Neuropsychological and Neuroimaging Findings in Traumatic Brain Injury and Post Traumatic Stress Disorder

Brain Region	Function	PTSD and/or TBI
Amygdala	Generation and maintenance of emotional respones[48]	PTSD[41]; TBI[1]
Cerebellum	Movement and motor coordination; processing fear memories[47]	PTSD[47]; Chronic mild TBI[49]
Corona Radiata	Attentional processes[36]	Chronic mild TBI[54]
Corpus Collosum	Intra-hemispheric communication[66]	Acute and chronic mTBI[36]; Moderate to severe TBI[68]; TBI[1]
Hippocampus	Explicit and declarative memory, working memory, episodic/autobiographical memory, contextual learning[36,48];Control of stress responses and contextual aspects of fear conditioning[19]	PTSD[47]; TBI[1]
Insula	Core affect, associated consciousness of subjective feelings, developing and updating motivational states, autobiographical memory, cognitive control, affective processing, pain, and conveyance of homeostatic information[48]	PTSD[41]
Internal Capsule	Motor and sensory communication	Acute and chronic mTBI[36]
Medial Temporal Lobe	Declarative memory	Chronic mild TBI[49]; TBI[1]
Parietal Cortex	Volitional and avolitional allocation of attentional resources during the retrieval of episodic memories[60]	PTSD[60]
Prefrontal Cortex	Manipulation of emotions and memories[60]; Extinguishing conditioned fear[32]; Inhibitory action on the amygdala[16]	PTSD[32,41,47,60]; TBI[1,68]
Anterior Cingulate Cortex	Processing of cognitive and emotional interactions[48] including interference from emotional stimuli and performance monitoring, response selection, error detection, and decision making[67]; Conflict monitoring, attention and pain[47]	PTSD[32,41,47]
Uncinate Fasciculus	Working memory[36]	Chronic mild TBI[54]

Brain Regions and Functions Often Discussed in Relationship to PTSD and/or TBI

	Traumatic Brain Injury			Post Traumatic Stress Disorder
	Mild		Moderate to Severe	
Cognitive Domain	**Acute/Chronic**	**Study**	**Study**	**Study**
Attention	Acute/Chronic	Frencham et al[34];Peskind et al[49]	Mathias and Wheaton[39]; Senathi-Raja et al[10]	Aupperle et al[41]; Golier et al[69]; Samuelson et al[44]
Sustained Attention	Chronic	Kraus et al[3]	Mathias and Wheaton[39]	Vasterling et al[70]; Vasterling et al[27]
Emotional Processing				Halligan et al[46]; Milad et al[47]; McNally[17]; McNally[32]
Executive Dysfunction	Acute/Chronic	Frencham et al[34];Peskind et al[49]	Mathias and Wheaton[39]; Draper and Ponsford[38]; Senathi-Raja et al[10]	Aupperle et al[41]; Vasterling et al[70]
Working Memory	Acute/Chronic	Frencham[34]; Peskind et al[49]	Senathi-Raja et al[10]	Aupperle et al[41];Moores et al[45] ; McNally[32]; Samuelson et al[44]; Vasterling et al[27]
Intelligence				Gilbertson et al[26]; Vasterling et al[27]
Language and Communication			Levin and Chapman[71]	McNally
Learning	Acute	Frencham et al[34]	Draper and Ponsford[38];Vanderploeg et al[72]	Samuelson et al[44]; Vasterling et al[70]; Vasterling et al[27]
Processing Speed	Acute/Chronic	Frencham et al[34];Niogi et al[54]; Peskind et al[49]	Draper and Ponsford[38]; Mathias and Wheaton[29]; Senathi-Raja et al e[10]; Willmott et al[68]	Nelson et al[31]; Samuelson et al[44]
Verbal Memory	Acute/Chronic	Frencham et al[34]; Fan et al[74]	Senathi-Raja et al et al[10]; Lezak et al[66]	Golier[69]; McNally[32]; van Pragg[73]
Visual Memory	Acute	Frencham et al[34]	Senathi-Raja et al[10]	Marx et al[40]

Neuropsychological Findings Often Discussed Among those with TBI or PTSD

Treatment: Co-Occurring TBI and PTSD

Psychological treatment for anxiety in people with traumatic brain injury (Review)

Soo C, Tate R

This is a reprint of a Cochrane review, prepared and maintained by The Cochrane Collaboration and published in *The Cochrane Library* 2007, Issue 3

http://www.thecochranelibrary.com

3,038 References – 3 Studies

- Corresponding group comparisons were as follows.
  - CBT versus supportive counseling (SC) (Bryant 2003)
  - Interpersonal process recall (IPR) therapy versus controls with no feedback on interpersonal functioning (Helffenstein 1982)
  - CBT combined with neurorehabilitation (NR) versus no psychological intervention controls (Tiersky 2005)

Total # of Subjects

60

Findings

- Cognitive behavioral therapy (CBT) techniques following TBI effective in comparison to supportive counseling (n=24) (Bryant 2003)
- Combining CBT and neurorehablitation for targeting general anxiety sx for mild to mod TBI (n=16) (Helffenstein 1982)
- Limited empirical support for Interpersonal process recall (n=20) (Helffenstein 1982)

Report of (VA) Consensus Conference: Practice Recommendations for Treatment of Veterans with Comorbid TBI, Pain, and PTSD

Executive Summary:

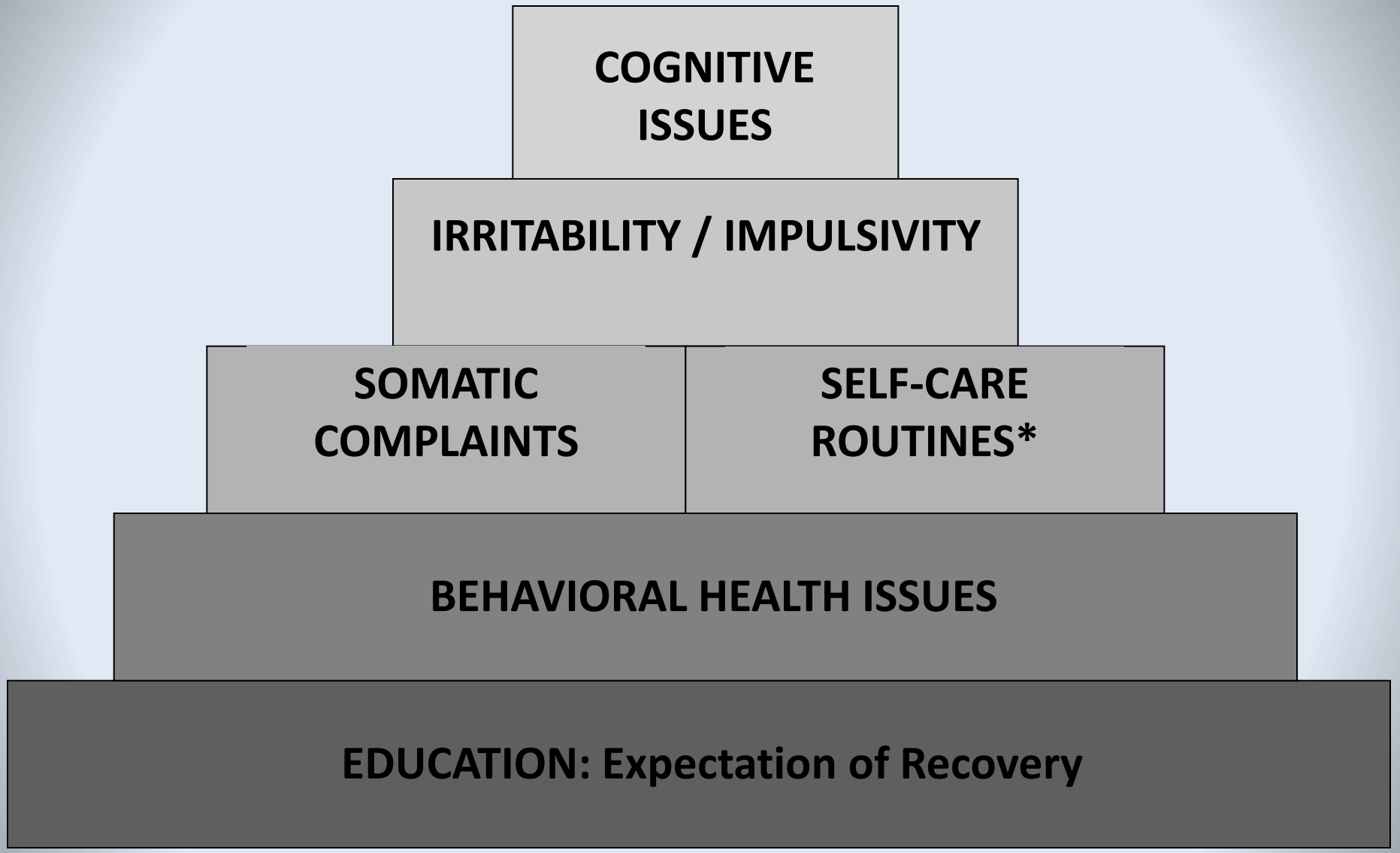
The Special Committee on PTSD in FY2008 recognized the dilemma of increasing numbers of Veterans presenting with PTSD and co-morbid Mild Traumatic Brain Injury (mTBI) faced by VA clinicians and recommended a consensus conference be planned and convened. The Undersecretary for Health concurred and in the VA response to the Committee's 2008 Report, charged the National Center for PTSD to develop a multidisciplinary workgroup to proceed with plans. The group was asked to propose treatment recommendations within the context of current programs and processes that could be rapidly disseminated to VA clinicians.

A conference planning committee was organized in October 2008, with membership from VA's

The new clinical practice guideline for concussion/mTBI focuses on promoting a recovery expectation, noting that a vast majority of patients will improve without lasting effects and that mTBI is a common injury with a time-limited, predictable course. It states that education of patients and families is the best available intervention for veterans starting treatment. For ongoing or chronic post-concussive symptoms, the guidelines take the clinician through each symptom profile step-by-step for recommended assessments and treatments.

“In summary, there was agreement that Veterans who experience mTBI and/or pain, along with PTSD, should have the opportunity to receive the two best evidence-based treatments in the VA/DoD practice guidelines for PTSD, prolonged exposure therapy or cognitive processing therapy.”

TBI Step-Care Treatment Model†



† Begin each encounter at the bottom of the pyramid and progress upward

* Includes sleep hygiene, diet, exercise, and avoiding further TBI

Terrio 2009

mTBI and PTSD: Symptoms, Functioning and Outcomes

- What would recovery look like for this veterans?
- Could this be accomplished even if symptoms persisted?
- How can therapists help veterans track symptoms, functioning, and outcomes?

The is more work to be done!

Thank You

Lisa.Brenner@va.gov

http://www.mirecc.va.gov/visn19/