# APPENDIX A. SEARCH STRATEGIES

## KEY QUESTIONS 1 AND 2

1. (operation enduring freedom or operation iraqi freedom or operation new dawn).mp.
2. (OEF or OIF or OND).mp.
3. exp Afghan Campaign 2001-/
4. exp Iraq War, 2003-2011/
5. 1 or 2 or 3 or 4
6. (blast$ and injur$).mp.
7. blast$.mp.
8. ep.fs.
9. incidence.mp.
10. prevalence.mp.
11. 8 or 9 or 10
12. 6 or 7
13. 5 and 11 and 12
14. military personnel.mp. or exp Military Personnel/
15. 5 or 14
16. blast injuries.mp. or exp Blast Injuries/
17. 6 or 7 or 16
18. 11 and 15 and 17
19. limit 18 to (english language and yr = "2001 -Current")

## KEY QUESTION 3

1. brain injury.mp. or exp Brain Injuries/
2. exp Wounds, Nonpenetrating/
3. exp Wounds, Penetrating/
4. (blast or (non-blast or nonblast)).mp.
5. (traumatic brain injur$ or tbi).mp.
6. brain.mp.
7. exp Afghan Campaign 2001-/
8. exp Iraq War, 2003-2011/
9. (operation enduring freedom or operation iraqi freedom or operation new dawn).mp.
10. (OEF or OIF or OND).mp.
11. 7 or 8 or 9 or 10
12. 2 or 3 or 4
13. 1 or 5 or 6
14. 11 and 12 and 13
15. (military or combat or deploy$).mp.
16. 12 and 13 and 15
17. 14 or 16
18. limit 17 to (english language and yr = "2001 -Current")
19. military personnel.mp. or exp Military Personnel/
20. (military or veteran$ or soldier$).mp.
21. 15 or 19 or 20
22. 12 and 13 and 21
23. 16 or 22
24. limit 23 to (english language and yr = "2001 -Current")

# APPENDIX B. PEER REVIEWER COMMENTS AND RESPONSES

| | Reviewer Comment | Response |
|---|---|---|
| Are the objectives, scope, and methods for this review clearly described? | Yes | |
| | Yes | |
| | Yes | |
| | Yes | |
| | Yes | |
| | No - The questions were too broad. In light of the lack of detail in reporting, we should have picked one or two types of injury common to blast. In addition, failure to answer the first two questions indicates a problem with the process of reporting. | We sought input from Operational Partners and Technical Expert Panels to guide the report development. |
| Is there any indication of bias in our synthesis of the evidence? | No | |
| | No | |
| | No | |
| | No | |
| | No | |
| | No | |
| Are there any published or unpublished studies that we may have overlooked? | No | |
| | Yes - Consider including the following article for DoD TBI incidence/denominator sample data: Regasa, et.al. (2015, JHTR ahead of pub) "Military Deployment May Increase the Risk for TBI Following Deployment". Posted under Reviewer attachments for your consideration. | We have included this article in the Discussion section. Although it includes a large sample, it is not truly an incidence report given that some service members were excluded. Furthermore, there was inadequate data for the authors to comment on causes of injury. |
| | Yes - Noted within the comments but there are unpublished, classified studies that we do not mention and it appears that no attempts were made to obtain data from JTAPIC. | Classified studies would be out of scope.<br><br>We looked at the military injury database sites for posted reports. |
| | Yes - Not sure if these were reviewed, but there is limited mention of VA data related to the TBI screening and evaluation process. There are questions specific to blast in both the screen and evaluation template. Studies with this data may not have been strong enough to include, but it would appear to be an area for possible expanded use in the future. | We have added information about the VA TBI screening and evaluation process including the findings of Scholten et al.(2012). We did not find other reports of findings related to the VA protocol.<br><br>We have noted in the Future Research section that additional analyses of existing databases are needed. |

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| | Yes - The data from VA re incidence/prevalence for key questions 1 and 2: Scholten JD,Sayer NA et al: Analysis of US Veterans Health Administration for Traumatic Brain Injury...Brain Injury ISSN: 0269 = 9052; DePalma RG Combat TBI: History, Epidemiology, and Injury Modes. DePalma RG.In:Kobeissy FH, editor: Brain Neurotrauma: Molecular, Neuropsychological, and Rehabilitation Aspects. Boca Raton (FL): CRC Press/Taylor & Francis; 2015. Chapter 2. Frontiers in Neuroengineering | We have reviewed the suggested references and have included them in the Applicability section. We have noted that most studies do not include a denominator that allows determination of true incidence or prevalence. |
| | Yes - MSMR was not cited, a major resource of traumatic injuries due to blast. VA TBI Screen and Comprehensive Eval publications were not cited. | We searched the contents of MSMR for relevant publications and have added the Surveillance Snapshot from the February 2015 edition. Other reports either did not distinguish blast-related injuries (combining gun and explosive events), included all service members (not limited to OEF/OIF/OND), or did not provide an appropriate denominator. |
| Additional suggestions or comments can be provided below. If applicable, please indicate the page and line numbers from the draft report. | Thank you for an excellent and very focused review. It is unfortunate that after so many years of research, we continue to find there is little known about a variety of TBI-related issues. The root cause of many of our lingering questions stems from our shortcomings in diagnostic accuracy, among other limitations of existing data. We have a growing expertise treating symptoms associated with TBI, but without objective diagnostic criteria and without adequately controlled, comparative studies the best outcomes may elude us.<br><br>In addition to the DoDTR and MTR (which likely contain the best blast data), data from the Armed Forces Health Surveillance Center (AFHSC) may be the most comprehensive for (first) TBI incident reporting (see 2015 article attached).<br>Editing comments:<br>1) Page 34 - Cognitive Function / Other, review of Clark 2009 was not easy to read/follow. The sentence seems broken.<br>2) Page 40 - vestibular EFFECTS (not affects) | We have added information about limitations of the existing data in the Discussion section.<br><br>We have cited the Regassa 2015 reference. As noted above, we have checked military injury database sites for posted reports.<br><br>Editing:<br>1) we have revised this sentence<br>2) we have made the suggested change |

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| | p. 7, line 22 - citation to Cernak or Okie related to definition of injury would be best here<br>p. 11, line 15 - are we certain that there is no study related to amputation due to blast injury -is this included in extremity injury. I think amputation is considered differently than musculoskeletal injury<br>p. 14, line 33 - I would refer to this as musculoskeletal injury and again would clarify if this is extremity trauma vs. orthopedic injury (fracture/soft tissue)<br>p. 14, line 53 - I believe there are citations related to burn related to explosion<br>1: Escolas SM, Archuleta DJ, Orman JA, Chung KK, Renz EM. Postdischarge Cause-of-Death Analysis of Combat-Related Burn Patients. J Burn Care Res. 2015 Dec 1. [Epub ahead of print] PubMed PMID: 26629656.<br>2: Barillo DJ, Pozza M, Margaret-Brandt M. A literature review of the military uses of silver-nylon dressings with emphasis on wartime operations. Burns. 2014 Dec;40 Suppl 1:S24-9. doi: 10.1016/j.burns.2014.09.017. Review. PubMed PMID: 25418434.<br>3: Valerio IL, Sabino J, Mundinger GS, Kumar A. From battleside to stateside: the reconstructive journey of our wounded warriors. Ann Plast Surg. 2014 May;72 Suppl 1:S38-45. doi: 10.1097/SAP.0000000000000168. PubMed PMID: 24740023.<br>4: Jeevaratnam JA, Pandya AN. One year of burns at a role 3 Medical Treatment Facility in Afghanistan. J R Army Med Corps. 2014 Mar;160(1):22-6. doi: 10.1136/jramc-2013-000100. Epub 2013 Jun 7. PubMed PMID: 24109100.<br>5: Feldt BA, Salinas NL, Rasmussen TE, Brennan J. The joint facial and invasive neck trauma (J-FAINT) project, Iraq and Afghanistan 2003-2011. Otolaryngol Head Neck Surg. 2013 Mar;148(3):403-8. doi: 10.1177/0194599812472874. Epub 2013 Jan 11. PubMed PMID: 23314163.<br>6: Chan RK, Siller-Jackson A, Verrett AJ, Wu J, Hale RG. Ten years of war: a characterization of craniomaxillofacial injuries incurred during operations Enduring Freedom and Iraqi Freedom. J Trauma Acute Care Surg. 2012 Dec;73(6 Suppl 5):S453-8. doi: 10.1097/TA.0b013e3182754868. PubMed PMID: 23192069.<br>7: Mora AG, Ritenour AE, Wade CE, Holcomb JB, Blackbourne LH, Gaylord KM. Posttraumatic stress disorder in combat casualties with burns sustaining primary blast and concussive injuries. J Trauma. 2009 Apr;66(4 Suppl):S178-85. doi: 10.1097/TA.0b013e31819ce2d6. PubMed PMID: 19359963.<br>8: Gaylord KM, Cooper DB, Mercado JM, Kennedy JE, Yoder LH, Holcomb JB. Incidence of posttraumatic stress disorder and mild | p7/22. We have added the Cernak reference to the full report (we did not include references in the Executive Summary).<br>p11/15. The report of musculoskeletal injuries included amputations. We have noted this in the Executive Summary and full report and have added data to the Appendix tables.<br>p14/33. We have made this change and clarified the type of injury.<br>p14/53. We have reviewed each of the suggested references. Two were already included (Chan, Mora) although Chan has now been removed because the denominator was not number deployed. We added a burn outcome reported by Mora to the outcomes for KQ3. None of the other references provided outcomes pertaining to the key questions.<br><br>p17/26. We have added the Cernak reference.<br>p26/14. The study this comment refers to has been deleted because it did not provide a suitable denominator.<br>p26/23. The study this comment refers to has also been deleted because it did not provide a suitable denominator.<br>p28/30. The inconsistency and spacing issues noted have been eliminated with the switch to superscript reference citations in the final version of the report.<br>p35/8. We have made this correction.<br>p45/35. We have made this change and clarified the type of injury included.<br>p46/6. We have made this change.<br>p46/50. We included only published data. As noted above, we looked at the military injury database sites for posted reports.<br>p47//21. We have added “published” to this sentence.<br>p47/55. We have revised this sentence. |

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|---|---|---|
| | traumatic brain injury in burned service members: preliminary report. J Trauma. 2008 Feb;64(2 Suppl):S200-5; discussion S205-6. doi: 10.1097/TA.0b013e318160ba42. PubMed PMID: 18376167.<br><br>p. 17, line 26 - again would reference Okie or Cernak<br>p. 26, line 14 - Did they include deployed population at time as the denominator? Should that be reported for consistency<br>p. 26, line 23 - suggest overall number be reported<br>p. 28, line 30 - this happens multiple times in the document, after this point, the period and the parentheses seem misaligned and are done inconsistently - some with period before, some after; other formatting problems with spacing should also be checked, noted this throughout the document.<br>p. 35, line 8 - s missing from patients<br>p. 45, line 35 - usually referred to as musculoskeletal injury and unclear if this includes SCI<br>p. 46, line 6 - change contraction don't to do not<br>p. 46, line 50 - was any attempt made to request data or technical reports from JTAPIC or DVBIC for unpublished data? http://jtapic.amedd.army.mil/getStarted.php<br>p. 47, line 21 - I think the caveat here is related to what is available in the published literature. There are unpublished data on the classified side that we know exist but to which we do not have access.<br>p. 47, line 55 - this sentence is awkward and I cannot rewrite because I cannot understand what is meant by it. | |
| | Applicability of Report page9 lines 9-18 references the 1,906 754 OEF/OIF/OND veterans becoming eligible for VA Care. It is known that ~55% reported for VA care. All those screened for TBI; the numbers reporting, screened and completing TBI evaluation are also known. Currently these approach 80-90,000; with additional arriving with DOD diagnosed TBI 125-126,000(Bidelspach/Cifu). This is a partial denominator which needs to be taken into consideration, recognizing that we cannot extrapolate to those not reporting and seen. | There were many reports of “proportional” outcomes – the fraction of an exposed group (*ie,* those injured in combat)(Holcomb 2006) but we have defined incidence based on number deployed and included only studies that report incidence or prevalence for the deployed population. We have included information about the VA TBI evaluation program in the Applicability section of the report. |

# APPENDIX C. EVIDENCE TABLES

## Table 1. Study Characteristics – Key Questions 1 and 2

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics |
|---|---|---|---|---|
| | Registry/ Database | Clinical Cohort | | |
| Belmont, 2010[6]<br><br>Funding Source: No external funding received | ✓<br>Joint Theater Trauma Registry<br><br>Electronic medical records<br><br>4,122 deployed during study period | | 2007<br>Iraq (surge)<br><br>US Army Brigade Combat Team (BCT)<br><br>ICD-9 Codes 800-960 | Branch of service: 100% Army<br>Rank:<br>E1-E4 (junior enlisted): 50%<br>E5-E9 (senior enlisted): 40%<br>O1-O3/WO1-WO5 (junior officers and warrant officers): 8%<br>O4-O6 (senior officers): 1%<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: N/A<br>Duration of deployment: 15 months<br>Rural vs urban residence: NR<br>Gender (% male): 92<br>Mean age (years): 27 |
| Belmont, 2012[8]<br><br>Funding Source: None reported | ✓<br>Joint Theater Trauma Registry<br><br>1,992,232 deployed during study period | | 2005-2009<br>Iraq and Afghanistan<br><br>ICD-9 Codes 800-960<br><br>Did not include killed in action (KIA) | **Combat Casualty Cohort**<br>Branch of service: 78% Army, 2% Navy, 1% Air Force, 19% Marines<br>Rank:<br>E1-E4 (junior-enlisted): 59%<br>E5-E9 (senior-enlisted): 34%<br>O1-O3 (junior officers) and all warrant officers: 6%<br>O4-O10 (senior officers): 1%<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural vs urban residence: NR<br>Gender (% male): 99<br>Mean age (years): 26 |
| Belmont, 2013[7]<br><br>Funding Source: None received<br><br>(Additional analysis of cohort described in Belmont 2012) | ✓<br>Joint Theater Trauma Registry<br><br>1,992,232 deployed during study period | | 2005-2009<br>Iraq and Afghanistan<br><br>Musculoskeletal combat casualty: wound to upper or lower extremities, spine, or pelvis | **Musculoskeletal Combat Casualty Cohort**<br>Branch of service: 78% Army, 2% Navy, 1% Airforce, 19% Marines<br>Rank: 59% Junior Enlisted, 34% Senior Enlisted, 6% Junior Officer, 1% Senior Officer, <1% unknown<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural vs urban residence: NR<br>Gender (% male): 99<br>Mean age (years): 26 |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics |
|---|---|---|---|---|
| | Registry/ Database | Clinical Cohort | | |
| Schoenfeld, 2013[9]<br><br>Funding Source: None received<br><br>(Additional analysis of cohort described in Belmont 2012) | ✓ Department of Defense Trauma Registry[a]<br><br>1,992,236 person-years of exposure during study period | | 2005-2009<br>Iraq and Afghanistan<br><br>Spinal injury identified from manual search of records from 7,877 casualties; included spine fractures, spinal dislocations, disk displacements, nerve root injuries, and spinal cord injuries<br><br>(Additional analysis of data reported in Belmont 2012) | **Spinal Injury Cohort**<br>Branch of service: 81% Army, 2% Navy, 1% Airforce, 16% Marines<br>Rank: 57% Junior Enlisted, 36% Senior Enlisted, 7% Officers, 1% unknown<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural vs urban residence: NR<br>Gender (% male): 99<br>Mean age (years): 27 |
| Freedman, 2014[10]<br><br>Funding Source: None reported | ✓ Joint Theater Trauma Registry<br><br>Landstuhl Regional Medical Center (spinal surgery and radiology reports) | | 2007-2010 (test cohort 2009-2010, historical controls 2007-2008 and 2008-2009)<br>Iraq and Afghanistan<br><br>Thoracolumbar *combat* burst fracture defined as improvised explosive device attack against an armored vehicle | **Combat Casualty Cohort**<br>Branch of service: Army > Marines > Air Force<br>Rank: 59% from lowest four enlisted ranks<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural vs urban residence: NR<br>Gender (% male): 97<br>Mean age (years): 30 |
| Goldberg, 2014[11]<br><br>Funding Source: Congressional Budget Office | ✓ Department of Defense tabular reports | | OEF, OIF, OND from beginning of conflicts to April 4, 2011<br><br>Major amputation defined as loss of limb at or proximal to wrist or ankle | **Amputation Cohort**<br>n = 1,186 service members with at least 1 major amputation (809 in Iraq, 377 in Afghanistan)<br>Branch of service: NR<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural vs urban residence: NR<br>Gender (% male): NR<br>Mean age (years): NR |

[a] Joint Theater Trauma Registry renamed Department of Defense Trauma Registry in 2012

**Table 2. Incidence and Prevalence Outcomes**

| Author, Year | Blast Injury Incidence | Other Incidence Findings | Blast Injury Prevalence | Other Prevalence Findings |
|---|---|---|---|---|
| Belmont, 2010[6] | 2007: 8% (341 explosion casualties/4,122 deployed or 83 explosion casualties/1,000 deployed)[a]<br>KIA: 0.6% (25/4,122)<br>DOW: 0.05% (2/4,122)<br>MEDEVAC: 1.6% (68/4,122)<br>RTD: 6.0% (246/4,122) | Blast Characteristics: NR<br>Injury Site (number of body regions injured by explosion/total number of body regions injured):<br>Head/Neck: 49.3%<br>Thorax: 2.9%<br>Abdomen: 4.4%<br>Extremity: 31.2%<br>Injury Outcome: 97.8% of concussions were explosion related | | |
| Belmont, 2012[8] | WIA-DOW<br>2005: 0.45% (1,476 explosion casualties/ 331,593 deployed or 4.5/1,000)<br>2006: 0.35% (1,347/383,896 or 3.5/1,000)<br>2007: 0.40% (1,549/390,943 or 4.0/1,000)<br>2008: 0.17% (736/438,220 or 1.7/1,000)<br>2009: 0.17% (754/447,580 or 1.7/1,000) | Blast Characteristics: NR<br>Injury Site: NR<br>Injury Outcome: NR | 5 years (2005-2009)<br>WIA-DOW:<br><br>0.29% (5,862 explosion casualties/ 1,992,232 deployed)<br><br>74.4% (5,862/7,877) WIA-DOW casualties were explosion related | Blast Characteristics: NR<br>Injury Site: NR<br>Injury Outcome: NR |

| Author, Year | Blast Injury Incidence | Other Incidence Findings | Blast Injury Prevalence | Other Prevalence Findings |
|---|---|---|---|---|
| Belmont, 2013[7]<br><br>(Additional analysis of cohort described in Belmont 2012) | WIA-DOW<br>2005: 0.35% (1,177 explosion-related musculoskeletal casualties/331,593 deployed or 3.5/1,000)<br>2006: 0.27% (1,048/383,896 or 2.7/1,000)<br>2007: 0.31% (1,205/390,943 or 3.1/1,000)<br>2008: 0.13% (563/438,220 or 1.3/1000)<br>2009: 0.13% (570/447,580 or 1.3/1,000) | Blast Characteristics: NR<br>Injury Site NR<br>Injury Outcome: NR | Musculoskeletal Injury (2005-2009) WIA-DOW:<br><br>0.23% (4,563 explosion-related musculoskeletal casualties/1,992,232 deployed)<br><br>82% (14,158/17,177) of musculoskeletal wounds were explosion related | Blast Characteristics: NR<br>Blast-related Injury Site:<br>Axial skeleton fracture<br>0.42/1,000 deployed per year (841/1,142 fractures [74%])<br>Upper extremity fracture<br>0.96/1,000 deployed per year (1,917/2,470 fractures [78%])<br>Lower extremity fracture<br>1.32/1,000 deployed per year (2,662/3,182 fractures [84%])<br>Amputation<br>0.49/1,000 deployed per year (976/1,039 amputations [94%])<br>Neurological injury<br>0.30/1,000 deployed per year (596/927 injuries [64%]; includes 45/96 spinal cord injuries [47%])<br>Joint dislocation<br>0.15/1,000 deployed per year (304/361 dislocations [84%])<br>Soft tissue injury<br>3.42/1,000 deployed per year (6,862/8,056 injuries [85%])<br>Injury Outcome: NR |
| Schoenfeld, 2013[9]<br><br>(Additional analysis of cohort described in Belmont 2012) | Spinal Injury<br>2005: 0.04% (134 explosion-related spinal injuries/331,593 deployed or 0.40/1,000)<br>2006: 0.04% (144/383,900 or 0.38/1,000)<br>2007: 0.04% (152/390,943 or 0.38/1,000)<br>2008: 0.02% (78/438,220 or 0.18/1,000)<br>2009: 0.03% (137/447,580 or 0.31/1,000) | Blast Characteristics: NR<br>Injury Site: NR<br>Injury Outcome: NR | Spinal Injury (2005-2009)<br><br>0.03% (650 with explosion-related spinal injuries/1,992,236 deployed) or 3.3/10,000<br><br>75% (650/872) of individuals with spinal injuries had explosion-related injuries | Blast Characteristics: NR<br>Injury Site: NR<br>Injury Outcome: NR |

| Author, Year | Blast Injury Incidence | Other Incidence Findings | Blast Injury Prevalence | Other Prevalence Findings |
|---|---|---|---|---|
| Freedman, 2014[10] | Thoracolumbar burst fracture incidence per 10,000 soldier-years<br>2007-2008: 0.45 (9 events [4 IED related])<br>2008-2009: 0.60 (11 events [6 IED related])<br>2009-2010: 2.08 (38 events [32 IED related])[b] | Blast Characteristics: NR<br>Injury Site: NR<br>Injury Outcome: NR | Thoracolumbar burst fractures per 10,000 soldier-years (2007-2010)<br><br>Combat mechanism of injury (IED): 2.02 (38 events)<br><br>Other mechanisms of injury: 1.06 (20 events) | Blast Characteristics: NR<br>Blast Injury Site: All thoracolumbar<br>Injury Outcome: NR |
| Goldberg, 2015[11] | | | Major IED-related amputations (2001-April 2011):<br><br>OIF, OND (Iraq): 38.3/100,000 troop years<br><br>OEF (Afghanistan): 87.8/100,000 troop years. | Blast Characteristics: NR<br>Injury Site: NR<br>Injury Outcome: NR |

[a] Some soldiers had >1 casualty but exact number of soldiers with explosion and non-explosion casualties not reported
[b] In the 2009-2010 cohort, there were 38 events among Service Members; 28 of those events were IED-related; 4 events were in non-US Service Members
DOW = died of wounds; WIA = wounded in action; KIA = killed in action; MEDEVAC = medically evacuated; RTD = returned to duty; IED = improvised explosive device; NR = not reported

**Table 3. Study Characteristics – Key Question 3**

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
|---|---|---|---|---|---|
| | Registry/ Database | Clinical Cohort | | | |
| Akin, 2011[15]<br><br>Funding Source: VA | | ✓ | Inclusion: Consecutive Veterans with history of blast and/or mTBI; referred to VAMC Vestibular/Balance Laboratory for complaints of dizziness and/or imbalance | N = 18 with mTBI (n = 9 blast, n = 9 non-blast)<br>Age (years): 37 (total sample); range 23-76; 25 (81%) Veterans from Iraq/Afghanistan wars<br>Gender: NR<br>Cohort or service year(s): NR<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural or urban residence: NR | Vestibular and balance assessment<br>a. Horizontal semicircular canal function (rotary chair videonystagmography)<br>b. Otolith function (cVEMPs and SVV tests during unilateral centrifugation)<br>c. Tests for BPPV (Dix-Hallpike, roll test)<br>d. Central vestibular function (ocular motor and fixation tests)<br>d. Postural stability (SOT)<br>e. Self-perceived handicap (Dizziness Handicap Inventory) |
| Belanger, 2009[26]<br><br>Funding Source: resources and use of facilities at 4 VA Medical Centers and the Mid-Atlantic MIRECC | | ✓ | Inclusion: Consecutively assessed individuals from Tampa VAMC and selected research volunteers from 3 VAMCs in the Mid-Atlantic MIRECC<br>Exclusion: Suspected of poor effort and malingering based on clinical presentation and/or failed certain measured of symptom validity; other known neurological disorders (apart from TBI), brain injury due to gunshot | N = 102 (n = 61 blast, n = 41 non-blast)<br>Age (years) at evaluation:<br>-Blast: 29<br>-Non-blast: 28 (P>.59)<br>Gender (% male): 96<br>Cohort or service years(s): NR (Iraq and Afghanistan)<br>Rank: NR<br>Duty/description: active duty: 67%<br>Blast exposure history: NR<br>Time since exposure: 443 days (blast); 954 days (non-blast); P>.13<br>Duration of deployment: NR<br>Rural or urban residence: NR | Trail Making Test<br><br>Digit Symbol-Coding subset of Wechsler Adult Intelligence Scale-3rd edition (WAIS-III)<br><br>Brief Visuospatial Memory Test-Revised (BVMT-R)<br><br>California Verbal Learning Test-II (CVLT-II)<br><br>Post-traumatic stress disorder checklist (PCL) (self-report) |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
|---|---|---|---|---|---|
| | Registry/ Database | Clinical Cohort | | | |
| Belanger, 2011[27]<br><br>Funding Source: VHA, DVBIC | | ✓ | Inclusion: Patient from Tampa or Bay Pines VAMC or WRAMC; reported history of mTBI based on diagnostic interview and available records; TBI diagnosis based on DoD criteria (external force acting on individual resulting in alteration or loss of consciousness); mild TBI was loss of consciousness < 30 minutes and post-traumatic amnesia < 24 hours; completed measures used in study; consented to participate | N = 390 (n = 298 blast, n = 92 non-blast)<br>Tampa VAMC: 40; Bay Pines VAMC: 25; WRAMC: 325<br>Age (years):<br>-Blast: 28<br>-Non-blast: 30 (P = .08)<br>Gender (% male): 94%<br>Cohort years: NR<br>Rank: NR<br>Duty/description: 87% active duty<br>Time since exposure (mean):<br>-Blast: 11.9 months<br>-Non-blast: 25.9 months (P = .002)<br>Duration of deployment: NR<br>Rural or urban residence: NR | PTSD Checklist (PCL); self-report; 17 items (rated 1-5 with 1 = not at all and 5 = extremely)<br><br>Neurobehavioral Symptom Inventory (NSI); self-report; post-concussion symptoms; 22 items (rated 0-4 with 0 = none and 4 = very severe) |
| Brahm, 2009[28]<br><br>Funding Source: VA Quality and Enhancement Research Initiative (QUERI) grant | | ✓ | Inclusion: Consecutive polytrauma inpatients (PRC) or outpatients (PNS); combat-injured<br><br>PRC: 84% with moderate to severe TBI, polytrauma; typically acute or sub-acute stage of rehabilitation<br>PNS: mTBI, postacute | Inpatients N = 68 (n = 57 blast, n = 11 non-blast)<br>Age (years):<br>-Blast: 28.6<br>-Non-blast: 28.8<br>Gender (% male): 96% overall<br>Cohort years: 2004-2006<br>Outpatients N = 124 (n = 112 blast, n = 12 non-blast)<br>Age (years):<br>-Blast: 29.7<br>-Non-blast: 37.9 (P<.025)<br>Gender (% male): 96 overall<br>Cohort years: 2006-2007<br>Both Groups:<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural vs urban residence. NR | Visual impairment: loss of visual acuity (Feinbloom chart or other tests used for verbally non-responsive patients) or visual field (Goldmann visual fields if patient capable)<br><br>Ocular injuries<br><br>Subjective visual complaint |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
|---|---|---|---|---|---|
| | Registry/ Database | Clinical Cohort | | | |
| Clark, 2009[29]<br><br>Funding Source: Department of Veterans Affairs Rehabilitation Research and Development grant | | ✓ | Inclusion: Consecutively admitted to TPRC; active duty and Veterans; patient's medical records had self-reported admission pain scores<br>Exclusion: Severe brain injuries and associated significant communications deficits<br><br>TBI: 83% of blast group, 79% of non-blast group; more penetrating TBI in blast group, more closed TBI in non-blast group | N = 128 (n = 51 combat blast; n = 34 combat non-blast)*<br>Age (years):<br>-Blast: 28<br>-Non-blast: 27<br>Gender (% male)<br>-Blast: 96<br>-Non-blast: 94<br>Cohort years: 2003-2006<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural or urban residence: NR<br>*NOTE: n = 43 non-combat not included in analysis | Functional Independence Measure (FIM) – 18 items<br>a) ability for independent function in daily activities<br>b) cognitive function<br>-Rancho Los Amigos Scale (Rancho) – behavioral characteristics and cognitive deficits associated with recovery from brain injury<br>-Pain Numeric Rating Scale (NRS) – pain intensity in those capable of self-report; extracted if Rancho ≥ VI<br>-Number of pain sites<br>-Number of psychiatric diagnoses |
| Cockerham, 2013[30]<br><br>Funding Source: Veterans Administration Merit Review Award | | ✓ | Inclusion: Diagnosis of TBI; ability to undergo clinical examination and psychometric testing<br>Exclusion: Eyes with open-globe injury; using topical ocular medications | N = 53 (n = 44 blast, n = 9 non-blast)<br>Age (years): 26<br>Gender (% male): 100<br>Cohort years: NR<br>Rank: NR<br>Duty/description: 100% Veterans<br>Blast exposure history:<br>Time since exposure (median): 6 months (range 1-60)<br>Duration of deployment: NR<br>Rural or urban residence: NR | Ocular Surface Disease Index (OSDI) – interview by research team member to assess dry eye disease (DED) symptoms; 12 items scored 0 (none of the time) to 4 (all of the time); higher scores = greater disability |
| Collen, 2012[31]<br><br>Funding Source: No funding received | | ✓ | Inclusion: Consecutive soldiers with combat-related TBI (85% mTBI, 9% moderate, 6% severe); receiving care at WRAMC; age ≥ 18y; sustained non-penetrating TBI<br>Exclusion: sleep disorders diagnosed prior to injury | N = 116 (n = 82 blast, n = 34 blunt)<br>Age (years):<br>-Blast: 30<br>-Non-blast: 35 (P = .01)<br>Gender (% male): 97<br>Cohort years: 2005-2010<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: 16 months<br>Duration of deployment: NR<br>Rural vs urban residence. NR | Epworth Sleepiness Scale (ESS): subjective assessment of daytime somnolence<br><br>Polysomnography: to detect insomnia and obstructive sleep apnea syndrome (OSAS); completed in 79% of patients |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
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| | Registry/ Database | Clinical Cohort | | | |
| Cooper, 2012[32]<br><br>Funding Source: None reported | | ✓ | Inclusion: Consecutive admissions of OEF/OIF service members referred to TBI clinic at BAMC for neuropsychological testing Jan 2008-Jan 2010; at least 18 years old; fluent English; sustained injury while on active duty military service<br>Exclusion: no mTBI; major body burns and/or traumatic amputations affecting administration of neurocognitive measures; fell below empirically derived cut scores for suboptimal effort o psychometric testing; missing variables on key measures of interest | N = 60 (n = 32 blast, n = 28 non-blast)<br>Age (years):<br>-Blast: 29.5<br>-Non-blast: 29.4 (P = .97)<br>Gender (%male):<br>-Blast: 100<br>-Non-blast: 79% (P = .006)<br>Cohort years: 2008-2010<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure:<br>-Blast: 192 days<br>-Non-blast: 149 days<br>Duration of deployment: NR<br>Rural or urban residence: NR | Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) – cognitive functioning<br><br>Headache Impact Test (HIT-6) – headache severity and impact on daily function<br><br>Post-Traumatic Checklist-Military version (PCL-M) – self-rated |
| DuBose, 2011[13]<br><br>Funding Source: None reported | ✓ Joint Theater Trauma Registry | | Inclusion: 18 to 55 years old; sustained isolated TBI | N = 604 (n = 374 blast, n = 118 gunshot, n = 112 blunt)<br>Age (years):<br>-Blast: 25.5<br>-Gunshot: 25.1<br>-Blunt: 27.1 (P = .04)<br>Gender (% male):<br>-Blast: 98.4<br>-Gunshot: 100<br>-Blunt: 94.6 (P = .01)<br>Cohort years: 2003-2007<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural or urban residence: NR | Mortality |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
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| | Registry/ Database | Clinical Cohort | | | |
| Fortier, 2014[33]<br><br>Funding Source: Translational Research Center for TBI and Stress Disorders, a VA Rehabilitation Research and Development (RR&D) Traumatic Brain Injury Center of Excellence | | ✓ | Inclusion: Consecutive deployed Veterans of OEF/OIF; enrolled in VA RR&D-supported TBI Center of Excellence<br>Exclusion: History of seizures; prior serious medical illness; current active suicidal and/or homicidal ideation, intent, or plan; bipolar disorder, schizophrenia, or other psychotic disorder; cognitive disorder not due to TBI<br><br>NOTE: total sample of 131 enrolled (56 with military TBI) | N = 56 (n = 26 blast, n = 30 non-blast)<br>Age (years): 34 (total sample)<br>Gender (% male): 86 (total sample)<br>Cohort years: NR<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history (for 101/131 with blast exposure within 100 meters: mean blasts/person = 14, median = 2<br>Time since exposure (mean): 31 months (range 1-99) since last deployment (total sample)<br>Duration of deployment (mean): 13 months (range 3-38) (total sample)<br>Rural vs urban residence. NR | Boston Assessment of Traumatic Brain Injury-Lifetime (BAT-L): questionnaire for preliminary screen administered as a self-report questionnaire; captures number of exposures to blasts within 100 meters and number of TBIs due to blast, TBIs and their severity, and neurobehavioral symptoms (occurrence, timing of onset, and duration) |
| French, 2014[25]<br><br>Funding Source: No funding received | | ✓ | Inclusion: US male Service members who sustained closed mTBI and were evaluated at WRAMC or SAMMC after injuries sustained during OEF/OIF (typically with other injuries); deployed ≤3 times; completed NSI, PCL-C, and Abbreviated Injury Scale (AIS); divided into 4 groups based on injury severity based in Injury Severity Score (ISS)<br>Exclusion: no additional criteria reported | N = 579 (n = 73 minor injury, 278 moderate, 148 serious, 80 severe/critical); 82% injured as a result of blast exposure<br>Age (years): 27<br>Gender (% male): 100<br>Cohort years: NR<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure (mean): 12 months or less (mean 73 days)<br>Duration of deployment (mean): NR<br>Rural vs urban residence. NR | -Neurobehavioral Symptom Inventory (NSI): 22 items, presence/severity of each symptom rated 0 (none) to 4 (very severe); total 0 (no symptoms) to 88 (all symptoms at very severe level); 3 cluster scores (somatic/sensory, cognitive, affective)<br>-PCL-C: 17 items; self-reported PTSD symptoms; range 17 (not at all) to 85 (all symptoms at extreme level); 3 cluster scores (re-experiencing, avoidance, hyper-arousal)<br>-ISS: based on AIS for 3 most severely injured body region (brain excluded for this study) |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
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| | Registry/ Database | Clinical Cohort | | | |
| Goodrich, 2013<br>Goodrich, 2014[34,35]<br><br>Funding Source: Veterans Affairs Quality Enhancement Research Initiative (QUERI) grant | | ✓ | Inclusion: Admitted to VA PRC; documented eye exams with optometry; history of TBI<br>Exclusion: None reported<br><br>NOTES:<br>a. many of the 50 non-blast TBIs occurred in non-combat settings<br>b. mTBI:<br>-Blast: 53% (26/49)<br>-Non-blast: 2% (1/49) (P = .0001)<br>c. 16 in blast group had *documented* secondary or tertiary trauma (non-primary injuries *may not* have been documented in remaining patients) | N = 100 (n = 50 blast, n = 50 non-blast)<br>Age (years):<br>-Blast: 29<br>-Non-blast: 29<br>Gender (% male)<br>-Blast: 94%<br>-Non-blast: 96%<br>Cohort years: NR<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history:<br>-32% (16/50) of blast group had documented secondary or tertiary trauma<br>-32% (16/50) had >1 exposure<br>Time since exposure (mean):<br>-Blast: 1 year (range 0.03-4.79)<br>-Non-blast: 0.32 years (range 0.02-3.13)<br>Duration of deployment: NR<br>Rural or urban residence: NR | Subjective and objective ocular and vision data from eye examinations nearest in date to injury date<br><br>Self-reported vision complaints<br><br>Visual acuity<br><br>Reading ability<br><br>Ocular injuries |
| Hoffer, 2009[36]<br><br>Funding Source: None reported | | ✓ | Inclusion: war-injured with diagnosis of or significant risk factors for mTBI; presented over 9 month period | **VOR study:** N = 55 (n = 21 blast, n = 34 blunt)<br>Age (years): 26<br>Gender (% male): 100<br>**VSR study:** N = 72 (n = 39 blast, n = 32 blunt)<br>Age (years): 24<br>Gender (% male): 96<br>**Both studies:**<br>Cohort years: NR<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural or urban residence: NR | **VOR study:** Gain, phase and symmetry of sinusoidal harmonic acceleration testing (rotational chair)<br><br>**VSR study:**<br>a. Sensory organization test (SOT)<br>b. Motor control test (latency times) |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
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| | Registry/ Database | Clinical Cohort | | | |
| Kennedy, 2010[16]<br><br>Funding Source: US Army Medical Research and Materiel Command | | ✓ | Inclusion: outpatients at SAMMC; screened and identified with mTBI due to blast or other mechanism while deployed; consented to allow information to be used for research<br>Exclusion: incomplete data on Posttraumatic Stress Disorder Checklist-Civilian version (PCL-C); more severe TBI; no clear date of injury<br><br>NOTE: Blast group included significantly more Army soldiers (described as "more likely to engage in activities involving high risk of exposure to explosive munitions") | N = 724 (n = 586 blast, n = 138 non-blast)<br>Age (years):<br>-Blast: 27.4<br>-Non-blast: 30.0 (P = .001)<br>Gender (% male)<br>-Blast: 98<br>-Non-blast: 92 (P = .001)<br>Cohort years: 2005-2009<br>Rank:<br>-Blast: 95% enlisted, 5% officer<br>-Non-blast: 92% enlisted, 8% officer (P = .16 for blast vs non-blast)<br>Duty/description: NR (See NOTE)<br>Blast exposure history: NR<br>Time since exposure (mean): 31 weeks (range 2 days to 5.4 years); P = .43 (blast vs non-blast)<br>Duration of deployment: NR<br>Rural or urban residence: NR | PCL-C: 17- items measuring severity of PTSD symptoms; PTSD = score>50 |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
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| | Registry/ Database | Clinical Cohort | | | |
| Kontos, 2013[22]<br><br>Funding Source: US Special Operations Command Biomedical Initiatives Steering Committee | ✓ | | Inclusion: US Army Special Operations Command (USASOC) personnel completing web-based standardized baseline evaluations for mTBI symptoms, PTSD symptoms, and neurocognitive performance; at least 1 diagnosis of mTBI; deployed and non-deployed settings<br>Exclusion: history of diagnosed moderate to severe TBI, brain surgery, major psychiatric disorder or neurologic disorder; neurocognitive assessment deemed invalid | N = 2,813 (n = 861 blast, n = 1,700 blunt, n = 252 blast-blunt combination)<br>Age (years): 29.5<br>Gender (% male): 96<br>Cohort years: 2009-2011<br>Rank: NR<br>Duty/description: NR*<br>Blast exposure history: 1,113 with blast or combination (764 [69%] 1 blast, 181 [16%] 2 blasts, 168 [15%] ≥3 blasts)<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural or urban residence: NR<br>*USASOC includes “Special Forces, Army Rangers, and other unconventional units involved in high-risk training, multifaceted global operations, and challenging combat missions” | Immediate Post-Concussion Assessment Cognitive Test (ImPACT) – military version: neurocognitive performance; 4 composite scores<br><br>Post-Concussion Symptom Scale (PCSS): 22 self-reported symptoms rated from 0 (none) to 6 (severe)<br><br>PTSD Check List (PCL):17 items, how much each item bothered them for past month; 0 (not at all) to 5 (extremely) |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
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| | Registry/ Database | Clinical Cohort | | | |
| Lange, 2012[37]<br><br>Funding Source: No financial support received for completion of manuscript | | ✓ | Inclusion: sustained deployment related closed mTBI and evaluated at WRAMC following medical evacuation from OEF/OIF combat theater; completed core neuropsychological test battery; adequate effort on Word Memory Test; valid clinical profile on Personality Assessment Inventory; able to classify severity of injury as mild; assessed by TBI Service within 14 months of injury; male<br><br>NOTES:<br>a. most patients evacuated for limb loss or systemic injuries<br>b. selected from sample of 662 evaluated at WRAMC | N = 56 (n = 35 blast plus, n = 21 non-blast)<br>Age (years):<br>-Blast: 32.7<br>-Non-blast: 31.4 (P = .58)<br>Gender (% male): 100<br>Cohort years: 2002-2009<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure (mean):<br>-Blast: 4.5 months<br>-Non-blast: 4.3 months (P = .83)<br>Duration of deployment (mean): NR<br>Rural or urban residence: NR | Personality Assessment Inventory (PAI): T-score ≥ 60 = mild or higher, ≥ 70 = moderate or higher<br><br>Neurocognitive measures:<br>a. Trail Making Test (TMT)<br>b. California Verbal Learning Test 2nd ed (CVLT-II)<br>c. Conner's Continuous Performance Test-2nd ed (CPT-II)<br>d. Subsets from Wechsler Adult Intelligence Scale-3rd ed<br>e. Wechsler Test of Adult Reading<br>f. Word Memory Test (WMT) |
| Lew, 2011[14]<br><br>Funding Source: VA Office of Research and Development, Health Services Research and Development Service | ✓ DoD Defense Management Data Center | | Inclusion: medical records with information on demographics and results of comprehensive TBI evaluations performed in Veterans Health Administration<br>Exclusion: test cases; duplicate TBI evaluations; cases involving inconsistent responses regarding blast exposure; reported sustaining TBI at time other than deployment | N = 12,521 deployment related TBI (n = 10,431 blast, n = 2,090 non-blast)<br>(85% mTBI)<br>Age (years): 31.3<br>Gender (% male): 93.9<br>Cohort years: 2007-2009<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure (mean): NR<br>Duration of deployment (mean): NR (median number of deployments = 1.0 [range 1-19]; median years of service = 4.0 [range 0-36])<br>Rural or urban residence: NR | Neurobehavioral Symptom Inventory (NSI-22): 22 items, self-report extent to which cognitive, affective, somatic, or sensory symptoms have impacted them in past 30 days |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
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| | Registry/ Database | Clinical Cohort | | | |
| Lew, 2007[38]<br><br>Funding Source: Unfunded at time of manuscript publication | | ✓ | Inclusion: new admissions to inpatient rehabilitation unit of a VAMC; TBI<br>Exclusion: none reported<br><br>NOTE: blast vs non-blast analysis only includes patients admitted 2003-2006 (no blast-related TBI in patients earlier) | N = 150 (n = 42 blast, n = 108 non-blast)<br>Age (years): 31.6<br>Gender (% male): 93<br>Cohort years: 2003-2006<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure (mean): NR<br>Duration of deployment (mean): NR<br>Rural or urban residence: NR | Hearing loss<br><br>Tinnitus |
| Lippa, 2010[39]<br><br>Funding Source: Supported in part by a Department of VA Center of Excellence Grant | | ✓ | Inclusion: Referred for TBI screening by nationwide VA process (*ie,* Veteran endorses each item):<br>1) Injury during deployment<br>2) Injury resulted in any of the following: dazed, confused, memory problems, losing consciousness, head injury, *etc*)<br>3) Symptoms begin or get worse afterward<br>4) Presented with symptoms in the past week<br>Only patients with both *possible history of TBI* and *current symptoms* referred for evaluation<br>Exclusion: Did not report altered mental status or LOC post injury, altered mental status for > 24 hr post-injury or LOC for > 30 mins; incomplete data | N = 339 with mTBI (n = 138 blast, n = 56 non-blast)<br><br>2 VAMCs<br><br>Age (years):<br>-Blast: 30<br>-Non-blast: 33 (P = .02)<br>Gender (% male):<br>-Blast: 99%<br>-Non-blast: 89%<br>Cohort years: NR<br>Rank: NR<br>Duty/description: NR<br>Time since exposure:<br>-Blast: 35 months<br>-Non-blast: 42 months<br>Duration of deployment: NR<br>Rural or urban residence: NR | PSTD Checklist (PCL): self-report, 17 items (rated 1-5 with 1 = not at all and 5 = extremely)<br><br>Neurobehavioral Symptom Inventory (NSI): self-report; 22 items (rated 0-4 with 0 = none and 4 = very severe)<br><br>Injury Questionnaire: date(s), mechanism(s) (*ie,* fall, motor vehicle, bullet, blast or a combination), and number of deployment related injuries |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
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| | Registry/ Database | Clinical Cohort | | | |
| Luethcke, 2011[17]<br><br>Funding Source:<br>No sources of financial support | | ✓ | Inclusion: Military and civilian contractors referred to outpatient TBI Clinic at a forward-deployed combat support hospital (CSH) in Iraq (OIF); assessed within 72 hr of injury; meeting the DoD and VA criteria for mild TBI<br>Exclusion: none reported<br><br>NOTE: Blast injury defined as primary blast injury (blast wave); "non-blast" injury included secondary, tertiary, or quaternary blast injuries plus injuries not involving blasts | N = 82 (n = 40 blast, n = 42 non-blast)<br>Age (years)<br>-Blast: 27.1<br>-Non-blast: 26.6 (P = .73)<br>Gender (% male)<br>-Blast: 98%<br>-Non-blast: 91% (P = .18)<br>Cohort years: NR<br>Rank (P = .07)<br>Junior enlisted (E1-E4):<br>-Blast: 63%<br>-Non-blast: 61%<br>Duty/description (P = .20)<br>Active duty:<br>-Blast: 53%<br>-Non-blast: 74%<br>Blast exposure history: NR<br>Time since exposure:<br>-Blast: 1.5 days<br>-Non-blast: 1.6 days<br>Duration of deployment (mean): 4.8 months<br>Rural or urban residence: NR | Concussive Symptoms: Self-report and clinical interview<br><br>Automated Neuropsychological Assessment Metrics (ANAM): 6 cognitive domains reported in 2 dimensions (speed, accuracy)<br><br>PTSD Checklist – Military (PCL-M): 17 items, self-report<br><br>Behavioral Health Measure (BHM): 20 items, self-report<br><br>Insomnia Severity Index (ISI): 7 items |

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| | Registry/ Database | Clinical Cohort | | | |
| Mac Donald, 2014[18]<br><br>Funding Source: Congressionally Directed Medical Research program | | ✓ | Inclusion: Active duty US military evacuated from Iraq or Afghanistan to Landstuhl Regional Medical Center (Germany); met DoD criteria for TBI<br>Exclusion: none reported<br><br>Followed 6-12 months after injury at Washington University in St. Louis<br><br>NOTE: blast plus impact TBI group had blast exposure plus another mechanism of head injury (*eg,* fall, motor vehicle crash, strike by blunt object); non-blast TBI group experienced falls, motor vehicle crashes, blunt object strikes without blast exposure | N = 178 with follow-up data including n = 53 blast plus impact TBI, n = 29 non-blast TBI*<br>Age (years):<br>-Blast: 25 (median)<br>-Non-blast: 27 (median)<br>Gender (% male):<br>-Blast: 95<br>-Non-blast: 91<br>Cohort years: NR<br>Rank:<br>Enlisted:<br>-Blast: 97%<br>-Non-blast: 95%<br>Duty/description:<br>Active duty:<br>-Blast: 76%<br>-Non-blast: 73%<br>Blast exposure history: NR<br>Time since exposure (for initial evaluation):<br>-Blast: 11.5 days<br>-Non-blast: 13.8 days<br>Duration of deployment: NR<br>Rural or urban residence: NR<br><br>*data for n = 96 without TBI not included in this review | Glasgow Outcome Scale-Extended: monthly telephone or e-mail for 6-12 months<br><br>In-person<br>1. Standard neurological exam<br>a. Structured interview (Neurobehavioral Rating Scale-Revised)<br>b. 2 headache interviews capturing recent frequency and intensity (Migraine Disability Assessment [MIDAS] & Headache Impact Test 6)<br>c. Neurological Outcomes scale for Traumatic Brain Injury (NOS-TBI)<br>2. Neuropsychological test battery - 9 standard quantitative tests<br>3. Psychiatric evaluation<br>a. Clinician-Administered PTSD scale for DSM-IV (CAPS)<br>b. Montgomery-Asberg Depression Rating Scale<br>c. Combat Exposures Scale (CES)<br>d. Michigan Alcoholism Screening Test |

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| | Registry/ Database | Clinical Cohort | | | |
| MacGregor, 2011[20]<br><br>Funding Source: US Navy Medicine Bureau of Medicine and Surgery | ✓ EMED | | Inclusion: Sustained TBI in OIF; identified from EMED with query for all personnel injured during OIF (3/2004 to 4/2008) who completed Post-Deployment Health Assessment (PDHA) and Post-Deployment Health Re-Assessment (PDHRA); both surveys completed within 1 year of injury date | N = 2074 (n = 1987 blast, n = 87 non-blast)<br>Age (years): 22<br>Gender (% male): 99.5%<br>Enlisted: 96% (49% E1-E2, 40% E4-E6)<br>Cohort years: 2004-2008<br>Rank:<br>- Enlisted: 96%<br>Duty/description: Infantry 58%<br>Blast exposure history: NR<br>Time since exposure: <1 year<br>Duration of deployment: NR<br>Rural or urban residence: NR | Abbreviated Injury Scale (AIS): TBI severity (mild = 1 or 2, moderate = 3, severe = 4, 5, or 6)<br><br>Concomitant injuries |
| Maguen, 2012[40]<br><br>Funding Source: Supported by Department of Defense Psychological Health and Traumatic Brain Injury Research Program and VA Health Sciences Research and Development Career Development Award | | ✓ | Inclusion: OEF/OIF Veterans who received a TBI screen at a VA from April 1, 2007 through Jan 8, 2010; either reported no head injury or both a head injury mechanism and TBI-related symptoms<br>Exclusion: Previously screened elsewhere and data not available; previous TBI diagnosis; refused screening; reported head injury with unknown mechanism or no TBI symptoms; incomplete screen | N = 1,082 (968 for PTSD analysis)<br>N = 152 with 1 mechanism of injury (n = 103 blast)<br>N = 310 with 2+ mechanisms of injury (n = 287 blast + other)<br>Age (years): 29.5<br>Gender (% male): 95%<br>Cohort years: 2007-2010<br>Rank: Enlisted: 96%<br>Duty/description: Active duty: 70%<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR (42% with multiple deployments)<br>Rural or urban residence: NR | Primary Care PTSD Screen (PC-PTSD): 4 item self-report screening instrument<br><br>Patient Health Questionnaire-2 (PHQ-2): 2 item self-report screening instrument; responses on 4 point scale (0-3); score ≥ 3 is positive screen for depression<br><br>Alcohol Use Disorders Identification Test Consumption (AUDIT-C): 3 item self-report screening instrument; total score from 0 to 12; ≥4 for men or ≥3 for women is positive screen for hazardous or harmful consumption |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
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| | Registry/ Database | Clinical Cohort | | | |
| Mendez, 2013[42]<br>Mendez, 2013[41]<br><br>Funding Source: Veterans Affairs Administration | | ✓ | Inclusion: Recent US Veterans of Iraq or Afghanistan wars; presented at VAMC for Second Level TBI evaluation; community dwelling outpatients; reported deployment-related mTBI and met DoD/VA criteria for mTBI; history of primary blast or primary blunt force mTBI; patient reported persistent symptoms they attributed to mTBI; medically and psychiatrically stable; availability of significant other informant willing to participate in study<br><br>Exclusion: Mixed TBI; blunt controls with blast exposure/effects; PTSD, depression, or other mental illness; intervening head injuries, focal neurological deficits, visual impairments sufficient to impair reading, or abnormalities on prior, clinically-obtained brain imaging (magnetic resonance imaging (MRI) or computerized tomography (CT))<br><br>**NOTE: blast is primary blast force only** | N = 24 (n = 12 blast, n = 12 blunt)<br>Age (years):<br>-Blast: 31<br>-Blunt: 31<br>Gender (% male): NR<br>Cohort years: NR<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: 33% (4/12) reported multiple "pure" blast exposures related to combat duties<br>Time since exposure:<br>-Blast: 52 months<br>-Blunt: 49 months<br>Duration of deployment: NR<br>Rural or urban residence: NR<br><br>NOTE: of 12 blast injury subjects, 10 reported distances of < 10 feet from blast exposure, 1 reported < 30 feet, 1 reported < 50 feet | **Mendez 2013[42]:**<br>-Neurobehavioral Symptom Inventory (NSI) self-report of difficulties on 22 symptoms; 5 point scale (4 = very severe)<br>-Rivermead Post-Concussion Symptom Questionnaire (RPQ): 16 symptoms, self-rate degree to which symptoms are more of a problem compared with premorbid levels; scale of 0 (no change) to 4 (most severe symptoms)<br>-Health Related Quality of Life 36-item Short Form for Veterans (SF36-V): self -administered; 8 subscales and 2 summary scores (physical, mental)<br>-Paced Auditory Serial Addition Test (PASAT): cognitive; single digits presented at 3 second intervals; patient adds new digit to one immediately prior<br>-Iowa Gambling Test (IGT): mental flexibility and decision-making ability; calculated by advantageous minus disadvantageous card selections<br>-Frontal Assessment Battery (FAB): six executive operations; items rated 0-3; lower scores indicate greater impairment<br>**Mendez 2013[41]:**<br>-Interpersonal Measure of Psychopathy (IM-P): interpersonal behaviors associated with psychopathy<br>-Big Five Inventory (BFI): 5-factor model of personality<br>-Interpersonal Adjectives Scale (IAS): primary dimensions of |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
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| | | | | | interpersonal transaction<br>-Frontal Systems Behavior Scale (FrSBe): dimension of apathy and disinhibition and executive dysfunction |
| Mora, 2009[43]<br><br>Funding Source: None reported | | ✓ a | Inclusion: OEF/OIF combat casualties injured in explosions and treated at USAISR Burn Center March 2003 to March 2006; PLC-M assessment at least 30 days post-injury<br><br>NOTE: Blast is IED with primary blast injury; non-blast is IED without primary blast injury | N = 19 with mTBI (n = 6 blast, n = 13 non-blast)<br>Age (years):<br>-Blast: 28<br>-Non-blast: 29<br>Gender (%male):<br>-Blast: 83%<br>-Non-blast: 86%<br>Cohort years: 2003-2006<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure:<br>-Blast 117 days<br>-Non-blast: 233 days<br>Duration of deployment: NR<br>Rural or urban residence: NR | PCL-M: 17 item self-report; PTSD indicated by score of 44 and above |

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|---|---|---|---|---|---|
| | Registry/ Database | Clinical Cohort | | | |
| Nakase-Richardson, 2013[44]<br><br>Funding Source: Veterans Affairs Health Services Research and Development/ Rehabilitation Research and Development Center of Excellence for Maximizing Rehabilitation Outcomes | | ✓ | Inclusion: Consecutive admissions to Polytrauma Rehabilitation System of Care (Jan 2004 to Oct 2009) with a disorder of consciousness (DOC)<br>Exclusion: none reported | N = 122 (29 blast, 10 penetrating, 67 other trauma, 16 non-trauma*)<br>Age (years, median):<br>-Blast: 25<br>-Non-blast: 25<br>Gender (% male):<br>-Blast: 100<br>-Non-blast: 95<br>Cohort years: 2004-2009<br>Rank: NR<br>Duty/description – Active duty:<br>-Blast: 97<br>-Non-blast: 80<br>Blast exposure history: NR<br>Time since exposure(median):<br>-Blast: 67 days<br>-Non-blast: 46 days (P = .04)<br>Duration of deployment: NR<br>Rural or urban residence: NR<br><br>*Non-trauma patients not included in non-blast group | -Rancho Levels of Cognitive Functioning Scale (LCFS): 8 level index; awareness, behavioral competence and environmental interaction; higher levels = greater cognitive functioning<br>-Functional Independence Measure (FIM): 18 items; functional independence in self-care and cognition; higher scores = greater level of independence; cognitive and motor subscales<br>-Return to consciousness: assessed with Coma Recovery Scale-Revised (CRS-R) or evidence of interactive communication, functional object use during self-care tasks, or Rancho LCFS score ≥4 |
| Oleksiak, 2012[45]<br><br>Funding Source: VA Office of Research and Development, Health Services Research and Development grant | | ✓ | Inclusion: Confirmed diagnosis of mTBI<br><br>Exclusion: moderate/severe TBI, prior history of ear disease or hearing loss, non-VA care for hearing loss | N = 189 (n = 154 blast or mixed, n = 35 non-blast)<br>Age (years): 27.9<br>Gender (% male): 92%<br>Cohort years: 2007-2009<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural or urban residence: NR | Comprehensive 2nd level TBI evaluation<br><br>Neurobehavioral Symptom Inventory (NSI): 22 symptoms including hearing difficulty |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
|---|---|---|---|---|---|
| | Registry/ Database | Clinical Cohort | | | |
| Pogoda, 2012[46]<br><br>Funding Source: VA Office of Research and Development, Health Services Research and Development Service | ✓ Defense Manage-ment Data Center | | Inclusion: Veterans completing VA CTBIE Oct 2007 to June 2009; did not report brain injury pre-deployment or since returning from deployment; met criteria for mTBI history (self-report); VA clinician-confirmed deployment related mTBI history<br>Exclusion: none reported | N = 9,998 (n = 8,038 blast, n = 1,960 non-blast/etiology NR)<br>Age(years): 31*<br>Gender (% male): 95%<br>Cohort years: 2007-2009<br>Rank:<br>-Junior Enlisted 52%<br>-Mid-level Enlisted 39%<br>-Senior Enlisted/Officer 9%<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: NR<br>Duration of deployment: NR<br>Rural or urban residence: NR<br><br>*demographic information not reported for blast vs non-blast mTBI | Diagnostic codes for depression and PTSD (2007- 2009)<br><br>Comprehensive Traumatic Brain Injury Evaluation (CTBIE): performed by VA clinician<br><br>Neurobehavioral Symptom Inventory (NSI -22): patient self-report checklist administered during CTBIE; rate extent to which each symptom has affected them in past 30 days from 0 (none) to 4 (very severe) |
| Reid, 2014[47]<br><br>Funding Source: None reported | | ✓ | Inclusion: service members evaluated at 1 of 6 Military Medical Centers (all in US); CHI only; valid and complete PCL-C and NSI; injury sustained in OEF/OIF; tested 1-24 months post-injury; mTBI associated with most recent blast exposure; male<br>Exclusion: missing data regarding number of previous blast exposures; exposure to >10 blasts<br><br>**NOTE: unknown whether prior blast exposures resulted in undocumented mTBI** | N = 573 (n = 505 blast, n = 68 non-blast)<br>Age (years): 27<br>Gender (% male); 100%<br>Cohort years: NR<br>Rank:<br>-E1-4: 59%<br>-E5+: 41%<br>Duty/description: NR<br>Blast exposure history:<br>1 blast: n = 123<br>2 blasts: n = 178<br>3 blasts: n = 106<br>4-10 blasts: n = 98<br>Time since exposure: 1-24 months<br>Duration of deployment: NR;<br>Rural or urban residence: NR | Neurobehavioral Symptom Inventory (NSI -22): presence/severity of each symptom within past 2 weeks; 0 = none, 4 = very severe; total score and subscales (cognitive, affective, sensory, somatic)<br><br>Posttraumatic Checklist – Civilian version (PCL-C): self-rated, 17 items (clusters for re-experiencing, avoidance, hyperarousal); how much bothered by symptom in past month; 1 = not at all, 5 = extremely; scores range from 17 to 85 |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
|---|---|---|---|---|---|
| | Registry/ Database | Clinical Cohort | | | |
| Sayer, 2008[48]<br><br>Funding Source: VA Health Service Research and Development grant | | ✓ | Inclusion: all service members injuries in OEF/OIF and receiving inpatient VA rehabilitation services at a polytrauma rehabilitation center (PRC)<br>Exclusion: none reported | N = 188 (n = 106 blast, n = 82 non-blast); 97% with TBI<br>Age (years): 28<br>Gender (% male): 97%<br>Cohort years: 2001-2006<br>Rank: NR<br>Duty/description: 74% active duty, 26% Reserves/National Guard<br>Blast exposure history: 6 with injuries secondary to >1 blast<br>Time since exposure: 87 days<br>Duration of deployment: NR<br>Rural or urban residence: NR | Mortality from VA administrative database<br><br>Impairments in body structures and organs from medical records; classified using World Health Organization *International Classification of Functioning, Disability and Health*<br><br>Psychiatric symptoms from medical records: PTSD, anxiety disorders other than PTSD, depression, psychosis<br><br>Functional Independence Measure (FIM): 13 motor items, 5 cognitive items |
| Schneiderman, 2008[23]<br><br>Funding Source: Department of Veterans Affairs, War-Related Illness and Injury Study Center | | ✓ | Inclusion: responded to self-administered mail questionnaire (addresses/info obtained from National Change of Address databased and the US Department of Defense); OEF/OIF Veterans who left combat theaters by 9/30/2004; living in northern Virginia, Maryland, Washington DC or eastern West Virginia; active duty personnel separated from the military and National Guard/Reserve members were eligible<br>Exclusion: none reported | N = 2,235 surveys returned (34% response)<br>N = 275 with mTBI (n = 70 blast, n = 205 non-blast)<br>Age (years): NR<br>Gender (% male): 86%<br>Cohort years: OEF/OIF before 9/30/2004<br>Rank: NR<br>Duty/description: 27% active duty<br>Blast exposure history: NR<br>Time since exposure: “left combat theaters at least 5 months earlier”<br>Duration of deployment: NR<br>Rural or urban residence: NR | 3-item Brief Traumatic Brain Injury Screen for diagnosis of mTBI<br><br>PCS 3+: self-attribution of ≥3 current neuropsychiatric symptoms to possible head injury or concussion |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
|---|---|---|---|---|---|
| | Registry/ Database | Clinical Cohort | | | |
| Wilk, 2010[21]<br><br>Funding Source: None reported | | ✓ | Inclusion: US soldiers from one National Guard and 2 Active Duty infantry brigades; surveyed in 2006 and 2007 (3-6 months after return from combat deployment to Iraq); consented and completed some portion of the questionnaire (N = 4,383)<br>Exclusion: none reported | N = 574 with concussion data (15% of 3,952 who completed concussion questions)<br>Age (years): 67% <30 years<br>Gender (% male): 98<br>Cohort years:<br>Rank: Junior Enlisted 53%<br>Duty/description: "soldiers in this study saw high levels of combat"<br>Blast exposure history: NR<br>Time since exposure: NR (surveyed 3-6 months post-deployment)<br>Duration of deployment: 1 year<br>Rural or urban residence: NR | Concussion (mTBI): self-report of "dazed, confused, or seeing stars," "not remembering the injury," or "losing consciousness" as a result of injury during deployment<br><br>Patient Health Questionnaire 15-item scale (PHQ-15): how much individual has been bothered by each symptom in past 4 weeks (0 = not, 2 = bothered a lot); high severity is score ≥15<br><br>Posttraumatic Stress Disorder Checklist 17-item (PCL-17): PTSD defined by presence of intrusion, avoidance, and hyperarousal symptoms with total score ≥50<br><br>PHQ depression module (PHQ-9): depression defined as ≥5 DSM-IV symptoms and functional impairment at very difficult or extremely difficult level<br><br>Two-Item Conjoint Screen for Alcohol (modified): alcohol misuse defined by positive answer on either item |

| Author, Year Funding Source | Data Source | | Inclusion/Exclusion Criteria | Cohort Characteristics | Measures |
|---|---|---|---|---|---|
| | Registry/ Database | Clinical Cohort | | | |
| Wojcik, 2010[19]<br><br>Funding Source: None reported | ✓ Defense Manpower Data Center; Standard Inpatient Data Record (Army); Defense Casualty Information Processing System (Army); Joint Theater Trauma Registry | | Inclusion: hospitalized in Army facility in-theater, Europe, or US; TBI<br>Exclusion: none reported | N = 2,448 episodes of hospitalization with TBI (n = 1,388 episodes with mechanism of injury data: 871 blast, 517 non-blast)<br>Age (years): mean NR (66% of all TBI hospitalizations in 20-29 year range)<br>Gender (% male): 97.5% (all TBI hospitalizations)<br>Cohort years: 2001-2007<br>Rank: 93% enlisted, 7% officers (all TBI hospitalizations)<br>Duty/description: 76% active duty; also 66% combat, 16% combat service, 13% combat service support, 5% unknown<br>Blast exposure history: NR<br>Time since exposure: <30 days<br>Duration of deployment: NR<br>Rural or urban residence: NR | TBI severity (based on ICD-9-CM codes and Barell Matrix classification):<br>-Type 1 [most severe]<br>-Type 2<br>-Type 3 [least severe]) |
| Xydakis, 2012[24]<br><br>Funding Source: None reported | | ✓ | Inclusion: consecutive polytrauma inpatients; transported to WRAMC following injury during combat operations requiring immediate stateside evaluation; closed head injury (CHI) from blunt or blast mechanism<br>Exclusion: none reported | N = 365 blast CHI, 198 with TBI<br>N = 102 non-blast CHI, 58 with TBI<br>Age (years): 24 (blast group only)<br>Gender (% male): 99 (blast group only)<br>Cohort years: NR<br>Rank: NR<br>Duty/description: NR<br>Blast exposure history: NR<br>Time since exposure: 8 days (median, blast group only)<br>Duration of deployment: NR<br>Rural or urban residence: NR | TBI evaluation |

BAMC = Brooke Army Medical Center; DoD = Department of Defense; DVBIC = Defense and Veterans Brain Injury Center; EMED = Expeditionary Medical Encounter Database; SAMMC = San Antonio Military Medical Center; TPRC = Tampa Polytrauma Rehabilitation Center; VAMC = VA Medical Center; VHA = Veterans Health Administration; WRAMC = Walter Reed Army Medical Center; MIRECC = Mental Illness Research, Education, and Clinical Center; PRC = Polytrauma Rehabilitation Center (inpatients); PNS = Polytrauma Network Site (outpatients); USAISR = US Army Institute of Surgical Research; mTBI = mild traumatic brain injury; LOC = loss of consciousness; NBR = non-blast-related; BR = blast-related; BPPV = benign paroxysmal positional vertigo; cVEMP = cervical vestibular evoked myogenic potential; SVV = subjective visual vertical; SOT = sensory organization test; PCL-C = PTSD Checklist – Civilian version PCL-M = PTSD Checklist – Military version; NSI = Neurobehavioral Symptom Inventory; CHI = closed head injury; VOR = vestibular-ocular reflex; VSR = vestibular-spinal reflex

[a] Patients treated at US Army Institute of Surgical Research (USAISR) Burn Center; medical records obtained from Joint Theater Trauma Registry

## Table 4a. Mortality Outcomes by Time Post-exposure – Key Question 3

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| DuBose, 2011[13] | | | | | | | Blunt: 9.8% (11/112)<br>Blast (explosion): 8.6% (32/374); OR 0.66 (0.31, 1.41)<br>Gunshot: 6.8% (8/118); OR 0.60 (0.19, 1.89) | |
| Sayer, 2008[48] | | | | | | | 3% (3/106) | 1% (1/82); P = .63 |

## Table 4b. PTSD Outcomes by Time Post-exposure – Key Question 3

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Belanger, 2009[26] | | | | | | | **PCL:**<br>41.1 (18.0) | **PCL:**<br>32.9 (17.2); P<.07 |
| Belanger, 2011[27] | | | **PCL:**<br>41.5 (17.4) | | | **PCL:**<br>37.3 (17.6); P = .047 | | |
| Clark, 2009[29] | | | | | | | **PTSD diagnosis:**<br>45.1% | **PTSD diagnosis:**<br>11.8%; P<.05 |
| Collen, 2012[31] | | | | | **PTSD (comorbid diagnosis)**<br>60.5% | **PTSD**<br>48.6%; P = .24 | | |
| Cooper, 2012[32] | | | **PCL-M:**<br>37.88 (16.42) | **PCL-M:**<br>36.29 (14.72); P = .696 | | | | |
| Goodrich, 2014[35] | | | **PTSD diagnosis:**<br>62% (31/50) | **PTSD diagnosis:**<br>20% (10/50); P<.001 | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Kennedy, 2010[16] | | | **PCL-C total:** 44.3 (17.6)<br>**PCL-C > 50:** 38.2%<br>**Re-experiencing**: 13.3 (5.9)<br>**Avoidance:** 15.8 (7.4)<br>**Hyper-Arousal:** 15.2 (5.6) | **PCL-C total:** 42.7 (16.9); P = .20<br>**PCL-C > 50:** 33.3%; P = .29<br>**Re-experiencing:** 12.0 (5.7); P = .02<br>**Avoidance**: 15.6 (7.0); P = .83<br>**Hyper-Arousal**: 14.5 (5.7); P = .20 | | | | |
| Kontos, 2013[22] | | | | | | | **PTSD symptoms, Mean (SD):** 22.6 (8.8)<br>**OR - clinical levels of PTSD symptoms (blast vs blunt):** 2.12 (1.68, 2.66); P = .001<br>**Blast history dose-response**[a]:<br>a. Symptom scores increased significantly with increased number of diagnosed blast mTBIs<br>b. OR for clinical levels of PTSD symptoms significant for 3+ blasts vs 1 blast but not 2 vs 1 or 3+ vs 2 | **PTSD symptoms:** 20.3 (7.1); P<.01 |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Lippa, 2010[39] | | | | | **PCL total Mean (SD):** 54. 5 (15.0)<br><br>**PCL total ≥ 50** 89/138 (64.5%) | **PCL total:** 49.8 (15.1); P = .054<br><br>**PCL total ≥ 50** 25/56 (44.6%); P<.05 | | |
| Luethcke, 2011[17]<br><br>Blast is primary blast<br><br>Non-blast includes secondary, tertiary, quaternary, and non-blast | **PCL-M Mean (SD)** 27.8 (8.9) | **PCL-M Mean (SD)** 26.7 (13.2); P = .33 | | | | | | |
| Mac Donald, 2014[18]<br><br>Blast is blast plus other mechanism of head injury<br><br>Non-blast is other mechanism of head injury only | | | **PTSD** 22/53 (42%) | **PTSD** 14/29 (48%); P = .56<br><br>**PTSD Severity** P = .90 | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Maguen, 2012[40]<br><br>(n = 968 for PTSD analysis) | | | | | | | **PTSD positive screen**<br>Blast only head injury: 55/90 (61%) OR 4.7 (2.9, 7.7)*<br><br>Blast plus other mechanism of head injury : 185/266 (70%) OR 6.5 (4.6, 9.3)* | **PTSD positive screen**<br>1 Non-blast head injury:<br>25/43 (58%)<br>OR 4.6 (2.4, 8.8)*<br><br>2+ Non-blast head injuries:<br>9/19 (47%)<br>OR 3.4 (1.3, 8.6)*<br><br>*Reference for all ORs is TBI with no head injury (129/550; 24%) |
| Mora, 2009[43]<br><br>Blast is IED exposure with primary blast injury<br><br>Non-blast is IED exposure without primary blast injury | | | **PTSD Prevalence:**<br>67% (4/6) | **PTSD Prevalence:**<br>21% (3/13); P = .13 (calculated) | | | | |
| Reid, 2014[47] | | | | | | | **PCL-C**<br>**Mean (SD)**; P = .016 across groups<br>Non-blast: 42.9 (18.2)<br>1 blast: 34.9 (17.1)<br>2 blasts: 41.5 (16.5)<br>3 blasts: 45.8 (17.5)<br>4-10 blasts: 46.5 (17.5) | |
| Sayer, 2008[48] | | | **PTSD Symptoms:**<br>42% (45/106) | **PTSD Symptoms:**<br>24% (20/82); P<.01 | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Wilk, 2010[21] | | | **PTSD Diagnosis**<br>LOC: 72/161 (45%)<br><br>CIC: 79/263 (30%) | **PTSD Diagnosis**<br>LOC: 15/39 (39%); P = .59<br><br>CIC: 32/110 (29%); P = .90 | | | | |

CIC = concussion with change in consciousness; LOC = concussion with loss of consciousness; NSI = Neurobehavioral Symptom Inventory; PCL = Post-traumatic Stress Disorder Checklist; PCL-M = PCL Military version; PCL-C = PCL Civilian version

[a] Analysis includes blast-only mTBI and combination blast-blunt mTB

**Table 4c. Pain Outcomes by Time Post-exposure – Key Question 3**

| Author, Year | Short-term (< 30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Clark, 2009[29] | | | | | | | **Pain intensity (NRS):** 5.4 (2.3) **Number of pain sites:** 2.4 (1.3) | **Pain intensity:** 4.4 (2.8); P = NS **Number of pain sites:** 2.0 (1.5); P = NS |
| Sayer, 2008[48] | | | **Impairment:** 83% (88/106) | **Impairment:** 80% (65/82); P = NS | | | | |
| Wilk, 2010[21] | | | **Stomach pain** LOC: 13/156 (8.3%) CIC: 14/254 (5.5%) **Back pain** LOC: 71/157 (45.2%) CIC: 84/257 (32.7%) **Arm, leg or joint pain** LOC: 78/156 (50.0%) CIC: 105/256 (41.0%) | **Stomach pain** LOC: 4/40 (10.0%); P = .76 CIC: 16/107 (15.0%); P = .01 **Back pain** LOC: 14/40 (35.0%); P = .29 CIC: 36/108 (33.3); P = .90 **Arm, leg or joint pain** LOC: 17/40 (42.5); P = .48 CIC: 54/107 (50.5); P = .11 | | | | |

CIC = concussion with change in consciousness; LOC = concussion with loss of consciousness; NRS = Pain Numeric Rating Scale (0 = no pain, 10 = worst pain)

## Table 4d. Burn Outcomes by Time Post-exposure – Key Question 3

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Clark, 2009[29] | | | | | | | **Burn diagnosis:** 9.9% | **Burn diagnosis:** 2.1%; P = NS |
| Mora, 2009[43]<br><br>Blast is IED exposure with primary blast injury<br><br>Non-blast is IED exposure without primary blast injury | | | **TBSA** 8.1% (6.9%) | 17.0% (10.6%); P = NR | | | | |
| Sayer, 2008[48] | | | **Skin or soft tissue burn injury:** 13% (14/106) | **Skin or soft tissue burn injury:** 4% (3/62); P<.05 | | | | |

TBSA = total body surface area

## Table 4e. Limb Loss Outcomes by Time Post-exposure – Key Question 3

| Author, Year | Short-term (< 30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Clark, 2009[29] | | | | | | | **Amputation:** 16.0% | **Amputation:** 2.9%; P<.05 |
| Sayer, 2008[48] | | | **Amputation:** 9% (10/106) | **Amputation:** 2% (2/82) P<.10 (NS) | | | | |

**Table 4f. Vision Loss Outcomes by Time Post-exposure – Key Question 3**

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Brahm, 2009[28]<br><br>NOTE: Inpatients had moderate/severe TBI; outpatients had mTBI | | | | | | | *Inpatients*<br>**Subjective visual complaint:** 77% (41/53)<br>**Ocular injury:** 44% (25/57)<br>**Legally blind:** 9% (5/54)<br><br>*Outpatients*<br>**Subjective visual complaint:** 76% (85/112)<br>**Ocular injury:** 7% (8/112)<br>**Legally blind:** 2% (2/112) | *Inpatients*<br>**Subjective visual complaint:** 63% (5/8); P = .39<br>**Ocular injury:** 9% (1/11); P = .04<br>**Legally blind:** 33% (3/9); P = .08<br><br>*Outpatients*<br>**Subjective visual complaint:** 75% (9/12); P = 1.0<br>**Ocular injury:** 17% (2/12); P = .25<br>**Legally blind:** (0/12); P = 1.0 |
| Clark, 2009[29] | | | | | | | **Eye injury:** 37.5% | **Eye injury:** 23.5%; P = NS |
| Cockerham, 2013[30]<br><br>(NOTE: Analyses of blast/non-blast were considered exploratory due to small size of non-blast sample; OSDI and dry eye disease measures were reported to be similar for blast and non-blast TBI) | | | **OSDI:** mean (SD): 21 (25) n = 44<br>**Tear production < 4mm:** 17 /44 (39%)<br><br>**Tear osmolarity: >314:** 13/24 (54%)<br>**Ocular surface staining:** 35/44 (80%) | **OSDI:** 16 (13) n = 9<br><br>**Tear production < 4mm:** 2/9 (22%)<br><br>**Tear osmolarity >314:** 6/9 (67%)<br>**Ocular surface staining:** 7/9 (78%) | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Goodrich, 2013[34] | | | **Ocular injury:** 31% (15/49)<br><br>**Monocular vision:** 12% (6/50)<br>**Vision complaints**: 66% (33/50)<br><br>**Light sensitivity:** 67% (31/46)<br><br>**Reading complaints:** 56% (27/48)<br><br>**Visual acuity poor (worse eye):** 28% (15/50) | **Ocular Injury:** 29% (14/49); P = 1.0<br>**Monocular vision:** 2% (1/5); P = .112<br>**Vision complaints:** 69% (34/49); P = NS<br>**Light sensitivity**: 33% (13/40); P = .002<br>**Reading complaints:** 47% (20/43); P = NS<br>**Visual acuity poor (worse eye):** 18% (9/50); P = .34 | | | | |
| Lew, 2011[14] | | | | | | | **Visual impairment only:** 8.8% (918/10431) (blast exposure was significant predictor of visual impairment with more with non-blast TBI reporting severe impairment P≤.001) | **Visual impairment only:** 15.7% (328/2090); P<.001 (calculated) |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Luethcke, 2011[17]<br><br>Blast is primary blast<br><br>Non-blast includes secondary, tertiary, quaternary, and non-blast | **Symptoms**<br>Immediate<br>7/40 (18%)<br><br>Current<br>5/40 (13%) | **Symptoms**<br>Immediate<br>12/42 (29%); P = .24<br>Current<br>4/42 (10%); P = .67 | | | | | | |
| Reid, 2014[47] | | | | | | | **NSI Vision Problems**<br>**Mean (SD);** P<.001 across groups adjusted for demographics and loss of consciousness<br>Non-blast: 0.83 (1.02)<br>1 blast: 0.58 (0.84)<br>2 blasts: 0.97 (1.12)<br>3 blasts: 1.14 (1.17)<br>4-10 blasts: 1.20 (1.21) | |
| Sayer, 2008[48] | | | **Eye injury:** 47% (50/206)<br>**Vision impairment** 58% (61/106) | **Eye injury:** 26% (21/82); P<.01<br>**Vision impairment:** 46% (38/82); P = NS | | | | |

OSDI = Ocular Surface Disease Index; SD = standard deviation

## Table 4g. Hearing Loss Outcomes by Time Post-exposure – Key Question 3

| Author, Year | Short-term (< 30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Clark, 2009[29] | | | | | | | **Hearing problems** 35.3% | **Hearing problems** 32.4%; P = NS |

| Author, Year | Short-term (< 30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Lew, 2011[14] | | | | | | | **Auditory impairment only:** 33.1% (3453/10431) (blast exposure was significant predictor of auditory impairment; P≤.001)<br>**Dual sensory impairment:** 35.4% (3692/10431) | **Auditory impairment only:** 22.7% (474/2090); P<.001 (calculated)<br>**Dual sensory impairment:** 30.3% (622/2090); P<.001 (calculated) |
| Lew, 2007[38] | | | | | | | **Hearing loss:** 62% (26/42)<br>**Tinnitus:** 38% (16/42) | **Hearing loss:** 44% (48/108); P = .04<br>**Tinnitus:** 18% (19/108); P = .007 |
| Luethcke, 2011[17]<br>Blast is primary blast<br>Non-blast includes secondary, tertiary, quaternary, and non-blast | **Symptoms**<br>Immediate<br>21/40 (53%)<br>Current<br>9/40 (23%) | **Symptoms**<br>Immediate<br>7/42 (17%); P = .001<br>Current<br>4/42 (10%); P = .11 | | | | | | |
| Mac Donald, 2014[18]<br>Blast is blast plus other mechanism of head injury<br>Non-blast is other mechanism of head injury only | | | **Hearing deficit** 10/53 (19%) | **Hearing deficit** 4/29 (14%); P = NS | | | | |

| Author, Year | Short-term (< 30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Oleksiak, 2012[45] | | | | | | | **NSI-Hearing Difficulty score**<br>Blast: 1.99 (0.98)<br>Mixed: 1.83 (1.04)[a]<br><br>Primary Blast: 2.09 (0.98)<br>Secondary Blast: 1.81 (0.87); P = NS between blast types<br><br>**% with score >1[b]**<br>Blast: 93%<br>Mixed: 88%<br>Primary blast: 94%<br>Secondary blast: 100% | **NSI-Hearing Difficulty score**<br>Fall: 1.92 (1.15)<br>Vehicle: 1.50 (1.08);<br>P = NS across groups<br><br>**% with score >1**<br>Fall: 84%<br>Vehicle: 80% |
| Reid, 2014[47] | | | | | | | **NSI Hearing Difficulty Mean (SD)**; P<.001 across groups adjusted for demographics and loss of consciousness<br>Non-blast: 1.10 (0.99)<br>1 blast: 1.48 (1.16)<br>2 blasts: 1.34 (1.19)<br>3 blasts: 1.53 (1.17)<br>4-10 blasts: 1.84 (1.08) | |

| Author, Year | Short-term (< 30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Sayer, 2008[48] | | | **Otologic injury:** 46% (49/106) **Hearing loss:** 48% (51/106) **Tinnitus:** 26% (28/106) | **Otologic injury:** 23% (19/82); P<.01 **Hearing loss:** 33% (27/82); P<.05 **Tinnitus:** 12% (10/82); P<.05 | | | | |
| Wilk, 2010[21] | | | **Ringing in Ears** LOC 53/154 (34.4%) CIC 57/257 (22.2%) | **Ringing in Ears** LOC 6/40 (15%); P = .02 CIC 18/106 (17.0%); P = .32 | | | | |

CIC = concussion with change in consciousness; LOC = concussion with loss of consciousness; NSI = Neurobehavioral Symptom Inventory (0 = no hearing loss, 4 = very severe hearing loss)

[a] Mixed = any combination of accident types

[b] Score > 1 is mild or more severe hearing loss

**Table 4h. Vestibular Dysfunction Outcomes by Time Post-exposure – Key Question 3**

| Author, Year | Short-term (< 30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Akin, 2011[15] | | | | | | | **DHI:** 58.9 (mean) (score of > 54 = severe)<br>**SOT**<br>-abnormal: 8/9 (89%)<br>-normal: 1/9 (11%) | **DHI:** 41.8 (mean) (scores of 36 to 52 = moderate)<br>**SOT**<br>-abnormal: 5/9 (56%); P = .29 (calculated)<br>-normal: 2/9 (22%)<br>-did not complete: 2/9 (22%) |
| Hoffer, 2009[36] | | | | | | | **VOR study:** Descriptive differences between blunt and blast for phase and symmetry; no difference in gain function<br>**VSR study:**<br>**Sensory organization test (SOT):** Trend toward significantly better scores for blunt exposure groups, particularly if migraine-associated dizziness diagnosis<br>**Motor Control Test (MCT):** Significantly more patients in blast groups had abnormal latency times | |

| Author, Year | Short-term (< 30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Luethcke, 2011[17]<br><br>Blast is primary blast<br><br>Non-blast includes secondary, tertiary, quaternary, and non-blast | **Balance Symptoms**: Immediate 10/40 (25%) Current 3/40 (8%) **Dizziness Symptoms** Immediate 22/40 (55%) Current 7/40 (18%) | **Balance Symptoms**: Immediate 19/42 (45%); P = .06 Current symptoms: 5/41 (12%); P = .50 **Dizziness Symptoms** Immediate 28/42 (67%); P = .28 Current 9/42 (21%); P = .65 | | | | | | |
| Reid, 2014[47] | | | | | | | **NSI Loss of Balance Mean (SD)**; P<.001 across groups adjusted for demographics and loss of consciousness<br>Non-blast: 0.98 (1.07)<br>1 blast: 0.72 (0.86)<br>2 blasts: 0.87 (0.95)<br>3 blasts: 1.18 (1.08)<br>4-10 blasts: 1.28 (0.91) | |
| Sayer, 2008[48] | | | **Balance/ equilibrium impairment:** 68% (72/106) | | | | | |

| Author, Year | Short-term (< 30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Wilk, 2010[21] | | | **Dizziness**<br>LOC: 15/155 (9.7%)<br>CIC: 16/258 (6.2%)<br><br>**Balance Problems**<br>LOC: 14/155 (9.0%)<br>CIC: 17/258 (6.6%) | **Dizziness**<br>LOC: 5/40 (12.5%); P = .57<br>CIC: 7/107 (6.5%); P = 1.0<br>**Balance Problems**<br>LOC: 6/40 (15.0%); P = .26<br>CIC: 6/106 (5.7%); P = .82 | | | | |

CIC = concussion with change in consciousness; LOC = concussion with loss of consciousness; DHI = Dizziness Handicap Inventory (higher score = greater perceived handicap due to dizziness); SOT = Sensory Organization Test (composite equilibrium); VOR = vestibular-ocular reflex; VSR = vestibular-spinal reflex

**Table 4i. Cognitive Function Outcomes by Time Post-exposure – Key Question 3**

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Belanger, 2009[26] | | | | | | | **Trail Making Test**<br>**WAIS-III**<br>**BVMT-R**[a]<br>**CLVT-II**<br>No between-subjects effect for TBI etiology | |
| Clark, 2009[29] | | | | | | | **Rancho Score**<br>6.3 (1.4) | **Rancho Score**<br>6.0 (1.0); P = NS |
| Cooper, 2012[32] | | | **RBANS – total:**<br>94.88 (12.92) | 98.62 (9.33); P = .211<br>(Groups also similar on all RBANS subscales) | | | | |
| Kontos, 2013[22] | | | | | | | **Verbal memory:**<br>90.2 (7.9)<br>**Visual memory:**<br>70.3 (13.0)<br>**Visual processing speed:**<br>27.5 (4.3)<br>**Reaction time:**<br>1.2 (0.2)<br>**Blast history dose-response:**<br>slower reaction time if 3+ blast mTBIs vs no mTBI; P<.05<br>**All scores: mean (SD)** | **Verbal memory:** 90.9 (7.7); P = NS<br>**Visual memory:**<br>72.6 (13.2); P = .001<br>**Visual processing speed**: 28.3 (4. 5); P<.01<br>**Reaction time:** 1.1 (0.2); P = .001 |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Lange, 2012[37] | | | **Neurocognitive Tests:** Between group differences (P<.05) for 2 of 12 measures with non-blast group performing worse; similar results with adjustment for months tested post-injury | | | | | |
| Luethcke, 2011[17]<br><br>Blast is primary blast<br><br>Non-blast includes secondary, tertiary, quaternary, and non-blast | **ANAM - Cognitive** Across 6 cognitive domains, speed (P = .74) and accuracy (P = .65) scores did not differ by injury type (blast/non-blast) | | | | | | | |
| Mendez, 2013[42]<br><br>Blast is primary blast only<br><br>Non-blast is blunt injury | | | | | Mean (SD)<br>**PASAT**<br>28.9 (11.1)<br>**FAB**<br>16.5 (1.4)<br>**IGT**<br>-7.0 (13.6) | **PASAT**<br>44.0 (4.5); P<.001<br>**FAB**<br>16.7 (2.2); P = NS<br>**IGT**<br>2.2 (17.4); P = NS | | |
| Nakase-Richardson, 2013[44] | | | **Rancho LCFS (median)**<br>admission: 3<br>discharge: 4<br><br>**FIM-cognitive (median)**<br>admission: 5<br>discharge: 7 | **Rancho LCFS (median)**<br>admission: 2<br>discharge: 4 (penetrating trauma), 5 (other trauma);<br>P = NS<br>**FIM-cognitive (median)**<br>admission: 5<br>discharge: 5 (penetrating), 12 (other);<br>P = NR | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Reid, 2014[47] | | | | | | | **NSI Cognitive**<br>**Mean (SD) unadjusted**; P<.001 across groups (unadjusted); P = .003 across groups adjusted for demographics and PCL-C)<br>Non-blast: 8.3 (5.0)<br>1 blast: 6.5 (5.0)<br>2 blasts: 7.3 (5.2)<br>3 blasts: 9.0 (5.3)<br>4-10 blasts: 9.6 (5.2) | |
| Sayer, 2008[48] | | | **Cognition impairment:**<br>88% (93/106) | **Cognition impairment:**<br>93% (76/82); P = NS | | | | |
| Wilk, 2010[21] | | | **Memory Problems**<br>LOC: 48/154 (31.2%)<br>CIC: 45/257 (17.5%)<br>**Concentration Problems**<br>LOC: 49/155 (31.6%)<br>CIC: 62/255 (24.3%) | **Memory Problems**<br>LOC: 12/40 (30%); P = 1.0<br>CIC: 33/107 (30.8%); P = .01<br>**Concentration Problems**<br>LOC: 13/38 (34.2%); P = .85<br>CIC: 37/106 (34.9%); P = .05 | | | | |

WAIS-III = Digit Symbol-Coding subset of Wechsler Adult Intelligence Scale-3rd edition; BVMT-R = Brief Visuospatial Memory Test-Revised; CVLT-II = California Verbal Learning Test-II; RBANS = Repeatable Battery for the Assessment of Neuropsychological Status; Rancho = Rancho Los Amigos Scale; ANAM = Automated Neuropsychological Assessment Metrics; PSAT = Paced Auditory Serial Addition Test; FAB = frontal Assessment Battery; IGT = Iowa Gambling Task; Rancho LCFS = Rancho Levels of Cognitive Functioning Scale; FIM = Functional Independence Measure; CIC = concussion with change in consciousness; LOC = concussion with loss of consciousness

[a] Etiology X severity interaction for BVMT-R with highest scores (best performance) for blast-injured mild TBI and lowest scores (worst performance for blast-injured moderate/severe TBI (means for non-blast mTBI and moderate/severe TBI were between means for blast mTBI and moderate/severe TBI)

## Table 4j. Quality of Life Outcomes by Time Post-exposure – Key Question 3

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Mendez, 2013[42]<br><br>Blast is primary blast only<br><br>Non-blast is blunt injury | | | | | **SF36-V***<br>Physical Composite<br>45.3 (9.4)<br><br>Mental Composite<br>35.5 (13.2)<br><br>*P = NS for all sub-scales | Physical<br>44.1 (12.3); P = NS<br><br>Mental<br>37.3 (10.7); P = NS | | |

SF36-V = Health Related Quality of Life 36-item Short Form for Veterans

## Table 4k. Functional Status/Employment Outcomes by Time Post-exposure – Key Question 3

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Clark, 2009[29] | | | | | | | **FIM**<br>81.0 (31.8) | **FIM**<br>80.1 (30.4); P = NS |
| Mac Donald, 2014[18]<br><br>Blast is blast plus other mechanism of head injury<br><br>Non-blast is other mechanism of head injury only | | | **Global outcome (GOS-E)** P = .82<br>Moderate to severe disability (GOS-E ≤6):<br>-Blast plus impact TBI: 41/53 (77%)<br>-Non blast TBI 23/29 (79%); P = .84 | | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Nakase-Richardsion, 2013[44] | | | **FIM-motor (median)** admission: 13 discharge:13 | **FIM-motor (median)** admission: 13 discharge:13 (penetrating trauma), 28 (other trauma) P = .02 for other trauma vs blast/ penetrating | | | | |
| Sayer, 2008[48] | | | **Motor functioning impairment:** 62% (66/106) | **Motor functioning impairment:** 65% (53/82); P = NS | | | | |
| Wilk, 2010[21] | | | **≥ 2 missed workdays due to illness** LOC: 32/156 (20.5%) CIC: 44/260 (16.9%) | **≥ 2 missed workdays due to illness** LOC: 9/40 (22.5%); P = .83 CIC: 11/108 (10.2%); P = .11 | | | | |

FIM = Functional Independence Measure (higher scores = greater independence); GOS-E = Glasgow Outcome Scale-Extended; CIC = concussion with change in consciousness; LOC = concussion with loss of consciousness

## Table 4l. Other Outcomes by Time Post-exposure – Key Question 3

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Belanger, 2011[27] | | | | | **NSI**<br>no significant effect for mechanism of injury (P = .36) | | | |
| Clark, 2009[29] | | | | | | | **Depression diagnosis**<br>25.5%<br>**Any psychiatric diagnosis**<br>86.3% | **Depression diagnosis**<br>14.7%; P = NS<br>**Any psychiatric diagnosis**<br>52.9%; P<.05 |
| Collen, 2012[31] | | | | | **Sleep**<br>Insomnia: 63%<br>OSAS: 25.9%<br>ESS: 8.8 (4.6)<br>**Depression (comorbid diagnosis)**<br>87.7%<br>**Anxiety (comorbid diagnosis)**<br>50.6% | **Sleep**<br>Insomnia: 40%; P = .02<br>OSAS: 54.3%; P = .003<br>ESS: 11.3 (5.7); P = .04<br>**Depression**<br>80%; P = .29<br>**Anxiety**<br>20%; P = .002 | | |
| Cooper, 2012[32] | | | **HIT-6:**<br>56.03 (9.54) | 54.32 (9.44); P = .489 | | | | |
| Fortier, 2014[33] | | | | | **mTBI Grade**[a]<br>I: 14/26 (54%)<br>II: 11/26 (42%)<br>III: 1/26 (4%) | **mTBI Grade**<br>I: 16/30 (53%)<br>II: 12/30 (40%)<br>III: 2/30 (7%); P = NS (calculated) | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| French, 2014[25] | | | **Injury Severity (of 474 with blast mTBI)**<br>Minor: 12%<br>Moderate: 46%<br>Serious: 27%<br>Severe/critical: 15% | **(of 105 with non-blast mTBI)**<br>Minor: 13%<br>Moderate: 56%<br>Serious: 21%<br>Severe/critical: 10%;<br>P = .202 | | | | |
| Lange, 2012[37] | | | **Personality Assessment Inventory (14 items including depression, anxiety, alcohol problems):**<br>No significant between-group differences (P<.05); similar results with adjustment for months tested post-injury | | | | | |
| Lippa, 2010[39] | | | | | **Post-concussive symptoms** (cognitive, affective, sensory, somatic, and headache) were similar (blast vs non-blast) | | | |
| Luethcke, 2011[17]<br><br>Blast is primary blast<br><br>Non-blast includes secondary, tertiary, quaternary, and non-blast | **Global Mental Health Mean (SD)**<br>3.5 (0.4)<br>**Insomnia Severity Index Mean (SD)**<br>7.7 (6.0)<br>**Headache Symptoms**<br>Immediate: 28/40 (70%)<br><br>Current 21/40 (53%) | **Global Mental Health Mean (SD)**<br>3.4 (0.6); P = .87<br>**Insomnia Severity Index Mean (SD)**<br>8.2 (6.6); P = .87<br>**Headache Symptoms**<br>Immediate: 34/42 (81%); P = .25<br>Current symptoms: 35/42 (83%); P = .003 | | | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Mac Donald, 2014[18]<br><br>Blast is blast plus other mechanism of head injury<br><br>Non-blast is other mechanism of head injury only | | | **Smell (Deficit)** 9/53 (17%) **Headache (MIDAS):** Blast and non-blast TBI groups similar (P = .48) **Neuropsycho-logical testing:** Blast and non-blast TBI groups similar (P = NS) **Neuro-behavioral assessment:** Blast and non-blast TBI groups similar (P = NS) **Alcohol Misuse:** Blast and non-blast TBI groups similar (P = NR) **Depression Severity:** Blast and non-blast TBI groups similar (P = .38) | **Smell (Deficit)** 15/29 (52%); P = .0009 | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| MacGregor, 2011[20] | | | **TBI Blast-related**<br>Mild: 1822/1852 (98%)<br>Moderate: 76/90 (84%)<br>Severe: 89/132 (67%)<br>**Concomitant Injuries**<br>Other HNF 1204/1987 (61%)<br>Any extremity 611/1987 (31%)<br>Spine/Back Injury 237/1987 (12%) | **TBI Non-blast**<br>Mild: 30/1852 (2%)<br>Moderate: 14/90 (16%)<br>Severe: 43/132 (33%); P<.001<br>**Concomitant Injuries**<br>Other HNF 41/87 (47%); P = .01<br>Any extremity 22/87 (25%); P = .28<br>Spine/Back 2/87 (3%); P = .006 | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Maguen, 2012[40]<br><br>(n = 974 for depression analysis; n = 968 for alcohol analysis) | | | | | | | **Depression Positive Screen**<br>Blast only head injury: 24/86 (28%)<br>OR 2.2 (1.3, 3.8)*<br>Blast plus other mechanism of head injury: 119/267 (45%)<br>OR 4.4 (3.0, 6.4)*<br><br>**Alcohol Misuse Positive Screen**<br>Blast injury only 48/89 (54%)<br>OR 1.5 (0.9, 2.5)*<br>Blast plus other mechanism of head injury 143/262 (55%)<br>OR1.6 (1.1, 2.2)* | **Depression Positive Screen**<br>1 non-blast head injury: 15/42 (36%); P = .42 (calculated)<br>OR 3.2 (1.6, 6.3)*<br>2 + non-blast head injury: 5/22 (23%)<br>OR 1.66 (0.6, 4.7)*<br><br>**Alcohol Misuse Positive Screen**<br>1 non-blast head injury 19/43 (44%); P = .35 (calculated)<br>OR 1.2 (0.6, 2.2)*<br>2+non-blast head injury 13/21 (62%)<br>OR 2.4 (1.0, 6.0)*<br><br>*Reference is TBI with no head injury |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Mendez, 2013[42]<br><br>Blast is primary blast only<br><br>Non-blast is blunt injury | | | | | Mean (SD)<br>**RPQ-Total**<br>38.0 (8.8)<br>**NSI**<br>42.1 (17.8)<br>**IM-P**<br>23.2 (2.3) | **RPQ Total**<br>41.6 (9.2); P = NS<br>**NSI**<br>46.2 (10.7); P = NS<br>**IM-P**<br>21.3 (0.7); P<.001<br>**BFI, FrSBe, IAS** P = NS for all items | | |
| Mora, 2009[43]<br><br>Blast is IED exposure with primary blast injury<br>Non-blast is IED exposure without primary blast injury | | | **ISS:**<br>7.8 (9.3) | **ISS:**<br>15.0 (11.6) | | | | |
| Nakase-Richardson, 2013[44] | | | **Emergence from LOC**<br>60% | **Emergence from LOC**<br>56% (penetrating trauma)<br>76% (other trauma)<br>P = .03 for other trauma vs blast/ penetrating | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Pogoda, 2012[46] | | | | | | | **Multisensory Impairment**<br>Reference: no mTBI etiology reported<br>Non-blast only: OR 1.00 (0.80, 1.25); P = .99<br>Blast only: OR 1.03 (0.84, 1.25); P = .81<br>>1 Non-blast and >1 blast: OR 1.61 (1.30, 2.00); P<.001 | |
| Reid, 2014[47] | | | | | | | **NSI (total)**<br>**Mean (SD) unadjusted**; P<.001 across groups (unadjusted); P = .001 across groups adjusted for demographics and PCL-C)<br>Non-blast: 29.3 (17.9)<br>1 blast: 24.1 (16.6)<br>2 blasts: 27.6 (17.2)<br>3 blasts: 32.9 (17.7)<br>4-10 blasts: 35.0 (17.8)<br>**NSI Difficulty Falling or Staying Asleep**<br>**Mean (SD)**; P<.001 across groups adjusted for demographics and loss of consciousness<br>Non-blast: 2.37 (1.19)<br>1 blast: 1.82 (1.30)<br>2 blasts: 2.21 (1.32)<br>3 blasts: 2.34 (1.28)<br>4-10 blasts: 2.55 (1.28)<br>**NSI Feeling Depressed or Sad**<br>**Mean (SD)** P = .087cross groups adjusted for demographics and loss of consciousness<br>Non-blast: 1.14 (1.33)<br>1 blast: 0.88 (1.11)<br>2 blasts: 1.01 (1.11)<br>3 blasts: 1.21 (1.24)<br>4-10 blasts: 1.17 (1.22) | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Sayer, 2008[48] | | | **Sleep impairment:** 60% (64/106) **Depressive symptoms:** 37% (39/106) | **Sleep impairment:** 57% (47/82); P = NS **Depressive symptoms:** 38% (29/82); P = NS | | | | |
| Schneiderman, 2008[23] | | | | | | | **PCS 3+** Prevalence ratio (PR) = 1.19 (CI not reported) Blast exposure vs non-blast (defined as no high-energy injury mechanism) NOTE: PR 1.02 (95% CI 0.69, 1.52) for any high-energy injury mechanism vs none; high-energy includes blast, bullet, shrapnel, motor vehicle crash, fall, air/water transport | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Wilk, 2010[21] | | | **Major Depression** LOC: 33/156 (21.2%) CIC: 26/255 (10.2%) **Sleep Problems** LOC: 95/154 (61.7%) CIC: 126/251 (50.2%) **Alcohol Misuse** LOC: 60/154 (39.0%) CIC: 72/255 (28.2%) **Headache** LOC: 63/157 (40.1%) CIC: 53/258 (20.5%) | **Major Depression** LOC: 6/38 (15.8%); P = .65 CIC: 17/106 (16%); P = .15 **Sleep Problems** LOC: 22/38 (57.9%); P = .71 CIC: 53/106 (50%); P = 1.0 **Alcohol Misuse** LOC: 16/38 (42.1%); P = .72 CIC: 40/107 (37.4%); P = .11 **Headache** LOC: 9/40 (22.5); P = .04 CIC: 19/108 (17.6); P = .57 | | | |
| Wojcik, 2010[19] | ***TBI Severity[a] (Hospitalization episodes)*** **Type 1 TBI:** 55% (501/911)**Type 2 TBI:** 39% (353/911) **Type 3 TBI:** 6% (57/911) | ***TBI Severity[b] (Hospitalization episodes)*** **Type 1 TBI:** 43% (239/550)**Type 2 TBI:** 50% (277/550) **Type 3 TBI:** 6% (34/550) All: P = NR | | | | | | |

| Author, Year | Short-term (<30 days) | | Mid-term (30 days to 1 year) | | Long-term (> 1 year) | | Not Specified | |
|---|---|---|---|---|---|---|---|---|
| | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI | Blast TBI | Non-blast TBI |
| Xydakis, 2012[24] | ***TBI Severity*** **Mild:** 68% (134/198) **Moderate:** 28% (55/198) **Severe:** 5% (9/198) | ***TBI Severity*** **Mild:** 58% (34/58) **Moderate:** 33% (19/58) **Severe:** 9% (5/58) All: P = NR | | | | | | |

BFI = Big Five Inventory; FrSBe = Frontal Systems Behavior Scale; IAS = Interpersonal Adjectives Scale; IM-P = Interpersonal Measure of Psychopathy; MIDAS = Migraine Disability Assessment; NSI = Neurobehavioral Symptom Inventory; RPQ = Rivermead Post-Concussion Symptom Questionnaire; LOC = loss of consciousness; CIC = concussion with change in consciousness; PCS 3+ = post concussive symptoms (≥3 persistent); NSI = Neurobehavioral Symptom Inventory (post-concussion symptoms); HIT-6 = Headache Impact Test; ESS = Epworth Sleepiness Scale; OSAS = obstructive sleep apnea syndrome; LOC = loss of consciousness; AMS = alteration of mental state; PTA = posttraumatic amnesia

[a] Grade I = no LOC, 0-15 min of AMS, 0-15 min PTA; Grade II = LOC < 5 min, AMS >15 min to < 24 hours, PTA >15 min to < 24 hours; Grade II = LOC >5 and < 30 min, AMS > 24 hours, PTA > 24 hours

[b] Type 1 TBI = most severe; Type 3 TBI = least severe (Barell Injury Matrix)