

APPENDICES TO THE REPORT FROM THE
PEDIATRIC MILD TRAUMATIC BRAIN INJURY GUIDELINE WORKGROUP

Contents

| | |
|--|-----|
| Appendix A: Roster | 3 |
| Appendix B: Rationales for Clinical Questions | 9 |
| Appendix C: Literature Search Strategy | 13 |
| Appendix D: Classification of Evidence Scheme | 89 |
| Appendix E: Evidence Tables..... | 95 |
| Appendix F: PRISMA Diagram | 97 |
| Appendix G: Recommendation Process Methodology | 99 |
| Appendix H: Clinical Contextual Profiles..... | 102 |

Appendix A: Roster

**Appendix A
Roster**

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Appendix B: Rationales for Clinical Questions

Appendix B

Rationales for Clinical Questions

Selection of Clinical Questions

After presentation of an analytic framework and an introduction to the Patient-Intervention-Comparator or Co-Intervention-Outcome format for questions, Workgroup members independently nominated questions for consideration. Candidate questions were collated and presented to the entire group. Using a modified Delphi process, questions were anonymously ranked on a 9-point ordinal scale of importance over three rounds of voting. Facilitated discussions amongst Workgroup members occurred between voting rounds. Through this process, the Workgroup selected 6 clinical questions. The questions and a brief rationale for their selection are discussed below.

Clinical Questions and Rationale

Although evidence-based clinical decision rules have been recently published to guide the use of head computed tomography (CT) imaging to identify intracranial injury, challenges in the acute diagnosis of mild traumatic brain injury (mTBI) still exist.¹ Advanced imaging techniques such as diffusion tensor imaging, magnetic resonance spectroscopy, perfusion weighted imaging, and functional magnetic resonance imaging (MRI) of the brain have shown changes in patients with mTBI, though their utility in management and feasibility of use has yet to be determined. There is a need for more evidence regarding the reliability and validity of various tools and questionnaires to diagnose mTBI. To address these issues, the Workgroup developed the first research question:

1. For children (18 years of age and younger) with suspected mild TBI, do specific tools as compared with a reference standard*, accurately diagnose mild TBI?

**Acceptable diagnostic reference standards for question 1 will not be pre-specified. We will track the reference standards used in the identified studies during the data extraction process.*

A clinical decision rule designed to predict clinically-important brain injuries was recently published based on sign and symptom evaluation of more than 40,000 children with suspected mTBI.¹ Despite the availability of such decision rules, confusion remains regarding how to best distinguish mild versus more significant TBI in acute care settings. Biomarker and imaging diagnostics for mTBI are reported in the literature and continue to be researched. The decision to obtain head CT imaging following suspected mTBI remains a concern due to exposure to ionizing radiation. This led to the development of the next two questions:

¹ Kupperman N, et al. Identification of children at very low risk of clinically-important brain injuries after head trauma: a prospective cohort study. *The Lancet*, Vol 374, Iss 9696, 1160 - 1170, 3 Oct 2009.

2. For children (18 years of age and younger) presenting to the emergency department (or other acute care setting) with mild TBI, how often does routine head imaging* identify important intracranial injury#?

3. For children (18 years of age and younger) presenting to the emergency department (or other acute care setting) with mild TBI, which features identify patients at risk for important intracranial injury?

**Routine head imaging pertinent to questions 2 and 3 will include skull x-rays, CT and MRI. #Important craniocerebral abnormalities will be those that change acute treatment. For example, those abnormalities which prompt more prolonged emergency room observation, hospitalization or neurosurgical consultation (e.g., intracranial hemorrhage, depressed and basilar skull fractures). Subtle changes of unclear significance (e.g. changes on diffusion tensor MRI images) will not be considered for questions 2 and 3. Such imaging changes will be considered as potential prognostic features in questions 4 and 5.*

A significant subset of children with mTBI develop pronounced and prolonged symptoms prompting the need to identify factors that contribute to their course of recovery. A number of factors have previously been identified as potential predictors of recovery following mTBI including: age at injury, individual characteristics including genomics and medical history, social-demographic and family characteristics, the mechanism of the insult, repeat injury, acute medical management and follow-up. The need to identify evidence-based predictors of protracted recovery led to development of the fourth and fifth questions:

4. For children (18 years of age and younger) with mild TBI, what factors* identify patients at increased risk for ongoing impairment, more severe symptoms, or delayed recovery (<1 year post-injury)?

5. For children (18 years of age and younger) with mild TBI, which factors identify patients at increased risk of long-term# (>1 year) sequelae?

**Any feature of potential prognostic importance will be considered relevant to questions 3, 4 and 5. All potential features cannot be exhaustively anticipated before reviewing the literature. Potential features include those already listed in the questions and will also include the mechanism of injury and the timing of the imaging after injury.*

#The distinction in timing (> 1 year) of post-injury sequelae between questions 4 and 5 is somewhat arbitrary. The literature relevant to both of these questions will be identified with a single search. The timing of the sequelae described from each identified study will be tracked during the data extraction process. A reasonable distinction between short and long term mTBI

consequences will be made based upon the descriptions provided in the literature. At the protocol development stage, 1 year will be working distinction between short and long-term sequelae.

The emergency department and outpatient medical management of children with mTBI is controversial. Expert recommendations for the treatment of mTBI have been published without extensive supporting research. Generally, supportive care, cognitive rest, and a step-wise return to play have been recommended. However, with growing subspecialty clinics, unique application of computerized neurocognitive testing, emerging research on novel therapies, and increasing concerns about potential iatrogenic effects of cognitive rest, further evaluation is required. This led to the development of the sixth and final question:

6. For children (18 years of age and younger) with mild TBI (with ongoing symptoms) which treatments* improve mild TBI-related outcomes?

*Any therapeutic modality will be considered pertinent to question 6.

Appendix C: Literature Search Strategy

mTBI Updated Literature Search: ERIC, CINAHL, PubMed

December 2012-July 2015

ERIC

| Strategy | Search Limits | Results |
|--|---|---------|
| Original Search Strategy | Keyword Identifier tag†; January 1990-November 2012 | 200 |
| Updated Search _Original Strategy | Keyword Identifier tag†; December 2012-July 2015 | 16 |
| Search Strategy Not limited by Keyword tag | Search All Fields; January 1990-November 2012 | 102* |
| Updated Search _Not limited by Keyword tag | Search All Fields; December 2012-July 2015 | 15* |

*In 2014 ERIC launched a new, more intuitive search algorithm encouraging the use of simple language which the ERIC Thesaurus then uses to produce results, creating a more inclusive search. ERIC discourages large, specific, Boolean searches as too limiting. While speaking with ERIC's Customer Support, we determined the change in search algorithm accounts for the difference in results between searches using the Keyword Identifier and those that do not.

†At the time of this search, in the ERIC database the Keyword, or Identifier, tag searched all fields.

ERIC Original Search Strategy

((**Keywords:sport*** or **Keywords:athlete*** or **Keywords:athletic** or **Keywords:recreation***) and (**Keywords:"head injury"** or **Keywords:"head injuries"** or **Keywords:"brain injury"** or **Keywords:"brain injuries"** or **Keywords:"head trauma"** or **Keywords:"brain trauma"** or **Keywords:"skull injury"** or **Keywords:"skull injuries"** or **Keywords:tbi** or **Keywords:tbis** or **Keywords:"cerebral trauma"** or **Keywords:"cerebral injury"** or **Keywords:"cerebral injuries"**))**Publication Date:1990-2013**

OR

(**Keywords:"gcs 13-15"** or **Keywords:concussion*** or **Keywords:postconcussion** or **Keywords:"post concussion"** or **Keywords:postconcussive** or **Keywords:"post concussive"** or **Keywords:"mild tbi"** or **Keywords:"mild tbis"** or **Keywords:mtbi** or **Keywords:mtbis** or **Keywords:"mild traumatic brain injury"** or **Keywords:"mild traumatic brain injuries"**)**Publication Date:1990-2013**

OR

((**Keywords:**"traumatic brain injury" or **Keywords:**"traumatic brain injuries" or **Keywords:**tbi or **Keywords:**tbis or **Keywords:**"brain contusion" or **Keywords:**"brain contusions" or **Keywords:**"brain trauma" or **Keywords:**"brain laceration" or **Keywords:**"brain lacerations" or **Keywords:**"cerebral injury" or **Keywords:**"cerebral injuries" or **Keywords:**"head injury" or **Keywords:**"head injuries" or **Keywords:**"head trauma" or **Keywords:**"cerebral trauma" or **Keywords:**"skull injury" or **Keywords:**"skull injuries" or **Keywords:**"craniocerebral trauma") and (**Keywords:**mild or **Keywords:**minor))**Publication Date:**1990-2013

Search Strategy Not Limited by Keyword Tag

((sport* OR athlete* OR athletic OR recreation*) and ("head injury" OR "head injuries" OR "brain injury" OR "brain injuries" OR "head trauma" OR "brain trauma" OR "skull injury" OR "skull injuries" OR tbi OR tbis OR "cerebral trauma" OR "cerebral injury" OR "cerebral injuries"))

OR

("gcs 13-15" OR concussion* OR postconcussion OR "post concussion" OR postconcussive OR "post concussive" OR "mild tbi" OR "mild tbis" OR mtbi OR mtbis OR "mild traumatic brain injury" OR "mild traumatic brain injuries")

OR

("traumatic brain injury" OR "traumatic brain injuries" OR tbi OR tbis OR "brain contusion" OR "brain contusions" OR "brain trauma" OR "brain laceration" OR "brain lacerations" OR "cerebral injury" OR "cerebral injuries" OR "head injury" OR "head injuries" OR "head trauma" OR "cerebral trauma" OR "skull injury" OR "skull injuries" OR "craniocerebral trauma") and (mild OR minor))

CINAHL

| Strategy | Search Limits | Results |
|--|---|---------|
| Original Search Strategy | Limiters - Exclude MEDLINE records Narrow by SubjectAge6: - infant, newborn: birth-1 month Narrow by SubjectAge5: - infant: 1-23 months Narrow by SubjectAge4: - all infant Narrow by SubjectAge3: - child, preschool: 2-5 years Narrow by SubjectAge2: - adolescent: 13-18 years Narrow by SubjectAge1: - child: 6-12 years Narrow by SubjectAge0: - all child Search modes - Boolean/Phrase | 551 |

| | | |
|-----------------------|--|---|
| | January 1990-November 2012 | |
| Updated Search | <p>Limiters - Exclude MEDLINE records</p> <p>Narrow by SubjectAge6: - infant, newborn: birth-1 month</p> <p>Narrow by SubjectAge5: - infant: 1-23 months</p> <p>Narrow by SubjectAge4: - all infant</p> <p>Narrow by SubjectAge3: - child, preschool: 2-5 years</p> <p>Narrow by SubjectAge2: - adolescent: 13-18 years</p> <p>Narrow by SubjectAge1: - child: 6-12 years</p> <p>Narrow by SubjectAge0: - all child</p> <p>Search modes - Boolean/Phrase</p> <p>December 2012-July 2015</p> | 0 |

CINAHL Original Search Strategy

| | | | |
|------------|------------|---|---|
| S43 | S41 | <p>Limiters - Exclude MEDLINE records</p> <p>Narrow by SubjectAge6: - infant, newborn: birth-1 month</p> <p>Narrow by SubjectAge5: - infant: 1-23 months</p> <p>Narrow by SubjectAge4: - all infant</p> <p>Narrow by SubjectAge3: - child, preschool: 2-5 years</p> <p>Narrow by SubjectAge2: - adolescent: 13-18 years</p> <p>Narrow by SubjectAge1: - child: 6-12 years</p> <p>Narrow by SubjectAge0: - all child</p> <p>Search modes - Boolean/Phrase</p> | <p>Interface - EBSCOhost</p> <p>Search Screen - Advanced Search</p> <p>Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive</p> |
| S42 | S41 | <p>Limiters - Exclude MEDLINE records</p> <p>Search modes - Boolean/Phrase</p> | <p>Interface - EBSCOhost</p> <p>Search Screen - Advanced Search</p> <p>Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive</p> |

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|------------|--|----------------------------------|---|
| S41 | S40 AND S15 | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S40 | ("NEUROFEEDBACK") OR (S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39) | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S39 | "NEUROFEEDBACK" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S38 | (MH "Patient Positioning+") OR "POSITIONING" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S37 | "RANGE OF MOTION EXERCISE" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S36 | (MH "Sensory Deprivation") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S35 | (MH "Sensory Stimulation+") OR (MH "Physical Stimulation+") OR (MH "Transcutaneous Electric Nerve Stimulation") OR (MH "Acoustic Stimulation") OR (MH "Electric Stimulation+") OR (MH "Electrical Stimulation, Functional") OR (MH "Electrical Stimulation, Neuromuscular") OR | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |

| | | | |
|------------|--|-------------------------------|--|
| | (MH "Deep Brain Stimulation") OR "STIMULATION" | | |
| S34 | (MH "Massage+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S33 | (MH "Dietary Supplements+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S32 | (MH "Functional Food") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S31 | "COGNITIVE REST" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S30 | (MH "Stress Management") OR "STRESS REDUCTION" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S29 | "PHYSICAL REST" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S28 | (MH "Bed Rest") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S27 | (MH "Hypothermia, Induced") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; |

| | | | |
|------------|---|----------------------------------|---|
| | | | Nursing & Allied Health Collection: Comprehensive |
| S26 | (MH "Cognitive Therapy") OR "COGNITIVE THERAPY" OR (MH "Recreational Therapy") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S25 | (MH "Physical Therapy+") OR "PHYSICAL THERAPY" OR (MH "Pediatric Physical Therapy") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S24 | (MH "Therapeutic Exercise+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S23 | (MH "Hyperbaric Oxygenation") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S22 | (MH "Biofeedback") OR "BIOFEEDBACK" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S21 | (MH "Rehabilitation, Athletic") OR (MH "Rehabilitation") OR "REHABILITATION" OR (MH "Rehabilitation, Psychosocial") OR (MH "Rehabilitation, Speech and Language") OR (MH "Rehabilitation, Pediatric") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S20 | (MH "Diet Therapy") OR (MH "Apitherapy") OR (MH "Pediatric Physical Therapy") OR (MH "Behavior Therapy") OR (MH "Pediatric Occupational Therapy") OR (MH "Motion Therapy, | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |

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|------------|---|-------------------------------|--|
| | Continuous Passive") OR (MH "Magnet Therapy") OR (MH "Color Therapy") OR (MH "Electroconvulsive Therapy") | | |
| S19 | (MH "Pharmacological and Biological Treatments") OR (MH "Treatment Outcomes") OR "TREATMENT" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S18 | (MH "Drug Therapy") OR (MH "Drug Therapy, Combination") OR (MH "Fluid Therapy") OR (MH "Intravenous Therapy") OR (MH "Prescriptions, Drug") OR (MH "Manual Therapy") OR (MH "Phototherapy") OR (MH "Radiotherapy") OR (MH "Rehabilitation") OR (MH "Respiratory Therapy") OR (MH "Stress Management") OR (MH "Therapy, Computer Assisted") OR (MH "Vestibular Stimulation") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S17 | TX THERAPEUTIC | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S16 | "THERAPY" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S15 | S13 NOT S14 | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S14 | TI IRAQ OR IRAQI OR AFGHANISTAN OR "GULF WAR" OR "GULF WARS" OR AFGHAN OR "OPERATION ENDURING | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; |

| | | | |
|------------|--|--|--|
| | FREEDOM" OR MILITARY OR BATTLEFIELD OR ARMY OR "ARMED FORCES" OR MARINES OR TROOPS OR SERVICEMEN OR "COMBAT RELATED" OR "AIR FORCE" OR SOLDIERS OR "OIF/oEF" OR VETERANS OR "ACTIVE DUTY" OR "SERVICE MEMBERS" | | Nursing & Allied Health Collection: Comprehensive |
| S13 | S7 OR S9 OR S10 OR S11 | Limiters - Published Date from: 19900101-20121231 Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S12 | S7 OR S9 OR S10 OR S11 | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S11 | TX "MINIMAL TRAUMATIC BRAIN INJURY" OR "MINIMAL TRAUMATIC BRAIN INJURIES" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S10 | TX (TBI OR TBIS OR "BRAIN CONTUSION" OR "BRAIN CONTUSIONS" OR "BRAIN TRAUMA" OR "BRAIN LACERATION" OR "BRAIN LACERATIONS" OR "CEREBRAL INJURY" OR "CEREBRAL INJURIES" OR "HEAD INJURY" OR "HEAD INJURIES" OR "HEAD TRAUMA" OR "CEREBRAL TRAUMA" OR "SKULL INJURY" OR "SKULL INJURIES" OR "CRANIOCEREBRAL TRAUMA" OR "BRAIN INJURY" OR "BRAIN INJURIES") AND TX (MILD OR MINOR) | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S9 | "GCS 13-15" OR MTBI OR MTBIS OR "MILD TRAUMATIC BRAIN | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; |

| | | | |
|-----------|---|-------------------------------|--|
| | INJURY" OR "MILD TRAUMATIC BRAIN INJURIES" | | Nursing & Allied Health Collection: Comprehensive |
| S8 | (MH "Brain Concussion+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S7 | S6 AND (S2 OR S1) | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S6 | S5 OR S4 OR S3 | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S5 | (MH "Recreation+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S4 | (MH "Athletes+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S3 | (MH "Sports+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S2 | (MH "Head Injuries+") OR TX (tbi or tbis) | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; Nursing & Allied Health Collection: Comprehensive |
| S1 | (MH "Head Injuries+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text; |

| | | | |
|--|--|--|--|
| | | | Nursing & Allied Health Collection: Comprehensive |
|--|--|--|--|

PubMed

| Strategy | Strategy | Search Limits | Results |
|----------------|--|-----------------------------------|---------|
| Question 1 | Original Search Strategy | Human; January 1990-November 2012 | 380 |
| Question 1 | Updated Search _Original Strategy | Human; December 2012-July 2015 | 78 |
| Question 2 & 3 | Original Search Strategy | Human; January 1990-November 2012 | 956 |
| Question 2 & 3 | Updated Search _Original Strategy | Human; December 2012-July 2015 | 168 |
| Question 4 & 5 | Original Search Strategy | Human; January 1990-November 2012 | 3405 |
| Question 4 & 5 | Updated Search _Original Strategy | Human; December 2012-July 2015 | 790 |
| Question 6 | Original Search Strategy | Human; January 1990-November 2012 | 74 |
| Question 6 | Updated Search _Original Strategy | Human; December 2012-July 2015 | 16 |

[PubMed Question 1_Original Search Strategy](#)

POPULATION AND DIAGNOSIS

POPULATION:

SPORT*[TW] OR ATHLETE[TW] OR ATHLETES[TW] OR ATHLETIC*[TW] OR RECREATION*[TIAB]) AND (HEAD INJUR*[TW] OR BRAIN INJUR*[TW] OR HEAD TRAUMA*[TIAB] OR BRAIN TRAUMA*[TIAB] OR SKULL INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR CEREBRAL TRAUMA*[TW] OR CEREBRAL INJUR*[TW])

OR

GCS 13-15[TIAB] OR BRAIN CONCUSSION[MH] OR CONCUSSION*[TW] OR CONCUSSIVE[TIAB] OR COMMOTIO CEREBRI[TW] OR POST CONCUSSIVE[TW] OR POSTCONCUSSIVE[TW] OR MILD TBI[TIAB] OR MILD TBIS[TIAB] OR MTBI[TIAB] OR MTBIS[TIAB] OR MILD TRAUMATIC BRAIN INJUR*[TIAB]

OR

(TRAUMATIC BRAIN INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR BRAIN CONTUSION*[TW] OR BRAIN TRAUMA*[TW] OR BRAIN LACERATION*[TW] OR CEREBRAL INJUR*[TW] OR HEAD INJUR*[TW] OR HEAD TRAUMA*[TW] OR CEREBRAL TRAUMA*[TIAB] OR SKULL INJUR*[TW] OR CRANIOCEREBRAL TRAUMA[MH:NOEXP] OR BRAIN INJUR* [TW]) AND (MILD[TIAB] OR MINOR[TIAB])

OR

MINIMAL TRAUMATIC BRAIN INJUR*[TIAB] OR MINIMAL TBI[TIAB]

NOT

(ANIMALS[MH] NOT (ANIMALS[MH] AND HUMAN*[MH]))

NOT

(ADULT[MH] NOT (ADULT[MH] AND (CHILD[MH] OR ADOLESCENT*[MH] OR INFANT*[MH]))

NOT

(IRAQ WAR, 2003 [MAJR] OR IRAQ WAR [TI] OR GULF WAR [TI] OR OPERATION IRAQI FREEDOM [TI] OR GULF WARS [TI] OR AFGHAN CAMPAIGN 2001[MAJR] OR OPERATION ENDURING FREEDOM [TI] OR AFGHAN WAR [TI] OR WAR [MAJR] OR MILITARY [TI] OR BATTLEFIELD [TI] OR ARMY [TI] OR ARMED FORCES [TI] OR MARINES [TI] OR TROOPS [TI] OR SERVICEMEN [TI] OR COMBAT RELATED [TI] OR MILITARY PERSONNEL [MAJR] OR AIR FORCE [TI] OR SOLDIERS [TI] OR MILITARY MEDICINE [MAJR] OR OIF/OEF [TI] OR COMBAT VETERAN* [TI] OR COMBAT DISORDERS [MAJR] OR VETERANS [MAJR] OR ACTIVE DUTY [TI] OR SERVICE MEMBERS [TI]) NOT (MILITARY [TW] AND (CIVILIAN* [TIAB] OR SPORTS [TIAB] OR ATHLETE* [TIAB] OR SPORT RELATED [TI] OR SPORTS RELATED [TI]))

DIAGNOSIS:

ASSESSMENT* [TIAB] OR DIAGNOSTIC TECHNIQUES, NEUROLOGICAL[MH:NOEXP] OR NEUROLOGIC EXAMINATION[MH] OR DIAGNOSIS, DIFFERENTIAL[MH] OR DIAGNOSIS[MH:NOEXP] OR DIAGNOSIS[SH] OR DIAGNOSTIC ERRORS[MH] OR DIAGNOS*[TIAB] OR DIAGNOSTIC*[TW] OR MEASURES[TW] OR SCALE[TW] OR SCALES[TW] OR SCORE[TW] OR SCORES[TW] OR INDEX[TW] OR INDICES[TW] OR INSTRUMENT[TW] OR INSTRUMENTS[TW] OR MEASURE[TW] OR SENSORY MODALITY ASSESSMENT[TIAB] OR SENSORY STIMULATION

ASSESSMENT[TIAB] OR WESSEX HEAD INJURY MATRIX[TIAB] OR WESTERN NEURO SENSORY STIMULATION PROFILE[TIAB] OR SENSITIVITY AND SPECIFICITY[MH] OR SPECIFICITY[TIAB] OR PREDICTIVE VALUE OF TESTS[MH] OR CONFIDENCE INTERVAL[MH] OR DETECT*[TIAB] OR CHARACTERISTIC*[TIAB] OR CATEGORIZ*[TIAB] OR CATEGORIS*[TIAB] OR DISTINGUISH*[TIAB] OR DIFFERENTIAT*[TIAB] OR BEHAVIOURAL ASSESSMENT*[TIAB] OR BEHAVIORAL ASSESSMENT*[TIAB] OR BEHAVIOR ASSESSMENT*[TIAB] OR BEHAVIOUR ASSESSMENT*[TIAB] OR NEUROPSYCHOLOGICAL TESTS[MH:NOEXP] OR TRAUMA SEVERITY INDICES [MH] OR DETERMINANT* [TIAB] OR KING DEVICK TEST [TIAB] OR MILITARY ACUTE CONCUSSION EVALUATION [TIAB] OR REACTION TIME [MH] OR REACTION TIME* [TIAB] OR RESPONSE LATENCY [TW] OR SCREENING TEST* [TIAB] OR SCREENING TOOL* [TIAB] OR BALANCE TEST* [TW] OR POSTURAL BALANCE [MH] OR POSTURAL EQUILIBRIUM [TW] OR SENSATION DISORDERS [MH] OR BALANCE ASSESSMENT [TIAB] OR MEDICAL SYMPTOM VALIDITY TEST [TIAB] OR EVOKED POTENTIALS[MH] OR EVOKED POTENTIAL*[TIAB]OR CLASSIFICATION [MH] OR CLASSIFICATION [SH]OR NEUROCOGNITIVE TEST* [TIAB]OR PSYCHOMOTOR PERFORMANCE [MH] OR MEMORY [MH]OR IMMEDIATE POST-CONCUSSION ASSESSMENT AND COGNITIVE TEST* [TIAB] OR ELECTROENCEPHALOGRAPHY[MH] OR ELECTROENCEPHALOGRAPHY[TIAB] OR ELECTROENCEPHALOGRAM*[TIAB] OR ECHOENCEPHALOGRAPHY[MH] OR EEG[TIAB] OR EEGS[TIAB] OR QEEG[TIAB] OR QEEGS[TIAB] OR ELECTROMYOGRAPH*[TW] OR EMG[TIAB] OR EMGS[TIAB] OR ELECTROPHYSIOLOGIC TECHNIQUE*[TIAB]

OR

PREDICTIVE[TIAB] AND VALUE*[TIAB]

PubMed Question 2 & 3_Original Search Strategy

(POPULATION AND ACUTE CARE SETTING) AND (IMAGING OR INTRACRANIAL INJURY)

POPULATION:

GCS 13-15[TIAB] OR BRAIN CONCUSSION[MH] OR CONCUSSION*[TW] OR COMMOTIO CEREBRI[TW] OR POST CONCUSSIVE[TW] OR POSTCONCUSSIVE[TW] OR MTBI[TIAB] OR MTBIS[TIAB] OR BRAIN INJURIES[MH] OR BRAIN INJUR*[TW] OR TBI[TIAB] OR TBIS[TIAB] OR BRAIN CONTUSION*[TW] OR BRAIN TRAUMA*[TW] OR BRAIN LACERATION*[TW] OR HEAD TRAUMA*[TW] OR CEREBRAL TRAUMA*[TW] OR CEREBRAL INJUR*[TW] OR SKULL INJUR*[TW] OR SKULL TRAUMA[TW] OR CRANIOCEREBRAL TRAUMA[MH:noexp] OR HEAD INJUR*[TW]

NOT

(ANIMALS[MH] NOT (ANIMALS[MH] AND HUMAN*[MH]))

NOT

(ADULT[MH] NOT (ADULT[MH] AND (CHILD[MH] OR ADOLESCENT*[MH] OR INFANT*[MH]))

NOT

(IRAQ WAR, 2003 [MAJR] OR IRAQ WAR [TI] OR GULF WAR [TI] OR OPERATION IRAQI FREEDOM [TI] OR GULF WARS [TI] OR AFGHAN CAMPAIGN 2001[MAJR] OR OPERATION ENDURING FREEDOM [TI] OR AFGHAN WAR [TI] OR WAR [MAJR] OR MILITARY [TI] OR BATTLEFIELD [TI] OR ARMY [TI] OR ARMED FORCES [TI] OR MARINES [TI] OR TROOPS [TI] OR SERVICEMEN [TI] OR COMBAT RELATED [TI] OR MILITARY PERSONNEL [MAJR] OR AIR FORCE [TI] OR SOLDIERS [TI] OR MILITARY MEDICINE [MAJR] OR OIF/OEF [TI] OR COMBAT VETERAN* [TI] OR COMBAT

DISORDERS [MAJR] OR VETERANS [MAJR] OR ACTIVE DUTY [TI] OR SERVICE MEMBERS [TI]) NOT (MILITARY [TW] AND (CIVILIAN* [TIAB] OR SPORTS [TIAB] OR ATHLETE* [TIAB] OR SPORT RELATED [TI] OR SPORTS RELATED [TI]))

ACUTE CARE SETTING:

MEDICAL CENTRE*[TIAB] OR TRAUMA CENTRE*[TIAB] OR NON TRAUMA CENTRE* [TIAB] OR NONTRAUMA CENTRE* [TIAB] OR INPATIENT*[TW] OR MEDICAL CENTER*[TW] OR ACADEMIC MEDICAL CENTERS[MH] OR HEALTH FACILITIES[MH] OR ACUTE CARE[TW] OR HOSPITALS[MH] OR HOSPITAL*[TW] OR NON TRAUMA CENTER*[TW] OR NONTRAUMA CENTER*[TW] OR TRAUMA CENTERS[MH] OR TRAUMA CENTER*[TW] OR TRAUMA UNIT*[TW] OR EMERGENCY SERVICE, HOSPITAL[MH] OR EMERGENCY[TW] OR ACUTE SETTING* [TIAB] OR TERTIARY CARE [TIAB]

IMAGING:

MAGNETIC RESONANCE IMAGING [MH] OR ZEUGMATOGRAPHY [TW] OR TOMOGRAPHY [TW] OR MRI SCAN* [TW] OR FMRI [TW] OR FMRIS [TW] OR MRI [TW] OR MRIS [TW] OR IMAGING* [TW] OR NEUROIMAGING [MH:NOEXP] OR NEUROIMAGING* [TIAB] OR NEURO IMAGING* [TIAB] OR TOMOGRAPHY, X-RAY COMPUTED [MH] OR CAT SCAN* [TW] OR CT SCAN* [TW] OR CT X RAY* [TW] OR TOMODENSITOMETRY [TW] OR CINE-CT [TW] OR X-RAYS [MH] OR X RAY* [TIAB] OR RADIOGRAPHY [SH]

INTRACRANIAL INJURY:

INTRACRANIAL INJUR* [TIAB] OR INTRACRANIAL HEMORRHAGES[MH] OR BRAIN HEMORRHAGE, TRAUMATIC[MH] OR HEMATOMA, SUBDURAL[MH] OR HEMORRHAGE*[TW] OR HAEMORRHAGE*[TIAB] OR BRAIN BLEED*[TIAB] OR HAEMATOMA*[TIAB] OR HEMATOMA*[TIAB] OR PITUITARY APOPLEXY[TW] OR EDEMA[TW] OR DIFFUSE AXONAL INJURY[MH] OR AXONAL SWELLING[TW] OR RETRACTION BALLS[TIAB] OR CEREBRAL ATROPHY[TIAB] OR INTRACEREBRAL INJUR*[TIAB] OR OEDEMA[TIAB] OR BRAIN CONTUSION*[TIAB] OR CEREBRAL CONTUSION*[TIAB] OR AXONAL INJUR*[TW] OR PNEUMOCEPHALUS[MH] OR PNEUMOCEPHALUS[TIAB] OR CRANIAL PNEUMOCYST*[TW] OR INTRACRANIAL GAS[TW] OR MICROBLEED*[TIAB] OR MICRO BLEED* [TIAB] OR WHITE MATTER INJUR*[TIAB] OR SKULL FRACTURES[MH] OR SKULL FRACTURE*[TIAB] OR CRANIAL INJUR*[TW] OR LESION*[TW] OR NEUROPATHOLOG*[TW] OR BLEEDING[TIAB] OR MICROHEMORRHAGE*[TIAB] OR MICROHAEMORRHAGE*[TIAB] OR MICRO HEMORRHAGE*[TIAB] OR MICRO HAEMORRHAGE*[TIAB] OR INTRACRANIAL SEQUELAE[TIAB]

PubMed Question 4 & 5_Original Search Strategy

POPULATION AND (PROGNOSIS OR RISK FACTORS FOR SEQUELAE)

POPULATION:

SPORT*[TW] OR ATHLETE[TW] OR ATHLETES[TW] OR ATHLETIC*[TW] OR RECREATION*[TIAB]) AND (HEAD INJUR*[TW] OR BRAIN INJUR*[TW] OR HEAD TRAUMA*[TIAB] OR BRAIN TRAUMA*[TIAB] OR SKULL INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR CEREBRAL TRAUMA*[TW] OR CEREBRAL INJUR*[TW])

OR

GCS 13-15[TIAB] OR BRAIN CONCUSSION[MH] OR CONCUSSION*[TW] OR CONCUSSIVE[TIAB] OR COMMOTIO CEREBRI[TW] OR POST CONCUSSIVE[TW] OR POSTCONCUSSIVE[TW] OR MILD TBI[TIAB] OR MILD TBIS[TIAB] OR MTBI[TIAB] OR MTBIS[TIAB] OR MILD TRAUMATIC BRAIN INJUR*[TIAB]

OR

(TRAUMATIC BRAIN INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR BRAIN CONTUSION*[TW] OR BRAIN TRAUMA*[TW] OR BRAIN LACERATION*[TW] OR CEREBRAL INJUR*[TW] OR HEAD INJUR*[TW] OR HEAD TRAUMA*[TW] OR CEREBRAL TRAUMA*[TIAB] OR SKULL INJUR*[TW] OR CRANIOCEREBRAL TRAUMA[MH:NOEXP] OR BRAIN INJUR* [TW]) AND (MILD[TIAB] OR MINOR[TIAB])

OR

MINIMAL TRAUMATIC BRAIN INJUR*[TIAB] OR MINIMAL TBI[TIAB]

NOT

(ANIMALS[MH] NOT (ANIMALS[MH] AND HUMAN*[MH]))

NOT

(ADULT[MH] NOT (ADULT[MH] AND (CHILD[MH] OR ADOLESCENT*[MH] OR INFANT*[MH])))

NOT

(IRAQ WAR, 2003 [MAJR] OR IRAQ WAR [TI] OR GULF WAR [TI] OR OPERATION IRAQI FREEDOM [TI] OR GULF WARS [TI] OR AFGHAN CAMPAIGN 2001[MAJR] OR OPERATION ENDURING FREEDOM [TI] OR AFGHAN WAR [TI] OR WAR [MAJR] OR MILITARY [TI] OR BATTLEFIELD [TI] OR ARMY [TI] OR ARMED FORCES [TI] OR MARINES [TI] OR TROOPS [TI] OR SERVICEMEN [TI] OR COMBAT RELATED [TI] OR MILITARY PERSONNEL [MAJR] OR AIR FORCE [TI] OR SOLDIERS [TI] OR MILITARY MEDICINE [MAJR] OR OIF/OEF [TI] OR COMBAT VETERAN* [TI] OR COMBAT DISORDERS [MAJR] OR VETERANS [MAJR] OR ACTIVE DUTY [TI] OR SERVICE MEMBERS [TI]) NOT (MILITARY [TW] AND (CIVILIAN* [TIAB] OR SPORTS [TIAB] OR ATHLETE* [TIAB] OR SPORT RELATED [TI] OR SPORTS RELATED [TI]))

PROGNOSIS:

EXTENDED [TIAB] OR LASTING [TIAB] OR LONGTERM [TIAB] OR LONG TERM [TIAB] OR "LONGER THAN" [TIAB] OR "MORE THAN" [TIAB] OR "GREATER THAN" [TIAB] OR DELAYED [TIAB] OR FAILURE* [TW] OR PROLONG* [TIAB] OR PROTRACTED [TIAB] OR COMPLICATED [TIAB] OR ENDURING [TIAB] OR CONTINUING [TIAB] OR CONTINUED [TIAB] OR UNRESOLVED [TIAB] OR UNREMITTING [TIAB] OR LINGERING [TIAB] OR PROBLEMATIC [TIAB]) AND (FUNCTIONAL LEVEL [TIAB] OR PROGRESS*[TW] OR RECUPERAT*[TIAB] OR CONVALESCENCE[TW] OR CONVALESCENCE[TIAB] OR CONVALESCED[TIAB] OR CONVALESCES[TIAB] OR CONVALESCING[TIAB] OR RECOVER[TIAB] OR RECOVERS[TIAB] OR RECOVERY[TIAB] OR RECOVERING[TIAB] OR RECOVERIES[TIAB] OR IMPROVE* [TW] OR IMPROVEMENT* [TIAB] OR IMPROVING[TW] OR RESTORATION[TW] OR RESTORE*[TW] OR RECOVERY OF FUNCTION[TW] OR RESOLUTION* [TW] OR PROGNOSIS [MH] OR DISEASE FREE SURVIVAL [MH OR PROGNOS*[TW] OR PREDICT*[TIAB] OR NOMOGRAM*[TW] OR MEDICAL FUTILITY [MH] OR FUTIL* [TW] OR TREATMENT OUTCOME [MH:NOEXP] OR TREATMENT FAILURE [MH] OR PREDICTIVE VALUE OF TESTS [MH] OR FORECASTING [MH] OR FORECAST* [TIAB] OR PROJECTION* [TW])

RISK FACTORS FOR SEQUELAE:

(PATHOPHYSIOLOG* [TW] OR DYSFUNCTION [TIAB] OR SYMPTOMATOLOGY [TIAB] OR SUBSYMPTOM* [TIAB] OR SUB SYMPTOM* [TIAB] OR SYMPTOMS [TW] OR SYMPTOMATIC [TIAB] OR DISEASE-FREE SURVIVAL[MH] OR TREATMENT FAILURE[MH] OR DISEASE PROGRESSION[MH] OR DISEASE PROGRESSION [TIAB] OR SEQUELAE [TW] OR ENDURING [TW] OR DELAYED [TIAB] OR PROLONGED [TIAB] OR ONGOING [TIAB] OR PERSISTENT [TIAB] OR

PERSISTENCE [TIAB] OR PERSISTING [TIAB] OR LASTING [TIAB] OR LONGTERM [TIAB] OR LONG TERM [TIAB] OR POST CONCUSSION SYNDROME* [TIAB] OR POST-CONCUSSION SYNDROME [MH] OR POST-CONCUSSIVE SYNDROME [TW] OR POSTCONCUSSION SYNDROME* [TIAB] OR POSTCONCUSSIVE SYNDROME* [TIAB] OR UNRESOLVED [TIAB] OR CONTINUING [TIAB] OR CONTINUE* [TIAB] OR UNREMITTING [TIAB] OR LINGERING [TIAB] OR PROTRACTED [TIAB] OR POSTTRAUMATIC [TW] OR POST TRAUMATIC [TIAB] OR COMPLICATIONS [SH] OR COMPLICATION* [TIAB] OR COMPLICATED [TIAB] OR EXTENDED [TIAB] OR DISABILITY [TW] OR DISABILITIES [TW] OR DISABLED [TW] OR IMPAIRMENT [TW] OR IMPAIRED [TIAB] OR FAILURE [TW] OR REFRACTORY [TW] OR MORE SEVERE* [TIAB])

AND

(RISK [MH:NOEXP]OR RISK ASSESSMENT [MH] OR RISK FACTORS [MH] OR RISK* [TIAB] OR RISK ADJUSTMENT [MH] OR PRECIPITATING FACTORS [MH] OR EPIDEMIOLOGIC FACTORS [MH] OR CAUSALITY [MH] OR CAUSALITY [TW] OR CAUSATION* [TW] OR ETIOLOGY [SH:NOEXP] OR EPIDEMIOLOGY [SH] OR FEATURE* [TIAB] OR FACTOR [TIAB] OR FACTORS [TIAB] OR IDENTIFY [TIAB] OR IDENTIFICATION [TIAB] OR IDENTIFIES [TIAB] OR IDENTIFIED [TIAB] OR AGE FACTORS [MH] OR SEX [TW] OR SEXES [TW] OR GENDER [TW] OR TIME SINCE INJUR* [TIAB] OR TIME FACTORS [MH] OR BETWEEN GROUP DIFFERENCE* [TIAB] OR MECHANISM OF INJURY [TIAB] OR MECHANISMS OR INJURY [TIAB] OR INDICATOR* [TIAB] OR CHARACTERISTIC* [TIAB] OR ANALYSIS OF VARIANCE [MH])

PubMed Question 6_Original Search Strategy

POPULATION AND ONGOING SYMPTOMS AND TREATMENTS

POPULATION:

SPORT*[TW] OR ATHLETE[TW] OR ATHLETES[TW] OR ATHLETIC*[TW] OR RECREATION*[TIAB]) AND (HEAD INJUR*[TW] OR BRAIN INJUR*[TW] OR HEAD TRAUMA*[TIAB] OR BRAIN TRAUMA*[TIAB] OR SKULL INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR CEREBRAL TRAUMA*[TW] OR CEREBRAL INJUR*[TW])

OR

GCS 13-15[TIAB] OR BRAIN CONCUSSION[MH] OR CONCUSSION*[TW] OR CONCUSSIVE[TIAB] OR COMMOTIO CEREBRI[TW] OR POST CONCUSSIVE[TW] OR POSTCONCUSSIVE[TW] OR MILD TBI[TIAB] OR MILD TBIS[TIAB] OR MTBI[TIAB] OR MTBIS[TIAB] OR MILD TRAUMATIC BRAIN INJUR*[TIAB]

OR

(TRAUMATIC BRAIN INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR BRAIN CONTUSION*[TW] OR BRAIN TRAUMA*[TW] OR BRAIN LACERATION*[TW] OR CEREBRAL INJUR*[TW] OR HEAD INJUR*[TW] OR HEAD TRAUMA*[TW] OR CEREBRAL TRAUMA*[TIAB] OR SKULL INJUR*[TW] OR CRANIOCEREBRAL TRAUMA[MH:NOEXP] OR BRAIN INJUR* [TW]) AND (MILD[TIAB] OR MINOR[TIAB])

OR

MINIMAL TRAUMATIC BRAIN INJUR*[TIAB] OR MINIMAL TBI[TIAB]

NOT

(ANIMALS[MH] NOT (ANIMALS[MH] AND HUMAN*[MH]))

NOT

(ADULT[MH] NOT (ADULT[MH] AND (CHILD[MH] OR ADOLESCENT*[MH] OR INFANT*[MH])))

NOT

(IRAQ WAR, 2003 [MAJR] OR IRAQ WAR [TI] OR GULF WAR [TI] OR OPERATION IRAQI FREEDOM [TI] OR GULF WARS [TI] OR AFGHAN CAMPAIGN 2001[MAJR] OR OPERATION ENDURING FREEDOM [TI] OR AFGHAN WAR [TI] OR WAR [MAJR] OR MILITARY [TI] OR BATTLEFIELD [TI] OR ARMY [TI] OR ARMED FORCES [TI] OR MARINES [TI] OR TROOPS [TI] OR SERVICEMEN [TI] OR COMBAT RELATED [TI] OR MILITARY PERSONNEL [MAJR] OR AIR FORCE [TI] OR SOLDIERS [TI] OR MILITARY MEDICINE [MAJR] OR OIF/OEF [TI] OR COMBAT VETERAN* [TI] OR COMBAT DISORDERS [MAJR] OR VETERANS [MAJR] OR ACTIVE DUTY [TI] OR SERVICE MEMBERS [TI]) NOT (MILITARY [TW] AND (CIVILIAN* [TIAB] OR SPORTS [TIAB] OR ATHLETE* [TIAB] OR SPORT RELATED [TI] OR SPORTS RELATED [TI]))

ONGOING SYMPTOMS:

LONGTERM [TIAB] OR SYMPTOMS [TW] OR SYMPTOMATIC [TIAB] OR SEQUELAE [TW] OR ENDURING [TW] OR DELAYED [TIAB] OR PROLONG* [TIAB] OR ONGOING [TIAB] OR PERSISTENT [TIAB] OR PERSISTENCE [TIAB] OR PERSISTING [TIAB] OR LASTING [TIAB] OR LONG TERM [TIAB] OR POST-CONCUSSION SYNDROME [MH] OR POST-CONCUSSIVE SYNDROME [TW] OR POSTCONCUSSION SYNDROME* [TIAB] OR POSTCONCUSSIVE SYNDROME* [TIAB] OR SYMPTOMATOLOGY [TIAB] OR SUBSYMPTOM* [TIAB] OR UNRESOLVED [TIAB] OR CONTINUING [TIAB] OR CONTINUED [TIAB] OR UNREMITTING [TIAB] OR LINGERING [TIAB] OR PROTRACTED [TIAB] OR "LONGER THAN" [TIAB] OR "MORE THAN" [TIAB] OR "GREATER THAN" [TIAB] OR POST CONCUSSION SYNDROME [MH] OR POST CONCUSSION SYNDROME* [TIAB] OR POSTCONCUSSION SYNDROME* [TIAB] OR POSTTRAUMATIC [TW] OR POST TRAUMATIC [TIAB] OR COMPLICATIONS [SH] OR COMPLICATION* [TIAB] OR COMPLICATED [TIAB] OR EXTENDED [TIAB] OR RECOVERY OR RECOVER [TIAB] OR RECOVERED [TIAB] OR COMMUNITY DWELLING [TIAB] OR DISABILITY [TW] OR DISABILITIES [TW] OR DISABLED [TW] OR IMPAIRMENT [TW] OR IMPAIRED [TIAB] OR REHABILITATION [MH] OR REINTEGRATION [TW] OR REHABILITATION [TIAB] OR RE-INTEGRATION [TIAB] OR FAILURE [TW] OR REMEDIATION [TW] OR REMEDIATE [TW] OR REFRACTORY [TW] OR EXTENDED [TIAB] OR "LONGER THAN" [TIAB] OR "MORE THAN" [TIAB] OR "GREATER THAN" [TIAB] OR PROBLEMATIC [TIAB]

TREATMENTS:

THERAPY [SH] OR THERAPEUTIC USE [SH] OR DRUG THERAPY[MH]OR PHARMACOTHERAP* [TW] OR PHARMACOLOGIC* [TW] OR DRUG THERAP* [TIAB]OR THERAPY [TW] OR THERAPIES [TW] OR THERAPEUTIC* [TW] OR TREATMENT* [TW] OR TREATMENT OUTCOME [MH] OR DIET THERAPY [MH] OR DIET THERAPY [SH] OR NUTRITION THERAPY [MH] OR REHABILITATION OUTCOME* [TW] OR REHABILITATION [SH] OR REHABILITAT* [TIAB] OR TREATED [TIAB] OR MANAGEMENT [TIAB] OR INTERVENTION* [TIAB] OR BIOFEEDBACK, PSYCHOLOGY [MH] OR BIOFEEDBACK [TIAB] OR HYPERBARIC

OXYGENATION [MH] OR EXERCISE THERAPY [MH] OR PHYSICAL THERAPY MODALITIES [MH] OR PHYSIOTHERAPY [TW] OR COGNITIVE THERAPY [MH] OR HYPOTHERMIA, INDUCED [MH:NOEXP] OR HYPOTHERMIA [TIAB] OR REST [MH] OR NEUROREHABILIT* [TIAB] OR STRESS REDUCTION [TIAB] OR PHYSICAL REST [TIAB] OR COGNITIVE REST [TIAB] OR NEUROPROTECTIVE AGENTS [MH] OR SALINE SOLUTION, HYPERTONIC [MH] OR NUTRACEUTICAL* [TIAB] OR DIETARY SUPPLEMENTS [MH] OR DIETARY SUPPLEMENT* [TIAB] OR NEUTRACEUTICAL* [TIAB] OR NEUROFEEDBACK [TIAB] OR NEURO FEEDBACK [TIAB] OR BIO FEEDBACK [TIAB] OR MASSAGE [MH] OR MASSAGE [TIAB] OR COGNITIVE RETRAINING [TIAB] OR STIMULATION [TW] OR SENSORY [TW] OR DEPRIVATION[TW] OR RANGE OF MOTION EXERCISE* [TW] OR POSITIONING [TIAB] OR POSITIONAL CHANGE* [TW] OR POSTURAL CHANGE* [TIAB] OR ACETAMINOPHEN [TW] OR ASPIRIN [TW] OR IBUPROFEN [TW] NAPROXEN [TW] OR DICLOFENAC [TW] OR ANALGESICS [TW] OR NSAIDS [TW] OR ANTIDEPRESSANT* [TW] OR AMITRIPTYLINE [TW] OR NORTRIPTYLINE [TW] OR ANTICONVULSANT* [TW] OR VALPROIC ACID [TW] OR TOPIRAMATE [TW] OR GABAPENTIN [TW] OR PROPRANOLOL [TW] OR B-ADRENERGIC ANTAGONIST* [TW] OR METOPROLOL [TW] OR DIHYDROERGOTAMINE [TW] OR ERGOT [TW] OR SUMATRIPTAN [TW] OR TRIPTANS [TW] OR ZOLMITRIPTAN [TW] OR RIZATRIPTAN [TW] OR VESTIBULAR SUPPRESSANT* [TW] OR MECLIZINE [TW] OR SCOPOLAMINE [TW] OR DIMEHYDRINATE [TW] OR BENZODIAZEPINES [TW] OR LORAZEPAM [TW] OR CLONAZEPAM [TW] OR DIAZEPAM [TW] OR NEUROSTIMULANT* [TW] OR METHYLPHENIDATE [TW] OR DEXTROAMPHETAMINE [TW] OR MODAFANIL [TW] OR AMANTADINE [TW] OR ATOMOXETINE [TW] OR ANTIEMETIC* [TW] OR ONDANSETRON [TW] OR PHENERGAN [TW] OR SEDATIVE-HYPNOTIC* [TW] OR ZOLPIDEM [TW] OR SEROTONIN MODULATOR* [TW] OR TRAZODONE [TW] OR A-ADRENERGIC ANTAGONIST* [TW] OR PRAZOSIN [TW] OR MELATONIN [TW] OR SERTRALINE [TW] OR CITALOPRAM [TW] OR ESCITALOPRAM [TW] OR PAROXETINE [TW] OR FLUOXETINE [TW] OR BUPROPION [TW] OR ACETYLCHOLINESTERASE INHIBITOR* [TW] OR SELECTIVE SEROTONIN REUPTAKE INHIBITOR* [TW] OR DONEPEZIL [TW] OR RIVASTIGMINE [TW] OR GALANTAMINE [TW] OR CYTIDINE DIPHOSPHATE CHOLINE [TW]

EMBASE SEARCH STRATEGIES—Updated Search

December 2012-July 2015

Question 1:

2,208

#2.3 AND #4.31

3,075,946

#2.3

#2.1 OR #2.2

696,823

#2.2

'evoked response'/exp OR 'response time'/exp OR 'body equilibrium'/exp OR 'psychomotor performance'/de OR 'task performance'/exp OR 'memory'/exp OR 'sensory dysfunction'/exp

2,515,609

#2.1

'diagnostic procedure'/de OR 'clinical assessment tool'/exp OR 'clinical observation'/exp OR 'computer assisted diagnosis'/de OR 'delayed diagnosis'/exp OR 'diagnostic accuracy'/exp OR 'diagnostic error'/exp OR 'diagnostic reasoning'/exp OR 'diagnostic test'/de OR 'diagnostic test accuracy study'/exp OR 'diagnostic value'/exp OR 'differential diagnosis'/exp OR 'early diagnosis'/exp OR 'electrodiagnosis'/de OR 'laboratory diagnosis'/exp OR 'molecular diagnosis'/exp OR 'physical examination'/de OR 'qualitative diagnosis'/exp OR 'quantitative diagnosis'/exp OR 'diagnosis'/de OR 'diagnostic approach route'/exp OR 'evaluation or follow up' OR 'clinical assessment'/exp OR 'clinical evaluation'/exp OR 'clinical global impression scale'/exp OR 'course evaluation'/exp OR 'expanded disability status scale'/exp OR 'functional assessment inventory'/exp OR 'gross motor function classification system'/exp OR 'gross motor function measure'/exp OR 'international classification of functioning, disability or health' OR 'oars multidimensional functional assessment questionnaire'/exp OR 'patient assessment'/exp OR 'sensory evaluation'/exp OR 'examination'/de OR 'contact examination'/exp OR 'medical examination'/de OR 'clinical examination'/exp OR 'functional assessment'/exp OR 'measurement'/de OR 'named inventories, questionnaires or rating scales' OR 'neurologic examination'/de OR 'dubowitz neurological assessment'/exp OR 'electroencephalography'/exp OR 'neuropsychological test'/exp OR 'stabilography'/exp OR 'tilt table test'/exp OR 'non invasive measurement'/exp OR 'rating scale'/exp OR 'scoring system'/exp OR 'screening'/de OR 'screening test'/exp OR 'sensory system examination'/de OR 'vestibular test'/exp OR 'summed rating scale'/exp

5,412

#4.31

#4.27 OR #4.30

163

#4.30

#4.29 NOT #4.19

163

#4.29

#4.28 NOT #4.24

163

#4.28

('glasgow coma scale'/exp OR 'glasgow outcome scale'/exp) AND '13-15':ab,ti

5,295

#4.27

#4.23 NOT #4.26

11,241

#4.26

#4.24 OR #4.25

30

#4.25

'oif/oef':ti AND [1990-2013]/py

11,235

#4.24

'iraq war':ti OR 'gulf war':ti OR 'gulf wars':ti OR 'operation iraqi freedom':ti OR 'afghan campaign':ti OR 'operation enduring freedom':ti OR military:ti OR battlefield:ti OR army:ti OR armed AND forces:ti OR marines:ti OR troops:ti OR servicemen:ti OR 'combat related':ti OR 'military personnel':ti OR 'air force':ti OR soldiers:ti OR 'combat veteran':ti OR 'combat disorder':ti OR 'combat disorders':ti OR veterans:ti OR 'active duty':ti OR 'service members':ti AND [1990-2013]/py

5,335

#4.23

#4.22 AND ('case report'/de OR 'clinical article'/de OR 'clinical protocol'/de OR 'clinical trial'/de OR 'cohort analysis'/de OR 'comparative study'/de OR 'control group'/de OR 'controlled clinical trial'/de OR 'controlled study'/de OR 'human'/de OR 'human tissue'/de OR 'interview'/de OR 'major clinical study'/de OR 'medical record review'/de OR 'methodology'/de OR 'model'/de OR 'nonhuman'/de OR 'normal human'/de OR 'outcomes research'/de OR 'practice guideline'/de OR 'prospective study'/de OR 'questionnaire'/de OR 'retrospective study'/de OR 'systematic review'/de) AND ('article'/it OR 'article in press'/it OR 'conference abstract'/it OR 'conference paper'/it OR 'letter'/it OR 'review'/it OR 'short survey'/it)

6,018

#4.22

#4.20 NOT #4.21

452,516

#4.21

'editorial'/exp

6,140

#4.20

#4.16 NOT #4.19

30,949

#4.19

#4.17 NOT #4.18

1,241

#4.18

('military phenomena'/exp/mj OR 'veteran'/exp/mj) AND (civilian*:ab,ti OR sport* OR athlete*)
AND [1990-2013]/py

32,190

#4.17

'military phenomena'/exp/mj OR 'veteran'/exp/mj

6,202

#4.16

#4.12 NOT #4.15

8,001,374

#4.15

#4.13 NOT #4.14

10,227,651

#4.14

'animal'/exp AND 'human'/exp AND [1990-2013]/py

18,229,025

#4.13

'animal'/exp

7,286

#4.12

#4.8 NOT #4.11

[4,719,417](#)

#4.11

#4.9 NOT #4.10

[665,955](#)

#4.10

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp AND ('newborn'/exp OR 'child'/exp OR 'adolescent'/exp) AND [1990-2013]/py

[5,385,372](#)

#4.9

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp

[10,092](#)

#4.8

#4.4 OR #4.5 OR #4.6 OR #4.7 AND [embase]/lim AND [1990-2013]/py

[974](#)

#4.7

mtbi:ab,ti OR mtbis:ab,ti OR 'minimal traumatic brain injury':ab,ti OR 'minimal traumatic brain injuries':ab,ti OR 'minimal tbi':ab,ti OR 'minimal tbis':ab,ti

[9,904](#)

#4.6

#4.2 AND (mild:ab,ti OR minor:ab,ti)

[3,409](#)

#4.5

'brain concussion'/exp

[2,878](#)

#4.4

#4.2 AND #4.3

[103,017](#)

#4.3

'sport'/exp OR 'athlete'/exp

[156,672](#)

#4.2

'brain injury'/exp OR 'head injury'/de OR 'skull injury'/exp

[3,578,947](#)

#4.1

'therapy'/de OR 'acupuncture'/exp OR 'animal assisted therapy'/exp OR 'apitherapy'/exp OR 'biological therapy'/exp OR 'computer assisted therapy'/exp OR 'conservative treatment'/exp OR 'counseling'/exp OR 'device therapy'/exp OR 'drug therapy'/exp OR 'early intervention'/exp OR 'experimental therapy'/exp OR 'fluid therapy'/exp OR 'homeopathy'/exp OR 'intensive care'/de OR 'neuromonitoring'/exp OR 'blood pressure monitoring'/exp OR 'body temperature monitoring'/exp OR 'capnography'/exp OR 'life sustaining treatment'/exp OR 'maintenance therapy'/de OR 'patient positioning'/exp OR 'rehabilitation care'/exp OR 'radiotherapy'/de OR 'cognitive rehabilitation'/exp OR 'functional training'/exp OR 'muscle training'/exp OR 'occupational therapy'/exp OR 'pediatric rehabilitation'/exp OR 'psychosocial rehabilitation'/exp OR 'recreational therapy'/exp OR 'rejuvenation'/exp OR 'sensorimotor integration'/exp OR 'speech rehabilitation'/exp OR 'sleep therapy'/exp OR 'supplementation'/exp OR 'systemic therapy'/exp OR 'therapy effect'/exp OR 'treatment response'/exp

Questions 2 & 3

3,539

2,194,721

#7.19

#7.17 OR #7.18

897,748

#7.18

'diffuse axonal injury'/exp OR 'nerve fiber degeneration'/exp OR 'axonal swelling':ab,ti OR 'retraction balls':ab,ti OR 'brain atrophy'/exp OR 'intracerebral injury':ab,ti OR 'intracerebral injuries':ab,ti OR 'edema'/de OR 'brain edema'/exp OR oedema:ab,ti OR 'axonal injury'/exp OR 'pneumocephalus'/exp OR 'cranial pneumocyst':ab,ti OR 'cranial pneumocysts':ab,ti OR 'intracranial gas':ab,ti OR 'white matter injury':ab,ti OR 'white matter injuries':ab,ti OR 'white matter injury'/exp OR 'skull fracture'/exp OR 'cranial injury':ab,ti OR 'cranial injuries':ab,ti OR lesion*:ab,ti OR 'neuropathology'/exp OR microhemorrhage*:ab,ti OR 'micro hemorrhage':ab,ti OR 'micro hemorrhages':ab,ti OR 'intracranial sequelae':ab,ti

1,504,683

#7.17

#7.13 OR #7.16

347,602

#7.16

#7.14 OR #7.15

347,060

#7.15

'bleeding'/de OR 'brain hemorrhage'/exp OR 'hematoma'/de OR 'brain hematoma'/exp OR 'traumatic hematoma'/exp OR 'meningeal hemorrhage'/exp OR 'brain bleed':ab,ti OR 'brain bleeds':ab,ti OR 'brain bleeding':ab,ti OR microbleed*:ab,ti OR 'micro-bleed':ab,ti OR 'micro-bleeds':ab,ti OR hemorrhage*:ab,ti OR haemorrhage*:ab,ti OR haematoma*:ab,ti

[782](#)

#7.14

'intracranial injury':ab,ti OR 'intracranial injuries':ab,ti

[1,213,947](#)

#7.13

'nuclear magnetic resonance imaging'/exp OR zeugmatography:ab,ti OR 'tomography'/de OR 'brain tomography'/exp OR 'computer assisted tomography'/exp OR 'emission tomography'/exp OR 'optical coherence tomography'/exp OR tomography:ab,ti OR 'mri scan':ab,ti OR 'mri scans':ab,ti OR fmri:ab,ti OR fmr:ab,ti OR mri:ab,ti OR mris:ab,ti OR 'neuroimaging'/exp OR 'cat scan':ab,ti OR 'cat scans':ab,ti OR 'ct scan':ab,ti OR 'ct scans':ab,ti OR 'radiodensitometry'/exp OR 'x ray'/exp OR 'x-ray':ab,ti OR 'x rays':ab,ti OR 'x-rays':ab,ti OR xray*:ab,ti

[8,388](#)

#7.12

#7.10 AND #7.11

[1,466,199](#)

#7.11

'health care facility'/de OR 'hospital'/exp OR 'emergency health service'/exp OR 'hospital service'/exp OR 'emergency department':ab,ti OR 'emergency departments':ab,ti OR 'hospital patient'/de OR 'hospitalized adolescent'/exp OR 'hospitalized child'/exp OR 'hospitalized infant'/exp OR 'emergency patient'/exp OR 'critically ill patient'/exp OR 'high risk patient'/exp OR 'medical center':ab,ti OR 'medical centers':ab,ti OR 'acute care':ab,ti OR hospital*:ab,ti OR 'trauma center':ab,ti OR 'trauma centers':ab,ti OR 'trauma unit':ab,ti OR 'trauma units':ab,ti OR 'emergency service':ab,ti OR 'nontrauma center':ab,ti OR 'non trauma center':ab,ti OR 'nontrauma centers':ab,ti OR 'non trauma centers':ab,ti

[54,306](#)

#7.10

#7.8 NOT #7.9

[32,259](#)

#7.9

'military phenomena'/exp/mj OR 'veteran'/exp/mj OR 'veterans health'/exp/mj

[54,493](#)

#7.8

#7.4 NOT #7.7

[4,153,342](#)

#7.7

#7.5 NOT (#7.5 AND #7.6)

[2,632,147](#)

#7.6

'child'/exp OR 'adolescent'/exp OR 'newborn'/exp

[5,090,845](#)

#7.5

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp

[82,997](#)

#7.4

#7.3 AND (1990:py OR 1991:py OR 1992:py OR 1993:py OR 1994:py OR 1995:py OR 1996:py OR 1997:py OR 1998:py OR 1999:py OR 2000:py OR 2001:py OR 2002:py OR 2003:py OR 2004:py OR 2005:py OR 2006:py OR 2007:py OR 2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py) AND ('article'/it OR 'article in press'/it OR 'conference paper'/it OR 'letter'/it OR 'review'/it)

[137,019](#)

#7.3

#7.1 NOT #7.2

[4,236,760](#)

#7.2

'animal'/exp NOT ('animal'/exp AND 'human'/exp)

[159,318](#)

#7.1

'brain concussion'/exp OR 'brain injury'/exp OR mtbi:ab,ti OR mtbis:ab,ti OR 'head injury'/de OR 'skull injury'/de OR 'second impact syndrome'/exp OR tbi:ab,ti OR tbis:ab,ti OR concussion*:ab,ti OR 'brain laceration':ab,ti OR 'brain lacerations':ab,ti OR 'cerebral injury':ab,ti OR 'cerebral injuries':ab,ti OR 'brain contusion':ab,ti OR 'brain contusions':ab,ti OR 'brain trauma':ab,ti OR 'brain traumas':ab,ti OR 'brain injury':ab,ti OR 'brain injuries':ab,ti OR 'skull fracture'/de OR 'skull base fracture'/de

[Questions 4 & 5](#)

[3,229](#)

#3.39

#3.36 NOT #3.38

[241](#)

#3.38

#3.36 AND #3.37

[1,895,899](#)

#3.37

'case report'/exp

[3,470](#)

#3.36

#3.35 NOT #3.32

[3,541](#)

#3.35

#3.31 AND #3.34

[4,251,395](#)

#3.34

#3.1 OR #3.33

[1,628,084](#)

#3.33

'risk factor'/exp OR 'risk'/de OR 'high risk patient'/exp OR 'high risk infant'/exp OR 'risk assessment'/exp OR 'precipitating factor':ab,ti OR 'precipitating factors':ab,ti OR 'age factor':ab,ti OR 'age factors':ab,ti OR 'time factor':ab,ti OR 'time factors':ab,ti OR 'analysis of variance'/exp OR 'sex difference'/exp OR 'mechanism of injury':ab,ti OR 'mechanisms of injury':ab,ti OR 'time since injury':ab,ti OR 'between group difference':ab,ti OR 'between group differences':ab,ti OR epidemiology:de,ab,ti OR 'age distribution':de OR 'seasonal variation':de

[1,470,038](#)

#3.32

rat:ti OR rats:ti OR rodent*:ti OR mice:ti OR mouse:ti OR geriatric:ti OR elderly:ti OR 'animal model':ti OR alzheimer*:ti OR 'oif/oef':ti OR 'oef/oif':ti OR military:ti OR iraq:ti OR afghanistan:ti OR 'combat related':ti OR army:ti OR soldiers:ti OR veterans:ti OR 'air force':ti OR 'gulf war':ti OR 'gulf wars':ti OR 'operation enduring freedom':ti OR 'operation iraqi freedom':ti OR 'afghan war':ti OR 'afghan campaign':ti OR marines:ti OR troops:ti OR servicemen:ti OR 'combat disorders':ti OR 'combat disorder':ti OR 'active duty':ti

[5,412](#)

#3.31

#3.27 OR #3.30

163

#3.30

#3.29 NOT #3.19

163

#3.29

#3.28 NOT #3.24

163

#3.28

'glasgow coma scale'/exp OR 'glasgow outcome scale'/exp AND '13-15':ab,ti

5,295

#3.27

#3.23 NOT #3.26

11,241

#3.26

#3.24 OR #3.25

30

#3.25

'oif/oef':ti AND [1990-2013]/py

11,235

#3.24

'iraq war':ti OR 'gulf war':ti OR 'gulf wars':ti OR 'operation iraqi freedom':ti OR 'afghan campaign':ti OR 'operation enduring freedom':ti OR military:ti OR battlefield:ti OR army:ti OR armed AND forces:ti OR marines:ti OR troops:ti OR servicemen:ti OR 'combat related':ti OR 'military personnel':ti OR 'air force':ti OR soldiers:ti OR 'combat veteran':ti OR 'combat disorder':ti OR 'combat disorders':ti OR veterans:ti OR 'active duty':ti OR 'service members':ti AND [1990-2013]/py

5,335

#3.23

#3.22 AND ('case report'/de OR 'clinical article'/de OR 'clinical protocol'/de OR 'clinical trial'/de OR 'cohort analysis'/de OR 'comparative study'/de OR 'control group'/de OR 'controlled clinical trial'/de OR 'controlled study'/de OR 'human'/de OR 'human tissue'/de OR 'interview'/de OR 'major clinical study'/de OR 'medical record review'/de OR 'methodology'/de OR 'model'/de OR 'nonhuman'/de OR 'normal human'/de OR 'outcomes research'/de OR 'practice guideline'/de OR 'prospective study'/de OR 'questionnaire'/de OR 'retrospective study'/de OR 'systematic review'/de) AND ('article'/it OR 'article in press'/it OR 'conference abstract'/it OR 'conference paper'/it OR 'letter'/it OR 'review'/it OR 'short survey'/it)

6,018

#3.22

#3.20 NOT #3.21

452,516

#3.21

'editorial'/exp

6,140

#3.20

#3.16 NOT #3.19

30,949

#3.19

#3.17 NOT #3.18

1,241

#3.18

('military phenomena'/exp/mj OR 'veteran'/exp/mj) AND (civilian*:ab,ti OR sport* OR athlete*)
AND [1990-2013]/py

32,190

#3.17

'military phenomena'/exp/mj OR 'veteran'/exp/mj

6,202

#3.16

#3.12 NOT #3.15

8,001,374

#3.15

#3.13 NOT #3.14

10,227,651

#3.14

'animal'/exp AND 'human'/exp AND [1990-2013]/py

18,229,025

#3.13

'animal'/exp

7,286

#3.12

#3.8 NOT #3.11

[4,719,417](#)

#3.11

#3.9 NOT #3.10

[665,955](#)

#3.10

('adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp) AND ('newborn'/exp OR 'child'/exp OR 'adolescent'/exp) AND [1990-2013]/py

[5,385,372](#)

#3.9

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp

[10,092](#)

#3.8

#3.4 OR #3.5 OR #3.6 OR #3.7 AND [embase]/lim AND [1990-2013]/py

[974](#)

#3.7

mtbi:ab,ti OR mtbis:ab,ti OR 'minimal traumatic brain injury':ab,ti OR 'minimal traumatic brain injuries':ab,ti OR 'minimal tbi':ab,ti OR 'minimal tbis':ab,ti

[9,904](#)

#3.6

#3.2 AND (mild:ab,ti OR minor:ab,ti)

[3,409](#)

#3.5

'brain concussion'/exp

[2,878](#)

#3.4

#3.2 AND #3.3

[103,017](#)

#3.3

'sport'/exp OR 'athlete'/exp

[156,672](#)

#3.2

'brain injury'/exp OR 'head injury'/de OR 'skull injury'/exp

[3,030,325](#)

#3.1

'complication'/de OR 'disease exacerbation'/exp OR 'neurological complication'/exp OR 'posttraumatic complication'/exp OR 'posttraumatic pain'/exp OR 'prognosis'/de OR 'disease course'/de OR 'chronic disease'/exp OR 'illness trajectory'/exp OR 'recurrent disease'/exp OR 'relapse'/exp OR 'terminal disease'/exp OR 'acute disease'/exp OR 'adverse outcome'/exp OR 'bothersomeness'/exp OR 'deterioration'/exp OR 'disability severity'/exp OR 'injury severity'/exp OR 'nomogram'/exp OR 'treatment failure'/exp OR 'forecasting'/exp OR 'prediction'/exp OR 'predictive value'/exp OR 'death'/de OR 'lethality'/exp OR 'disability'/exp OR 'disease severity'/de OR impairment*:ab,ti OR sequelae:ab,ti OR impairment*:de OR dysfunction:ab,ti OR refractory:ab,ti OR 'more severe':ab,ti OR 'persisting symptoms':ab,ti OR 'persistent symptoms':ab,ti OR 'enduring symptoms':ab,ti OR 'lingering symptoms':ab,ti OR prolonged:ab,ti OR 'long term symptoms':ab,ti OR 'longterm symptoms':ab,ti OR 'symptomatology'/exp

Question 6

976

#4.44

#4.41 NOT #4.43

126

#4.43

#4.41 AND #4.42

1,894,200

#4.42

'case report'/exp

1,102

#4.41

#4.39 NOT #4.40

1,385,362

#4.40

rat:ti OR rats:ti OR mouse:ti OR mice:ti OR rodent*:ti OR geriatric:ti OR elderly:ti OR 'animal model':ti OR 'oif/oef':ti OR 'oef/oif':ti

1,111

#4.39

#4.37 AND #4.38

5,588,005

#4.38

longterm:ab,ti OR symptom*:de,ab,ti OR symptomatic:ab,ti OR sequelae:ab,ti OR enduring:ab,ti OR delayed:ab,ti OR prolong*:ab,ti OR ongoing:ab,ti OR persistent:ab,ti OR persistence:ab,ti OR

persisting:ab,ti OR lasting:ab,ti OR 'long term':ab,ti OR 'long-term':ab,ti OR 'post-concussion syndrome':de,ab,ti OR 'postconcussive syndrome':ab,ti OR 'post-concussive syndrome':ab,ti OR 'postconcussion syndrome':ab,ti OR symptomatology:de,ab,ti OR subsymptom*:ab,ti OR unresolved:ab,ti OR continuing:ab,ti OR continued:ab,ti OR unremitting:ab,ti OR lingering:ab,ti OR protracted:ab,ti OR 'greater than':ab,ti OR posttraumatic:ab,ti OR 'post-traumatic':ab,ti OR complication*:de,ab,ti OR complicated:ab,ti OR recovery:de,ab,ti OR recover:de,ab,ti OR recovered:ab,ti OR disability:de,ab,ti OR disabilities:de,ab,ti OR disabled:de,ab,ti OR impairment*:de,ab,ti OR impaired:ab,ti OR rehabilitation:de,ab,ti OR reintegration:ab,ti OR 're-integration':ab,ti OR failure:de,ab,ti OR remediation:ab,ti OR remediate:ab,ti OR refractory:ab,ti OR extended:ab,ti OR 'longer than':ab,ti OR 'more than':ab,ti OR problematic:ab,ti

[1,546](#)

#4.37

#4.31 AND #4.36

[6,141,110](#)

#4.36

#4.1 OR #4.32 OR #4.33 OR #4.34 OR #4.35

[1,610,488](#)

#4.35

'paracetamol'/exp OR acetaminophen:de,ab,ti OR 'acetylsalicylic acid'/exp OR 'ibuprofen'/exp OR 'naproxen'/exp OR 'diclofenac'/exp OR 'analgesic agent'/exp OR 'nonsteroid antiinflammatory agent'/exp OR nsaid*:ab,ti OR 'antidepressant agent'/exp OR 'amitriptyline'/exp OR 'nortriptyline'/exp OR 'anticonvulsive agent'/exp OR 'valproic acid'/exp OR 'topiramate'/exp OR 'gabapentin'/exp OR 'propranolol'/exp OR 'beta adrenergic receptor blocking agent'/exp OR 'metoprolol'/exp OR 'dihydroergotamine'/exp OR ergot*:de,ab,ti OR 'sumatriptan'/exp OR 'antimigraine agent'/exp OR 'vestibular suppressant':ab,ti OR 'vestibular suppressants':ab,ti OR 'meclozine'/exp OR 'scopolamine'/exp OR 'benzodiazepine derivative'/exp OR neurostimulant*:ab,ti OR 'methylphenidate'/exp OR 'dexamphetamine'/exp OR modafanil:ab,ti OR 'amantadine'/exp OR 'atomoxetine'/exp OR 'antiemetic agent'/exp OR 'promethazine'/exp OR 'hypnotic sedative agent'/exp OR 'zolpidem'/exp OR 'serotonin modulator':ab,ti OR 'serotonin modulators':ab,ti OR 'trazodone'/exp OR 'alpha adrenergic receptor blocking agent'/exp OR 'melatonin'/exp OR 'sertraline'/exp OR 'citalopram'/exp OR 'escitalopram'/exp OR 'paroxetine'/exp OR 'fluoxetine'/exp OR 'amfebutamone'/exp OR 'cholinesterase inhibitor'/exp OR 'serotonin uptake inhibitor'/exp OR 'donepezil'/exp OR 'rivastigmine'/exp OR 'galantamine'/exp OR 'cytidine diphosphate choline':ab,ti

[569,867](#)

#4.34

'neurofeedback'/exp OR biofeedback:de,ab,ti OR 'hyperbaric oxygen'/exp OR 'kinesiotherapy'/exp OR 'physiotherapy'/exp OR 'cognitive therapy'/exp OR 'induced hypothermia'/exp OR 'rest'/exp OR neurorehabilitation:ab,ti OR 'stress reduction':ab,ti OR 'cognitive rest':ab,ti OR 'neuroprotective agent'/exp OR 'sodium chloride'/exp OR 'hypertonic

saline solution':ab,ti OR 'nutraceutical'/exp OR 'diet supplementation'/exp OR 'massage'/exp
OR 'cognitive retraining':ab,ti OR 'sensory stimulation'/exp OR 'exercise'/exp OR 'positional
change':ab,ti OR 'postural change':ab,ti

[144,728](#)

#4.33

intervention*:de,ti

[2,010,750](#)

#4.32

treatment*:de,ti

[5,412](#)

#4.31

#4.27 OR #4.30

[163](#)

#4.30

#4.29 NOT #4.19

[163](#)

#4.29

#4.28 NOT #4.24

[163](#)

#4.28

('glasgow coma scale'/exp OR 'glasgow outcome scale'/exp) AND '13-15':ab,ti

[5,295](#)

#4.27

#4.23 NOT #4.26

[11,241](#)

#4.26

#4.24 OR #4.25

[30](#)

#4.25

'oif/oef':ti AND [1990-2013]/py

[11,235](#)

#4.24

'iraq war':ti OR 'gulf war':ti OR 'gulf wars':ti OR 'operation iraqi freedom':ti OR 'afghan
campaign':ti OR 'operation enduring freedom':ti OR military:ti OR battlefield:ti OR army:ti OR

armed AND forces:ti OR marines:ti OR troops:ti OR servicemen:ti OR 'combat related':ti OR 'military personnel':ti OR 'air force':ti OR soldiers:ti OR 'combat veteran':ti OR 'combat disorder':ti OR 'combat disorders':ti OR veterans:ti OR 'active duty':ti OR 'service members':ti AND [1990-2013]/py

5,335

#4.23

#4.22 AND ('case report'/de OR 'clinical article'/de OR 'clinical protocol'/de OR 'clinical trial'/de OR 'cohort analysis'/de OR 'comparative study'/de OR 'control group'/de OR 'controlled clinical trial'/de OR 'controlled study'/de OR 'human'/de OR 'human tissue'/de OR 'interview'/de OR 'major clinical study'/de OR 'medical record review'/de OR 'methodology'/de OR 'model'/de OR 'nonhuman'/de OR 'normal human'/de OR 'outcomes research'/de OR 'practice guideline'/de OR 'prospective study'/de OR 'questionnaire'/de OR 'retrospective study'/de OR 'systematic review'/de) AND ('article'/it OR 'article in press'/it OR 'conference abstract'/it OR 'conference paper'/it OR 'letter'/it OR 'review'/it OR 'short survey'/it)

6,018

#4.22

#4.20 NOT #4.21

452,516

#4.21

'editorial'/exp

6,140

#4.20

#4.16 NOT #4.19

30,949

#4.19

#4.17 NOT #4.18

1,241

#4.18

'military phenomena'/exp/mj OR 'veteran'/exp/mj AND (civilian*:ab,ti OR sport* OR athlete*) AND [1990-2013]/py

32,190

#4.17

'military phenomena'/exp/mj OR 'veteran'/exp/mj

6,202

#4.16

#4.12 NOT #4.15

8,001,374

#4.15

#4.13 NOT #4.14

10,227,651

#4.14

'animal'/exp AND 'human'/exp AND [1990-2013]/py

18,229,025

#4.13

'animal'/exp

7,286

#4.12

#4.8 NOT #4.11

4,719,417

#4.11

#4.9 NOT #4.10

665,955

#4.10

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp AND ('newborn'/exp OR 'child'/exp OR 'adolescent'/exp) AND [1990-2013]/py

5,385,372

#4.9

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp

10,092

#4.8

#4.4 OR #4.5 OR #4.6 OR #4.7 AND [embase]/lim AND [1990-2013]/py

974

#4.7

mtbi:ab,ti OR mtbis:ab,ti OR 'minimal traumatic brain injury':ab,ti OR 'minimal traumatic brain injuries':ab,ti OR 'minimal tbi':ab,ti OR 'minimal tbis':ab,ti

9,904

#4.6

#4.2 AND (mild:ab,ti OR minor:ab,ti)

3,409

#4.5

'brain concussion'/exp

2,878

#4.4

#4.2 AND #4.3

103,017

#4.3

'sport'/exp OR 'athlete'/exp

156,672

#4.2

'brain injury'/exp OR 'head injury'/de OR 'skull injury'/exp

3,578,947

#4.1

'therapy'/de OR 'acupuncture'/exp OR 'animal assisted therapy'/exp OR 'apitherapy'/exp OR 'biological therapy'/exp OR 'computer assisted therapy'/exp OR 'conservative treatment'/exp OR 'counseling'/exp OR 'device therapy'/exp OR 'drug therapy'/exp OR 'early intervention'/exp OR 'experimental therapy'/exp OR 'fluid therapy'/exp OR 'homeopathy'/exp OR 'intensive care'/de OR 'neuromonitoring'/exp OR 'blood pressure monitoring'/exp OR 'body temperature monitoring'/exp OR 'capnography'/exp OR 'life sustaining treatment'/exp OR 'maintenance therapy'/de OR 'patient positioning'/exp OR 'rehabilitation care'/exp OR 'radiotherapy'/de OR 'cognitive rehabilitation'/exp OR 'functional training'/exp OR 'muscle training'/exp OR 'occupational therapy'/exp OR 'pediatric rehabilitation'/exp OR 'psychosocial rehabilitation'/exp OR 'recreational therapy'/exp OR 'rejuvenation'/exp OR 'sensorimotor integration'/exp OR 'speech rehabilitation'/exp OR 'sleep therapy'/exp OR 'supplementation'/exp OR 'systemic therapy'/exp OR 'therapy effect'/exp OR 'treatment response'/exp

SportDiscus: Updated Search

Run: August 3, 2015

Contact: Alix Hayden, PhD, University of Calgary
ahayden@ucalgary.ca

| | Query | Limiters/Expanders | Results |
|----|---|---|---------|
| S6 | TX (youth or child or children or childhood or toddler* or infant* or teen or teens or teenager* or "teen ager" or "teen agers" or adolescent* or adolescence or pediatric* or paediatric*) AND S4 | Limiters - Published Date: 19900101-20151231; Language: English Search modes - Boolean/Phrase | 1,441 |
| S5 | TX (youth or child or children or childhood or toddler* or infant* or teen or teens or teenager* or "teen ager" or "teen agers" or adolescent* or adolescence or pediatric* or paediatric*) AND S4 | Search modes - Boolean/Phrase | 1,482 |
| S4 | S1 OR S2 OR S3 | Search modes - Find all my search terms | 4,851 |
| S3 | ("head injury" or "head injuries" or "brain injury" or "brain injuries" or "head trauma" or "brain trauma" or "skull injury" or "skull injuries" or tbi or tbis or "cerebral trauma" or "cerebral injury" or "cerebral injuries") AND (sport* or athlete* or athletic or recreation) | Search modes - Boolean/Phrase | 1,616 |
| S2 | ("gcs 13-15" or concussion* or concussive or postconcussion or "post concussion" or postconcussive or "post concussive" or "mild tbi" or "mild tbis" or mtbi or mtbis or "mild traumatic brain injury" or "mild traumatic brain injuries") | Search modes - Boolean/Phrase | Display |
| S1 | ("traumatic brain injury" or "traumatic brain injuries" or tbi or tbis or "brain contusion" or "brain contusions" or "brain trauma" or "brain laceration" or "brain lacerations" or "cerebral injury" or "cerebral injuries" or "head injury" or "head injuries" or "head trauma" or "cerebral trauma" or "skull injury" or "skull injuries" or "craniocerebral trauma" or "brain injury" or "brain injuries") AND TX (mild or minor) | Search modes - Boolean/Phrase | 1,549 |

mTBI – SEARCH STRATEGIES—Initial Search

January 1, 1990 to December 31, 2013

All searches were limited by date from January 1, 1990 to December 31, 2013. No languages were excluded.

PUBMED SEARCH STRATEGIES

Publication types excluded from PubMed searches were: comments, editorials, patient education handouts, newspaper articles, biographies, autobiographies, and festschrifts.

Question 1: Last run 11/25/12

This search included a POPULATION component and a DIAGNOSIS component. In *Boolean* terms, these components were combined as follows:

POPULATION AND DIAGNOSIS

POPULATION:

SPORT*[TW] OR ATHLETE[TW] OR ATHLETES[TW] OR ATHLETIC*[TW] OR RECREATION*[TIAB]) AND (HEAD INJUR*[TW] OR BRAIN INJUR*[TW] OR HEAD TRAUMA*[TIAB] OR BRAIN TRAUMA*[TIAB] OR SKULL INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR CEREBRAL TRAUMA*[TW] OR CEREBRAL INJUR*[TW]

OR

GCS 13-15[TIAB] OR BRAIN CONCUSSION[MH] OR CONCUSSION*[TW] OR CONCUSSIVE[TIAB] OR COMMOTIO CEREBRI[TW] OR POST CONCUSSIVE[TW] OR POSTCONCUSSIVE[TW] OR MILD TBI[TIAB] OR MILD TBIS[TIAB] OR MTBI[TIAB] OR MTBIS[TIAB] OR MILD TRAUMATIC BRAIN INJUR*[TIAB]

OR

(TRAUMATIC BRAIN INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR BRAIN CONTUSION*[TW] OR BRAIN TRAUMA*[TW] OR BRAIN LACERATION*[TW] OR CEREBRAL INJUR*[TW] OR HEAD INJUR*[TW] OR HEAD TRAUMA*[TW] OR CEREBRAL TRAUMA*[TIAB] OR SKULL INJUR*[TW] OR CRANIOCEREBRAL TRAUMA[MH:NOEXP] OR BRAIN INJUR* [TW]) AND (MILD[TIAB] OR MINOR[TIAB])

OR

MINIMAL TRAUMATIC BRAIN INJUR*[TIAB] OR MINIMAL TBI[TIAB]

NOT

(ANIMALS[MH] NOT (ANIMALS[MH] AND HUMAN*[MH]))

NOT

(ADULT[MH] NOT (ADULT[MH] AND (CHILD[MH] OR ADOLESCENT*[MH] OR INFANT*[MH])))

NOT

(IRAQ WAR, 2003 [MAJR] OR IRAQ WAR [TI] OR GULF WAR [TI] OR OPERATION IRAQI FREEDOM [TI] OR GULF WARS [TI] OR AFGHAN CAMPAIGN 2001[MAJR] OR OPERATION ENDURING FREEDOM [TI] OR AFGHAN WAR [TI] OR WAR [MAJR] OR MILITARY [TI] OR BATTLEFIELD [TI] OR ARMY [TI] OR ARMED FORCES [TI] OR MARINES [TI] OR TROOPS [TI] OR SERVICEMEN [TI] OR COMBAT RELATED [TI] OR MILITARY PERSONNEL [MAJR] OR AIR FORCE [TI] OR SOLDIERS [TI] OR MILITARY MEDICINE [MAJR] OR OIF/OEF [TI] OR COMBAT VETERAN* [TI] OR COMBAT DISORDERS [MAJR] OR VETERANS [MAJR] OR ACTIVE DUTY [TI] OR SERVICE MEMBERS [TI]) NOT (MILITARY [TW] AND (CIVILIAN* [TIAB] OR SPORTS [TIAB] OR ATHLETE* [TIAB] OR SPORT RELATED [TI] OR SPORTS RELATED [TI]))

DIAGNOSIS:

ASSESSMENT* [TIAB] OR DIAGNOSTIC TECHNIQUES, NEUROLOGICAL[MH:NOEXP] OR NEUROLOGIC EXAMINATION[MH] OR DIAGNOSIS, DIFFERENTIAL[MH] OR DIAGNOSIS[MH:NOEXP] OR DIAGNOSIS[SH] OR DIAGNOSTIC ERRORS[MH] OR DIAGNOS*[TIAB] OR DIAGNOSTIC*[TW] OR MEASURES[TW] OR SCALE[TW] OR SCALES[TW] OR SCORE[TW] OR SCORES[TW] OR INDEX[TW] OR INDICES[TW] OR INSTRUMENT[TW] OR INSTRUMENTS[TW] OR MEASURE[TW] OR SENSORY MODALITY ASSESSMENT[TIAB] OR SENSORY STIMULATION ASSESSMENT[TIAB] OR WESSEX HEAD INJURY MATRIX[TIAB] OR WESTERN NEURO SENSORY STIMULATION PROFILE[TIAB] OR SENSITIVITY AND SPECIFICITY[MH] OR SPECIFICITY[TIAB] OR PREDICTIVE VALUE OF TESTS[MH] OR CONFIDENCE INTERVAL[MH] OR DETECT*[TIAB] OR CHARACTERISTIC*[TIAB] OR CATEGORIZ*[TIAB] OR CATEGORIS*[TIAB] OR DISTINGUISH*[TIAB] OR DIFFERENTIAT*[TIAB] OR BEHAVIOURAL ASSESSMENT*[TIAB] OR BEHAVIORAL ASSESSMENT*[TIAB] OR BEHAVIOR ASSESSMENT*[TIAB] OR BEHAVIOUR ASSESSMENT*[TIAB] OR NEUROPSYCHOLOGICAL TESTS[MH:NOEXP] OR TRAUMA SEVERITY INDICES [MH] OR DETERMINANT* [TIAB] OR KING DEVICK TEST [TIAB]

OR MILITARY ACUTE CONCUSSION EVALUATION [TIAB] OR REACTION TIME [MH]
OR REACTION TIME* [TIAB] OR RESPONSE LATENCY [TW] OR SCREENING TEST*
[TIAB] OR SCREENING TOOL* [TIAB] OR BALANCE TEST* [TW] OR POSTURAL
BALANCE [MH] OR POSTURAL EQUILIBRIUM [TW] OR SENSATION DISORDERS
[MH] OR BALANCE ASSESSMENT [TIAB] OR MEDICAL SYMPTOM VALIDITY TEST
[TIAB] OR EVOKED POTENTIALS[MH] OR EVOKED POTENTIAL*[TIAB]OR
CLASSIFICATION [MH] OR CLASSIFICATION [SH]OR NEUROCOGNITIVE TEST*
[TIAB]OR PSYCHOMOTOR PERFORMANCE [MH] OR MEMORY [MH]OR
IMMEDIATE POST-CONCUSSION ASSESSMENT AND COGNITIVE TEST* [TIAB] OR
ELECTROENCEPHALOGRAPHY[MH] OR ELECTROENCEPHALOGRAPHY[TIAB] OR
ELECTROENCEPHALOGRAM*[TIAB] OR ECHOENCEPHALOGRAPHY[MH] OR
EEG[TIAB] OR EEGS[TIAB] OR QEEG[TIAB] OR QEEGS[TIAB] OR
ELECTROMYOGRAPH*[TW] OR EMG[TIAB] OR EMGS[TIAB] OR
ELECTROPHYSIOLOGIC TECHNIQUE*[TIAB]

OR

PREDICTIVE[TIAB] AND VALUE*[TIAB]

Questions 2 and 3: Last run 11/25/12

This search included a larger (more results) POPULATION component than Question 1. It also included a component to identify emergency or other acute care settings, and components for IMAGING and for INTRACRANIAL INJURY. In Boolean terms, the components were combined as follows:

(POPULATION AND ACUTE CARE SETTING) AND (IMAGING OR INTRACRANIAL INJURY)

POPULATION:

GCS 13-15[TIAB] OR BRAIN CONCUSSION[MH] OR CONCUSSION*[TW] OR
COMMOTIO CEREBRI[TW] OR POST CONCUSSIVE[TW] OR POSTCONCUSSIVE[TW]
OR MTBI[TIAB] OR MTBIS[TIAB] OR BRAIN INJURIES[MH] OR BRAIN INJUR*[TW]
OR TBI[TIAB] OR TBIS[TIAB] OR BRAIN CONTUSION*[TW] OR BRAIN
TRAUMA*[TW] OR BRAIN LACERATION*[TW] OR HEAD TRAUMA*[TW] OR
CEREBRAL TRAUMA*[TW] OR CEREBRAL INJUR*[TW] OR SKULL INJUR*[TW] OR
SKULL TRAUMA[TW] OR CRANIOCEREBRAL TRAUMA[MH:noexp] OR HEAD
INJUR*[TW]

NOT

(ANIMALS[MH] NOT (ANIMALS[MH] AND HUMAN*[MH]))

NOT

(ADULT[MH] NOT (ADULT[MH] AND (CHILD[MH] OR ADOLESCENT*[MH] OR INFANT*[MH])))

NOT

(IRAQ WAR, 2003 [MAJR] OR IRAQ WAR [TI] OR GULF WAR [TI] OR OPERATION IRAQI FREEDOM [TI] OR GULF WARS [TI] OR AFGHAN CAMPAIGN 2001[MAJR] OR OPERATION ENDURING FREEDOM [TI] OR AFGHAN WAR [TI] OR WAR [MAJR] OR MILITARY [TI] OR BATTLEFIELD [TI] OR ARMY [TI] OR ARMED FORCES [TI] OR MARINES [TI] OR TROOPS [TI] OR SERVICEMEN [TI] OR COMBAT RELATED [TI] OR MILITARY PERSONNEL [MAJR] OR AIR FORCE [TI] OR SOLDIERS [TI] OR MILITARY MEDICINE [MAJR] OR OIF/OEF [TI] OR COMBAT VETERAN* [TI] OR COMBAT DISORDERS [MAJR] OR VETERANS [MAJR] OR ACTIVE DUTY [TI] OR SERVICE MEMBERS [TI]) NOT (MILITARY [TW] AND (CIVILIAN* [TIAB] OR SPORTS [TIAB] OR ATHLETE* [TIAB] OR SPORT RELATED [TI] OR SPORTS RELATED [TI]))

ACUTE CARE SETTING:

MEDICAL CENTRE*[TIAB] OR TRAUMA CENTRE*[TIAB] OR NON TRAUMA CENTRE* [TIAB] OR NONTRAUMA CENTRE* [TIAB] OR INPATIENT*[TW] OR MEDICAL CENTER*[TW] OR ACADEMIC MEDICAL CENTERS[MH] OR HEALTH FACILITIES[MH] OR ACUTE CARE[TW] OR HOSPITALS[MH] OR HOSPITAL*[TW] OR NON TRAUMA CENTER*[TW] OR NONTRAUMA CENTER*[TW] OR TRAUMA CENTERS[MH] OR TRAUMA CENTER*[TW] OR TRAUMA UNIT*[TW] OR EMERGENCY SERVICE, HOSPITAL[MH] OR EMERGENCY[TW] OR ACUTE SETTING* [TIAB] OR TERTIARY CARE [TIAB]

IMAGING:

MAGNETIC RESONANCE IMAGING [MH] OR ZEUGMATOGRAPHY [TW] OR TOMOGRAPHY [TW] OR MRI SCAN* [TW] OR FMRI [TW] OR FMRIS [TW] OR MRI [TW] OR MRIS [TW] OR IMAGING* [TW] OR NEUROIMAGING [MH:NOEXP] OR NEUROIMAGING* [TIAB] OR NEURO IMAGING* [TIAB] OR TOMOGRAPHY, X-RAY COMPUTED [MH] OR CAT SCAN* [TW] OR CT SCAN* [TW] OR CT X RAY* [TW] OR TOMODENSITOMETRY [TW] OR CINE-CT [TW] OR X-RAYS [MH] OR X RAY* [TIAB] OR RADIOGRAPHY [SH]

INTRACRANIAL INJURY:

INTRACRANIAL INJUR* [TIAB] OR INTRACRANIAL HEMORRHAGES[MH] OR BRAIN HEMORRHAGE, TRAUMATIC[MH] OR HEMATOMA, SUBDURAL[MH] OR HEMORRHAGE*[TW] OR HAEMORRHAGE*[TIAB] OR BRAIN BLEED*[TIAB] OR HAEMATOMA*[TIAB] OR HEMATOMA*[TIAB] OR PITUITARY APOPLEXY[TW] OR

EDEMA[TW] OR DIFFUSE AXONAL INJURY[MH] OR AXONAL SWELLING[TW] OR RETRACTION BALLS[TIAB] OR CEREBRAL ATROPHY[TIAB] OR INTRACEREBRAL INJUR*[TIAB] OR OEDEMA[TIAB] OR BRAIN CONTUSION*[TIAB] OR CEREBRAL CONTUSION*[TIAB] OR AXONAL INJUR*[TW] OR PNEUMOCEPHALUS[MH] OR PNEUMOCEPHALUS[TIAB] OR CRANIAL PNEUMOCYST*[TW] OR INTRACRANIAL GAS[TW] OR MICROBLEED*[TIAB] OR MICRO BLEED* [TIAB] OR WHITE MATTER INJUR*[TIAB] OR SKULL FRACTURES[MH] OR SKULL FRACTURE*[TIAB] OR CRANIAL INJUR*[TW] OR LESION*[TW] OR NEUROPATHOLOG*[TW] OR BLEEDING[TIAB] OR MICROHEMORRHAGE*[TIAB] OR MICROHAEMORRHAGE*[TIAB] OR MICRO HEMORRHAGE*[TIAB] OR MICRO HAEMORRHAGE*[TIAB] OR INTRACRANIAL SEQUELAE[TIAB]

Questions 4 and 5: Last run 11/25/12

This search included the same POPULATION component as Question 1. In addition it included components for PROGNOSIS and for RISK FACTORS FOR SEQUELAE. In Boolean terms, they were combined as follows:

POPULATION AND (PROGNOSIS OR RISK FACTORS FOR SEQUELAE)

POPULATION:

SPORT*[TW] OR ATHLETE[TW] OR ATHLETES[TW] OR ATHLETIC*[TW] OR RECREATION*[TIAB]) AND (HEAD INJUR*[TW] OR BRAIN INJUR*[TW] OR HEAD TRAUMA*[TIAB] OR BRAIN TRAUMA*[TIAB] OR SKULL INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR CEREBRAL TRAUMA*[TW] OR CEREBRAL INJUR*[TW])

OR

GCS 13-15[TIAB] OR BRAIN CONCUSSION[MH] OR CONCUSSION*[TW] OR CONCUSSIVE[TIAB] OR COMMOTIO CEREBRI[TW] OR POST CONCUSSIVE[TW] OR POSTCONCUSSIVE[TW] OR MILD TBI[TIAB] OR MILD TBIS[TIAB] OR MTBI[TIAB] OR MTBIS[TIAB] OR MILD TRAUMATIC BRAIN INJUR*[TIAB]

OR

(TRAUMATIC BRAIN INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR BRAIN CONTUSION*[TW] OR BRAIN TRAUMA*[TW] OR BRAIN LACERATION*[TW] OR CEREBRAL INJUR*[TW] OR HEAD INJUR*[TW] OR HEAD TRAUMA*[TW] OR CEREBRAL TRAUMA*[TIAB] OR SKULL INJUR*[TW] OR CRANIOCEREBRAL TRAUMA[MH:NOEXP] OR BRAIN INJUR* [TW]) AND (MILD[TIAB] OR MINOR[TIAB])

OR

MINIMAL TRAUMATIC BRAIN INJUR*[TIAB] OR MINIMAL TBI[TIAB]

NOT

(ANIMALS[MH] NOT (ANIMALS[MH] AND HUMAN*[MH]))

NOT

(ADULT[MH] NOT (ADULT[MH] AND (CHILD[MH] OR ADOLESCENT*[MH] OR INFANT*[MH]))

NOT

(IRAQ WAR, 2003 [MAJR] OR IRAQ WAR [TI] OR GULF WAR [TI] OR OPERATION IRAQI FREEDOM [TI] OR GULF WARS [TI] OR AFGHAN CAMPAIGN 2001[MAJR] OR OPERATION ENDURING FREEDOM [TI] OR AFGHAN WAR [TI] OR WAR [MAJR] OR MILITARY [TI] OR BATTLEFIELD [TI] OR ARMY [TI] OR ARMED FORCES [TI] OR MARINES [TI] OR TROOPS [TI] OR SERVICEMEN [TI] OR COMBAT RELATED [TI] OR MILITARY PERSONNEL [MAJR] OR AIR FORCE [TI] OR SOLDIERS [TI] OR MILITARY MEDICINE [MAJR] OR OIF/OEF [TI] OR COMBAT VETERAN* [TI] OR COMBAT DISORDERS [MAJR] OR VETERANS [MAJR] OR ACTIVE DUTY [TI] OR SERVICE MEMBERS [TI]) NOT (MILITARY [TW] AND (CIVILIAN* [TIAB] OR SPORTS [TIAB] OR ATHLETE* [TIAB] OR SPORT RELATED [TI] OR SPORTS RELATED [TI]))

PROGNOSIS:

EXTENDED [TIAB] OR LASTING [TIAB] OR LONGTERM [TIAB] OR LONG TERM [TIAB] OR "LONGER THAN" [TIAB] OR "MORE THAN" [TIAB] OR "GREATER THAN" [TIAB] OR DELAYED [TIAB] OR FAILURE* [TW] OR PROLONG* [TIAB] OR PROTRACTED [TIAB] OR COMPLICATED [TIAB] OR ENDURING [TIAB] OR CONTINUING [TIAB] OR CONTINUED [TIAB] OR UNRESOLVED [TIAB] OR UNREMITTING [TIAB] OR LINGERING [TIAB] OR PROBLEMATIC [TIAB]) AND (FUNCTIONAL LEVEL [TIAB] OR PROGRESS*[TW] OR RECUPERAT*[TIAB] OR CONVALESCENCE[TW] OR CONVALESCENCE[TIAB] OR CONVALESCED[TIAB] OR CONVALESCES[TIAB] OR CONVALESCING[TIAB] OR RECOVER[TIAB] OR RECOVERS[TIAB] OR RECOVERY[TIAB] OR RECOVERING[TIAB] OR RECOVERIES[TIAB] OR IMPROVE* [TW] OR IMPROVEMENT* [TIAB] OR IMPROVING[TW] OR RESTORATION[TW] OR RESTORE*[TW] OR RECOVERY OF FUNCTION[TW] OR RESOLUTION* [TW] OR PROGNOSIS [MH] OR DISEASE FREE SURVIVAL [MH OR PROGNOS*[TW] OR PREDICT*[TIAB] OR NOMOGRAM*[TW] OR MEDICAL FUTILITY [MH] OR FUTIL* [TW] OR TREATMENT OUTCOME

[MH:NOEXP] OR TREATMENT FAILURE [MH] OR PREDICTIVE VALUE OF TESTS [MH] OR FORECASTING [MH] OR FORECAST* [TIAB] OR PROJECTION* [TW]

RISK FACTORS FOR SEQUELAE:

(PATHOPHYSIOLOG* [TW] OR DYSFUNCTION [TIAB] OR SYMPTOMATOLOGY [TIAB] OR SUBSYMPTOM* [TIAB] OR SUB SYMPTOM* [TIAB] OR SYMPTOMS [TW] OR SYMPTOMATIC [TIAB] OR DISEASE-FREE SURVIVAL[MH] OR TREATMENT FAILURE[MH] OR DISEASE PROGRESSION[MH] OR DISEASE PROGRESSION [TIAB] OR SEQUELAE [TW] OR ENDURING [TW] OR DELAYED [TIAB] OR PROLONGED [TIAB] OR ONGOING [TIAB] OR PERSISTENT [TIAB] OR PERSISTENCE [TIAB] OR PERSISTING [TIAB] OR LASTING [TIAB] OR LONGTERM [TIAB] OR LONG TERM [TIAB] OR POST CONCUSSION SYNDROME* [TIAB] OR POST-CONCUSSION SYNDROME [MH] OR POST-CONCUSSIVE SYNDROME [TW] OR POSTCONCUSSION SYNDROME* [TIAB] OR POSTCONCUSSIVE SYNDROME* [TIAB] OR UNRESOLVED [TIAB] OR CONTINUING [TIAB] OR CONTINUE* [TIAB] OR UNREMITTING [TIAB] OR LINGERING [TIAB] OR PROTRACTED [TIAB] OR POSTTRAUMATIC [TW] OR POST TRAUMATIC [TIAB] OR COMPLICATIONS [SH] OR COMPLICATION* [TIAB] OR COMPLICATED [TIAB] OR EXTENDED [TIAB] OR DISABILITY [TW] OR DISABILITIES [TW] OR DISABLED [TW] OR IMPAIRMENT [TW] OR IMPAIRED [TIAB] OR FAILURE [TW] OR REFRACTORY [TW] OR MORE SEVERE* [TIAB])

AND

(RISK [MH:NOEXP]OR RISK ASSESSMENT [MH] OR RISK FACTORS [MH] OR RISK* [TIAB] OR RISK ADJUSTMENT [MH] OR PRECIPITATING FACTORS [MH] OR EPIDEMIOLOGIC FACTORS [MH] OR CAUSALITY [MH] OR CAUSALITY [TW] OR CAUSATION* [TW] OR ETIOLOGY [SH:NOEXP] OR EPIDEMIOLOGY [SH] OR FEATURE* [TIAB] OR FACTOR [TIAB] OR FACTORS [TIAB] OR IDENTIFY [TIAB] OR IDENTIFICATION [TIAB] OR IDENTIFIES [TIAB] OR IDENTIFIED [TIAB] OR AGE FACTORS [MH] OR SEX [TW] OR SEXES [TW] OR GENDER [TW] OR TIME SINCE INJUR* [TIAB] OR TIME FACTORS [MH] OR BETWEEN GROUP DIFFERENCE* [TIAB] OR MECHANISM OF INJURY [TIAB] OR MECHANISMS OR INJURY [TIAB] OR INDICATOR* [TIAB] OR CHARACTERISTIC* [TIAB] OR ANALYSIS OF VARIANCE [MH])

Question 6: Last run 11/25/12

This search included the same POPULATION component as Question 1. It also included a TREATMENT component and a component for the concept of ONGOING SYMPTOMS. In Boolean terms, the components were combined as follows:

POPULATION AND ONGOING SYMPTOMS AND TREATMENTS

POPULATION:

SPORT*[TW] OR ATHLETE[TW] OR ATHLETES[TW] OR ATHLETIC*[TW] OR RECREATION*[TIAB]) AND (HEAD INJUR*[TW] OR BRAIN INJUR*[TW] OR HEAD TRAUMA*[TIAB] OR BRAIN TRAUMA*[TIAB] OR SKULL INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR CEREBRAL TRAUMA*[TW] OR CEREBRAL INJUR*[TW]

OR

GCS 13-15[TIAB] OR BRAIN CONCUSSION[MH] OR CONCUSSION*[TW] OR CONCUSSIVE[TIAB] OR COMMOTIO CEREBRI[TW] OR POST CONCUSSIVE[TW] OR POSTCONCUSSIVE[TW] OR MILD TBI[TIAB] OR MILD TBIS[TIAB] OR MTBI[TIAB] OR MTBIS[TIAB] OR MILD TRAUMATIC BRAIN INJUR*[TIAB]

OR

(TRAUMATIC BRAIN INJUR*[TIAB] OR TBI[TIAB] OR TBIS[TIAB] OR BRAIN CONTUSION*[TW] OR BRAIN TRAUMA*[TW] OR BRAIN LACERATION*[TW] OR CEREBRAL INJUR*[TW] OR HEAD INJUR*[TW] OR HEAD TRAUMA*[TW] OR CEREBRAL TRAUMA*[TIAB] OR SKULL INJUR*[TW] OR CRANIOCEREBRAL TRAUMA[MH:NOEXP] OR BRAIN INJUR* [TW]) AND (MILD[TIAB] OR MINOR[TIAB])

OR

MINIMAL TRAUMATIC BRAIN INJUR*[TIAB] OR MINIMAL TBI[TIAB]

NOT

(ANIMALS[MH] NOT (ANIMALS[MH] AND HUMAN*[MH]))

NOT

(ADULT[MH] NOT (ADULT[MH] AND (CHILD[MH] OR ADOLESCENT*[MH] OR INFANT*[MH]))

NOT

(IRAQ WAR, 2003 [MAJR] OR IRAQ WAR [TI] OR GULF WAR [TI] OR OPERATION IRAQI FREEDOM [TI] OR GULF WARS [TI] OR AFGHAN CAMPAIGN 2001[MAJR] OR OPERATION ENDURING FREEDOM [TI] OR AFGHAN WAR [TI] OR WAR [MAJR] OR MILITARY [TI] OR BATTLEFIELD [TI] OR ARMY [TI] OR ARMED FORCES [TI] OR MARINES [TI] OR TROOPS [TI] OR SERVICEMEN [TI] OR COMBAT RELATED [TI] OR

MILITARY PERSONNEL [MAJR] OR AIR FORCE [TI] OR SOLDIERS [TI] OR MILITARY MEDICINE [MAJR] OR OIF/OEF [TI] OR COMBAT VETERAN* [TI] OR COMBAT DISORDERS [MAJR] OR VETERANS [MAJR] OR ACTIVE DUTY [TI] OR SERVICE MEMBERS [TI]) NOT (MILITARY [TW] AND (CIVILIAN* [TIAB] OR SPORTS [TIAB] OR ATHLETE* [TIAB] OR SPORT RELATED [TI] OR SPORTS RELATED [TI]))

ONGOING SYMPTOMS:

LONGTERM [TIAB] OR SYMPTOMS [TW] OR SYMPTOMATIC [TIAB] OR SEQUELAE [TW] OR ENDURING [TW] OR DELAYED [TIAB] OR PROLONG* [TIAB] OR ONGOING [TIAB] OR PERSISTENT [TIAB] OR PERSISTENCE [TIAB] OR PERSISTING [TIAB] OR LASTING [TIAB] OR LONG TERM [TIAB] OR POST-CONCUSSION SYNDROME [MH] OR POST-CONCUSSIVE SYNDROME [TW] OR POSTCONCUSSION SYNDROME* [TIAB] OR POSTCONCUSSIVE SYNDROME* [TIAB] OR SYMPTOMATOLOGY [TIAB] OR SUBSYMPTOM* [TIAB] OR UNRESOLVED [TIAB] OR CONTINUING [TIAB] OR CONTINUED [TIAB] OR UNREMITTING [TIAB] OR LINGERING [TIAB] OR PROTRACTED [TIAB] OR "LONGER THAN" [TIAB] OR "MORE THAN" [TIAB] OR "GREATER THAN" [TIAB] OR POST CONCUSSION SYNDROME [MH] OR POST CONCUSSION SYNDROME* [TIAB] OR POSTCONCUSSION SYNDROME* [TIAB] OR POSTTRAUMATIC [TW] OR POST TRAUMATIC [TIAB] OR COMPLICATIONS [SH] OR COMPLICATION* [TIAB] OR COMPLICATED [TIAB] OR EXTENDED [TIAB] OR RECOVERY OR RECOVER [TIAB] OR RECOVERED [TIAB] OR COMMUNITY DWELLING [TIAB] OR DISABILITY [TW] OR DISABILITIES [TW] OR DISABLED [TW] OR IMPAIRMENT [TW] OR IMPAIRED [TIAB] OR REHABILITATION [MH] OR REINTEGRATION [TW] OR REHABILITATION [TIAB] OR RE-INTEGRATION [TIAB] OR FAILURE [TW] OR REMEDIATION [TW] OR REMEDIATE [TW] OR REFRACTORY [TW] OR EXTENDED [TIAB] OR "LONGER THAN" [TIAB] OR "MORE THAN" [TIAB] OR "GREATER THAN" [TIAB] OR PROBLEMATIC [TIAB]

TREATMENTS:

THERAPY [SH] OR THERAPEUTIC USE [SH] OR DRUG THERAPY [MH] OR PHARMACOTHERAP* [TW] OR PHARMACOLOGIC* [TW] OR DRUG THERAP* [TIAB] OR THERAPY [TW] OR THERAPIES [TW] OR THERAPEUTIC* [TW] OR TREATMENT* [TW] OR TREATMENT OUTCOME [MH] OR DIET THERAPY [MH] OR DIET THERAPY [SH] OR NUTRITION THERAPY [MH] OR REHABILITATION OUTCOME* [TW] OR REHABILITATION [SH] OR REHABILITAT* [TIAB] OR TREATED [TIAB] OR MANAGEMENT [TIAB] OR INTERVENTION* [TIAB] OR BIOFEEDBACK, PSYCHOLOGY [MH] OR BIOFEEDBACK [TIAB] OR HYPERBARIC OXYGENATION [MH] OR EXERCISE THERAPY [MH] OR PHYSICAL THERAPY MODALITIES [MH] OR PHYSIOTHERAPY [TW] OR COGNITIVE THERAPY [MH] OR HYPOTHERMIA, INDUCED [MH:NOEXP] OR HYPOTHERMIA [TIAB] OR REST [MH] OR NEUROREHABILIT* [TIAB] OR STRESS REDUCTION [TIAB] OR PHYSICAL REST [TIAB] OR COGNITIVE REST [TIAB] OR NEUROPROTECTIVE AGENTS [MH] OR

SALINE SOLUTION, HYPERTONIC [MH] OR NUTRACEUTICAL* [TIAB] OR DIETARY SUPPLEMENTS [MH] OR DIETARY SUPPLEMENT* [TIAB] OR NEUTRACEUTICAL* [TIAB] OR NEUROFEEDBACK [TIAB] OR NEURO FEEDBACK [TIAB] OR BIO FEEDBACK [TIAB] OR MASSAGE [MH] OR MASSAGE [TIAB] OR COGNITIVE RETRAINING [TIAB] OR STIMULATION [TW] OR SENSORY [TW] OR DEPRIVATION [TW] OR RANGE OF MOTION EXERCISE* [TW] OR POSITIONING [TIAB] OR POSITIONAL CHANGE* [TW] OR POSTURAL CHANGE* [TIAB] OR ACETAMINOPHEN [TW] OR ASPIRIN [TW] OR IBUPROFEN [TW] NAPROXEN [TW] OR DICLOFENAC [TW] OR ANALGESICS [TW] OR NSAIDS [TW] OR ANTIDEPRESSANT* [TW] OR AMITRIPTYLINE [TW] OR NORTRIPTYLINE [TW] OR ANTICONVULSANT* [TW] OR VALPROIC ACID [TW] OR TOPIRAMATE [TW] OR GABAPENTIN [TW] OR PROPRANOLOL [TW] OR B-ADRENERGIC ANTAGONIST* [TW] OR METOPROLOL [TW] OR DIHYDROERGOTAMINE [TW] OR ERGOT [TW] OR SUMATRIPTAN [TW] OR TRIPTANS [TW] OR ZOLMITRIPTAN [TW] OR RIZATRIPTAN [TW] OR VESTIBULAR SUPPRESSANT* [TW] OR MECLIZINE [TW] OR SCOPOLAMINE [TW] OR DIMEHYDRINATE [TW] OR BENZODIAZEPINES [TW] OR LORAZEPAM [TW] OR CLONAZEPAM [TW] OR DIAZEPAM [TW] OR NEUROSTIMULANT* [TW] OR METHYLPHENIDATE [TW] OR DEXTROAMPHETAMINE [TW] OR MODAFANIL [TW] OR AMANTADINE [TW] OR ATOMOXETINE [TW] OR ANTIEMETIC* [TW] OR ONDANSETRON [TW] OR PHENERGAN [TW] OR SEDATIVE-HYPNOTIC* [TW] OR ZOLPIDEM [TW] OR SEROTONIN MODULATOR* [TW] OR TRAZODONE [TW] OR A-ADRENERGIC ANTAGONIST* [TW] OR PRAZOSIN [TW] OR MELATONIN [TW] OR SERTRALINE [TW] OR CITALOPRAM [TW] OR ESCITALOPRAM [TW] OR PAROXETINE [TW] OR FLUOXETINE [TW] OR BUPROPION [TW] OR ACETYLCHOLINESTERASE INHIBITOR* [TW] OR SELECTIVE SEROTONIN REUPTAKE INHIBITOR* [TW] OR DONEPEZIL [TW] OR RIVASTIGMINE [TW] OR GALANTAMINE [TW] OR CYTIDINE DIPHOSPHATE CHOLINE [TW]

EMBASE SEARCH STRATEGIES

Question 1: Last run Nov 29, 2012

2,208

#2.3 AND #4.31

3,075,946

#2.3

#2.1 OR #2.2

696,823

#2.2

'evoked response'/exp OR 'response time'/exp OR 'body equilibrium'/exp OR 'psychomotor performance'/de OR 'task performance'/exp OR 'memory'/exp OR 'sensory dysfunction'/exp

2,515,609

#2.1

'diagnostic procedure'/de OR 'clinical assessment tool'/exp OR 'clinical observation'/exp OR 'computer assisted diagnosis'/de OR 'delayed diagnosis'/exp OR 'diagnostic accuracy'/exp OR 'diagnostic error'/exp OR 'diagnostic reasoning'/exp OR 'diagnostic test'/de OR 'diagnostic test accuracy study'/exp OR 'diagnostic value'/exp OR 'differential diagnosis'/exp OR 'early diagnosis'/exp OR 'electrodiagnosis'/de OR 'laboratory diagnosis'/exp OR 'molecular diagnosis'/exp OR 'physical examination'/de OR 'qualitative diagnosis'/exp OR 'quantitative diagnosis'/exp OR 'diagnosis'/de OR 'diagnostic approach route'/exp OR 'evaluation or follow up' OR 'clinical assessment'/exp OR 'clinical evaluation'/exp OR 'clinical global impression scale'/exp OR 'course evaluation'/exp OR 'expanded disability status scale'/exp OR 'functional assessment inventory'/exp OR 'gross motor function classification system'/exp OR 'gross motor function measure'/exp OR 'international classification of functioning, disability or health' OR 'oars multidimensional functional assessment questionnaire'/exp OR 'patient assessment'/exp OR 'sensory evaluation'/exp OR 'examination'/de OR 'contact examination'/exp OR 'medical examination'/de OR 'clinical examination'/exp OR 'functional assessment'/exp OR 'measurement'/de OR 'named inventories, questionnaires or rating scales' OR 'neurologic examination'/de OR 'dubowitz neurological assessment'/exp OR 'electroencephalography'/exp OR 'neuropsychological test'/exp OR 'stabilography'/exp OR 'tilt table test'/exp OR 'non invasive measurement'/exp OR 'rating scale'/exp OR 'scoring system'/exp OR 'screening'/de OR 'screening test'/exp OR 'sensory system examination'/de OR 'vestibular test'/exp OR 'summed rating scale'/exp

5,412

#4.31

#4.27 OR #4.30

163

#4.30
#4.29 NOT #4.19

163
#4.29
#4.28 NOT #4.24

163
#4.28
('glasgow coma scale'/exp OR 'glasgow outcome scale'/exp) AND '13-15':ab,ti

5,295
#4.27
#4.23 NOT #4.26

11,241
#4.26
#4.24 OR #4.25

30
#4.25
'oif/oef':ti AND [1990-2013]/py

11,235
#4.24
'iraq war':ti OR 'gulf war':ti OR 'gulf wars':ti OR 'operation iraqi freedom':ti OR 'afghan campaign':ti OR 'operation enduring freedom':ti OR military:ti OR battlefield:ti OR army:ti OR armed AND forces:ti OR marines:ti OR troops:ti OR servicemen:ti OR 'combat related':ti OR 'military personnel':ti OR 'air force':ti OR soldiers:ti OR 'combat veteran':ti OR 'combat disorder':ti OR 'combat disorders':ti OR veterans:ti OR 'active duty':ti OR 'service members':ti AND [1990-2013]/py

5,335
#4.23
#4.22 AND ('case report'/de OR 'clinical article'/de OR 'clinical protocol'/de OR 'clinical trial'/de OR 'cohort analysis'/de OR 'comparative study'/de OR 'control group'/de OR 'controlled clinical trial'/de OR 'controlled study'/de OR 'human'/de OR 'human tissue'/de OR 'interview'/de OR 'major clinical study'/de OR 'medical record review'/de OR 'methodology'/de OR 'model'/de OR 'nonhuman'/de OR 'normal human'/de OR 'outcomes research'/de OR 'practice guideline'/de OR 'prospective study'/de OR 'questionnaire'/de OR 'retrospective study'/de OR 'systematic review'/de) AND ('article'/it OR 'article in press'/it OR 'conference abstract'/it OR 'conference paper'/it OR 'letter'/it OR 'review'/it OR 'short survey'/it)

6,018

#4.22
#4.20 NOT #4.21

452,516
#4.21
'editorial'/exp

6,140
#4.20
#4.16 NOT #4.19

30,949
#4.19
#4.17 NOT #4.18

1,241
#4.18
('military phenomena'/exp/mj OR 'veteran'/exp/mj) AND (civilian*:ab,ti OR sport* OR athlete*)
AND [1990-2013]/py

32,190
#4.17
'military phenomena'/exp/mj OR 'veteran'/exp/mj

6,202
#4.16
#4.12 NOT #4.15

8,001,374
#4.15
#4.13 NOT #4.14

10,227,651
#4.14
'animal'/exp AND 'human'/exp AND [1990-2013]/py

18,229,025
#4.13
'animal'/exp

7,286
#4.12
#4.8 NOT #4.11

[4,719,417](#)

#4.11

#4.9 NOT #4.10

[665,955](#)

#4.10

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp AND ('newborn'/exp OR 'child'/exp OR 'adolescent'/exp) AND [1990-2013]/py

[5,385,372](#)

#4.9

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp

[10,092](#)

#4.8

#4.4 OR #4.5 OR #4.6 OR #4.7 AND [embase]/lim AND [1990-2013]/py

[974](#)

#4.7

mtbi:ab,ti OR mtbis:ab,ti OR 'minimal traumatic brain injury':ab,ti OR 'minimal traumatic brain injuries':ab,ti OR 'minimal tbi':ab,ti OR 'minimal tbis':ab,ti

[9,904](#)

#4.6

#4.2 AND (mild:ab,ti OR minor:ab,ti)

[3,409](#)

#4.5

'brain concussion'/exp

[2,878](#)

#4.4

#4.2 AND #4.3

[103,017](#)

#4.3

'sport'/exp OR 'athlete'/exp

[156,672](#)

#4.2

'brain injury'/exp OR 'head injury'/de OR 'skull injury'/exp

[3,578,947](#)

#4.1

'therapy'/de OR 'acupuncture'/exp OR 'animal assisted therapy'/exp OR 'apitherapy'/exp OR 'biological therapy'/exp OR 'computer assisted therapy'/exp OR 'conservative treatment'/exp OR 'counseling'/exp OR 'device therapy'/exp OR 'drug therapy'/exp OR 'early intervention'/exp OR 'experimental therapy'/exp OR 'fluid therapy'/exp OR 'homeopathy'/exp OR 'intensive care'/de OR 'neuromonitoring'/exp OR 'blood pressure monitoring'/exp OR 'body temperature monitoring'/exp OR 'capnography'/exp OR 'life sustaining treatment'/exp OR 'maintenance therapy'/de OR 'patient positioning'/exp OR 'rehabilitation care'/exp OR 'radiotherapy'/de OR 'cognitive rehabilitation'/exp OR 'functional training'/exp OR 'muscle training'/exp OR 'occupational therapy'/exp OR 'pediatric rehabilitation'/exp OR 'psychosocial rehabilitation'/exp OR 'recreational therapy'/exp OR 'rejuvenation'/exp OR 'sensorimotor integration'/exp OR 'speech rehabilitation'/exp OR 'sleep therapy'/exp OR 'supplementation'/exp OR 'systemic therapy'/exp OR 'therapy effect'/exp OR 'treatment response'/exp

Questions 2 & 3 – Last run on Dec. 1, 2012

[3,539](#)

[2,194,721](#)

#7.19

#7.17 OR #7.18

[897,748](#)

#7.18

'diffuse axonal injury'/exp OR 'nerve fiber degeneration'/exp OR 'axonal swelling':ab,ti OR 'retraction balls':ab,ti OR 'brain atrophy'/exp OR 'intracerebral injury':ab,ti OR 'intracerebral injuries':ab,ti OR 'edema'/de OR 'brain edema'/exp OR oedema:ab,ti OR 'axonal injury'/exp OR 'pneumocephalus'/exp OR 'cranial pneumocyst':ab,ti OR 'cranial pneumocysts':ab,ti OR 'intracranial gas':ab,ti OR 'white matter injury':ab,ti OR 'white matter injuries':ab,ti OR 'white matter injury'/exp OR 'skull fracture'/exp OR 'cranial injury':ab,ti OR 'cranial injuries':ab,ti OR lesion*:ab,ti OR 'neuropathology'/exp OR microhemorrhage*:ab,ti OR 'micro hemorrhage':ab,ti OR 'micro hemorrhages':ab,ti OR 'intracranial sequelae':ab,ti

[1,504,683](#)

#7.17

#7.13 OR #7.16

[347,602](#)

#7.16

#7.14 OR #7.15

[347,060](#)

#7.15

'bleeding'/de OR 'brain hemorrhage'/exp OR 'hematoma'/de OR 'brain hematoma'/exp OR 'traumatic hematoma'/exp OR 'meningeal hemorrhage'/exp OR 'brain bleed':ab,ti OR 'brain bleeds':ab,ti OR 'brain bleeding':ab,ti OR microbleed*:ab,ti OR 'micro-bleed':ab,ti OR 'micro-bleeds':ab,ti OR hemorrhage*:ab,ti OR haemorrhage*:ab,ti OR haematoma*:ab,ti

[782](#)

#7.14

'intracranial injury':ab,ti OR 'intracranial injuries':ab,ti

[1,213,947](#)

#7.13

'nuclear magnetic resonance imaging'/exp OR zeugmatography:ab,ti OR 'tomography'/de OR 'brain tomography'/exp OR 'computer assisted tomography'/exp OR 'emission tomography'/exp OR 'optical coherence tomography'/exp OR tomography:ab,ti OR 'mri scan':ab,ti OR 'mri scans':ab,ti OR fmri:ab,ti OR fmr:ab,ti OR mri:ab,ti OR mris:ab,ti OR 'neuroimaging'/exp OR 'cat scan':ab,ti OR 'cat scans':ab,ti OR 'ct scan':ab,ti OR 'ct scans':ab,ti OR 'radiodensitometry'/exp OR 'x ray'/exp OR 'x-ray':ab,ti OR 'x rays':ab,ti OR 'x-rays':ab,ti OR xray*:ab,ti

[8,388](#)

#7.12

#7.10 AND #7.11

[1,466,199](#)

#7.11

'health care facility'/de OR 'hospital'/exp OR 'emergency health service'/exp OR 'hospital service'/exp OR 'emergency department':ab,ti OR 'emergency departments':ab,ti OR 'hospital patient'/de OR 'hospitalized adolescent'/exp OR 'hospitalized child'/exp OR 'hospitalized infant'/exp OR 'emergency patient'/exp OR 'critically ill patient'/exp OR 'high risk patient'/exp OR 'medical center':ab,ti OR 'medical centers':ab,ti OR 'acute care':ab,ti OR hospital*:ab,ti OR 'trauma center':ab,ti OR 'trauma centers':ab,ti OR 'trauma unit':ab,ti OR 'trauma units':ab,ti OR 'emergency service':ab,ti OR 'nontrauma center':ab,ti OR 'non trauma center':ab,ti OR 'nontrauma centers':ab,ti OR 'non trauma centers':ab,ti

[54,306](#)

#7.10

#7.8 NOT #7.9

[32,259](#)

#7.9

'military phenomena'/exp/mj OR 'veteran'/exp/mj OR 'veterans health'/exp/mj

[54,493](#)

#7.8

#7.4 NOT #7.7

[4,153,342](#)

#7.7

#7.5 NOT (#7.5 AND #7.6)

[2,632,147](#)

#7.6

'child'/exp OR 'adolescent'/exp OR 'newborn'/exp

[5,090,845](#)

#7.5

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp

[82,997](#)

#7.4

#7.3 AND (1990:py OR 1991:py OR 1992:py OR 1993:py OR 1994:py OR 1995:py OR 1996:py OR 1997:py OR 1998:py OR 1999:py OR 2000:py OR 2001:py OR 2002:py OR 2003:py OR 2004:py OR 2005:py OR 2006:py OR 2007:py OR 2008:py OR 2009:py OR 2010:py OR 2011:py OR 2012:py OR 2013:py) AND ('article'/it OR 'article in press'/it OR 'conference paper'/it OR 'letter'/it OR 'review'/it)

[137,019](#)

#7.3

#7.1 NOT #7.2

[4,236,760](#)

#7.2

'animal'/exp NOT ('animal'/exp AND 'human'/exp)

[159,318](#)

#7.1

'brain concussion'/exp OR 'brain injury'/exp OR mtbi:ab,ti OR mtbis:ab,ti OR 'head injury'/de OR 'skull injury'/de OR 'second impact syndrome'/exp OR tbi:ab,ti OR tbis:ab,ti OR concussion*:ab,ti OR 'brain laceration':ab,ti OR 'brain lacerations':ab,ti OR 'cerebral injury':ab,ti OR 'cerebral injuries':ab,ti OR 'brain contusion':ab,ti OR 'brain contusions':ab,ti OR 'brain trauma':ab,ti OR 'brain traumas':ab,ti OR 'brain injury':ab,ti OR 'brain injuries':ab,ti OR 'skull fracture'/de OR 'skull base fracture'/de

[Questions 4 & 5 – Last run on Dec. 1, 2012](#)

[3,229](#)

#3.39

#3.36 NOT #3.38

[241](#)

#3.38

#3.36 AND #3.37

[1,895,899](#)

#3.37

'case report'/exp

[3,470](#)

#3.36

#3.35 NOT #3.32

[3,541](#)

#3.35

#3.31 AND #3.34

[4,251,395](#)

#3.34

#3.1 OR #3.33

[1,628,084](#)

#3.33

'risk factor'/exp OR 'risk'/de OR 'high risk patient'/exp OR 'high risk infant'/exp OR 'risk assessment'/exp OR 'precipitating factor':ab,ti OR 'precipitating factors':ab,ti OR 'age factor':ab,ti OR 'age factors':ab,ti OR 'time factor':ab,ti OR 'time factors':ab,ti OR 'analysis of variance'/exp OR 'sex difference'/exp OR 'mechanism of injury':ab,ti OR 'mechanisms of injury':ab,ti OR 'time since injury':ab,ti OR 'between group difference':ab,ti OR 'between group differences':ab,ti OR epidemiology:de,ab,ti OR 'age distribution':de OR 'seasonal variation':de

[1,470,038](#)

#3.32

rat:ti OR rats:ti OR rodent*:ti OR mice:ti OR mouse:ti OR geriatric:ti OR elderly:ti OR 'animal model':ti OR alzheimer*:ti OR 'oif/oef':ti OR 'oef/oif':ti OR military:ti OR iraq:ti OR afghanistan:ti OR 'combat related':ti OR army:ti OR soldiers:ti OR veterans:ti OR 'air force':ti OR 'gulf war':ti OR 'gulf wars':ti OR 'operation enduring freedom':ti OR 'operation iraqi freedom':ti OR 'afghan war':ti OR 'afghan campaign':ti OR marines:ti OR troops:ti OR servicemen:ti OR 'combat disorders':ti OR 'combat disorder':ti OR 'active duty':ti

[5,412](#)

#3.31

#3.27 OR #3.30

163

#3.30

#3.29 NOT #3.19

163

#3.29

#3.28 NOT #3.24

163

#3.28

'glasgow coma scale'/exp OR 'glasgow outcome scale'/exp AND '13-15':ab,ti

5,295

#3.27

#3.23 NOT #3.26

11,241

#3.26

#3.24 OR #3.25

30

#3.25

'oif/oef':ti AND [1990-2013]/py

11,235

#3.24

'iraq war':ti OR 'gulf war':ti OR 'gulf wars':ti OR 'operation iraqi freedom':ti OR 'afghan campaign':ti OR 'operation enduring freedom':ti OR military:ti OR battlefield:ti OR army:ti OR armed AND forces:ti OR marines:ti OR troops:ti OR servicemen:ti OR 'combat related':ti OR 'military personnel':ti OR 'air force':ti OR soldiers:ti OR 'combat veteran':ti OR 'combat disorder':ti OR 'combat disorders':ti OR veterans:ti OR 'active duty':ti OR 'service members':ti AND [1990-2013]/py

5,335

#3.23

#3.22 AND ('case report'/de OR 'clinical article'/de OR 'clinical protocol'/de OR 'clinical trial'/de OR 'cohort analysis'/de OR 'comparative study'/de OR 'control group'/de OR 'controlled clinical trial'/de OR 'controlled study'/de OR 'human'/de OR 'human tissue'/de OR 'interview'/de OR 'major clinical study'/de OR 'medical record review'/de OR 'methodology'/de OR 'model'/de OR 'nonhuman'/de OR 'normal human'/de OR 'outcomes research'/de OR 'practice guideline'/de OR 'prospective study'/de OR 'questionnaire'/de OR 'retrospective study'/de OR 'systematic review'/de) AND ('article'/it OR 'article in press'/it OR 'conference abstract'/it OR 'conference paper'/it OR 'letter'/it OR 'review'/it OR 'short survey'/it)

[6,018](#)

#3.22

#3.20 NOT #3.21

[452,516](#)

#3.21

'editorial'/exp

[6,140](#)

#3.20

#3.16 NOT #3.19

[30,949](#)

#3.19

#3.17 NOT #3.18

[1,241](#)

#3.18

('military phenomena'/exp/mj OR 'veteran'/exp/mj) AND (civilian*:ab,ti OR sport* OR athlete*)
AND [1990-2013]/py

[32,190](#)

#3.17

'military phenomena'/exp/mj OR 'veteran'/exp/mj

[6,202](#)

#3.16

#3.12 NOT #3.15

[8,001,374](#)

#3.15

#3.13 NOT #3.14

[10,227,651](#)

#3.14

'animal'/exp AND 'human'/exp AND [1990-2013]/py

[18,229,025](#)

#3.13

'animal'/exp

[7,286](#)

#3.12

#3.8 NOT #3.11

[4,719,417](#)

#3.11

#3.9 NOT #3.10

[665,955](#)

#3.10

('adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp) AND ('newborn'/exp OR 'child'/exp OR 'adolescent'/exp) AND [1990-2013]/py

[5,385,372](#)

#3.9

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp

[10,092](#)

#3.8

#3.4 OR #3.5 OR #3.6 OR #3.7 AND [embase]/lim AND [1990-2013]/py

[974](#)

#3.7

mtbi:ab,ti OR mtbis:ab,ti OR 'minimal traumatic brain injury':ab,ti OR 'minimal traumatic brain injuries':ab,ti OR 'minimal tbi':ab,ti OR 'minimal tbis':ab,ti

[9,904](#)

#3.6

#3.2 AND (mild:ab,ti OR minor:ab,ti)

[3,409](#)

#3.5

'brain concussion'/exp

[2,878](#)

#3.4

#3.2 AND #3.3

[103,017](#)

#3.3

'sport'/exp OR 'athlete'/exp

[156,672](#)

#3.2

'brain injury'/exp OR 'head injury'/de OR 'skull injury'/exp

[3,030,325](#)

#3.1

'complication'/de OR 'disease exacerbation'/exp OR 'neurological complication'/exp OR 'posttraumatic complication'/exp OR 'posttraumatic pain'/exp OR 'prognosis'/de OR 'disease course'/de OR 'chronic disease'/exp OR 'illness trajectory'/exp OR 'recurrent disease'/exp OR 'relapse'/exp OR 'terminal disease'/exp OR 'acute disease'/exp OR 'adverse outcome'/exp OR 'bothersomeness'/exp OR 'deterioration'/exp OR 'disability severity'/exp OR 'injury severity'/exp OR 'nomogram'/exp OR 'treatment failure'/exp OR 'forecasting'/exp OR 'prediction'/exp OR 'predictive value'/exp OR 'death'/de OR 'lethality'/exp OR 'disability'/exp OR 'disease severity'/de OR impairment*:ab,ti OR sequelae:ab,ti OR impairment*:de OR dysfunction:ab,ti OR refractory:ab,ti OR 'more severe':ab,ti OR 'persisting symptoms':ab,ti OR 'persistent symptoms':ab,ti OR 'enduring symptoms':ab,ti OR 'lingering symptoms':ab,ti OR prolonged:ab,ti OR 'long term symptoms':ab,ti OR 'longterm symptoms':ab,ti OR 'symptomatology'/exp

Question 6 – Last run on Dec. 1, 2012

976

#4.44

#4.41 NOT #4.43

126

#4.43

#4.41 AND #4.42

1,894,200

#4.42

'case report'/exp

1,102

#4.41

#4.39 NOT #4.40

1,385,362

#4.40

rat:ti OR rats:ti OR mouse:ti OR mice:ti OR rodent*:ti OR geriatric:ti OR elderly:ti OR 'animal model':ti OR 'oif/oef':ti OR 'oef/oif':ti

1,111

#4.39

#4.37 AND #4.38

5,588,005

#4.38

longterm:ab,ti OR symptom*:de,ab,ti OR symptomatic:ab,ti OR sequelae:ab,ti OR enduring:ab,ti OR delayed:ab,ti OR prolong*:ab,ti OR ongoing:ab,ti OR persistent:ab,ti OR persistence:ab,ti OR

persisting:ab,ti OR lasting:ab,ti OR 'long term':ab,ti OR 'long-term':ab,ti OR 'post-concussion syndrome':de,ab,ti OR 'postconcussive syndrome':ab,ti OR 'post-concussive syndrome':ab,ti OR 'postconcussion syndrome':ab,ti OR symptomatology:de,ab,ti OR subsymptom*:ab,ti OR unresolved:ab,ti OR continuing:ab,ti OR continued:ab,ti OR unremitting:ab,ti OR lingering:ab,ti OR protracted:ab,ti OR 'greater than':ab,ti OR posttraumatic:ab,ti OR 'post-traumatic':ab,ti OR complication*:de,ab,ti OR complicated:ab,ti OR recovery:de,ab,ti OR recover:de,ab,ti OR recovered:ab,ti OR disability:de,ab,ti OR disabilities:de,ab,ti OR disabled:de,ab,ti OR impairment*:de,ab,ti OR impaired:ab,ti OR rehabilitation:de,ab,ti OR reintegration:ab,ti OR 're-integration':ab,ti OR failure:de,ab,ti OR remediation:ab,ti OR remediate:ab,ti OR refractory:ab,ti OR extended:ab,ti OR 'longer than':ab,ti OR 'more than':ab,ti OR problematic:ab,ti

[1,546](#)

#4.37

#4.31 AND #4.36

[6,141,110](#)

#4.36

#4.1 OR #4.32 OR #4.33 OR #4.34 OR #4.35

[1,610,488](#)

#4.35

'paracetamol'/exp OR acetaminophen:de,ab,ti OR 'acetylsalicylic acid'/exp OR 'ibuprofen'/exp OR 'naproxen'/exp OR 'diclofenac'/exp OR 'analgesic agent'/exp OR 'nonsteroid antiinflammatory agent'/exp OR nsaid*:ab,ti OR 'antidepressant agent'/exp OR 'amitriptyline'/exp OR 'nortriptyline'/exp OR 'anticonvulsive agent'/exp OR 'valproic acid'/exp OR 'topiramate'/exp OR 'gabapentin'/exp OR 'propranolol'/exp OR 'beta adrenergic receptor blocking agent'/exp OR 'metoprolol'/exp OR 'dihydroergotamine'/exp OR ergot*:de,ab,ti OR 'sumatriptan'/exp OR 'antimigraine agent'/exp OR 'vestibular suppressant':ab,ti OR 'vestibular suppressants':ab,ti OR 'meclozine'/exp OR 'scopolamine'/exp OR 'benzodiazepine derivative'/exp OR neurostimulant*:ab,ti OR 'methylphenidate'/exp OR 'dexamphetamine'/exp OR modafanil:ab,ti OR 'amantadine'/exp OR 'atomoxetine'/exp OR 'antiemetic agent'/exp OR 'promethazine'/exp OR 'hypnotic sedative agent'/exp OR 'zolpidem'/exp OR 'serotonin modulator':ab,ti OR 'serotonin modulators':ab,ti OR 'trazodone'/exp OR 'alpha adrenergic receptor blocking agent'/exp OR 'melatonin'/exp OR 'sertraline'/exp OR 'citalopram'/exp OR 'escitalopram'/exp OR 'paroxetine'/exp OR 'fluoxetine'/exp OR 'amfebutamone'/exp OR 'cholinesterase inhibitor'/exp OR 'serotonin uptake inhibitor'/exp OR 'donepezil'/exp OR 'rivastigmine'/exp OR 'galantamine'/exp OR 'cytidine diphosphate choline':ab,ti

[569,867](#)

#4.34

'neurofeedback'/exp OR biofeedback:de,ab,ti OR 'hyperbaric oxygen'/exp OR 'kinesiotherapy'/exp OR 'physiotherapy'/exp OR 'cognitive therapy'/exp OR 'induced hypothermia'/exp OR 'rest'/exp OR neurorehabilitation:ab,ti OR 'stress reduction':ab,ti OR 'cognitive rest':ab,ti OR 'neuroprotective agent'/exp OR 'sodium chloride'/exp OR 'hypertonic

saline solution':ab,ti OR 'nutraceutical'/exp OR 'diet supplementation'/exp OR 'massage'/exp
OR 'cognitive retraining':ab,ti OR 'sensory stimulation'/exp OR 'exercise'/exp OR 'positional
change':ab,ti OR 'postural change':ab,ti

[144,728](#)

#4.33

intervention*:de,ti

[2,010,750](#)

#4.32

treatment*:de,ti

[5,412](#)

#4.31

#4.27 OR #4.30

[163](#)

#4.30

#4.29 NOT #4.19

[163](#)

#4.29

#4.28 NOT #4.24

[163](#)

#4.28

('glasgow coma scale'/exp OR 'glasgow outcome scale'/exp) AND '13-15':ab,ti

[5,295](#)

#4.27

#4.23 NOT #4.26

[11,241](#)

#4.26

#4.24 OR #4.25

[30](#)

#4.25

'oif/oef':ti AND [1990-2013]/py

[11,235](#)

#4.24

'iraq war':ti OR 'gulf war':ti OR 'gulf wars':ti OR 'operation iraqi freedom':ti OR 'afghan
campaign':ti OR 'operation enduring freedom':ti OR military:ti OR battlefield:ti OR army:ti OR

armed AND forces:ti OR marines:ti OR troops:ti OR servicemen:ti OR 'combat related':ti OR 'military personnel':ti OR 'air force':ti OR soldiers:ti OR 'combat veteran':ti OR 'combat disorder':ti OR 'combat disorders':ti OR veterans:ti OR 'active duty':ti OR 'service members':ti AND [1990-2013]/py

[5,335](#)

#4.23

#4.22 AND ('case report'/de OR 'clinical article'/de OR 'clinical protocol'/de OR 'clinical trial'/de OR 'cohort analysis'/de OR 'comparative study'/de OR 'control group'/de OR 'controlled clinical trial'/de OR 'controlled study'/de OR 'human'/de OR 'human tissue'/de OR 'interview'/de OR 'major clinical study'/de OR 'medical record review'/de OR 'methodology'/de OR 'model'/de OR 'nonhuman'/de OR 'normal human'/de OR 'outcomes research'/de OR 'practice guideline'/de OR 'prospective study'/de OR 'questionnaire'/de OR 'retrospective study'/de OR 'systematic review'/de) AND ('article'/it OR 'article in press'/it OR 'conference abstract'/it OR 'conference paper'/it OR 'letter'/it OR 'review'/it OR 'short survey'/it)

[6,018](#)

#4.22

#4.20 NOT #4.21

[452,516](#)

#4.21

'editorial'/exp

[6,140](#)

#4.20

#4.16 NOT #4.19

[30,949](#)

#4.19

#4.17 NOT #4.18

[1,241](#)

#4.18

'military phenomena'/exp/mj OR 'veteran'/exp/mj AND (civilian*:ab,ti OR sport* OR athlete*) AND [1990-2013]/py

[32,190](#)

#4.17

'military phenomena'/exp/mj OR 'veteran'/exp/mj

[6,202](#)

#4.16

#4.12 NOT #4.15

[8,001,374](#)

#4.15

#4.13 NOT #4.14

[10,227,651](#)

#4.14

'animal'/exp AND 'human'/exp AND [1990-2013]/py

[18,229,025](#)

#4.13

'animal'/exp

[7,286](#)

#4.12

#4.8 NOT #4.11

[4,719,417](#)

#4.11

#4.9 NOT #4.10

[665,955](#)

#4.10

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp AND ('newborn'/exp OR 'child'/exp OR 'adolescent'/exp) AND [1990-2013]/py

[5,385,372](#)

#4.9

'adult'/exp OR 'aged'/exp OR 'middle aged'/exp OR 'embryo'/exp OR 'fetus'/exp

[10,092](#)

#4.8

#4.4 OR #4.5 OR #4.6 OR #4.7 AND [embase]/lim AND [1990-2013]/py

[974](#)

#4.7

mtbi:ab,ti OR mtbis:ab,ti OR 'minimal traumatic brain injury':ab,ti OR 'minimal traumatic brain injuries':ab,ti OR 'minimal tbi':ab,ti OR 'minimal tbis':ab,ti

[9,904](#)

#4.6

#4.2 AND (mild:ab,ti OR minor:ab,ti)

[3,409](#)

#4.5

'brain concussion'/exp

2,878

#4.4

#4.2 AND #4.3

103,017

#4.3

'sport'/exp OR 'athlete'/exp

156,672

#4.2

'brain injury'/exp OR 'head injury'/de OR 'skull injury'/exp

3,578,947

#4.1

'therapy'/de OR 'acupuncture'/exp OR 'animal assisted therapy'/exp OR 'apitherapy'/exp OR 'biological therapy'/exp OR 'computer assisted therapy'/exp OR 'conservative treatment'/exp OR 'counseling'/exp OR 'device therapy'/exp OR 'drug therapy'/exp OR 'early intervention'/exp OR 'experimental therapy'/exp OR 'fluid therapy'/exp OR 'homeopathy'/exp OR 'intensive care'/de OR 'neuromonitoring'/exp OR 'blood pressure monitoring'/exp OR 'body temperature monitoring'/exp OR 'capnography'/exp OR 'life sustaining treatment'/exp OR 'maintenance therapy'/de OR 'patient positioning'/exp OR 'rehabilitation care'/exp OR 'radiotherapy'/de OR 'cognitive rehabilitation'/exp OR 'functional training'/exp OR 'muscle training'/exp OR 'occupational therapy'/exp OR 'pediatric rehabilitation'/exp OR 'psychosocial rehabilitation'/exp OR 'recreational therapy'/exp OR 'rejuvenation'/exp OR 'sensorimotor integration'/exp OR 'speech rehabilitation'/exp OR 'sleep therapy'/exp OR 'supplementation'/exp OR 'systemic therapy'/exp OR 'therapy effect'/exp OR 'treatment response'/exp

ERIC SEARCH STRATEGY

Due to the subject content of the ERIC database (education), only one search strategy was used. The rationale is that there will be so few citations relative to the major biomedical databases, such as PubMed and Embase, that searching only for the *population* will not generate enough results to necessitate narrowing down by the focus of each individual question.

((**Keywords:**sport* or **Keywords:**athlete* or **Keywords:**athletic or **Keywords:**recreation*) and (**Keywords:**"head injury" or **Keywords:**"head injuries" or **Keywords:**"brain injury" or **Keywords:**"brain injuries" or **Keywords:**"head trauma" or **Keywords:**"brain trauma" or **Keywords:**"skull injury" or **Keywords:**"skull injuries" or **Keywords:**tbi or **Keywords:**tbis or

Keywords:"cerebral trauma" or **Keywords:**"cerebral injury" or **Keywords:**"cerebral injuries"))**Publication Date:**1990-2013

OR

(**Keywords:**"gcs 13-15" or **Keywords:**concussion* or **Keywords:**postconcussion or **Keywords:**"post concussion" or **Keywords:**postconcussive or **Keywords:**"post concussive" or **Keywords:**"mild tbi" or **Keywords:**"mild tbis" or **Keywords:**mtbi or **Keywords:**mtbis or **Keywords:**"mild traumatic brain injury" or **Keywords:**"mild traumatic brain injuries"))**Publication Date:**1990-2013

Or

((**Keywords:**"traumatic brain injury" or **Keywords:**"traumatic brain injuries" or **Keywords:**tbi or **Keywords:**tbis or **Keywords:**"brain contusion" or **Keywords:**"brain contusions" or **Keywords:**"brain trauma" or **Keywords:**"brain laceration" or **Keywords:**"brain lacerations" or **Keywords:**"cerebral injury" or **Keywords:**"cerebral injuries" or **Keywords:**"head injury" or **Keywords:**"head injuries" or **Keywords:**"head trauma" or **Keywords:**"cerebral trauma" or **Keywords:**"skull injury" or **Keywords:**"skull injuries" or **Keywords:**"craniocerebral trauma") and (**Keywords:**mild or **Keywords:**minor))**Publication Date:**1990-2013

SPORTDISCUS SEARCH STRATEGY

Due to the subject content of the SportDiscus database (sports/recreation), only one search strategy was used. The rationale is that there will be so few citations relative to the major biomedical databases, such as PubMed and Embase, that searching only for the *population* will not generate enough results to necessitate narrowing down by the focus of each individual question.

| | | | | |
|----|--|---|--|-----|
| S6 | TX (youth or child or children or childhood or toddler* or infant* or teen or teens or teenager* or "teen ager" or "teen agers" or adolescent* or adolescence or pediatric* of paediatric*) AND S5 | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - SPORTDiscus with Full Text | 171 |
| S5 | KW s4 | Limiters - Publication Type: Journal Article, | Interface - EBSCOhost Search Screen - Advanced | 471 |

| | | | | |
|----|---|---|---|-----|
| | | Thesis or dissertation Search modes - Boolean/Phrase | Search Database - SPORTDiscus with Full Text | |
| S4 | KW S3 or S2 or S1 | Limiters - Published Date: 19900101-20121231; Publication Type: Journal Article, Thesis or dissertation Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - SPORTDiscus with Full Text | 471 |
| S3 | KW ("traumatic brain injury" or "traumatic brain injuries" or tbi or tbis or "brain contusion" or "brain contusions" or "brain trauma" or "brain laceration" or "brain lacerations" or "cerebral injury" or "cerebral injuries" or "head injury" or "head injuries" or "head trauma" or "cerebral trauma" or "skull injury" or "skull injuries" or "craniocerebral trauma" or "brain injury" or "brain injuries") AND TX (mild or minor) | Limiters - Published Date: 19900101-20121231; Publication Type: Journal Article, Thesis or dissertation Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - SPORTDiscus with Full Text | 322 |
| S2 | KW "gcs 13-15" or concussion* or concussive or postconcussion or "post concussion" or postconcussive or "post | Limiters - Published Date: 19900101-20121231; Publication Type: Journal Article, Thesis or dissertation | Interface - EBSCOhost Search Screen - Advanced Search Database - SPORTDiscus with Full Text | 259 |

| | | | | |
|----|--|---|---|----|
| | concussive" or "mild tbi" or "mild tbis" or mtbi or mtbis or "mild traumatic brain injury" or "mild traumatic brain injuries" | Search modes - Boolean/Phrase | | |
| S1 | KW ("head injury" or "head injuries" or "brain injury" or "brain injuries" or "head trauma" or "brain trauma" or "skull injury" or "skull injuries" or tbi or tbis or "cerebral trauma" or "cerebral injury" or "cerebral injuries") AND KW (sport* or athlete* or athletic or recreation) | Limiters - Published Date: 19900101-20121231; Publication Type: Journal Article, Thesis or dissertation Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - SPORTDiscus with Full Text | 43 |

CINAHL SEARCH STRATEGY

CINAHL was searched only for Question 6, dealing with treatment. The rationale is that CINAHL could have unique studies dealing with treatments provided by allied health professionals. The treatments searched did not include specific medications since it is unlikely that drug studies would appear in CINAHL, but not PubMed or Embase.

| | | | | |
|-----|-----|--|--|-----|
| S43 | S41 | Limiters - Exclude MEDLINE records Narrow by SubjectAge6: - infant, newborn: birth-1 month Narrow by SubjectAge5: - infant: 1-23 months Narrow by SubjectAge4: - all infant Narrow by SubjectAge3: - | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 369 |
|-----|-----|--|--|-----|

| | | | | |
|-----|---|---|---|-----------|
| | | <p>child, preschool: 2-5 years Narrow by SubjectAge2: - adolescent: 13-18 years Narrow by SubjectAge1: - child: 6-12 years Narrow by SubjectAge0: - all child Search modes - Boolean/Phrase</p> | | |
| S42 | S41 | <p>Limiters - Exclude MEDLINE records Search modes - Boolean/Phrase</p> | <p>Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive</p> | 6,650 |
| S41 | S40 AND S15 | <p>Search modes - Boolean/Phrase</p> | <p>Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive</p> | 9,413 |
| S40 | ("NEUROFEEDBACK") OR (S16 OR S17 OR S18 OR S19 OR S20 OR S21 OR S22 OR S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33 OR S34 OR S35 OR S36 OR S37 OR S38 OR S39) | <p>Search modes - Boolean/Phrase</p> | <p>Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive</p> | 1,064,298 |

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|-----|---|-------------------------------|--|--------|
| S39 | "NEUROFEEDBACK" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 168 |
| S38 | (MH "Patient Positioning+") OR "POSITIONING" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 10,049 |
| S37 | "RANGE OF MOTION EXERCISE" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 34 |
| S36 | (MH "Sensory Deprivation") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 218 |
| S35 | (MH "Sensory Stimulation+") OR (MH "Physical Stimulation+") OR (MH "Transcutaneous Electric Nerve Stimulation") OR (MH "Acoustic Stimulation") OR (MH "Electric | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL | 24,968 |

| | | | | |
|-----|---|-------------------------------|--|-------|
| | Stimulation+") OR (MH "Electrical Stimulation, Functional") OR (MH "Electrical Stimulation, Neuromuscular") OR (MH "Deep Brain Stimulation") OR "STIMULATION" | | with Full Text;Nursing & Allied Health Collection: Comprehensive | |
| S34 | (MH "Massage+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 7,089 |
| S33 | (MH "Dietary Supplements+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 9,906 |
| S32 | (MH "Functional Food") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 565 |
| S31 | "COGNITIVE REST" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 4 |

| | | | | |
|-----|--|-------------------------------|--|-------|
| S30 | (MH "Stress Management") OR "STRESS REDUCTION" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 5,530 |
| S29 | "PHYSICAL REST" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 13 |
| S28 | (MH "Bed Rest") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 773 |
| S27 | (MH "Hypothermia, Induced") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 1,405 |
| S26 | (MH "Cognitive Therapy") OR "COGNITIVE THERAPY" OR (MH "Recreational Therapy") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL | 8,545 |

| | | | | |
|-----|---|-------------------------------|--|--------|
| | | | with Full Text;Nursing & Allied Health Collection: Comprehensive | |
| S25 | (MH "Physical Therapy+") OR "PHYSICAL THERAPY" OR (MH "Pediatric Physical Therapy") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 81,215 |
| S24 | (MH "Therapeutic Exercise+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 24,929 |
| S23 | (MH "Hyperbaric Oxygenation") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 1,245 |
| S22 | (MH "Biofeedback") OR "BIOFEEDBACK" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 2,578 |

| | | | | |
|-----|---|-------------------------------|--|---------|
| S21 | (MH "Rehabilitation, Athletic") OR (MH "Rehabilitation") OR "REHABILITATION" OR (MH "Rehabilitation, Psychosocial") OR (MH "Rehabilitation, Speech and Language") OR (MH "Rehabilitation, Pediatric") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 114,697 |
| S20 | (MH "Diet Therapy") OR (MH "Apitherapy") OR (MH "Pediatric Physical Therapy") OR (MH "Behavior Therapy") OR (MH "Pediatric Occupational Therapy") OR (MH "Motion Therapy, Continuous Passive") OR (MH "Magnet Therapy") OR (MH "Color Therapy") OR (MH "Electroconvulsive Therapy") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 11,143 |
| S19 | (MH "Pharmacological and Biological Treatments") OR (MH "Treatment Outcomes") OR "TREATMENT" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 431,742 |
| S18 | (MH "Drug Therapy") OR (MH "Drug Therapy, Combination") OR (MH "Fluid Therapy") OR (MH "Intravenous Therapy") OR (MH "Prescriptions, Drug") OR (MH "Manual Therapy") OR (MH "Phototherapy") OR (MH "Radiotherapy") OR (MH "Rehabilitation") OR (MH "Respiratory Therapy") OR (MH "Stress Management") OR (MH "Therapy, Computer Assisted") OR (MH "Vestibular Stimulation") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 63,672 |
| S17 | TX THERAPEUTIC | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL | 392,389 |

| | | | | |
|-----|--|--|--|---------|
| | | | with Full Text;Nursing & Allied Health Collection: Comprehensive | |
| S16 | "THERAPY" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 603,914 |
| S15 | S13 NOT S14 | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 16,007 |
| S14 | TI IRAQ OR IRAQI OR AFGHANISTAN OR "GULF WAR" OR "GULF WARS" OR AFGHAN OR "OPERATION ENDURING FREEDOM" OR MILITARY OR BATTLEFIELD OR ARMY OR "ARMED FORCES" OR MARINES OR TROOPS OR SERVICEMEN OR "COMBAT RELATED" OR "AIR FORCE" OR SOLDIERS OR "OIF/oEF" OR VETERANS OR "ACTIVE DUTY" OR "SERVICE MEMBERS" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 14,619 |
| S13 | S7 OR S9 OR S10 OR S11 | Limiters - Published Date from: 19900101-20121231 Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 16,356 |

| | | | | |
|-----|--|-------------------------------|--|--------|
| S12 | S7 OR S9 OR S10 OR S11 | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 16,948 |
| S11 | TX "MINIMAL TRAUMATIC BRAIN INJURY" OR "MINIMAL TRAUMATIC BRAIN INJURIES" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 1 |
| S10 | TX (TBI OR TBIS OR "BRAIN CONTUSION" OR "BRAIN CONTUSIONS" OR "BRAIN TRAUMA" OR "BRAIN LACERATION" OR "BRAIN LACERATIONS" OR "CEREBRAL INJURY" OR "CEREBRAL INJURIES" OR "HEAD INJURY" OR "HEAD INJURIES" OR "HEAD TRAUMA" OR "CEREBRAL TRAUMA" OR "SKULL INJURY" OR "SKULL INJURIES" OR "CRANIOCEREBRAL TRAUMA" OR "BRAIN INJURY" OR "BRAIN INJURIES") AND TX (MILD OR MINOR) | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 15,832 |
| S9 | "GCS 13-15" OR MTBI OR MTBIS OR "MILD TRAUMATIC BRAIN INJURY" OR "MILD TRAUMATIC BRAIN INJURIES" | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 791 |
| S8 | (MH "Brain Concussion+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL | 1,395 |

| | | | | |
|----|--------------------|-------------------------------|--|--------|
| | | | with Full Text;Nursing & Allied Health Collection: Comprehensive | |
| S7 | S6 AND (S2 OR S1) | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 1,314 |
| S6 | S5 OR S4 OR S3 | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 51,836 |
| S5 | (MH "Recreation+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 11,629 |
| S4 | (MH "Athletes+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 12,216 |

| | | | | |
|----|--|-------------------------------|---|--------|
| S3 | (MH "Sports+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 36,674 |
| S2 | (MH "Head Injuries+") OR TX (tbi or tbiis) | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 37,418 |
| S1 | (MH "Head Injuries+") | Search modes - Boolean/Phrase | Interface - EBSCOhost Search Screen - Advanced Search Database - CINAHL with Full Text;Nursing & Allied Health Collection: Comprehensive | 18,968 |

Appendix D: Classification of Evidence Scheme

Appendix D

Classification of Evidence Scheme

American Academy of Neurology Classification of Evidence Schemes

Criteria for Rating Therapeutic Studies

Class I Criteria

- Randomized controlled clinical trial (RCT) in a representative population
- Masked or objective outcome assessment
- Relevant baseline characteristics are presented and substantially equivalent between treatment groups, or there is appropriate statistical adjustment for differences
- Additional Class I criteria:
 - a. Concealed allocation
 - b. No more than two primary outcomes specified
 - c. Exclusion and inclusion criteria clearly defined
 - d. Adequate accounting of dropouts (with at least 80 percent of participants completing the study) and crossovers
 - e. For noninferiority or equivalence trials claiming to prove efficacy for one or both drugs, the following are also required*:
 - i. The authors explicitly state the clinically meaningful difference to be excluded by defining the threshold for equivalence or noninferiority
 - ii. The standard treatment used in the study is substantially similar to that used in previous studies establishing efficacy of the standard treatment (e.g., for a drug, the mode of administration, dose, and dosage adjustments are similar to those previously shown to be effective)
 - iii. The inclusion and exclusion criteria for participant selection and the outcomes of participants on the standard treatment are comparable with those of previous studies establishing efficacy of the standard treatment
 - iv. The interpretation of the study results is based on a per-protocol analysis that accounts for dropouts or crossovers
 - f. For crossover trials, both period and carryover effects are examined and statistical adjustments performed, if appropriate

Class II Criteria

- RCT that lacks one or two Class I criteria a–e (see above)
- Cohort study meeting Class I criteria b–e (see above)
- Randomized crossover trial missing one of the following two criteria:
 - a. Period and carryover effects described
 - b. Baseline characteristics of treatment order groups presented
- All relevant baseline characteristics are presented and substantially equivalent across treatment groups, or there is appropriate statistical adjustment for differences
- Masked or objective outcome assessment

Class III Criteria

- Controlled studies (including studies with external controls such as well-defined natural history controls)

- Crossover trial missing both of the following two criteria:
 - a. Period and carryover effects
 - b. Presentation of baseline characteristics
- A description of major confounding differences between treatment groups that could affect outcome**
- Outcome assessment masked, objective,** or performed by someone who is not a member of the treatment team

Class IV Criteria

If any therapeutic study meets any one of the following criteria, the study must be classified as Class IV.

- Patients with the disease are not included
- Patients receiving different interventions are not included
- Interventions or outcome measures are undefined or unaccepted
- Measures of effectiveness or statistical precision are either not presented or not calculable

*Numbers i–iii in Class Ie are required for Class II in equivalence trials. If any one of the three is missing, the class is automatically downgraded to Class III

**Objective outcome measurement: an outcome measure that is unlikely to be affected by an observer's (patient, treating physician, investigator) expectation or bias (e.g., blood tests, administrative outcome data)

Criteria for Rating Causation Studies

Class I Criteria

- Cohort survey with prospective data collection
- All relevant confounding characteristics are presented and substantially equivalent between comparison groups, or there is appropriate statistical adjustment for differences
- Outcome measurement is objective or determined without knowledge of risk factor status
- Additional Class I criteria:
 - a. No more than two primary outcomes specified
 - b. Exclusion and inclusion criteria clearly defined
 - c. Accounting of dropouts indicated (with at least 80 percent of participants completing the study)

Class II Criteria

- Cohort study with retrospective data collection or case-control study. Study meets Class I criteria a–c (see above)
- All relevant confounding characteristics are presented and substantially equivalent across comparison groups, or there is appropriate statistical adjustment for differences
- Masked or objective outcome assessment

Class III Criteria

- Cohort or case-control study designs
- A description of major confounding differences between risk groups that could affect outcome**
- Outcome assessment masked, objective,** or performed by someone other than the

investigator who measured the risk factor

Class IV Criteria

If any study meets any one of the following criteria, the study must be classified as Class IV

- Persons at risk for the disease are not included
- Both patients with and patients without the risk factor are not included
- Measures of risk factor or outcomes are undefined or unaccepted
- Measures of association or statistical precision are either not presented or not calculable

****Objective outcome measurement:** an outcome measure that is unlikely to be affected by an observer's (patient, treating physician, investigator) expectation or bias (e.g., blood tests, administrative outcome data)

Criteria for Rating Prognostic Accuracy Studies

Class I Criteria

- Cohort survey with prospective data collection
- Inclusion of a broad spectrum of persons at risk for developing the outcome
- Outcome measurement is objective or determined without knowledge of risk factor status
- Additional Class I criteria:
 - a. Exclusion/inclusion criteria clearly defined
 - b. Both the risk factor and the outcome measured in at least 80 percent of participants

Class II Criteria

- Cohort study with retrospective data collection or case-control study. Study meets Class I criteria a and b (see above)
- Inclusion of a broad spectrum of persons with and persons without both the risk factor and the outcome
- Presence of the risk factor and outcome are determined objectively or without the investigator's knowledge of both in each study participant

Class III Criteria

- Cohort or case-control study
- Narrow spectrum of persons with or without the disease
- Presence of the risk factor and outcome are determined objectively, without the investigator's knowledge of both in each study participant, or by different investigators

Class IV Criteria

If any study meets any one of the following criteria, the study must be classified as Class IV

- Persons at risk for the outcome are not included
- Patients with and patients without the risk factor are not included
- Measures of risk factor or outcomes are undefined or unaccepted
- Measures of association or statistical precision are either not presented or not calculable

Criteria for Rating Diagnostic Accuracy Studies

Class I Criteria

- Cohort survey with prospective data collection

- Inclusion of a broad spectrum of persons suspected of having the disease
- Disease status determination is objective or made without knowledge of diagnostic test result
- Additional Class I criteria:
 - a. Exclusion/inclusion criteria clearly defined
 - b. Both the diagnostic test and disease status measured in at least 80 percent of participants

Class II Criteria

- Cohort study with retrospective data collection or case-control study. Study meets criteria a and b (see Class I)
- Includes a broad spectrum of persons with and persons without the disease
- The diagnostic test result and disease status are determined objectively or without knowledge of one another

Class III Criteria

- Cohort or case-control study
- Narrow spectrum of persons with or without the disease
- The diagnostic test result and disease status are determined objectively, without the investigator's knowledge of both in each participant, or by different investigators

Class IV Criteria

If any study meets any one of the following criteria, the study must be classified as Class IV

- Persons suspected of having the disease are not included
- Patients with and patients without the disease are not included
- Independent reference standard is undefined or unaccepted
- Measures of diagnostic accuracy or statistical precision are either not presented or not calculable

Criteria for Rating Population Screening Studies

Class I Criteria

- Study of a cohort of patients at risk for the outcome from a defined geographic area (i.e., population based)
- Outcome is objective
- Additional Class I criteria:
 - a. Exclusions and inclusion criteria clearly defined
 - b. At least 80 percent of patients undergo the screening of interest

Class II Criteria

- Non-population-based nonclinical cohort (e.g., mailing list, volunteer panel) or a general medical/neurology clinic/center without a specialized interest in the outcome. Study meets Class I criteria a and b (see above)
- Outcome is objective

Class III Criteria

- Referral cohort from a center with a potential specialized interest in the outcome

Class IV Criteria

If any study meets any one of the following criteria, the study must be classified as Class IV

- Persons at risk for the outcome are not included
- Patients were not statistically sampled, or patients were specifically selected for inclusion by outcome
- Screening procedure or outcome measure is undefined or unaccepted
- Measures of frequency or statistical precision are either not presented or not calculable

Appendix E: Evidence Tables

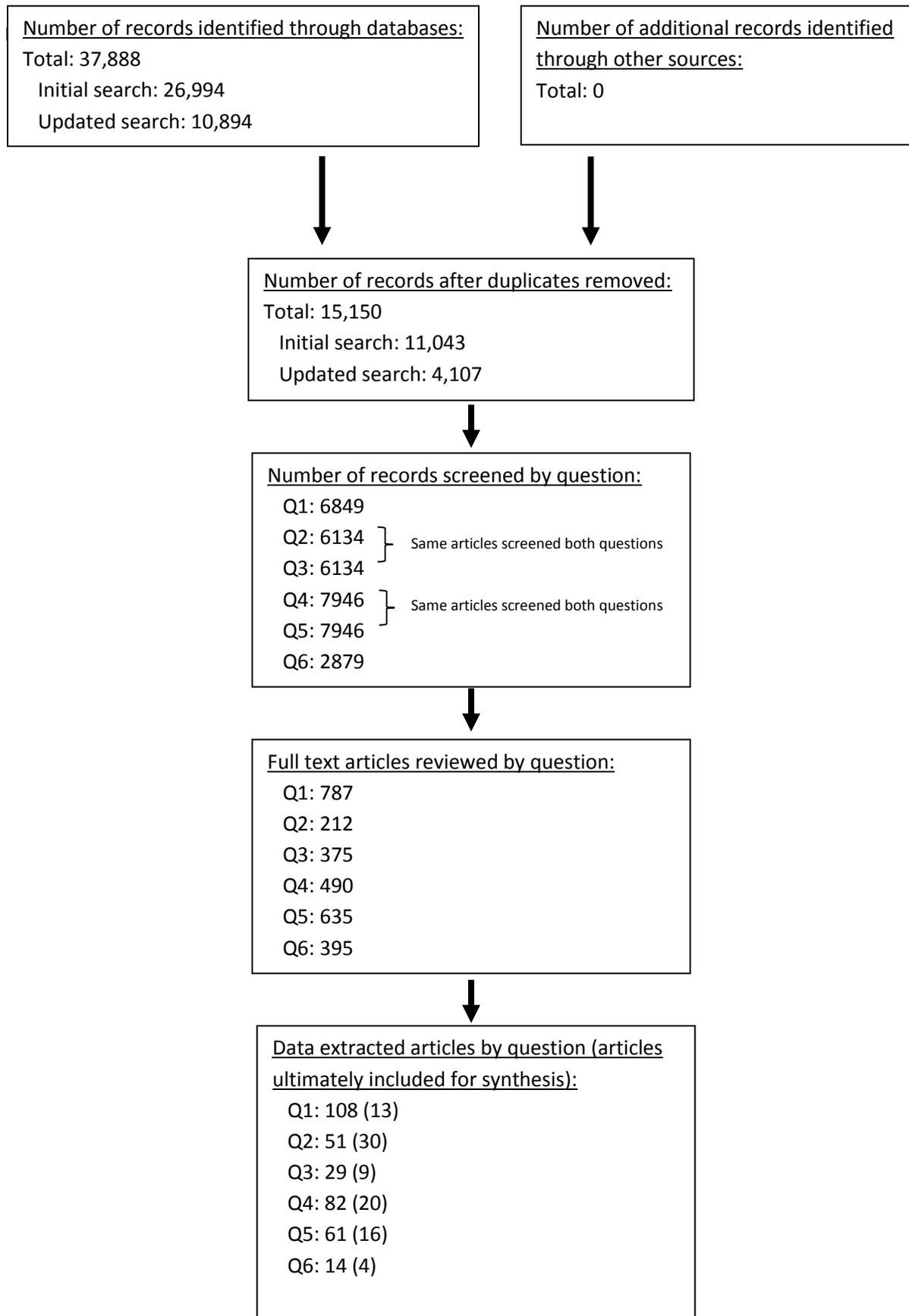
Appendix E
Evidence Tables

Please locate Appendix E in a separate Excel file.

Appendix F: PRISMA Diagram

Appendix F PRISMA Diagram

Appendix. Flow of article selection process



Appendix G: Recommendation Process Methodology

Appendix G

Recommendation Process Methodology

Constructing the recommendation and its rationale

Rationale for recommendation summarized in the Clinical Context includes three categories of premises

- Evidence-based conclusions based on the systematic review
- Stipulated axiomatic principles of care
- Strong related evidence not systematically reviewed
- Inferences from the other premises

Actionable recommendations include the following mandatory elements

- The patient population that is the subject of the recommendation
- The person performing the action of the recommendation statement
- The specific action to be performed
- The expected outcome to be attained

Assigning a level of obligation

Modal modifiers used to indicate the final level of obligation (LOO)

- Level A: “Must”
- Level B: “Should”
- Level C: “May”
- Level U: No recommendation supported
- Level R: The intervention should not be used outside of a research setting

LOO assigned by eliciting panel members’ judgments regarding multiple domains, using a modified Delphi process. Goal is to attain consensus after a maximum of four rounds of voting.

Consensus is defined by:

- > 80% agreement on dichotomous judgments
- > 80% agreement, within one point for ordinal judgments
- If consensus is obtained, LOO assigned at the median. If not obtained, LOO assigned at the 10th percentile

Three steps used to assign final LOO

1. Initial LOO determined by the cogency of the deductive inference supporting the recommendation on the basis of ratings within four domains. Initial LOO anchored to lowest LOO supported by any domain.

Confidence in evidence. LOO anchored to confidence in evidence determined by modified form of the Grading of Recommendations Assessment, Development and Evaluation process

Level A: High confidence

Level B: Moderate confidence

Level C: Low confidence

Level U: Very low confidence

Soundness of inference assuming all premises are true. LOO anchored to proportion of panel members convinced of soundness of the inference

Level A: 100%

- Level B: > 80% to < 100%
- Level C: > 50% to < 80%
- Level U or R: < 50%
- Acceptance of axiomatic principles: LOO anchored to proportion of panel members who accept principles
 - Level A: 100%
 - Level B: > 80% to < 100%
 - Level C: > 50% to < 80%
 - Level U or R: < 50%
- Belief that evidence cited from related conditions is strong: LOO anchored to proportion of panel members who believe the related evidence is strong
 - Level B: > 80% to 100% (recommendations dependent on inferences from non-systematically reviewed evidence cannot be anchored to a Level A LOO)
 - Level C: > 50% to < 80%
 - Level U or R: < 50%

2. LOO is modified mandatorily on the basis of the judged magnitude of benefit relative to harm expected to be derived from complying with the recommendation

- Magnitude relative to harm rated on 4-point ordinal scale
- Large benefit relative to harm: benefit judged large, harm judged none
- Moderate benefit relative to harm: benefit judged large, harm judged minimal; or benefit judged moderate, harm judged none
- Small benefit relative to harm: benefit judged large, harm judged moderate; or benefit judged moderate, harm judged minimal; or benefit judged small, harm judged none
- Benefit to harm judged too close to call: benefit and harm judged to be substantially similar
- Regardless of cogency of the recommendation the LOO can be no higher than that supported by the rating of the magnitude of benefit relative to harm
 - Level A: large benefit relative to harm
 - Level B: moderate benefit relative to harm
 - Level C: small benefit relative to harm
 - Level U: too close to call
- LOO can be increased by one grade if LOO corresponding to benefit relative to harm greater than LOO corresponding to the cogency of the recommendation

3. LOO optionally downgraded on the basis of the following domains

- Importance of the outcome: critical, important, mildly important, not important
- Expected variation in patient preferences: none, minimal, moderate, large
- Financial burden relative to benefit expected: none, minimal, moderate, large
- Availability of intervention: universal, usually, sometimes, limited

Appendix H: Clinical Contextual Profiles

Appendix H Clinical Contextual Profiles

Diagnosing Mild Traumatic Brain Injury Following Head Injury in Children (as compared to absence of brain injury or more severe injuries)

A. Risk Factor Identification and Imaging

- Risk Factors for Intracranial Injury and CT

Rationale: Up to 7.5% of children with mTBI will have intracranial injury (ICI).^{C1-C15} Identification of risk factors for ICI in children presenting with possible mTBI in the acute setting is important to the diagnosis of more severe forms of TBI, further directing observation and the possible need for emergent head CT. ICI further directs the prognosis of patients with mTBI (see Prognosis Recommendations). There is moderate evidence that several risk factors identify those patients with increased risk of ICI.^{C3,C5,C16-C18} These risk factors include age younger than 2 years, vomiting, loss of consciousness, severe mechanism of injury, severe or worsening headache, amnesia, non-frontal scalp hematoma, Glasgow Coma Score less than 15, and clinical suspicion for skull fracture. Notably, upon literature review, there is insufficient evidence to report seizures as a risk factor for ICI at this time. There is strong clinical evidence that use of clinical decision rules are effective in identifying children at low risk for ICI.^{C3,C5,C16,C18} The use of clinical decision rules may minimize the risk of failure to identify important ICI while avoiding unnecessary radiation exposure from head CT. Head CT is the preferred diagnostic tool in acute care settings to rapidly identify ICI. However, higher doses of radiation attributable to this type of imaging in children have been associated with an increase in the lifetime cancer mortality risk.^{C19-C22} Further, certain pediatric populations will require sedation in order to obtain adequate neuroimaging, increasing the overall risk related to imaging processes.^{C23} Families require clinical counseling regarding these risks in order to understand best practices for the clinical care of their child.

Pediatric head CT following mTBI in the acute care setting may possibly identify ICI in 7.5% (95% CI, 6.0-9.1%) of patients in the acute setting based on 16 Class III studies.^{C1-C15} However, this is likely an overestimate of the rate of findings due to bias in the selection of children for imaging. ICI included combinations of epidural hematoma, subdural hematoma, intracranial hemorrhage, subarachnoid hemorrhage, intraventricular hemorrhage, cerebral edema, and depressed skull fractures. Simple skull fractures were not included as ICI unless they occurred concomitantly with another intracranial finding.

In addition, head CT performed on children diagnosed initially with mTBI presenting to an acute care setting may possibly identify abnormalities resulting in clinically important outcomes in 1.9% (95% CI, 1.3-2.5) of patients based on 16 class III studies.^{C1-C3,C8-C10,C12,C14,C16,C24-C30} Clinically important outcomes included, but were not limited to, death, neurosurgical intervention, intubation for more than 24 hours, hospital admission of more than two nights for TBI, placement of intracranial pressure monitor, or other neurosurgical procedures. This is probably an overestimation of the rate of findings due to bias in the selection of children for imaging. Routine head CT in the acute care setting is possibly associated with neurosurgical intervention in 0.9% (95% CI, 0.5-1.2%) of patients based on 14 Class III studies.^{C1-C3,C8-C10,C12,C14,C16,C24-C30} Neurosurgical intervention was defined differently by the different authors, but included all craniotomies and occasionally intracranial pressure (ICP) monitors.

Following seemingly minor head injuries and mTBI, ICI resulting in the above stated clinically important outcomes is rare.^{C1-C3,C8-C10,C12,C16,C24-C31} Clinical evaluation of the child with possible mTBI includes balancing the likelihood of potentially devastating complications of a more severe injury against the risks associated with head CT (as well as possible concomitant sedation for imaging).

1. Healthcare providers *should not* routinely obtain head CT for diagnostic purposes in children with mTBI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-----------------------|---------------------|------------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate ¹⁰ | High | |
| Benefit relative to Harm | Harm ≥ Benefit 0 | Benefit > Harm 2 | Benefit >> Harm 4 | Benefit >>> Harm 11 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 8 | Critically Important 9 | Yes |
| Variation in preferences | Large 1 | Moderate 1 | Modest 12 | Minimal 3 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 3 | Always 14 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 1 | Moderate 2 | Small 14 | Yes |
| Strength of recommendation | R/U | C | B | A | |

2. Healthcare providers *should* use validated clinical decision rules to identify children at low risk for intracranial injury, in whom head CT is not indicated, as well as children who may be at higher risk for clinically important ICI, and therefore may warrant head CT. Existing decision rules combine a variety of risk factors, including the following:

- Age < 2 years old
- Vomiting
- Loss of consciousness
- Severe mechanism of injury
- Severe or worsening headache
- Amnesia
- Nonfrontal scalp hematoma
- Glasgow Coma Score < 15
- Clinical suspicion for skull fracture (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate 10 | High | |
| Benefit relative to Harm | Harm \geq Benefit 2 | Benefit > Harm 4 | Benefit >> Harm 6 | Benefit >>> Harm 7 | No |
| Importance of outcomes | Not Important or 1 | Mildly 1 | Very 8 | Critically Important 9 | Yes |
| Variation in preferences | Large 1 | Moderate 5 | Modest 6 | Minimal 7 | No |
| Feasible | Rarely 1 | Occasionally 0 | Usually 5 | Always 13 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 3 | Moderate 6 | Small 10 | Yes |
| Strength of recommendation | R/U | C | B | A | |

3. For children diagnosed with mTBI, healthcare providers *should* discuss the risks of pediatric head CT in the context of risk factors for ICI with the patient and his/her family. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|----------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate 10 | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 3 | Benefit >>> Harm 15 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 1 | Very 7 | Critically Important 10 | Yes |
| Variation in preferences | Large 0 | Moderate 0 | Modest 5 | Minimal 13 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 6 | Always 12 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 3 | Small 15 | Yes |
| Strength of recommendation | R/U | C | B | A | |

- **Brain Magnetic Resonance Imaging (MRI)**

Rationale: This review did not find any studies that met inclusion criteria addressing the use of brain MRI in the diagnosis of mTBI in children. MRI is more sensitive in identifying structural abnormalities than CT,^{C32,C33} and MRI avoids the use of ionizing radiation associated with CT. However, MRI more often requires sedation due to longer imaging acquisition times, and is more expensive than CT, though recently rapid, non-sedated MRI has been successfully employed in children with suspected acute TBI.^{C34} While current standard of care does not support the use of brain MRI in the diagnosis of pediatric mTBI for these reasons, specialized MRI imaging sequences such as functional MRI (fMRI), diffusion tensor imaging (DTI), Gradient recalled echo imaging (GREI), as well as others, have shown promise in research settings.^{C35} Studies on mixed groups, including children and adults, have found that early brain MRI can stratify outcome in mTBI.^{C36}

4. There is currently insufficient evidence to recommend the use of brain MRI in the diagnosis of mTBI in children. Healthcare providers *should not* routinely use MRI in the acute evaluation of suspected or diagnosed mTBI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 2 | Benefit > Harm 1 | Benefit >> Harm 9 | Benefit >>> Harm 7 | Yes |
| Importance of outcomes | Not Important or 2 | Mildly 1 | Very 11 | Critically Important 5 | Yes |
| Variation in preferences | Large 0 | Moderate 1 | Modest 7 | Minimal 11 | Yes |
| Feasible | Rarely 0 | Occasionally 2 | Usually 7 | Always 10 | Yes |
| Cost relative to net benefit | Very Large 2 | Large 1 | Moderate 4 | Small 12 | Yes |
| Strength of recommendation | R/U | C | B | A | |

- **Single Photon Emission Computed Tomography (SPECT)**

Rationale: SPECT may demonstrate brain hypoperfusion or hypometabolism following mTBI, but the qualitative nature of the images results in significant variability.^{C37-C39} A single Class I pediatric study looked at the presence of medial temporal hypometabolism on SPECT within 3 days of mTBI and reported a significant risk difference (RD: 0.732 [0.487–0.976]) for children with medial temporal hypometabolism having postconcussion syndrome.^{C37} However, confidence in this evidence was low due to significant issues with the generalizability of the data and this study did not use SPECT to diagnose mTBI specifically. SPECT is not commonly used in the clinical setting of TBI in children, may require patient sedation employing additional risks, requires intravenous access in the child with the injection of a radiopharmaceutical, and may be more expensive than head CT alone as it is often employed in conjunction with CT. This review did not find any studies that met our inclusion criteria addressing the use of SPECT in the diagnosis of mTBI in children.

5. Insufficient evidence currently exists to recommend the use of SPECT in the diagnosis of mTBI in children. Healthcare providers should not use SPECT in the acute evaluation of cases of suspected or diagnosed mTBI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 1 | Benefit > Harm 2 | Benefit >> Harm 3 | Benefit >>> Harm 12 | Yes |
| Importance of outcomes | Not Important or 4 | Mildly 3 | Very 8 | Critically Important 3 | No |
| Variation in preferences | Large 1 | Moderate 0 | Modest 0 | Minimal 17 | Yes |
| Feasible | Rarely 0 | Occasionally 5 | Usually 2 | Always 11 | No |
| Cost relative to net benefit | Very Large 1 | Large 1 | Moderate 2 | Small 14 | Yes |
| Strength of recommendation | R/U | C | B | A | |

- **Skull X-ray**

Rationale: This review identified two Class III studies evaluating the use of skull X-rays in children following minor head injury. The evidence identified a possible skull fracture in 7.14% (95% CI, 4.0-10.3%) of patients.^{C2} Because related literature reports that skull X-ray has a 63% sensitivity for diagnosing a single skull fracture in children, X-ray cannot detect intracranial injuries such as hemorrhage, shift from midline, or edema, and because X-ray employs radiation for imaging, it is not the best test to diagnose skull fracture with ICI following mTBI.^{C40} Clinical suspicion for skull fracture is a risk factor for other ICI following mTBI in children.^{C5,C16-C18} Neuroimaging modalities, such as head CT, better detect intracranial injuries, including skull fractures, making it the more appropriate diagnostic imaging choice when imaging is clinically indicated to assess for acute TBI.^{C40} In the instances where CT is not available, validated clinical decision rules are better than skull X-rays when screening patients with increased risk for ICI prior to determining the need for transfer to a facility with neuroimaging capabilities.^{C3, C5,C16,C18,C41}

6. Skull X-rays *should not* be used in the diagnosis of pediatric mTBI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 2 | Benefit >> Harm 3 | Benefit >>> Harm 13 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 2 | Very 9 | Critically Important 7 | Yes |
| Variation in preferences | Large 0 | Moderate 0 | Modest 3 | Minimal 15 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 4 | Always 14 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 4 | Small 14 | Yes |
| Strength of recommendation | R/U | C | B | A | |

7. Skull X-rays *should not* be used in the screening for ICI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 5 | Benefit >>> Harm 13 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 1 | Very 8 | Critically Important 9 | Yes |
| Variation in preferences | Large 0 | Moderate 0 | Modest 3 | Minimal 15 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 3 | Always 15 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 1 | Moderate 3 | Small 14 | Yes |
| Strength of recommendation | R/U | C | B | A | |

B. Neuropsychological Tools:

- **Symptom Scales**

Rationale:

This review demonstrated with moderate confidence that the Graded Symptom Checklist (GSC) is useful in distinguishing children ages 6 years and older with mTBI from those without TBI within the first 2 days after injury.^{C42} This review demonstrated with moderate confidence that the Postconcussion Symptom Scale used in the ImPACT neurocognitive testing battery distinguishes high school athletes with mTBI from those without TBI within the first 4 days after injury.^{C43,C44} There are several other validated symptom scales that are reliable in the diagnosis of mTBI and have demonstrated validity at ages younger than high school.^{C45} The consequences of missing a diagnosis of mTBI include failure to recommend appropriate treatment and management that may contribute to prolongation of symptoms and increased risk of re-injury. Symptom inventories can be applied quickly and inexpensively.

8. Healthcare providers *should* use an age-appropriate, validated symptom rating scale as a component of the diagnostic evaluation in children presenting with acute mTBI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-----------------------|---------------------|----------------------|----------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm ≥ Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 1 | Benefit >>> Harm 17 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 7 | Critically Important 11 | Yes |
| Variation in preferences | Large 0 | Moderate 3 | Modest 4 | Minimal 11 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 3 | Always 15 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 1 | Moderate 3 | Small 14 | Yes |
| Strength of recommendation | R/U | C | B | A | |

- **Computerized Cognitive Testing**

Rationale: This review identified two Class II studies meeting inclusion criteria evaluating computerized cognitive testing and the diagnosis of mTBI in children.^{C43,C44} These studies only evaluated ImPACT cognitive testing and demonstrated that ImPACT cognitive testing probably distinguishes high school athletes with and without mTBI in the first 4 days post-injury and may add sensitivity to use of a symptom rating scale alone.^{C43,C44} While these two studies only reviewed ImPACT testing, related evidence demonstrates that other validated computerized cognitive tests are also accurate in the diagnosis of mTBI in adults and children.^{C46,C47} There is insufficient evidence to determine whether baseline testing in children better identifies mTBI post-injury as compared to post-injury scores alone, though evidence in adults currently suggests that baseline testing may be unnecessary in most cases.^{C48,C49} The consequences of missing a diagnosis of mTBI include failure to recommend appropriate treatment and management that may contribute to prolongation of symptoms and increased risk of re-injury.

9. Healthcare providers *may* use validated, age-appropriate computerized cognitive testing in the acute period of injury as a component of the diagnosis of mTBI. (Level C)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|-------------------------|----------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 1 | Benefit > Harm 2 | Benefit \gg Harm 9 | Benefit $\gg\gg$ Harm 6 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 3 | Very 12 | Critically Important 3 | Yes |
| Variation in preferences | Large 0 | Moderate 5 | Modest 7 | Minimal 6 | No |
| Feasible | Rarely 0 | Occasionally 12 | Usually 6 | Always 0 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 7 | Moderate 8 | Small 3 | Yes |
| Strength of recommendation | R/U | C | B | A | |

- **Standardized Assessment of Concussion**

Rationale: This review demonstrated that cognitive screening using the Standardized Assessment of Concussion (SAC) was not accurate in distinguishing those children with mTBI from those without mTBI due to lack of statistical significance from a single Class III study.^{C42} Mixed literature in high school and collegiate athletes suggests that the SAC may detect effects of acute mTBI; however, these data were unable to be applied specifically to children in general or children specifically outside of the sports setting.^{C50} The consequences of missing a diagnosis of mTBI include failure to recommend appropriate treatment and management and may contribute to prolongation of symptoms and increased risk of re-injury.

10. There is insufficient evidence to support the use of the SAC in the diagnosis of children with mTBI, and this test *should not* be exclusively used to identify mTBI in children 6-18 years of age. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate 10 | High | |
| Benefit relative to Harm | Harm \geq Benefit 1 | Benefit > Harm 1 | Benefit >> Harm 5 | Benefit >>> Harm 10 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 1 | Very 14 | Critically Important 2 | Yes |
| Variation in preferences | Large 0 | Moderate 0 | Modest 4 | Minimal 13 | Yes |
| Feasible | Rarely 0 | Occasionally 3 | Usually 3 | Always 11 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 3 | Small 14 | Yes |
| Strength of recommendation | R/U | C | B | A | |

C. Serum Markers

Rationale: Blood serum markers that may aid in the diagnosis of pediatric mTBI would be beneficial due to their low-risk profile. In two Class II studies, S100B was shown to be associated with a low sensitivity but high specificity in severe TBI patients, with no discrimination in mild to moderate TBI.^{C51.C52} Low sensitivity limits the usefulness of biomarkers, including S100B, for identifying or categorizing mTBI in children. In a Class II study, Tau was significantly different between pediatric mTBI patients with normal head CT, abnormal CT, and with non-TBI control subjects.^{C53} The effect size was small, and the control group was poorly defined, thus limiting the application of the findings. Serum potassium, sodium, glucose, and white blood cell count were examined in a single Class II study.^{C54} There were significant differences between these tests in children with mTBI versus the control groups.^{C54} Because the effect sizes were small and the groups were ill-defined, conclusions from this study are limited. A single Class II study explored the use of autoantibodies against glutamate receptors and oxide metabolites as a marker to discriminate between severe and mild pediatric TBI.^{C55} There was good discrimination between the two groups, but there was no uninjured control group, and further data will be needed before the test's value in pediatric mTBI can be determined. A single Class III study examined multiplex bead array biomarkers in a small number of infants with TBI compared to controls and found significant differences in a number of biomarkers.^{C56} The size of the study and the specialized population limit the applicability of the results. Related studies have demonstrated associations between neuronal ubiquitin C-terminal hydrolase-L1 and glial fibrillary acidic protein biomarker levels and ICI in adults following mild to moderate TBI.^{C57-C60} This review evaluated a single Class II study of 23 children and determined that there is insufficient evidence to determine whether ubiquitin C-terminal hydrolase-L1 and glial fibrillary acidic protein biomarker levels are useful tools in distinguishing children with or without mTBI.^{C61} Biomarker studies are not generally obtained in the clinical setting of mTBI and are costly. The time to report serum biomarker results represents a limitation in their clinical use in the acute setting. The risk of utilizing unvalidated biomarkers to clinically diagnose pediatric mTBI is false identification or under-identification of the injury.

11. There is insufficient evidence to currently recommend any of the studied biomarkers for the diagnosis of mTBI in children. Healthcare providers *should not* perform these tests outside of a research setting at this time for the diagnosis of children with mTBI. (Level R)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 1 | Benefit > Harm 0 | Benefit >> Harm 7 | Benefit >>> Harm 9 | Yes |
| Importance of outcomes | Not Important or 2 | Mildly 2 | Very 9 | Critically Important 4 | No |
| Variation in preferences | Large 0 | Moderate 1 | Modest 1 | Minimal 15 | Yes |
| Feasible | Rarely 1 | Occasionally 5 | Usually 0 | Always 11 | No |
| Cost relative to net benefit | Very Large 0 | Large 1 | Moderate 2 | Small 14 | Yes |
| Strength of recommendation | R/U | C | B | A | |

Prognosis of mTBI in Children

A. General HealthCare Provider Counseling of Prognosis

Rationale: Recovery from pediatric mTBI is variable,^{C62-C64} and no factors can individually predict recovery of symptoms or outcome.^{C65} Therefore, much of the variance in outcomes remains unaccounted for, even when multiple factors are considered. Evidence also suggests that the symptoms experienced by the majority of children with mTBI resolve within 1-3 months post injury.^{C62} A single Class III study reported that providing informational booklets to families that counseled on symptoms and coping strategies for children with mTBI resulted in improved patient outcomes at 3 months.^{C66} Although some effect sizes were statistically significant, there is insufficient evidence to determine the clinical significance of this specific intervention. However, related studies in children and adults with mTBI report direct patient benefits of counseling by healthcare providers.^{C67,C68} Public health campaigns have emphasized the importance of parent and family education in mTBI because health outcomes in general are optimized through patient health literacy and the resulting behavior modifications.^{C69-C71} Important aspects of healthcare provider counseling include education regarding warning signs of more serious injury (Centers of Disease Control and Prevention [CDC] Heads Up “12 Danger Signs”); review of expected symptoms, monitoring of postconcussive symptoms, prevention of further injury, cognitive and physical activity/rest, instructions regarding return to play/recreation and school (www.cdc.gov/HEADSUP), and clear clinician follow-up instructions.

12. Healthcare providers *should* counsel patients and families that the large majority (70-80%) of children with mTBI do not show significant difficulties that last more than 1-3 months post injury. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 5 | Benefit >>> Harm 11 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 11 | Critically Important 5 | Yes |
| Variation in preferences | Large 0 | Moderate 0 | Modest 2 | Minimal 14 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 2 | Always 14 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 1 | Moderate 1 | Small 14 | Yes |
| Strength of recommendation | R/U | C | B | A | |

13. Healthcare providers *should* counsel patients and families that although some factors predict an increased or decreased risk for prolonged symptoms, each child’s recovery from mTBI is unique and will follow its own trajectory. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-------------------------------|-----------------------------|------------------------------|-----------------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate ₁₀ | High | |
| Benefit relative to Harm | Harm ≥ Benefit ₀ | Benefit > Harm ₀ | Benefit >> Harm ₂ | Benefit >>> Harm ₁₄ | Yes |
| Importance of outcomes | Not Important or ₀ | Mildly ₁ | Very ₁₀ | Critically Important ₅ | Yes |
| Variation in preferences | Large ₀ | Moderate ₀ | Modest ₁ | Minimal ₁₅ | Yes |
| Feasible | Rarely ₀ | Occasionally ₁ | Usually ₄ | Always ₁₁ | Yes |
| Cost relative to net benefit | Very Large ₀ | Large ₀ | Moderate ₃ | Small ₁₃ | Yes |
| Strength of recommendation | R/U | C | B | A | |

B. Prognosis Related to Premorbid Conditions

Rationale: Weak to strong evidence indicates that there is an increased risk of delayed recovery or prolonged symptoms associated with the following premorbid conditions in children with mTBI: premorbid history of concussion,^{C72,C73} lower cognitive ability in pediatric mTBI with intracranial lesion,^{C74} neurological or psychiatric disorder,^{C75,C76} learning difficulties,^{C63} increased preinjury symptoms,^{C75-C77} and family and social stressors.^{C77,C78} The assessment of premorbid history is likely to be most accurate when completed prior to injury (eg, as part of pre-participation athletic examinations) or as soon as possible post injury to avoid biases or inaccuracies in recall.^{C79} Healthcare providers can more effectively counsel patients with mTBI when they have assessed the risks of premorbid conditions for prognosis.

14. Healthcare providers *should* assess the premorbid history of children either prior to injury as a part of pre-participation athletic examinations, or as soon as possible post injury in children with mTBI, to assist in determining prognosis. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-------------------------------|-----------------------------|------------------------------|-----------------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate ¹⁰ | High | |
| Benefit relative to Harm | Harm ≥ Benefit ₀ | Benefit > Harm ₀ | Benefit >> Harm ₃ | Benefit >>> Harm ₁₃ | Yes |
| Importance of outcomes | Not Important or ₀ | Mildly ₀ | Very ₁₁ | Critically Important ₅ | Yes |
| Variation in preferences | Large ₀ | Moderate ₁ | Modest ₄ | Minimal ₁₁ | Yes |
| Feasible | Rarely ₀ | Occasionally ₀ | Usually ₅ | Always ₁₁ | Yes |
| Cost relative to net benefit | Very Large ₀ | Large ₂ | Moderate ₂ | Small ₁₂ | Yes |
| Strength of recommendation | R/U | C | B | A | |

15. Healthcare providers *should* counsel children and families completing pre-participation athletic examinations and children with mTBI as well as their families that recovery from mTBI might be delayed in those with: (Level B)

- Premorbid histories of mTBI
- Lower cognitive ability (for children with an intracranial lesion)
- Neurological or psychiatric disorder
- Learning difficulties
- Increased pre-injury symptoms (i.e., similar to those commonly referred to as “postconcussive”)
- Family and social stressors

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|-------------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 1 | Benefit > Harm 0 | Benefit \gg Harm 5 | Benefit \ggg Harm 9 | Yes |
| Importance of outcomes | Not Important or 1 | Mildly 0 | Very 10 | Critically Important 4 | Yes |
| Variation in preferences | Large 0 | Moderate 2 | Modest 2 | Minimal 11 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 5 | Always 10 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 3 | Moderate 1 | Small 11 | Yes |
| Strength of recommendation | R/U | C | B | A | |

C. Assessment of Cumulative Risk Factors and Prognosis

Rationale:

The outcomes of pediatric mTBI are known to be heterogeneous.^{C62-C64} Weak to strong evidence indicates that a variety of demographic and injury-related factors predict outcomes in pediatric mTBI, including age, gender, ethnicity, severity of injury, presence of ICI, and acute postconcussive symptoms. More specifically, symptoms may last longer for older children/adolescents,^{C62,C80,C81} for children of Hispanic ethnicity as compared with White ethnicity,^{C81} for children from lower socioeconomic status,^{C78,C81} for children with more severe presentations of mTBI^{C64,C82,C83} (including those associated with intracranial injury),^{C82,C84} and for children who report higher level of acute postconcussion symptoms.^{C63,C73,C85} Additionally, headaches persist longer in girls.^{C80} However, no single factor is strongly predictive of outcome.^{C65}

A 2016 prospective multicenter cohort study of 3,063 children with mTBI seen in emergency department (ED) settings demonstrated that an empirically derived and cross-validated prediction rule combining multiple risk factors stratified the risk of persistent postconcussion symptoms at 28 days.^{C86} Healthcare providers can more effectively counsel patients with mTBI when they have assessed cumulative risk factors for prognosis.

16. Healthcare providers *should* screen for known risk factors for persistent symptoms in children with mTBI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 1 | Benefit > Harm 0 | Benefit >> Harm 6 | Benefit >>> Harm 9 | Yes |
| Importance of outcomes | Not Important or 1 | Mildly 2 | Very 11 | Critically Important 2 | Yes |
| Variation in preferences | Large 1 | Moderate 1 | Modest 4 | Minimal 10 | Yes |
| Feasible | Rarely 1 | Occasionally 1 | Usually 8 | Always 6 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 6 | Small 10 | Yes |
| Strength of recommendation | R/U | C | B | A | |

17. Healthcare providers *may* use validated prediction rules, which combine information about multiple risk factors for persistent symptoms, to provide prognostic counseling to children with mTBI evaluated in ED settings. (Level C)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | No |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | No |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low 10 | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 1 | Benefit > Harm 1 | Benefit >> Harm 7 | Benefit >>> Harm 7 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 15 | Critically Important 1 | Yes |
| Variation in preferences | Large 0 | Moderate 1 | Modest 4 | Minimal 11 | Yes |
| Feasible | Rarely 1 | Occasionally 2 | Usually 7 | Always 6 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 7 | Small 9 | Yes |
| Strength of recommendation | R/U | C | B | A | |

D. Assessment Tools and Prognosis

Rationale: No single assessment tool is strongly predictive of outcome in children with mTBI.^{C65} However, multiple tools have shown utility in the assessment of individual patients and their recovery from mTBI.^{C87-C89} Multiple tools are likely to be necessary because recovery trajectories can differ across specific domains of assessment, including symptom report, cognitive test performance, and balance.^{C90,C91} Symptom scales and cognitive testing (including measures of reaction time) have the strongest evidence in terms of their contribution to diagnosis (see Diagnosis Recommendations, as well as predicting and assessing recovery^{C92}). There is less evidence supporting balance testing as a predictor for prognosis in children, but it has shown utility in older adolescent athletes.^{C93} Healthcare providers can more effectively counsel patients with mTBI when they have assessed risk factors for outcome and recovery.

18. Healthcare providers *should* use a combination of tools to assess recovery in children with mTBI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-------------------------------|-----------------------------|------------------------------|-----------------------------------|-----------|
| | < 50% | 50% to < 80% | 80% to < 100% | 100% | |
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate ₁₀ | High | |
| Benefit relative to Harm | Harm ≥ Benefit ₀ | Benefit > Harm ₀ | Benefit >> Harm ₅ | Benefit >>> Harm ₁₁ | Yes |
| Importance of outcomes | Not Important or ₀ | Mildly ₁ | Very ₁₂ | Critically Important ₃ | Yes |
| Variation in preferences | Large ₁ | Moderate ₀ | Modest ₄ | Minimal ₁₁ | Yes |
| Feasible | Rarely ₀ | Occasionally ₄ | Usually ₉ | Always ₃ | Yes |
| Cost relative to net benefit | Very Large ₀ | Large ₁ | Moderate ₁₀ | Small ₅ | Yes |
| Strength of recommendation | R/U | C | B | A | |

19. Healthcare providers *should* use validated symptom scales to assess recovery in children with mTBI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-----------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm ≥ Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 4 | Benefit >>> Harm 13 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 12 | Critically Important 5 | Yes |
| Variation in preferences | Large 0 | Moderate 0 | Modest 3 | Minimal 14 | Yes |
| Feasible | Rarely 0 | Occasionally 1 | Usually 10 | Always 6 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 8 | Small 9 | Yes |
| Strength of recommendation | R/U | C | B | A | |

20. Healthcare providers *may* use validated cognitive testing (including measures of reaction time) to assess recovery in children with mTBI. (Level C)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 1 | Benefit >> Harm 7 | Benefit >>> Harm 8 | Yes |
| Importance of outcomes | Not Important or 1 | Mildly 2 | Very 12 | Critically Important 1 | Yes |
| Variation in preferences | Large 1 | Moderate 2 | Modest 6 | Minimal 7 | Yes |
| Feasible | Rarely 0 | Occasionally 8 | Usually 8 | Always 0 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 4 | Moderate 11 | Small 1 | Yes |
| Strength of recommendation | R/U | C | B | A | |

21. Healthcare providers *may* use balance testing to assess recovery in adolescent athletes with mTBI. (Level C)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-------------------------------|-----------------------------|------------------------------|-----------------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate ₁₀ | High | |
| Benefit relative to Harm | Harm ≥ Benefit ₁ | Benefit > Harm ₃ | Benefit >> Harm ₆ | Benefit >>> Harm ₆ | No |
| Importance of outcomes | Not Important or ₂ | Mildly ₂ | Very ₁₁ | Critically Important ₁ | Yes |
| Variation in preferences | Large ₁ | Moderate ₁ | Modest ₇ | Minimal ₇ | Yes |
| Feasible | Rarely ₀ | Occasionally ₈ | Usually ₅ | Always ₃ | Yes |
| Cost relative to net benefit | Very Large ₁ | Large ₃ | Moderate ₉ | Small ₃ | No |
| Strength of recommendation | R/U | C | B | A | |

E. Interventions for mTBI With Poor Prognosis

Rationale: The symptoms experienced by the majority of children with mTBI resolve within 1-3 months post injury,^{C62} but some children are at risk for persistent symptoms and delayed recovery (ie, those who demonstrate certain premorbid characteristics and other risk factors; see rationales for recommendation items 5: Prognosis Related to Premorbid Conditions and 6: Assessment of Cumulative Risk Factors and Prognosis. Children with mTBI who are at high risk for persistent symptoms or delayed recovery are more likely to require intervention than children at low risk. Healthcare providers can more effectively counsel patients with mTBI when they have assessed risks for prognosis.

22. Healthcare providers should monitor children with mTBI who are determined to be at high risk for persistent symptoms based on premorbid history, demographics, and/or injury characteristics.

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | No |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 3 | Benefit >>> Harm 13 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 1 | Very 9 | Critically Important 6 | Yes |
| Variation in preferences | Large 0 | Moderate 2 | Modest 7 | Minimal 7 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 10 | Always 6 | Yes |
| Cost relative to net benefit | Very Large 1 | Large 1 | Moderate 3 | Small 11 | Yes |
| Strength of recommendation | R/U | C | B | A | |

23. For children with mTBI whose symptoms do not resolve as expected with standard care (i.e., within 4-6 weeks), healthcare providers *should* provide or refer for appropriate assessments and/or interventions (see Recommendations for Treatment and Management). (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate 10 | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 4 | Benefit >>> Harm 12 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 1 | Very 9 | Critically Important 6 | Yes |
| Variation in preferences | Large 0 | Moderate 2 | Modest 9 | Minimal 5 | Yes |
| Feasible | Rarely 0 | Occasionally 5 | Usually 10 | Always 1 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 2 | Moderate 11 | Small 3 | Yes |
| Strength of recommendation | R/U | C | B | A | |

Treatment and Management of mTBI in Children

A. Patient/Family Education and Reassurance

Rationale: There is no definitive evidence to support specific methods of patient and family education and reassurance following pediatric mTBI that are associated with clear improvements in patient health outcomes. Regardless, public health campaigns have emphasized the importance of parent and family education in mTBI because health outcomes in general are optimized through patient health literacy and the resulting behavior modifications.^{C69-C71}

Patient and family education and reassurance are key components of mTBI care initiatives and ED discharge instructions.^{C66-C68,C94} Standardized processes of evaluation and discharge instruction provide significant benefit to pediatric mTBI patient outcomes.^{C67} Important aspects of healthcare provider counseling include education regarding warning signs of more serious injury (CDC Heads Up “12 Danger Signs”), review of expected symptoms, monitoring of postconcussive symptoms, prevention of further injury, cognitive and physical activity/rest, instructions regarding return to play/recreation and school (www.cdc.gov/HEADSUP), and clear clinician follow-up instructions.

24. In providing education and reassurance to the family, the healthcare provider should include the following information:

- a. Warning signs of more serious injury
- b. Description of injury and expected course of symptoms and recovery
- c. Instructions on how to monitor postconcussive symptoms
- d. Prevention of further injury
- e. Management of cognitive and physical activity/rest
- f. Instructions regarding return to play/recreation and school
- g. Clear clinician follow-up instructions

(Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|----------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 1 | Benefit >> Harm 3 | Benefit >>> Harm 15 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 7 | Critically Important 12 | Yes |
| Variation in preferences | Large 0 | Moderate 0 | Modest 4 | Minimal 15 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 8 | Always 11 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 6 | Small 13 | Yes |
| Strength of recommendation | R/U | C | B | A | |

B. Cognitive/Physical Rest and Aerobic Activity

Rationale:

Historically, “rest” has been a foundation in the treatment of acute mTBI.^{C95,C96} However, scientific evidence supporting its timing, duration, and efficacy is limited.^{C97} A clear definition of rest is not provided in the literature and interpretations range from full bedrest to a reduced level of activity.^{C97} Related evidence suggests that rest or reduction in cognitive/physical activity is beneficial immediately following mTBI and, for those who are slow to recover, may help accelerate recovery.^{C98-C100} The rationale for rest is based on the attempted reduction of neurometabolic demand in the context of post-injury symptoms.^{C101} Exertional, early post-injury activity increases the metabolic demand of impaired neural cells, and may result in increased symptom manifestation.^{C101} Animal literature suggests that too much physical activity early post-injury may be counterproductive to recovery, but that later physical activity may accelerate recovery.^{C102} The post-injury period is a posited temporal window of vulnerability for re-injury,^{C103,C104} because the re-injury threshold is lower during recovery and the symptom burden may be greater.^{C105,C107,C126} Re-injury during this window of vulnerability has been associated with catastrophic injury in rare pediatric cases via unclear mechanisms.^{C108-C110} Studies in children and adults with prolonged symptoms beyond 4 weeks demonstrate that physical exercise managed below symptom exacerbation reduced postconcussive symptoms in active rehabilitation models.^{C111-C114} Animal studies demonstrate that physical exercise facilitates key neurobiological factors (eg, increased brain derived neurotrophic factor, positive changes in neurotransmitters), which may support recovery from brain injury.^{C102} However, these studies found that physical activity that was initiated early post injury had worse outcomes and may compromise the positive effects of exercise.^{C102} Related evidence demonstrates the deleterious effects of significant inactivity as well as significant health benefits of a regular program of exercise in other medical conditions in humans.^{C97,C115-C119}

The optimal timing to initiate an aerobic program following pediatric mTBI has not been established and only limited studies have applied this treatment to patients with symptoms persisting past 4 weeks.^{C111-C113} No evidence exists to provide guidance on the exact timing of activity onset, dosing (how much), and the progression of activity post injury for a given symptom profile.^{C97} Related evidence suggests that early rest within the first 3 days of the injury may be beneficial,^{C95,C120} but that inactivity beyond this time period for most children may worsen their symptom report.^{C121} As a result, the gradual resumption of noncontact activity that does not exacerbate symptoms has replaced the prescription of full rest until asymptomatic.

25. Healthcare providers *should* counsel patients to observe more restrictive physical and cognitive activity during the first several days following mTBI in children.

| Domain | Rating | | | | Consensus |
|--------------------------------------|-------------------------------|-----------------------------|------------------------------|-----------------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate ₁₀ | High | |
| Benefit relative to Harm | Harm ≥ Benefit ₁ | Benefit > Harm ₂ | Benefit >> Harm ₃ | Benefit >>> Harm ₁₂ | Yes |
| Importance of outcomes | Not Important or ₀ | Mildly ₀ | Very ₁₀ | Critically Important ₈ | Yes |
| Variation in preferences | Large ₀ | Moderate ₂ | Modest ₁₀ | Minimal ₆ | Yes |
| Feasible | Rarely ₁ | Occasionally ₀ | Usually ₅ | Always ₁₂ | Yes |
| Cost relative to net benefit | Very Large ₀ | Large ₀ | Moderate ₆ | Small ₁₂ | Yes |
| Strength of recommendation | R/U | C | B | A | |

26. Following these first several days, healthcare providers *should* counsel patients and families to resume a gradual schedule of activity that does not exacerbate symptoms, with close monitoring of symptom expression (number, severity). (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 1 | Benefit > Harm 1 | Benefit >> Harm 5 | Benefit >>> Harm 11 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 16 | Critically Important 2 | Yes |
| Variation in preferences | Large 0 | Moderate 1 | Modest 10 | Minimal 7 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 5 | Always 13 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 7 | Small 11 | Yes |
| Strength of recommendation | R/U | C | B | A | |

27. Following the successful resumption of a gradual schedule of activity (see 26), healthcare providers *should* offer an active rehabilitation program of progressive reintroduction of noncontact aerobic activity that does not exacerbate symptoms, with close monitoring of symptom expression (number, severity). (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High 10 | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 3 | Benefit >>> Harm 13 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 11 | Critically Important 5 | Yes |
| Variation in preferences | Large 0 | Moderate 1 | Modest 9 | Minimal 6 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 11 | Always 5 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 7 | Small 9 | Yes |
| Strength of recommendation | R/U | C | B | A | |

28. Healthcare providers *should* counsel patients to return to full activity when they return to premorbid performance if they have remained symptom free at rest and with increasing levels of physical exertion (see 25-27). (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 5 | Benefit >>> Harm 11 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 10 | Critically Important 6 | Yes |
| Variation in preferences | Large 0 | Moderate 0 | Modest 4 | Minimal 12 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 7 | Always 9 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 3 | Moderate 5 | Small 8 | Yes |
| Strength of recommendation | R/U | C | B | A | |

C. Psychosocial/Emotional Support

Rationale:

Social support exerts a powerful influence on a variety of health issues, including chronic diseases.^{C122,C123} Social support is positively associated with healthy behaviors and adherence, improved overall quality of life, and reduced deleterious effects of stress on health.^{C122-C124} Conversely, lack of social support (perceived or actual) increases morbidity and a greater likelihood of hospital admissions or re-hospitalizations.^{C124} Social isolation has been identified as an independent risk factor for all-cause mortality.^{C125} It is reasonable to assume that the role of social support in any human interaction is beneficial.

Social support takes many forms, including emotional, with the provision of empathy, love, trust, and caring; instrumental, involving the provision of tangible aid/services directly assisting persons in need; informational, with its provision of suggestions, advice, or information used to address problems; and appraisal, which provides information useful for self-evaluation such as constructive feedback and positive affirmations. Social support has proven useful in the recovery of persons with TBI, particularly those with cognitive deficits.^{C126,C127} Limited research with those who have suffered an mTBI demonstrates similar benefits.^{C128,C129} Direct, ancillary, and extrapolated evidence is strongly suggestive of the utility of social support in the management of mTBI.

29. Healthcare providers *may* assess the extent and types of social support (ie, emotional, informational, instrumental, appraisal) in children with mTBI and emphasize social support as a key element in the education of caregivers and educators. (Level C)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 9 | Benefit >>> Harm 9 | Yes |
| Importance of outcomes | Not Important or 1 | Mildly 6 | Very 9 | Critically Important 2 | Yes |
| Variation in preferences | Large 1 | Moderate 2 | Modest 8 | Minimal 7 | Yes |
| Feasible | Rarely 0 | Occasionally 3 | Usually 8 | Always 7 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 11 | Small 7 | Yes |
| Strength of recommendation | R/U | C | B | A | |

D. Return to School

Rationale:

Return to school following mTBI must be carefully planned given the adverse effects (eg, headaches and fatigue interfering with learning, greater problems concentrating on schoolwork, difficulty taking notes) that can affect learning and performance.^{C130,C131}

Limited evidence exists to guide the timing or progression of return to activity in relation to academic activities.^{C121} A subset of children with mTBI is at higher risk for more severe or prolonged postconcussive symptoms (see Prognosis Recommendations), which may interfere substantially with resumption of academic activities.^{C62,C65,C73,C78,C80-C85,C132}

Consensus-based recommendations for returning to school after mTBI attempt to minimize cognitive and physical overexertion.^{C96}

Return to school protocols affirm the need for continued collaboration among medical, school, and family systems to gradually adjust interventions and return the child to full participation without significant worsening of symptoms.^{C96,C130,C133-C136} The protocols target the student's symptoms as the focus of intervention, linking specific accommodations in efforts to limit symptom expression.

Because postconcussive symptoms resolve at different rates in different children after mTBI, individualization of return to school programming is necessary.

To protect their legal right for an appropriate education, children with mTBI who have greater symptom burden and prolonged recoveries may require formal educational planning incorporating protections under federal statutes.^{C137,C138} These protections are provided to qualifying students under Section 504 of the Rehabilitation Act and the Traumatic Brain Injury guidelines under the Individuals with Disabilities Education Act.^{C137}

30. To assist children returning to school following mTBI, medical and school-based teams *should* counsel the student and family regarding the process of gradually increasing the duration and intensity of academic activities as tolerated, with the goal of increasing participation without significantly exacerbating symptoms. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-------------------------------|-----------------------------|------------------------------|------------------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate ₁₀ | High | |
| Benefit relative to Harm | Harm ≥ Benefit ₁ | Benefit > Harm ₁ | Benefit >> Harm ₁ | Benefit >>> Harm ₁₃ | Yes |
| Importance of outcomes | Not Important or ₀ | Mildly ₀ | Very ₆ | Critically Important ₁₀ | Yes |
| Variation in preferences | Large ₀ | Moderate ₁ | Modest ₅ | Minimal ₁₀ | Yes |
| Feasible | Rarely ₀ | Occasionally ₀ | Usually ₇ | Always ₉ | Yes |
| Cost relative to net benefit | Very Large ₀ | Large ₃ | Moderate ₄ | Small ₉ | Yes |
| Strength of recommendation | R/U | C | B | A | |

31. Return to school protocols *should* be customized based on the severity of postconcussion symptoms in children with mTBI as determined jointly by medical and school-based teams. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|----------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 3 | Benefit >>> Harm 12 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 4 | Critically Important 11 | Yes |
| Variation in preferences | Large 0 | Moderate 2 | Modest 6 | Minimal 7 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 7 | Always 8 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 2 | Moderate 4 | Small 9 | Yes |
| Strength of recommendation | R/U | C | B | A | |

32. For any student with prolonged symptoms that interfere with academic performance, school-based teams *should* assess the educational needs of that student and determine the student’s need for additional educational supports, including those described under pertinent federal statutes (e.g., Section 504, IDEA).^{C137} (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 6 | Benefit >>> Harm 10 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 11 | Critically Important 5 | Yes |
| Variation in preferences | Large 0 | Moderate 4 | Modest 7 | Minimal 5 | No |
| Feasible | Rarely 0 | Occasionally 2 | Usually 13 | Always 1 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 16 | Small 0 | Yes |
| Strength of recommendation | R/U | C | B | A | |

33. Postconcussion symptoms and academic progress in school *should* be monitored collaboratively by the student, family, healthcare provider, and school teams, who jointly determine what modifications or accommodations are needed to maintain an academic workload without significantly exacerbating symptoms. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 7 | Benefit >>> Harm 11 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 11 | Critically Important 7 | Yes |
| Variation in preferences | Large 1 | Moderate 3 | Modest 8 | Minimal 6 | No |
| Feasible | Rarely 0 | Occasionally 4 | Usually 11 | Always 3 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 17 | Small 1 | Yes |
| Strength of recommendation | R/U | C | B | A | |

34. The provision of educational supports *should* be monitored and adjusted on an ongoing basis by the school-based team until the student's academic performance has returned to preinjury levels. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 3 | Benefit >>> Harm 7 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 6 | Critically Important 4 | Yes |
| Variation in preferences | Large 0 | Moderate 2 | Modest 5 | Minimal 3 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 9 | Always 1 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 2 | Moderate 5 | Small 3 | Yes |
| Strength of recommendation | R/U | C | B | A | |

35. For students who demonstrate prolonged symptoms and academic difficulties despite an active treatment approach, healthcare providers *should* refer the child for a formal evaluation by a specialist in pediatric mTBI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-----------------------|---------------------|------------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate ₁₀ | High | |
| Benefit relative to Harm | Harm ≥ Benefit 0 | Benefit > Harm 1 | Benefit >> Harm 4 | Benefit >>> Harm 13 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 1 | Very 8 | Critically Important 9 | Yes |
| Variation in preferences | Large 2 | Moderate 3 | Modest 9 | Minimal 4 | No |
| Feasible | Rarely 0 | Occasionally 7 | Usually 11 | Always 0 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 1 | Moderate 17 | Small 0 | Yes |
| Strength of recommendation | R/U | C | B | A | |

Symptom/problem-specific treatment/management:

A. Post-traumatic Headache Management

Rationale:

Headache is the most common symptom of pediatric mTBI in the acute setting. Children presenting with a headache, including worsening or severe headache, following mTBI are probably at moderate risk for ICI reflected by risk difference of 1.86% (CI 0.12%-3.59%) from three Class I studies and one Class II study.^{C3,C5,C16,C18} This evidence supports that the risk of not identifying more severe forms of TBI presenting with a progressive, severe headache in a child with or without other risk factors outweighs the risk of ionizing radiation.

There is no evidence supporting a relationship between headache severity on postconcussion symptom assessment in the ED and neurocognitive function during the acute period of recovery. Additionally, insufficient data exists to determine a relationship between early postconcussion symptoms, including headache, and later neurocognitive outcomes or behavioral function among children with mTBI.^{C132,C139} There is no evidence to support a relationship between age and headache following mTBI. However, among children presenting to an ED following mTBI, those injured above the age of 6 years are probably at a 5-10% increased risk of remaining symptomatic (including headache) for 12 months or longer as compared to children 6 years of age or younger.^{C62} There was a relationship between gender and headache with girls reporting recurrent and persisting headache after 3 months compared with boys.^{C80,C140}

Painful headache in children requires intervention. Non-narcotic analgesics such as ibuprofen and acetaminophen are often effective in treating headaches in children and opioids are not generally recommended as therapy for headaches.^{C141,C142,C143} While common clinical practice supports use of non-narcotic analgesics and avoidance of exertional activities for the treatment of headache secondary to pediatric mTBI, there is no evidence to support the success of such interventions in the acute setting or their impact on headache recurrence in the subacute or chronic setting.^{C144} Non-narcotic analgesic overuse carries important risks of toxicity and rebound headache.^{C145}

A single Class I study evaluated 3% hypertonic saline as a treatment for headache in children following acute mTBI presenting to an ED.^{C146} In children with mTBI and headache, hypertonic saline possibly decreases pain with headache immediately following the intervention, with a Z score of 1.53 (CI 0.85-2.200), though the study failed to show an effect at 3 days post intervention.^{C146} However, there are limitations in the study's sample size and inability to show sustained effect on pain improvement, as well as lack of related evidence and concerns for risks versus benefits of intravenous medication administration in children that preclude further recommendation at this time.

36. Healthcare providers in the ED *should* clinically observe and consider obtaining a head CT in children presenting with severe and worsening headache following mTBI to evaluate for ICI requiring further management in accordance with validated clinical decision making rules. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|----------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 5 | Benefit >>> Harm 11 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 5 | Critically Important 11 | Yes |
| Variation in preferences | Large 0 | Moderate 0 | Modest 5 | Minimal 11 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 6 | Always 10 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 12 | Small 4 | Yes |
| Strength of recommendation | R/U | C | B | A | |

37. Children undergoing observation periods for headache with acutely worsening symptoms *should* undergo emergent neuroimaging.
(Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|----------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 9 | Benefit >>> Harm 10 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 1 | Very 3 | Critically Important 15 | Yes |
| Variation in preferences | Large 0 | Moderate 1 | Modest 3 | Minimal 15 | Yes |
| Feasible | Rarely 0 | Occasionally 1 | Usually 11 | Always 7 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 16 | Small 3 | Yes |
| Strength of recommendation | R/U | C | B | A | |

38. Healthcare providers and caregivers *should* offer non-narcotic analgesia (i.e., ibuprofen or acetaminophen) to children with painful headache following acute mTBI, but also provide counseling to the family regarding the risks of analgesic overuse, including rebound headache. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-------------------------------|-----------------------------|------------------------------|-----------------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate ¹⁰ | High | |
| Benefit relative to Harm | Harm ≥ Benefit ₀ | Benefit > Harm ₂ | Benefit >> Harm ₅ | Benefit >>> Harm ₉ | Yes |
| Importance of outcomes | Not Important or ₀ | Mildly ₁ | Very ₁₃ | Critically Important ₂ | Yes |
| Variation in preferences | Large ₀ | Moderate ₀ | Modest ₆ | Minimal ₁₀ | Yes |
| Feasible | Rarely ₀ | Occasionally ₀ | Usually ₈ | Always ₈ | Yes |
| Cost relative to net benefit | Very Large ₀ | Large ₀ | Moderate ₈ | Small ₈ | Yes |
| Strength of recommendation | R/U | C | B | A | |

39. There is insufficient evidence to currently recommend the administration of 3% hypertonic saline as a treatment for acute headache following mTBI in children. Healthcare providers should not administer this medication to children with mTBI for treatment of symptoms outside of a research setting at this time. (Level R)

| Domain | Rating | | | | Consensus |
|--------------------------------------|-------------------------------|-----------------------------|------------------------------|-----------------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate ¹⁰ | High | |
| Benefit relative to Harm | Harm ≥ Benefit ₁ | Benefit > Harm ₂ | Benefit >> Harm ₈ | Benefit >>> Harm ₆ | Yes |
| Importance of outcomes | Not Important or ₁ | Mildly ₅ | Very ₉ | Critically Important ₂ | Yes |
| Variation in preferences | Large ₀ | Moderate ₂ | Modest ₁ | Minimal ₁₄ | Yes |
| Feasible | Rarely ₀ | Occasionally ₁ | Usually ₄ | Always ₁₂ | Yes |
| Cost relative to net benefit | Very Large ₀ | Large ₀ | Moderate ₆ | Small ₁₁ | Yes |
| Strength of recommendation | R/U | C | B | A | |

40. Chronic headache following mTBI is likely to be multifactorial, and, therefore, healthcare providers *should* refer children with chronic headache after mTBI for multidisciplinary evaluation and treatment, with consideration of analgesic overuse as a contributory factor. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 6 | Benefit >>> Harm 11 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 16 | Critically Important 1 | Yes |
| Variation in preferences | Large 0 | Moderate 2 | Modest 10 | Minimal 5 | Yes |
| Feasible | Rarely 0 | Occasionally 7 | Usually 8 | Always 2 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 2 | Moderate 14 | Small 1 | Yes |
| Strength of recommendation | R/U | C | B | A | |

B. Vestibulo-ocular Motor Dysfunction

Rationale:

Dizziness is a pervasive and debilitating symptom reported following mTBI in children. A single Class II study reported that vestibular and oculomotor dysfunction may contribute to the diagnosis of mTBI and longer symptom duration.^{C147} Gaining interest as an area for screening, as well as treatment, limited evidence suggests that early vestibular physical therapy may be of benefit for patients presenting with subjective complaints (symptom of dizziness) or objective physical examination findings.^{C148-C151} The optimal time to initiate vestibular physical therapy, the specific order and intensity of exercises, and longitudinal outcomes have yet to be studied.

41. Healthcare providers *may* refer children with subjective or objective evidence of persistent vestibulo-ocular motor dysfunction following mTBI to a program of vestibular rehabilitation. (Level C)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|-----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 1 | Benefit > Harm 0 | Benefit >> Harm 10 | Benefit >>> Harm 6 | Yes |
| Importance of outcomes | Not Important or 2 | Mildly 2 | Very 12 | Critically Important 1 | Yes |
| Variation in preferences | Large 1 | Moderate 4 | Modest 7 | Minimal 5 | No |
| Feasible | Rarely 1 | Occasionally 12 | Usually 4 | Always 0 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 4 | Moderate 13 | Small 0 | Yes |
| Strength of recommendation | R/U | C | B | A | |

C. Sleep

Rationale:

Sleep disturbance is a common problem following TBI, and may lead to ongoing disability.^{C152-C157} Sleep disturbance may impede the recovery process given the critical need for the availability of appropriate energy to support neurobiological recovery and daily functioning, and worsen symptoms. Related evidence in adolescents with mTBI reported poorer sleep quality and demonstrated significantly shorter actigraphic-measured sleep duration, poorer sleep efficiency, and more wake time after onset of sleep, compared with healthy adolescents (all, $p < 0.05$).^{C158} Receiving adequate sleep has been shown to facilitate health,^{C159} and when not appropriate, adversely affects medical conditions, including TBI.^{C154,C160,C161} Practices that promote healthy sleep include (1) age-appropriate and consistent bedtimes and wake times, (2) establishing bedtime routines, (3) maintaining appropriate lighting and sound control in the bedroom, (4) engaging in appropriate daytime exercise and an appropriate diet with limited caffeine consumption, (5) no electronics in the bedroom or before bed, (6) positivity, (7) independence when falling asleep, and (8) meeting the child's emotional needs during the day.^{C162-C164} Related evidence from studies in adults with TBI discuss potential treatments including cognitive behavior therapy supporting lifestyle modifications, pharmacologic treatments with modafinil and melatonin, and light therapy.^{C152,C165,C166} While limited evidence supports a recommendation for sleep hygiene specifically in children with mTBI, related evidence in adults with TBI indicates benefits, suggesting that the maintenance of appropriate sleep and management of disrupted sleep may be a critical target of treatment for the child with mTBI.

42. Healthcare providers *should* provide guidance on proper sleep hygiene methods to facilitate recovery from pediatric mTBI. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 1 | Benefit >>> Harm 16 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 14 | Critically Important 3 | Yes |
| Variation in preferences | Large 0 | Moderate 0 | Modest 7 | Minimal 10 | Yes |
| Feasible | Rarely 0 | Occasionally 0 | Usually 6 | Always 11 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 2 | Small 15 | Yes |
| Strength of recommendation | R/U | C | B | A | |

43. If sleep problems emerge or continue despite appropriate sleep hygiene measures, healthcare providers *may* refer children with mTBI to a sleep disorder specialist for further assessment. (Level C)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 1 | Benefit >> Harm 8 | Benefit >>> Harm 8 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 2 | Very 14 | Critically Important 1 | Yes |
| Variation in preferences | Large 1 | Moderate 4 | Modest 7 | Minimal 5 | No |
| Feasible | Rarely 0 | Occasionally 10 | Usually 7 | Always 0 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 2 | Moderate 15 | Small 0 | Yes |
| Strength of recommendation | R/U | C | B | A | |

D. Cognitive Impairment

Rationale:

Cognitive impairment occurs following mTBI and includes the following areas: attention, memory and learning, response speed, and aspects of executive functions.^{C43,C44,C167,C168} Dysfunctional attention or memory may result in significant problems with learning in school or social interactions.^{C131,C134}**Error! Reference source not found.** Current literature is insufficient to determine whether cognitive impairment is directly related to the pathology of the brain injury (i.e., impaired neurotransmission) or secondary effects of the plethora of other symptoms (e.g., ongoing headache pain, fatigue/low energy, low frustration tolerance), which, as a result of their distracting effects, may produce a disruption in cognitive processing. Understanding the etiology of the cognitive dysfunction is important to direct treatment/management appropriately. For example, primary cognitive impairment suggests the need to apply direct therapeutic interventions to the affected cognitive process (e.g., teaching memory or attentional strategies). In contrast, if the cognitive dysfunction is secondary to another symptom (e.g., headache pain), then the primary therapeutic intervention would be directed toward the reduction of the headaches. Neuropsychological evaluations can assist in determining etiology of cognitive impairment and directing treatment.²

44. Healthcare providers *should* attempt to determine the etiology of cognitive dysfunction, within the context of other mTBI symptoms. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|-------------------------|-----------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate 10 | High | |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 1 | Benefit \gg Harm 4 | Benefit $\gg\gg$ Harm 11 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 1 | Very 10 | Critically Important 5 | Yes |
| Variation in preferences | Large 1 | Moderate 2 | Modest 5 | Minimal 8 | Yes |
| Feasible | Rarely 1 | Occasionally 3 | Usually 9 | Always 3 | No |
| Cost relative to net benefit | Very Large 0 | Large 3 | Moderate 8 | Small 5 | Yes |
| Strength of recommendation | R/U | C | B | A | |

45. Healthcare providers *should* recommend treatment for cognitive dysfunction that reflects its presumed etiology. (Level B)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 0 | Benefit >> Harm 4 | Benefit >>> Harm 13 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 13 | Critically Important 4 | Yes |
| Variation in preferences | Large 0 | Moderate 3 | Modest 11 | Minimal 3 | Yes |
| Feasible | Rarely 0 | Occasionally 4 | Usually 12 | Always 1 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 0 | Moderate 14 | Small 3 | Yes |
| Strength of recommendation | R/U | C | B | A | |

46. Healthcare providers *may* refer children with persisting complaints related to cognitive function for a formal neuropsychological evaluation to assist in determining etiology and recommending targeted treatment. (Level C)

| Domain | Rating | | | | Consensus |
|--------------------------------------|--------------------------|---------------------|----------------------|---------------------------|-----------|
| Rationale is logical | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Evidence statements accurate | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Axioms true | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Related evidence strong & applicable | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Internal inferences logically follow | < 50% | 50% to < 80% | 80% to < 100% | 100% | Yes |
| Confidence in Inference | Very low | Low | Moderate | High | 10 |
| Benefit relative to Harm | Harm \geq Benefit 0 | Benefit > Harm 1 | Benefit >> Harm 6 | Benefit >>> Harm 10 | Yes |
| Importance of outcomes | Not Important or 0 | Mildly 0 | Very 11 | Critically Important 6 | Yes |
| Variation in preferences | Large 0 | Moderate 4 | Modest 10 | Minimal 3 | Yes |
| Feasible | Rarely 0 | Occasionally 7 | Usually 10 | Always 0 | Yes |
| Cost relative to net benefit | Very Large 0 | Large 1 | Moderate 16 | Small 0 | Yes |
| Strength of recommendation | R/U | C | B | A | |

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