

REVIEW ARTICLE

Systematic Review of Prognosis and Return to Play After Sport Concussion: Results of the International Collaboration on Mild Traumatic Brain Injury Prognosis



Carol Cancelliere, DC, MPH,^{a,b} Cesar A. Hincapié, DC, MHSc,^{a,c} Michelle Keightley, PhD,^{d,e} Alison K. Godbolt, MBChB, MD,^f Pierre Côté, DC, PhD,^{b,c,g,h} Vicki L. Kristman, PhD,^{c,i,j} Britt-Marie Stålnacke, MD, PhD,^k Linda J. Carroll, PhD,^l Ryan Hung, MD, MSc,^{m,n} Jörgen Borg, MD, PhD,^f Catharina Nygren-de Boussard, MD, PhD,^f Victor G. Coronado, MD, MPH,^o James Donovan, DC,^a J. David Cassidy, PhD, DrMedSc^{a,b,c,p}

From the ^aDivision of Health Care and Outcomes Research, Toronto Western Research Institute, University Health Network, University of Toronto, Toronto, Ontario, Canada; ^bInstitute of Health Policy, Management and Evaluation, University of Toronto, Toronto, Ontario, Canada; ^cDivision of Epidemiology, Dalla Lana School of Public Health, University of Toronto, Toronto, Ontario, Canada; ^dDepartments of Occupational Science and Occupational Therapy, Psychology and Graduate Department of Rehabilitation Science, University of Toronto, Toronto, Ontario, Canada; ^eBloorview Research Institute, Holland Bloorview Kids Rehabilitation Hospital, Toronto, Ontario, Canada; ^fDepartment of Clinical Sciences, Rehabilitation Medicine, Karolinska Institutet, Danderyd University Hospital, Stockholm, Sweden; ^gFaculty of Health Sciences, University of Ontario Institute of Technology, Oshawa, Ontario, Canada; ^hUOIT-CMCC Centre for the Study of Disability Prevention and Rehabilitation, Toronto, Ontario, Canada; ⁱDepartment of Health Sciences, Lakehead University, Thunder Bay, Ontario, Canada; ^jInstitute for Work and Health, Toronto, Ontario, Canada; ^kDepartment of Community Medicine and Rehabilitation, Rehabilitation Medicine, Umeå University, Umeå, Sweden; ^lSchool of Public Health and Alberta Centre for Injury Control and Research, University of Alberta, Edmonton, Alberta, Canada; ^mDepartment of Rehabilitation and Complex Continuing Care, Holland Bloorview Kids Rehabilitation Hospital, Toronto, Ontario, Canada; ⁿDepartment of Pediatrics, University of Toronto, Toronto, Ontario, Canada; ^oNational Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, GA; and ^pInstitute of Sports Science and Clinical Biomechanics, Faculty of Health, University of Southern Denmark, Odense, Denmark.

Abstract

Objective: To synthesize the best available evidence on prognosis after sport concussion.

Data Sources: MEDLINE and other databases were searched (2001–2012) with terms including “craniocerebral trauma” and “sports.” Reference lists of eligible articles were also searched.

Study Selection: Randomized controlled trials and cohort and case-control studies were selected according to predefined criteria. Studies had to have a minimum of 30 concussion cases.

Data Extraction: Eligible studies were critically appraised using a modification of the Scottish Intercollegiate Guidelines Network (SIGN) criteria. Two reviewers independently reviewed and extracted data from accepted studies into evidence tables.

Data Synthesis: Evidence was synthesized qualitatively according to modified SIGN criteria, and studies were categorized as exploratory or confirmatory based on the strength of their design and evidence. After 77,914 records were screened, 52 articles were eligible for this review, and 24 articles (representing 19 studies) with a low risk of bias were accepted. Our findings are based on exploratory studies of predominantly male football players at the high school, collegiate, and professional levels. Most athletes recover within days to a few weeks, and American and

Supported by the Ontario Neurotrauma Foundation (grant no. 2010-ABI-MTBIWHO-871). The funder was not involved in the design or preparation of the study protocol, or in the management of the project, analysis or interpretation of data, or the preparation of the final article.

No commercial party having a direct financial interest in the results of the research supporting this article has conferred or will confer a benefit on the authors or on any organization with which the authors are associated.

The findings and conclusions in this research are those of the authors alone and do not necessarily represent the official views or policies of the Centers for Disease Control and Prevention or any agency of the United States government. Inclusion of individuals, programs, or organizations in this article does not constitute endorsement by the United States government.

Australian professional football players return to play quickly after mild traumatic brain injury. Delayed recovery appears more likely in high school athletes, in those with a history of previous concussion, and in those with a higher number and duration of postconcussion symptoms.

Conclusions: The evidence concerning sports concussion course and prognosis is very preliminary, and there is no evidence on the effect of return-to-play guidelines on prognosis. Our findings have implications for further research. Well-designed, confirmatory studies are urgently needed to understand the consequences of sport concussion, including recurrent concussion, across different athletic populations and sports.

Archives of Physical Medicine and Rehabilitation 2014;95(3 Suppl 2):S210-29

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Concussion or mild traumatic brain injury (MTBI) has been defined as a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.¹ Concussions that result from participation in sports are a major public health issue affecting 1.6 to 3.8 million individuals in the United States annually.² While most persons with concussions are said to recover completely within the first 3 months in terms of cognitive function,³ the American Academy of Neurology stated that the long-term effects of multiple concussions are unknown.⁴ However, great concern remains regarding the potential for permanent cognitive and other neurologic deficits,^{5,6} and permanent brain injury causing dementia or movement disorders.⁷ In a large systematic review⁸ of MTBI prognosis, the World Health Organization (WHO) Collaborating Centre for Neurotrauma, Prevention, Management and Rehabilitation Task Force found that athletes recover rapidly after sport concussion. However, they found very few scientifically admissible studies focused on the long-term consequences of multiple concussions and could not make any strong conclusions regarding their effects on overall health.⁸ Previous research has been limited by methodological weaknesses such as small sample sizes, poor description and ascertainment of the exposure (concussion), and short follow-up periods.⁸

Understanding the course of recovery and identifying potential prognostic factors (eg, age, sex, sport) affecting recovery after sport concussion is important for effective management and return-to-play (RTP) decisions. However, expert opinions and research findings about the prognosis after sport concussion vary widely.⁹ Given the controversy and uncertainty that still exists, reviewing the scientific evidence is important.

The objective of this review is to update the WHO Collaborating Centre Task Force findings by synthesizing the best available evidence on prognosis of sport concussion and RTP.⁸ The terms *MTBI* and *concussion* are used interchangeably in this review.

Methods

The protocol registration, case definition, literature search, critical review strategy, and data synthesis are outlined in detail elsewhere.^{10,11} Briefly, the review was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement.¹² The electronic databases MEDLINE, PsycINFO, Embase, CINAHL, and

SPORTDiscus were systematically searched from 2001 to 2012, and the reference lists of all reviews and meta-analyses related to MTBI, and articles meeting the eligibility criteria were screened for additional studies.

Articles were screened for eligibility according to predefined criteria. Inclusion criteria included original, published peer-reviewed research reports in English, French, Swedish, Norwegian, Danish, and Spanish. Studies had to have a minimum of 30 concussion cases resulting from sports participation, and had to assess outcomes such as self-rated recovery, clinical improvement, or RTP.

The definition of MTBI had to fall within the definitions provided by the WHO Collaborating Centre Task Force on MTBI and the Centers for Disease Control and Prevention (CDC).¹⁰ The WHO Task Force defines MTBI as

“an acute brain injury resulting from mechanical energy to the head from external physical forces. Operational criteria for clinical identification include: (i) 1 or more of the following: confusion or disorientation, loss of consciousness for 30 minutes or less, posttraumatic amnesia for less than 24 hours, and/or other transient neurologic abnormalities such as focal signs, seizure, and intracranial lesion not requiring surgery; and (ii) Glasgow Coma Scale score of 13–15 after 30 minutes postinjury or later upon presentation for healthcare. These manifestations of MTBI must not be due to drugs, alcohol, medications, caused by other injuries or treatment for other injuries (eg, systemic injuries, facial injuries, or intubation), caused by other problems (eg, psychological trauma, language barrier, or coexisting medical conditions), or caused by penetrating craniocerebral injury.”^{8(p15)}

Persons with fractured skulls were included if they fit this case definition. The CDC provides an additional definition that can be derived from clinical records. According to the CDC, MTBI is present if an Abbreviated Injury Severity Scale score of 2 for the head region is documented.¹⁰ An administrative data definition for surveillance or research is also provided.¹⁰ Specifically, cases of MTBI are recognized among persons who are assigned certain *International Classification of Diseases, Ninth Revision, Clinical Modification* diagnostic codes.^{10,11}

Eligible study designs were randomized controlled trials and cohort and case-control studies. Exclusion criteria included study designs such as cross-sectional studies, and case reports and series, as well as cadaveric, biomechanical, and laboratory studies.

Eligible articles were critically appraised using a modification of the Scottish Intercollegiate Guidelines Network criteria.¹³ Two reviewers independently reviewed and extracted data from accepted articles into evidence tables. A third reviewer was consulted for disagreements. The evidence was synthesized according to the modified Scottish Intercollegiate Guidelines Network criteria, and a best-evidence synthesis was performed to provide clear and useful conclusions linked to the evidence tables. We also categorized the evidence on prognostic factors as exploratory or

List of abbreviations:

CDC	Centers for Disease Control and Prevention
CI	confidence interval
LOC	loss of consciousness
MCI	mild cognitive impairment
MTBI	mild traumatic brain injury
RTP	return to play
WHO	World Health Organization

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