Is protective equipment useful in preventing concussion? A systematic review of the literature

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CRD summary
This review concluded that wearing helmets decreased head injury in skiing, snowboarding and cycling and full facial protection reduced concussion severity in ice hockey. There was no strong evidence about helmets and mouth guards and concussion risk. The authors’ conclusions appeared over optimistic given the limited and sometimes diverse data.

Authors' objectives
To assess if use of a mouth guard, helmet/headgear and face shield reduced sport-related concussion or injury.

Searching
MEDLINE, HealthSTAR, SPORTDiscus, EMBASE, PubMed, CINAHL, OLDMEDLINE, Cochrane Database of Systematic Reviews, ACP Journal Club, DARE, Cochrane Central Register of Controlled Trials (CENTRAL) and AMED were searched. Search terms were reported. Science Citation Index Expanded, Social Sciences Citation Index, Arts and Humanities Citation Index, ISI Web of Science were searched for mouth guard articles. Search dates ranged from 1830 to September 2008. Bibliographies of selected articles were handsearched for additional material. Searches were for articles in English and other languages.

Study selection
Studies that assessed concussion associated with mouth guard, helmet/headgear or face shield use (with exposure measurements) in all types of sport (contact and non-contact) at all levels of competition were eligible for inclusion in the review. Eligible study designs were: case report, case series, cross-sectional, case control, cohort and quasi-experimental or experimental; derived from original data and published peer-reviewed abstracts; and peer reviewed and non-peer reviewed reports. Studies were excluded if they were review articles, commentaries, letters to the editor or examined head injuries other than concussion.

Primary outcomes were a measure of concussion or head injury. Concussion was measured by a variety of methods: time-loss, game injury, medical attention, self reporting and trainer assessment; Concussion in Sport Group definition; and incidence. Other outcomes included: sports-related injuries; neck and face injuries; severity of concussion; neurocognitive impairments; and laboratory-based measurements.

The predominant sports included in the review were rugby, bicycling, American football and football. Other stated sports were lacrosse, cricket, hockey, ice hockey, basketball, rodeo, skiing and snow boarding. Study population varied in age, sex and location. Where reported, duration of intervention was one to five seasons.

Two reviewers selected studies for inclusion in the review.

Assessment of study quality
Quality was assessed according to epidemiological criteria of internal and external validity (strength of study design, sample size/power calculation, selection bias, misclassification bias, control of potential confounding and effect modification).

The authors did not state how many reviewers performed the validity assessment.

Data extraction
Results data were extracted and presented in standardised tables.

The authors did not state how many reviewers performed data extraction.
Methods of synthesis
Studies were synthesised narratively with studies grouped by type of equipment, design, sport and outcome. Differences and similarities between studies were discussed in the text.

Results of the review
Fifty one studies were included in the review (total number of participants unclear).

Methodological flaws included self-selection of equipment use, no standardised definition of concussion, large drop-out rates, lack of measurement and control of confounders, selection bias and lack of reporting of validity of methods used to measure outcomes.

Mouth guards: One of four prospective cohort studies and three of five cross-sectional studies reported a protective effect of mouth guards on concussion rates. Two cluster RCTs and one prospective cohort study compared different types of mouth guards and provided no relevant data.

Results of case reports and case series were reported.

Helmets: In skiing and snowboarding, three case-control studies reported a protective effect of helmets on head injuries and one case series reported no significant effect. In rugby, two RCTs reported no significant protective effect of helmets on concussion and two prospective cohort studies and one cross-sectional study reported significant protective effect. In American football, one cross-sectional study reported a significant protective effect on concussion. Two prospective cohorts compared different types of helmets. In bicycling, five out of five case-control studies, two out of two case series and two out of two retrospective cohort studies reported a reduction in head injury associated with helmets. Results of single studies of football, ice hockey and rodeo and 10 biomechanical studies were reported.

Face shields: One prospective cohort study in ice hockey players reported no significant difference in concussion between full face shields versus visors (half face shields). Multivariate analysis of this cohort found that visors were associated with more missed playing time. Another prospective cohort reported no significant difference in concussion risk between full face, visor and no protection (hockey). One case series reported no significant effect on concussion for visor versus no visor in ice hockey players. Results of one biomechanical study were also reported.

Authors’ conclusions
Evidence suggested that helmet use reduced injury risk in skiing, snowboarding and bicycling. The effect on concussion was inconclusive. Full facial protection may reduce concussion severity (measured by time lost) in ice hockey. There was no strong evidence that mouth guards or face shields reduced concussion risk.

CRD commentary
The review question and inclusion criteria were clear. The authors searched a number of relevant sources without language restriction, which reduced error due to language bias. There were no specific attempts to locate unpublished studies, which introduced potential for publication bias. Search dates were not always clearly defined. No results of a formal validity assessment were reported, but methodological flaws in the study were discussed. Methods were used to minimise reviewer error and bias in study selection; whether similar methods were used for validity assessment and data extraction was unclear. Details were not provided of how many participants were included in all the studies. A narrative synthesis was appropriate in view of heterogeneity between included studies. Some limitations of the review were discussed by the authors. Conclusions about the lack of definitive evidence about the effects of mouth guards and face shields on concussion appeared to reflect the evidence, but conclusions regarding the effect of helmets and full facial protection in ice hockey appeared over optimistic given the limited evidence.

Implications of the review for practice and research
Practice: The authors did not state any implications for practice.

Research: The authors stated that further well-designed sport-specific prospective analytical studies were required to provide scientific evidence to advocate mouthguard, helmet/headgear or face shield use. Clear definitions were required for concussion and type of mouthguard, and rates of concussion needed to be reported, to improve comparisons in future studies.
Funding
Not stated.

Bibliographic details

PubMedID
19433427

DOI
10.1136/bjsm.2009.058271

Original Paper URL
http://bjsm.bmj.com/content/43/Suppl_1/i56.abstract

Indexing Status
Subject indexing assigned by NLM

MeSH
Athletic Injuries /prevention & control; Brain Concussion /prevention & control; Facial Injuries /prevention & control; Head Protective Devices; Humans; Mouth Protectors; Risk Factors

AccessionNumber
12009109730

Date bibliographic record published
10/03/2010

Date abstract record published
07/04/2010

Record Status
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.