

EBEM Commentator

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Helmets for Preventing Head, Brain, and Facial Injuries in Cyclists

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SYSTEMATIC REVIEW SOURCE

This is a systematic review abstract, a regular feature of the *Annals'* Evidence-Based Emergency Medicine (EBEM) series. Each features an abstract of a systematic review from the Cochrane Database of Systematic Reviews and a commentary by an emergency physician knowledgeable in the subject area.

The source for this systematic review abstract is: Thompson DC, Rivara FP, Thompson R. Helmets for preventing head and facial injuries in bicyclists (Cochrane Review). In: *The Cochrane Library*. Issue 1. Oxford, United Kingdom: Update Software; 2001.

The *Annals'* EBEM editors assisted in the preparation of the abstract of this Cochrane systematic review as well as the Evidence-Based Medicine Teaching Points.

OBJECTIVE

To determine whether helmets prevent head, brain, and facial injuries among cyclists who wear them.

DATA SOURCES

Studies were identified via electronic searches of MEDLINE, EMBASE, Sport, the Educational Resources Information Center (ERIC), the National Technical Information Service (NTIS), Expanded Academic Index, the Cumulative Index to Nursing and Allied Health (CINAHL), PsychINFO, Occupational Safety and Health, and Dissertation Abstracts. Reviewers also performed a manual search of the reference lists of review articles and contacted experts in the field. The search was most recently amended on February 27, 2001.

STUDY SELECTION

Studies were included if they used a controlled design to evaluate the effect of helmet use among cyclists of any age who had crashed. Because no randomized controlled trials or cohort studies were found, only case-control studies were included. Studies lacking prospective case ascertainment or medical record verification of injuries were excluded.

DATA EXTRACTION

Two independent reviewers assessed trial quality and extracted data. For each individual trial, odds ratios (ORs) with 95% confidence intervals

(CIs) for the protective effect of helmets on head, brain, and facial injuries were reported. "Head injury" refers to injury to the scalp, skull, or brain, whereas "brain injury" refers to a loss of consciousness or other objective evidence of traumatic brain injury/dysfunction. ORs were adjusted for several confounders related to crash severity, such as being hit by a car or falling on the street. In addition, brain and head injury results were summarized using meta-analytic techniques.

MAIN RESULTS

Five case-control trials involving 7,253 head-injured patients and 2 case-control trials involving 3,919 face-injured patients were identified. Helmets were associated with a 65% to 88% reduction in the risk of head and brain injury and a 65% reduction in the risk of upper/middle facial lacerations and fractures.

For head injuries overall, the summary statistic suggested a substantial reduction of head injuries for cyclists wearing helmets (OR 0.31; 95% CI 0.26 to 0.37). For head injuries among cyclists involved in crashes with motor vehicles, the adjusted statistic showed a similar trend (OR 0.31; 95% CI 0.2 to 0.48). Similar results were obtained for brain injury among cyclists involved in crashes with vehicles, regardless of age. For brain injuries overall, the summary statistic suggested a substantial reduction of brain injuries for cyclists wearing helmets (OR 0.31; 95% CI 0.23 to 0.42). Overall, helmets did not appear to protect cyclists from serious (lacerations and fractures) facial injuries (adjusted OR 0.81; 95% CI 0.45 to 1.5); however, they did appear to protect against serious upper (adjusted OR 0.36; 95% CI 0.26 to 0.49) and middle (adjusted OR 0.35; 95% CI 0.24 to 0.5) facial injuries.

CONCLUSIONS

Cyclists wearing helmets appear to be at significantly lower risk of head and brain injuries after a bicycle crash than those not wearing helmets, regardless of age or crash severity. Helmet wearers also have a lower risk of facial injuries, but only for injuries that are serious (lacerations or fractures) and to the upper or middle face. Helmet use among cyclists of all ages is encouraged.

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COMMENTARY: CLINICAL IMPLICATIONS

A major public health role of emergency medicine involves injury prevention. Traumatic brain injury is a common public health problem affecting more than 1.5 million Americans annually.^{1,2} Even the least severe form of this injury, mild traumatic brain injury (concussion), can result in substantial long-term disability.^{3,4} Because there are no effective treatments for the neurologic dysfunction that can occur after traumatic brain injury, the heavy emphasis placed on prevention seems justified. Cycling is an extremely popular recreational activity, especially among young adults and children. Moreover, crashes resulting in injuries often affect the head, face, and brain. Although the proportion of all traumatic brain injuries that occur as a result of a bicycle crash is small (<6%), their frequency and the fact that these traumatic brain injuries

are considered highly preventable through the use of helmets,² makes this review an important one for emergency physicians.

The 5 case-control studies examined by the authors of this Cochrane Review contribute significantly to the body of evidence that helmets are causally linked to the prevention of traumatic brain injury. Two additional studies examining facial injuries indicate that helmets effectively prevent facial injuries. Using accepted and systematic methodology, the authors evaluated the evidence from nonrandomized observational (eg, before-after, concurrent controls, ecological studies) research of helmet use to prevent head and facial injuries. Overall, the evidence strongly supports the role of helmets in reducing traumatic head, brain, and facial injuries while riding a bicycle. This evidence is accumulated over the past decade from 3 countries, so the information should be considered generalizable to developed nations.

Despite the data presented in these studies (which have been available since 1996), without legislation, helmet use among North Americans remains low (in the 15% to 25% range).^{5,6} Strategies to increase cyclist helmet use have been the subject of much controversy and debate. In many parts of the world, legislative changes have been required to increase the helmet use in the population above the baselines achieved through education. The public health desire to reduce the burden of injury to the population through legislation contrasts sharply with the belief that individual cyclists have the right to decide whether or not to wear a helmet. Although this Cochrane review cannot resolve this conflict, it lays the foundation on which a rational debate can occur.

TAKE HOME MESSAGE

Helmets appear to provide significant protection against head and brain injuries, as well as against serious injuries to the upper and middle part of the face. Helmets reduce the risk of head, brain, and facial injury among cyclists of all ages and crash severities, including those who collide with motor vehicles. Emergency physicians should advocate within their community for helmet legislation and for helmet use among their patients involved in cycling crashes in an attempt to increase overall helmet use among cyclists.

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EVIDENCE-BASED MEDICINE
TEACHING POINTS

Odds Ratio. ORs are commonly used in systematic reviews to report the pooled estimate of effects. An OR describes the odds of an exposure (ie, helmets) being present among cases relative to the odds of the same exposure being present among controls (ad/bc in a 2×2 table). The OR is a useful approximation of the relative risk (RR) when the incidence of the outcome under investigation—in this case, head/facial injuries after a bike crash—is rare.

Confounding. A situation in which a measure of the relative effect of an exposure (such as helmets) on an outcome (such as head injury) is distorted because of the exposure's association with another factor that also influences the outcome. An example is the observed increased risk of heart disease among those who consume alcohol. However, when the risk among those who

smoke is compared with the risk among those who do not, the alcohol-heart disease association is eliminated. Therefore, cigarette smoking is referred to as a confounder. In observational studies like the ones reviewed here, the effect of confounding can be minimized by stratifying the OR on the basis of the confounding variable and then calculating an adjusted OR. When multiple confounders exist, multivariate analytical techniques must be used to calculate a summary OR.

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