# An overview of arguments in the bicycle helmet debate

By Morten Lange, MSc

Icelandic Cyclists' Federation, Engjavegur 6, IS-104 Reykjavik, ICELAND

morten7an@yahoo.com, lhm@islandia.is

**Introduction:** *The following is an attempt at presenting an overview of the major arguments in the science and logic-based debate on the merits of bicycle helmet compulsion. As the arguments used for and partly against helmet promotion are often the same, this overview also pertains to helmet to helmet promotion, especially the emotionally laden and fact-lean form that bicycle helmet promotion often takes. The article attempts to organise the subject-matter in logical sections, denoted by numerals in three levels. The breadth of arguments and the restrictions on space means that most of the arguments are not explained, and that some references were dropped. The prime emphasis is in showing the breadth of arguments that I see after having followed the debate closely for two years. Part of the time I was as a member of the helmet group of the European Cyclists' Federation and of well-informed internet forums. The arguments, and not least the references, are even more numerous than shown here, and some might argue on prioritising them differently. I will be grateful for comments, questions and corrections.*

## *1* Importance of issue and nature of approach

**1.1 Relative effectiveness of measures**. In general it is more effective to treat the root causes of injuries, that is to reduce the number of crashes rather than try to lessen the effects of crashes. Protective gear can only provided a limited protection and only cover parts of the body. Furthermore risk compensation is well known in the traffic safety field, but in varying degrees. Several sources rate other measures as more efficient than helmets. Example: Kim, 2007

### 1.2 Danger level in cycling

**1.2.1 Per kilometre:** Almost invariably, when it is said that cycling is many times as risky as driving a car, the figures used compare the two transport forms are based on the total number of kilometres travelled. The figures used are skewed by including distances travelled on motorways. No such safety enhanced roads for cyclists. More relevant comparisons would be restricted to the types of trips that are commonly travelled on bicycles.

**1.2.2 Pr. trip :** If risk is calculated on a per trip basis, cycling does not fare very differently than car driving

**1.2.3 Age-adjusted :** If risk is calculated according to the age of the driver, young adults are safer pr. km on bicycle than in cars.

**1.2.4 Risk severity: Comparing apples and oranges ?** Cyclists might have more injuries in some comparisons, but the blind usage of those statistics may be questionable. Compared to car drivers and passengers a substantially greater

proportion of injuries to cyclists are minor injuries. It has also recently become clear that underreporting of cycling accidents has been overestimated very considerably ( Norwegian data). (Bjørnskau, T (TØI), 2005) , Ref for 1.2 as a whole: DG Environment (1999)

### 1.3 Frequency of head injuries in cyclists

Helmet proponents often claim "very many" head injuries amongst cyclists, and especially children, but although the numbers seem high, they would not if compared to injuries to other groups on the roads. If the total number of head injuries is split into victims, cycling is a small component. Falls is by far the largest contributor, and in traffic car occupants and pedestrians are similar in number to cyclists. Also the definition of a head injury might be misleading, as bleeding from a small wound on the ear might qualify as a head injury, but what is subconsciously implied is that all head injuries are serious and a potent danger to the brain.

### 1.4 Hidden problem

**1.4.1 Underreporting.** Often it is mentioned that injuries to cyclists are underreported. But underreporting of bicycle accidents is probably not as pronounced as previously thought, see above. The minor injuries are underreported, not the major ones, so this is not as serious a problem as implied.

**1.4.2 Concussions and long-term effects** It has been reported that even concussions that seem minor, may lead to handicaps. (Hawley, 2004) The abovementioned Norwegian study (Bjørnskau, 2005) found however, that 99% of cyclists with injuries had no symptoms some months after the incident.

### 1.5 The scientific frame of mind and the burden of proof

**1.5.1 Scout for opposing evidence: "**One of the Cresswell principles of expert evidence is always to consider material facts which could detract from one's concluded opinion." John Franklin in (BMJ debate 2006)

**1.5.2 Burden of proof:** As it quite clear that requiring users of bicycles to wear helmets constitutes a burden on those users, at least economically and in terms of at times drastically reduced comfort and convenience, the burden of proof must lie with the law-maker. In this context, claims that helmets are ill designed to fulfil their advertised function must be taken seriously.

## 2 Helmet studies

### 2.1 Case-control studies

**2.1.1 Studies:** A large number of case-control studies have concluded that bicycle helmets provide outstanding protection from head injuries in cyclists. Some claim that protection even for the face, and there is generally no distinction between hard-shell and soft-shell helmets. The most widely cited study is the "Seattle study" from 1989 of

children visiting emergency rooms at hospitals, incidentally a study at the upper edge of protection claimed : reduce head injuries by 85% and brain injuries by 88% (TRT 1989)

**2.1.2 Critique of studies:** The studies ignore knowledge on the mechanics of brain injury ( Curnow 2005 and later). Self selection of helmet wearers introduces bias in data (BHRF w1052). Self reporting of helmet usage possibly an important error source (BRHF personal comm.) The 1989 TRT study ignored data from a contemporary study from Seattle (DiGuiseppi, 1989) showing striking dissimilarities between helmet users and non-users: A) Affluent members of health clubs, where kids were riding in parks with their parents B) Low-income kids cycling unaccompanied in a street environment. (BHRF w1068)

**2.2 Cochrane review of Case control studies:** "We found no randomized controlled trials, but five well conducted case-control studies met our inclusion criteria. Helmets provide a 63 to 88% reduction in the risk of head, brain and severe brain injury for all ages of bicyclists. Helmets provide equal levels of protection for crashes involving motor vehicles (69%) and crashes from all other causes (68%). Injuries to the upper and mid facial areas are reduced 65%." (Main results, TRT 1999)

**2.2.1 Critique of review:** This review builds on a very limited set of studies, a considerable proportion of which are the authors' own. It ignores knowledge on the mechanics of brain injury, does not adequately account for the self-selection effect, and has not considered the dilemma poised by population based time series, where confounding is less (Cochrane comments 2001, Curnow 2005)

## 2.3 Population based studies

**2.3.1 Studies /reviews using time series and comparisons from other groups:** Robinson DL (1996) (2006) These and other studies analyse the trends over many years in head injuries, prior to, during and after substantial increases in helmet wearing following enforced compulsion. To further reduce the likelihood of drawing false conclusions, head injuries can be measured as a percentage of all injuries, and they can be compared to head injury rates in other groups in traffic. Head-injury rates in presented follow similar trends in cyclists and other groups while helmet usage goes up by more than 40%. The conclusion is that helmets have no discernible effect. Furthermore the helmet laws have a clear negative effect because cycling was reduced, and thereby health benefits from cycling were lost.

**2.3.2 Critique:** In population based studies you do not have sufficient data on the individuals to adjust for skewing/confounders. Furthermore the ill health effects of reduced cycling are not clear. (Hagel 2006, see BHRF w1171)

**2.3.3 Replies:** The datasets provide very convincing evidence on the viability of pedestrians and other groups as best-effort controls. Also there is no response in the data in spite of a very strong force in the system studied, that of the above 40% increase in helmet wearing over a short period. The health effects of decreased cycling are very clear. See e.g Andersen, 2000. Links to BMJ debate with many more well founded arguments pro et con at BHRF w1171 (see References)

**2.3.4 Other studies:** Macpherson, 2002 concluded “The bicycle-related head injury rate declined significantly (45% reduction) in provinces where legislation had been adopted compared with provinces and territories that did not adopt legislation (27% reduction)”.

**2.3.5 Critique:** “In 2006, the same authors reviewed the law in Ontario and showed that helmet wearing had returned to pre-law (or below pre-law) levels by 2001. Data from another source showed that, despite the reduction in helmet wearing, head injuries were still declining at a faster rate than non-head injuries” (BHRF w1106) A general critique on several population based studies concluding on detectable injury reduction on the population level centres on :

- A trends view of the data is not taken into account
- No account taken of the reduction of cyclists (a well known concern in the literature, with some support )
- Do not employ a measurement of head injuries as a percentage of all reported injuries. This method circumvents the analytical problem regarding the reduction in cyclist numbers. (BHRF w1106)

**2.3.6 Cochrane Review of population based studies:** The 2007 Cochrane review by Macpherson et al had the 2002 study by Macpherson as a very central source. The review did not consider, and hence did not exclude the 2006 review by Robinson. Other studies were excluded on the basis of lacking control groups. The study concludes with a protective effect of helmets for children, but admits that it can not be ruled out that reduction in cycling had a significant influence on the results.

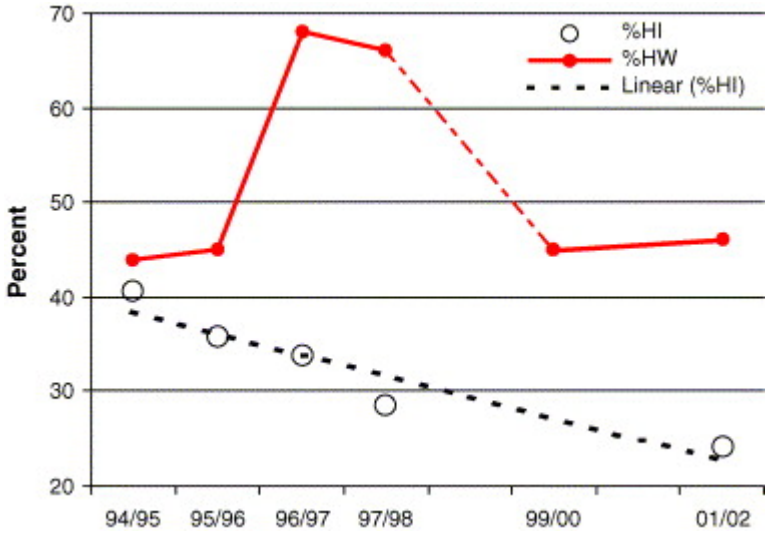


Figure from Robinson 2007, using data from Ontario, Canada from Macpherson et al and Parkin et al. HI% : Percent head injuries, HW% : Proportion wearing helmets

## 2.4 Other efficiency studies, different designs

Several other studies appear to show little protection of helmet usage. Examples:

Bjørnskau (2005), another Norwegian study, from the largest Trondheim Hospital, and a third study with a large number of cyclists from the USA, and commented in the New York Times. (NY 2001)

## 2.5 Cost-benefit analysis

Very few analyses of the cost-benefit ratios of helmet compulsion of promotion have been published, but even with possibly optimistic approximations for the injury reducing effects, the net benefit is small because the cost of helmets is so large. (Taylor 2002, BHRF w1018) A respected handbook on Traffic safety measures (Elvik 2004) estimates that the reduction in total numbers of head injuries when outlawing cycling without helmets is as much an effect of reduction in cycling, as the physical effect of the helmets, and that risk compensation eats up about half the physical effect of helmets. The publisher is now revising the estimates for the physical protection of helmets, and will reduce the estimate substantially (Bjørnskau 2006). None of the cost benefit analyses take into account the reduced health gains if helmet promotion or -compulsion reduce cycling. The "Safety in numbers" effect and its reverse is not mentioned either.

## *3* Helmet compulsion and reduced benefits of cycling

**3.1 Reduced cycling.** Evidence for reduction in cycling w. enforced helmet compulsion is fairly clear, especially in Australia. Robinson (1996, 2003, 2006). Hagel et al did not deny this in their critique of the 2006 study by Robinson. See also the text about the study by Macpherson and the stance of the British Medical Association.

**3.2 Barrier effect.** A report from the European Conference of Transport Ministers (ECMT) argues that even promotion of helmets will function as a barrier to cycling. (Leden/PROMISING 2001) Data from a region in Sweden where an experiment with strong promotion was run, have been interpreted to support this claim (BHRF).

## 3.3 Cycling is benign in many ways

**3.3.1 Health:** Physical health: Life-years gained outnumber those lost by a factor 10-20 (Nordic council 2005). Cycling reduced chance of death by 40% in those cycling to work (All-cause mortality). Even elderly persons who start to cycle for transport on a close-to daily basis will improve chances to prolong their lives. (Andersen 2000 + 2006) Mental health**:** A general positive effect for increased physical activity. Reduced health spending : Health gains give financial gains (Nordic council 2005)

**3.3.2 Reduced car usage:** If cycling replaces car driving, or even reduces the growth in care usage, there are a wide range of positive environmental effects: Greenhouse gas emissions, noise, fumes, particulate matter, water and soil pollution, resource depletion and more. In addition, there is an element of reducing congestion, financial gains by lowering spending for fuels, parking, infrastructure, insurance and the financing and purchase of the cars themselves.

**3.3.3 Various other effects:** Increased levels of cycling in the society has been claimed

to improve equity and enhance local communities (Harry Rutter 2004?),

**3.3.4 Safety in numbers:** Improved safety per cyclist as car drivers are more alert and reduce speed, and the number of experienced cyclists on the roads grows (Safety in numbers, Jacobsen 2003). A formula has been established that holds over a wide variety of cities in several countries. Even better results, with reduction in the total numbers of accidents and injuries have been seen in many European cities where cycling was promoted and subsequently increased in modal share. ( Krag, 2005) From lower speeds and more alert and considerate drivers follows reduced traffic unsafety for all.

## *4* Risk compensation when wearing helmets

**4.1 Risk compensation by cyclists** has been covered by Mok 2004 and Adams and Hillman, 2001 (referred to by Robinson 2007)

**4.2 Risk compensation by drivers:** A study by Ian Walker (2006) showed drivers pass closer to helmeted cyclist, perhaps assuming them to be more adept cyclists.

## *5* Bio-mechanics of brain injuries

**5.1** Clinical studies show that the forces needed to damage the brain by rotating it are much less than the forces associated with damaging the brain by linear motion. Helmet design does not account for this, but an inventor has started developing helmets with two concentric shells that slide relative to each other, the Phillips helmet. (Curnow 2005)

## *6* Helmet quality and usability

### 6.1 Helmet test standards

Helmet tests with a solid head model dictate a firm lining, but human heads are softer and require a softer lining. (Curnow 2005). The standard testing of helmets only use impact speeds of less than 25 km/h. Adding a body adds force to the fall, but the arms and the body in general will often have a protective effect. These are not considered.

### 6.2 Helmet durability

Users are urged to renew helmets after a few years of daily use. Helmets may have hairline cracks that greatly reduce the efficiency in dampening impacts. Users have no way to inspect for such cracks.

### 6.3 Helmet fit

96% of children's helmets were not fitted right by a parent in a controlled experiment. (Parkinson 2003) Bad adjustment of helmets has been offered as an explanation for poor performance of helmets in population based studies.

## 7 Country statistics on safety and helmet usage

The countries with most cycling have very low rates of helmet wearing
The countries with most cycling have lower fatality rates (killed per km cycled) than those with less cycling, at least when comparing available data for several OECD countries. (BHRF w1079)

## 8 Helmet compulsion : Prohibited to cycle without a helmet

This kind of compulsion runs contrary to personal freedom, and on the basis of very contested scientific findings, an thus needs thorough and open-minded debate, based on sound principles and science. Opponents say there is no logical reason to single out cyclists. Other groups in traffic have greater total numbers of head injuries. Helmets are not very well suited to being taken off and on very often, they are bulky when visiting shops, sitting down at a desk at school, and many need constant tedious adjustment. Many helmet users choose to not wear helmets

## 9 Opinions and findings of institutions and groups

### 9.1 ECMT report on promoting cycling

It reports from various countries on helmet promotion, without references to science. A footnote in the report from a study financed by the EU under the research programme PROMISING, points to helmet promotion as a restrictive measure. (see above). Restrictive measures might be said to constitute misguided security, in that they hamper inherently healthy, environmentally friendly, economical and otherwise desirable forms of transport.

### 9.2 British Medical Association (BMA)

1999 Study on helmet compulsion: This extensive study concluded that reduced cycling because of helmet compulsion would lead to a negative effect on the whole, by reducing cycling. 2005 turn face: The BMA now support helmet compulsion, but this stance is being challenged within the organisation. The change of conclusions was mainly based on claims in a single much criticised Canadian study, concluding that helmet compulsion does not reduce cycling (personal communication from BMA member) Later the authors of that study published an update from the same area, that cast doubt on this conclusion (MacPherson, 2006). See the section on population based studies.

**9.3 EU - DG Environment** Two relevant booklets are available online: "Kids on the move", 2002, Cycling the way ahead for towns and cities, 1999. They both emphasise the need to counter the myths about cycling being especially unsafe. The latter booklet specifically points to helmet promotion as a barrier to increased cycling.

**9.4 European Cyclists' Federation:** The brochure "Improving Bicycle Safety without making helmet-use compulsory" from 1998, and the ECF letter on helmets to vice-president of the EU, Jaques Barrot are available online. Most member

organisations of the ECF have a stance against compulsion, and some against promotion using exaggerated claims.

**9.5 The Institute of Transport Economics ( TØI, Norway)** The institution publishes "The Handbook of Road Safety Measures", referred to under the section of cost-benefit analysis.

**9.6 The World Bank and FIA** (International association of motorists and car racing) seem to indirectly suggest helmets also for pedestrians by using an image of Asiatic pedestrian school children with helmets on the front page of a road safety document.

### 9.7 WHO / FIA Helmet manual, 2006

**9.7.1 Compulsion supported** The manual from the World Health Organisation argues that helmet compulsion would save lives. Critics say it builds on a very limited and skewed literature review, and disregard the health benefits of increased cycling. (BHRF personal communication)

**9.7.2 The Dutch position:** The manual includes a textbox, where the Dutch stance is presented. Dutch health and safety professionals' generally agree that helmet promotion and compulsion is not the way forward, as it does not have many merits. Not a viable path to improve security for cyclists.

**9.8 UK: Advertising Standards Authority:** Ruled against claims by helmet promotion campaigners, and in favour of the Cyclist Touring Club, UK

**9.9 National Childrens' Bureau, UK:** A review on cycling and children by Tim Gill concludes that it is much more important to not impede children's freedom to explore and grow, than to force them into a (partially false) safety with helmets, and reap lower levels of physical activity.

**9.10 UK courts:** No negligence pertaining to insurance found in court hearings after several hearings following accidents where cyclist had no helmet. (BHRF)

## *10* "A helmet saved my life"

**10.1** A great proportion of helmet users have stories to tell about how their helmet prevented major injuries or even death A sample can be found at http://www.helmets.org/crashes.htm

**10.2** Critics say that the anecdotes are so many that if true, helmets would have saved a much greater proportion of those helmeted cyclists than the number of non-helmeted cyclists with fatal or serious head injuries. Perhaps too many fortunate outcomes are ascribed to helmets, or cyclists with helmets have more serious accidents

**10.3** The helmet sceptics have fewer stories but they are more than anecdotes: They

are incidents with an undeniable outcome and undeniable conclusion: That of tragic outcomes in spite of helmets being worn, both in collisions with cars and among cyclists colliding with other cyclists or even in accidents where others are not involved.

## *11* Ad hominem regarding debaters / research

**11.1 Follow the money** Some research on helmets appear to be financed by the car industry ( Deb 2007 ) Observers claim that helmet promotion is in part paid by car lobbies, among them the FIA, Fédération Internationale de l'Automobile, the international car association.

**11.2 Bad methods** Campaigners have very often used unscrupulous methods / grave exaggerations. In the UK Advertising Standards Authority decided to support the major claims of CTC (**Cyclists' Touring** Club, UK.) in ruling on a complaint by Bicycle Helmet Initiative Trust where CTC accused helmet campaigners of false assertions. http://www.ctc.org.uk/DesktopDefault.aspx?TabID=4079

**11.3 Bias** Paraphrase: Cyclist advocacy representatives are biased, and generally not to be taken seriously in a scientific debate. We scientists know about scientific methods and are not tainted by self interest in this matter

## *12* Ad hominem regarding users

**12.1** - They think more about their hairstyle than their brains

**12.2** - Cyclists with helmets look corny

## Longer, updated version of this document

A longer, updated and more complete version will be found on the internet searching for the authors name and the title.

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