



COMMENTARY

The potential for cycle helmets to prevent injury – a review of the evidence

*Hynd D, Cuerden R, Reid S, Adams S. Transport Research Laboratory report PPR446, 2009.
For the UK Department for Transport Road Safety Section*

[Original paper](#) **External Link**

Introduction

From 2008 to 2010 the UK Department for Transport (DfT) commissioned an extensive research programme into cycling safety which was carried out by the Transport Research Laboratory (TRL). One element of the research concerned cycle helmets and the results from this research were published separately from the rest of the project.

The research initially set out to resolve the conflicting evidence surrounding cycle helmets and to weigh up the potential injury reduction benefits against the possible loss of cycling's health and other benefits due to helmet laws or promotional policies. Regrettably, key elements of the study brief were not fulfilled; the report's summary omits important caveats made by the researchers, thereby misrepresenting their findings; and there are a number of places where conjecture is presented as fact.

Crucially the report's summary omits to mention that the extensive literature review found no reliable real-world evidence of helmets being beneficial in reducing cyclists' injuries, still less that they are a cost-effective way to achieve this aim. Moreover, the requirement in the study brief to weigh up the potential benefits and costs of different policy options on helmets – taking account of their potential adverse impacts on cycle use as well as any injury reduction benefits – was never delivered.

Methodology and process

In its initial proposals, the DfT agreed that its previous helmet research (Towner et al, 2002) would not constrain the new review..The project was to be overseen by an advisory group including representatives of cycling organisations and the group would be able to ensure that the subject was reviewed comprehensively and with best endeavour. At least one independent observer was to be appointed to oversee the biomechanical analysis and injury investigations.

Unfortunately, the remit of the research and the function of the advisory group were soon curtailed and the context of the project restricted to building upon the previous research published by the DfT. Although still included in the project brief, no independent observer was appointed. It is not known what expertise was used by the research team in its injury investigations as the DfT subsequently refused to identify those involved.

The final paper published by TRL was materially different to the last draft seen by the advisory group and the summary of the research was imposed rather than agreed. Like the summary, subsequent reference made about the study by the DfT to parliament and the media has misrepresented key findings and given precedence to speculation over fact.

Literature review – no reliable evidence of helmet benefit

The cycling safety project undertook a trawl through the published literature, identifying some 2,000 papers which were then tested for relevance and methodology before a much smaller subset of the papers was examined more closely. It was quite possibly the most extensive cycling literature search yet undertaken.



For the helmet review, papers were restricted to those that had been published in the previous 10 years (1998-2008) (although for an unknown reason a strongly pro-helmet paper from 1996 (Thompson, Rivara and Thompson, 1996) was also included). The reviewers conclude that the evidence did not make it possible to determine the level of effectiveness of cycle helmets as none of the reviewed studies controlled fully for all possible confounding variables. Some case-control studies, it is said, clearly over-state the likely protective effect of helmets, a reference to those studies that are most often cited in the promotion of helmet wearing and laws and which claim the greatest benefit. Studies sceptical of helmet benefit are also judged with some caution but, of course, the onus is always on those wishing to promote an intervention to show that it is effective.

The Executive Summary for the project is ambiguous in how it relates the outcome of the literature review, seeming unwilling to acknowledge that no benefit from helmets had been shown.

Biomechanical review – an idealised analysis

The DfT reneged on an original commitment to include a review of the actual risk when cycling (which, arguably, should be shown to be significant before any intervention to address risk is considered). However, it insisted on including a biomechanical review of how helmets might be expected to perform, despite the inherent speculative nature of such an investigation.

The review does not get off to a good start for its assumptions are laid out in the first sentence:

“Assuming that they are a good fit and are worn correctly, cycle helmets should be effective at reducing the risk of cranium fracture, scalp injury and focal (localised) brain injuries due to translational acceleration.”
(page 9)

However, neither at this stage in the review, nor at any point later, is any evidence presented to show that this is a reasonable assumption. If head injury is a significant problem for cyclists and helmets are effective in the ways described, it should be easy to show that head injuries have reduced where helmet use has become common, but the researchers did not find any such evidence.

TRL assumed that helmets behave as intended and in line with the standards to which they are accredited. They did not consider criticisms about the testing of helmets (with a brass ball that is much more solid than a human head, striking a helmet at right-angles when most crashes involve oblique impacts) or the fact that helmets commonly split upon impact before the absorbent liner has even started to give protection by compressing. The researchers' biomechanical tests also consider only right-angle impacts and make other assumptions that may not be correct.

Rotational injuries are a controversial subject with regard to helmets and not just those for cyclists. A majority of evidence suggests that helmets have little effect in reducing rotational injuries and may, in certain circumstances, make injuries worse. Surprisingly, the helmet review makes no reference to research carried out only a year earlier for the DfT by TRL (St Clair and Chinn, 2007) which concluded that cycle helmets may sometimes make injuries worse. For this review, TRL did no more than to add a further opinion with a simple analysis of the mechanics of head rotation (which has been criticised for ignoring time factors) and from this alone they conclude that cycle helmets can only be beneficial against rotational injuries. They fail to acknowledge that many specialists believe the subject to be less clear-cut.

Real-world injury investigations – speculation but no evidence

The study states that in-depth accident data was used to investigate the extent and nature of head injuries sustained by cyclists, which were correlated with accident circumstances. With the outcomes of the biomechanical review, predictions were then made of how effective helmets might be at mitigating or preventing serious injuries. The headline result from this investigation is speculation that the use of helmets *might* prevent up to 16% of



cyclist fatalities.

This speculative result has since been cited by the DfT as a proven fact, that helmets *would* be expected to prevent up to 16% of cyclist fatalities. However, the researchers quite clearly point out:

“However, it should be remembered that there was no specific evidence to support these estimates”. (page 37)

What TRL had done was to *assume* as a basis for its estimates that 50% of head injuries would be prevented by the wearing of a helmet following a fall and 10-30% when in collision with a vehicle. It then used these 'out of the air' figures to estimate that helmet-wearing would have prevented 10-16% of 113 cyclist fatalities investigated.

It might be expected that a "specialist biomechanical assessment" (as the DfT describes this process) would include important factors such as the impact speeds and the forces involved in each collision, but this was not the case. Instead TRL merely considered the crash investigation records for each fatality to try and determine whether a crash involved the cyclist's head colliding with another vehicle or the ground. Then they applied the assumed outcomes explained above.

Much more detailed analysis of individual crashes takes place when litigation follows a cyclist's death or serious injury. Independent experts are appointed to investigate the precise circumstances and there is usually much more certain information about the specific events leading up to the crash and the injuries sustained. Based upon these much more detailed investigations, no court in the UK has yet decided that wearing a cycle helmet would have made any material difference in the cases they have considered. It is difficult to believe that the more remote TRL analysis could have been any more certain.

Moreover, TRL ignored the likelihood that of the 69 fatalities identified as having been due to head injuries, around two-thirds would be expected to have also involved lethal injuries to other parts of the body. These cyclists would still have died even if helmets had prevented the head injuries. Allowing for this would have reduced the study's best estimate of the effectiveness of helmets to a few percent.

What's wrong with the study's summary and conclusions?

The introduction to the Executive Summary quantifies the number of reported cyclist casualties and then refers to cycle helmets as the only apparent possible response to this toll. An increase in helmet wearing rates is referred to although this is irrelevant to the study. The objectives of the study are stated as to evaluate the effectiveness of helmets. The introduction thus sets out a presumption that cycle helmets are necessary, effective and the best response to cycling casualties. Such a basis makes it difficult for the researchers subsequently to present contrary results.

Cycle helmet standards were evaluated to see how effective helmets might be in crash situations. However, no account was taken of the fact that a high proportion of helmets involved in crashes fail by breaking before their protective inner liner has started to compress. The analysis therefore has little association with real-world experience.

It is stated that no evidence was found for an increased risk of rotational head injury through wearing a helmet but this is on the basis of the researchers' own simplistic analysis alone. Evidence of a contrary view exists in the majority of the associated literature, including in a report by TRL for DfT only a year earlier (St Clair and Chinn, 2007). The study ought to have acknowledged that such evidence exists.

The Executive Summary under-states the factual outcome that no reliable evidence was found of helmet benefit in



the literature. By contrast, it over-states the purely speculative outcome from the accident studies that there might be benefit for cyclists in fatal crashes.

The Summary of Conclusions refers first and most prominently to the speculative accident studies, repeats the falsehood suggesting that there is no evidence of increased risk through rotational injury, and makes no reference at all to the principal factual outcome that no reliable evidence was found of helmet benefit.

Omissions

Some important aspects of risk and how helmets might affect this were not considered by the study but they are of much importance in the consideration of public policy.

- No comparison was made of risk of head injury when cycling compared with the risks encountered with other common activities. In absolute numbers, there are many more head injuries suffered by pedestrians and motor vehicle occupants than by cyclists. Also a person is more likely to be killed in a mile of walking than in a mile of cycling. By failing to put risk when cycling into perspective, the helmet study makes cycling appear a much more hazardous activity than is the case.
- There was no analysis of the wider health consequences of actively promoting or mandating helmet use. An analysis of the relative costs and benefits of cycling was supposed to be included in the project but was not carried out.
- No analysis was made of the many ways in which helmet-wearing might increase the likelihood of cyclists being involved in collisions in the first place despite evidence that, for example, motorists often overtake helmeted cyclists more closely. The study refused to consider young children strangled by helmets although this is the only unambiguous evidence linking helmets and fatalities and there have been calls by the medical profession to take this issue more seriously (BHRF, 1227).
- The study did not consider other inventions to improve cycling safety and their relative benefit-cost.

BHRF Conclusions

The study report includes a lot of useful analysis and data but several factors about the brief, methodology and the summary of results suggest a predisposition to results showing helmets to be beneficial.

In that context, it is a significant outcome that no reliable evidence was found that helmet wearing has reduced risks to cyclists in the real world.

It is also an important outcome that the published evidence commonly used to justify helmet wearing was shown to be unreliable.

Ethics

Misrepresenting the analysis by suggesting without qualification that helmets should be expected to prevent a specified proportion of fatalities is unethical and dishonest as there was no evidence to support such speculation.

Similarly, it is dishonest not to acknowledge that credible evidence does exist that helmets might increase the risk of rotational injury.

Robust, ethical analysis gives precedence to fact over speculation but this is the converse of how the DfT has represented this study.

References



BHRF, 1227

[Child deaths due to cycle helmets.](#)

<http://www.cyclehelmets.org/1227.html>

St Clair and Chinn, 2007

StClair VJM, Chinn BP, 2007. [Assessment of current bicycle helmets for the potential to cause rotational injury.](#) Transport Research Laboratory PPR213. **External Link**

http://www.trl.co.uk/store/report_detail.asp?srid=6190&pid=220

Thompson, Rivara and Thompson, 1996

Thompson DC, Rivara FP, Thompson RS., 1996. [Effectiveness of bicycle safety helmets in preventing head injuries: a case-control study.](#) JAMA 1996 Dec 25;276(24):1968-73. **Link includes commentary.**

<http://www.cyclehelmets.org/1159.html>

Towner et al, 2002

Towner E, Dowswell T, Burkes M, Dickinson H, Towner J, Hayes M, 2002. [Bicycle helmets - a review of their effectiveness: a critical review of the literature.](#) Department for Transport Road Safety Research Report 30. Link includes commentary

<http://www.cyclehelmets.org/1067.html>

The Bicycle Helmet Research Foundation (BHRF), an incorporated body with an international membership, exists to undertake, encourage and spread the scientific study of the use of bicycle helmets. Also to consider the effect of the promotion and use of helmets on the perception of cycling in terms of risk and the achievement of wider public health and societal goals.

BHRF strives to provide a resource of best-available factual information to assist the understanding of a complex subject, and one where some of the reasoning may conflict with received opinion. In particular BHRF seeks to provide access to a wider range of information than is commonly made available by those that take a strong helmet promotion stance. It is hoped that this will assist informed judgements about the pros and cons of cycle helmets.

For more information, please visit www.cyclehelmets.org.

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