

APPENDIX A

Cycle helmet studies: possible explanations for contradictory findings and failures to detect net benefits from helmet use

Contents

About this appendix	2
Introduction	2
1. Possible explanations for contradictory findings / lack of detectable net benefits	4
a. The weakness of case-control studies	4
b. Not accounting for wider trends in head injuries.....	4
c. Attitudes to risk / the ‘risk compensation’ theory	5
Examples of risk compensation theory research.....	6
d. Helmet design issues.....	7
‘Rotational force’ impacts	7
Incorrectly fitted helmets.....	8
Increased size and weight of helmeted head	8
e. Loss of ‘safety in numbers’ effect.....	8
f. Drivers’ behaviour towards helmeted/un-helmeted cyclists	9
2. Critiques of particular evidence	10
a. Thompson & Rivara, 1989 (America)	10
b. Macpherson, et al (Canada).....	11
Later findings from Canada.....	12
c. LeBlanc, et al (Canada)	12
d. Meta-analyses	13
Cochrane reviews, 1999 & 2007	13
Attewell (et al), 2001 and Towner (et al) 2002	13
DfT evidence review, 2010	14
e. Other studies	15

APPENDIX A

Cycle helmet studies: possible explanations for contradictory findings and failures to detect net benefits from helmet use

About this appendix

Many researchers have tried to calculate whether helmet use (compulsory or not) makes a statistically significant difference to the probability (or the severity) of head injuries among cyclists.

The resultant evidence-base, however, is not only extremely convoluted and prolific, but also often contradictory. This appendix investigates possible explanations for this phenomenon.

Introduction

As is clear from our [main briefing](#), many researchers who have examined hospital data over the years have failed to detect net benefits from cycle helmet use and/or have discovered that cyclists' safety has worsened as a result of making helmet-wearing compulsory.

Conversely, others have reported substantial safety benefits.¹

Perhaps the most famous of the earlier, pro-helmet studies is the heavily criticised Thompson & Rivara case-control study from Seattle (1989), which concluded that cycle helmets prevent 85% of head injuries and 88% of brain injuries. (These findings are a particularly good example of questionable methods and are discussed below).

On the other hand, analysis of Western Australia's 1992 mandatory helmet law concluded: "It is fair to say that, so far, there is no convincing evidence that Australian helmet legislation has reduced the risk of head injury in bicycle crashes. It is not clear why the legislation has not been more effective."²

Similarly, a systematic review of evidence from New Zealand, Nova Scotia (Canada) and Australia detected no link between increases in helmet-wearing and improvement in cyclists' safety, concluding: "Before and after data show enforced helmet laws discourage cycling but produce no obvious response in percentage of head injuries".³

Another study by the same author suggests that cyclists who keep riding following helmet legislation may, in fact, be less safe: 44% fewer child cyclists were counted in New South Wales in the second year of the law (1993), but serious and fatal injuries among them

¹ For a list of studies indicating positive results for helmet effectiveness, please see cyclehelmets.org/1147.html

² Robinson, B. [Is there any reliable evidence that Australian helmet legislation works?](#) 1996.

³ Robinson, D. [No clear evidence from countries that have enforced the wearing of helmets](#). British Medical Journal, vol. 332, pp wou722, 2006.

dropped by only 32%, and head injuries specifically by 40%, although many more were wearing helmets (up from 31% to 76% by 1992).⁴

“This suggests”, the author says, “the risk of injury, both to the head and elsewhere, is higher than before the law”.

In Halifax, Nova Scotia, the initial 60%+ reduction in cycle use recovered to a 40%+ reduction in the second year of the law; yet the initial c50% reduction in cyclist hospitalisations bounced back up and, in the second year of the law, total admissions were 6% higher than they had been in the year pre-law.⁵

As for the UK (where, of course, helmet-wearing is not compulsory), one academic found “... no evidence that cycle helmets reduce the overall cyclist injury burden at the population level in the UK when data on road casualties is examined.”⁶

The same researcher also concluded in 2005 that head injury rates among child pedestrians and cyclists in the UK were both falling, but that “the time series are inconsistent with helmet wearing data.”⁷

While others have come to similar conclusions, some researchers still claim that their studies prove that cycle helmets make a positive to cycle safety overall.

Looking at the research available by 2004, the Parliamentary Advisory Council on Transport Safety noted unsurprisingly that: “it is not possible to predict accurately expected injury reduction from increased rates of helmet use; estimates range between 0 and 85%”.⁸

A later review of helmet evidence for the UK Department for Transport in 2010 similarly concluded that it was “impossible to definitively quantify the effectiveness or otherwise of cycle helmets based on the literature reviewed” (for more on this review, see below).

Please refer to the [main briefing](#), section 7, for summaries of various studies on this topic.

⁴ Robinson, D. [Head injuries and bicycle helmet laws](#). Accident Analysis and Prevention, vol. 28, no. 4, pp 463-475, 1996. Table 3.

⁵ LeBlanc, J, et al. [Effect of legislation on the use of bicycle helmets](#). Canadian Medical Association Journal, vol 166 no.5, pp 592-5, 2002.

⁶ Hewson, P. [Cycle helmets and road casualties in the UK](#). Traffic Injury Prevention, vol 6 no. 2 pp 127-134, 2005.

⁷ Hewson, P. [Investigating population level trends in head injuries amongst child cyclists in the UK](#). Accident Analysis & Prevention, vol 37, no. 5, pp 807-815, 2005.

⁸ Parliamentary Advisory Council on Transport Safety. [Cycle helmet use and effectiveness](#). PACTS Parliamentary briefing PB05/04.

1. Possible explanations for contradictory findings / lack of detectable net benefits

a. The weakness of case-control studies

An important problem in this field of research relates to the weaknesses of the 'case-control' approach.

Typically, research into whether cycle helmets are an effective road safety measure is based on hospital data and compares a 'case' group (e.g. cyclists admitted with head injuries) with a 'control' group (e.g. cyclists admitted with non-head injuries), and logs whether they were or were not wearing a helmet at the time (a fact that is, incidentally, not always possible to establish from medical records).

While this kind of approach may be useful in certain medical contexts, robust conclusions heavily depend on identifying the correct controls to reduce the risk of yielding contradictory⁹, implausible¹⁰ or spurious findings. In fact, this is a major concern not just in research relating to cycle helmets but in other fields too.¹¹

Ideally, the case-control and case group must share similar characteristics and similar environments because it helps rule out the possibility that other factors may be influencing the findings.¹²

For cycle helmet researchers this means, for example, matching demographics, riding environments and attitudes to risk. Yet, as illustrated by some of the influential studies highlighted below (Thompson & Rivara, 1989; Macpherson, 2001), this is not always done nor, in fact, is it always possible.

b. Not accounting for wider trends in head injuries

Studies which only consider cyclists are not robust unless they also explore the wider context, i.e. trends in head injuries among other road users or more generally and, in the case of helmet legislation, trends leading up to compulsion.

- One researcher looking at data from New Zealand, for example, found that the percentage reduction in cyclists' head injuries following the 1994 legislation differed very little from the reduction in head injuries across the board. This was despite a very sharp increase in adult and teenage helmet wearing rates.¹³

⁹ For a list of contradictory evidence, see cyclehelmets.org/1052.html.

¹⁰ For example, Shafi, S, et al. [Impact of bicycle helmet safety legislation on children admitted to a regional pediatric trauma center](#). Journal of Pediatric Surgery, vol 33, issue 2, pp 317-321. 1998. This study claimed that helmets provide greater protection against more serious impacts than minor ones.

¹¹ Ioannidis, J. [Contradicted and initially stronger effects in highly cited clinical research](#). Journal of the American Medical Association, vol. 294 no. 2, pp 218-228, 2005.

¹² Tenny, S, et al. [Case Control Studies](#). National Library of Medicine. 2023.

¹³ Perry, N. The bicycle helmet legislation, curse or cure? University of Canterbury, 2001. Not online. Perry re-analysed data used by [Scuffham, P](#) (et al), who concluded that New Zealand's helmet law led to a 19% reduction in head injury to cyclists over its first three years. But, using the same data, Perry produced a graph showing that while helmet-wearing rose sharply and head injuries among cyclists declined, head

- Likewise, a claim that New Zealand’s law reduced head injuries among adult cyclists by 28% has been challenged on the grounds that the authors failed to fit time trends in their model (e.g. what was going on pre-law, or trends for other road users etc.).¹⁴
- Researchers who looked specifically at Alberta (Canada), where a helmet law was introduced for under-18s in 2002, concluded that there were “significant declines in the proportion of child bicyclist ED HIs [emergency department head injuries] and child, adolescent and adult bicyclist HI hospitalizations. This is in contrast to no significant trends in the proportion of ED or hospitalized HIs among pedestrians and the unexpected increases in the proportion of ED HIs for adult bicyclists.” On the back of that, the authors said this “suggests a bicycle helmet legislation effect.”¹⁵ While they did use pedestrians as a control, research by others reveals that in Alberta, as in other provinces, the rate of hospital admissions for cycling-related head injuries per 100,000 person years had been on its way down for some years prior to the law anyway (for both adults and people under 18, but more markedly for adults).¹⁶

c. Attitudes to risk / the ‘risk compensation’ theory

The ‘risk compensation’ theory contends that people typically adjust their behaviour in response to the perceived level of risk, becoming more careful where they sense greater risk and less careful if they feel more protected.

Naturally, this theory is of interest in the debate over how effective helmets/helmet laws may or may not be in terms of road safety. If the theory does apply to cycling, it means that helmeted cyclists may ride less cautiously than un-helmeted cyclists because they feel more protected.¹⁷ This could, in turn, impact how impactful any promotional campaign or legislation is deemed to be.

Inevitably, though, individuals’ perceptions about how much protection cycle helmets offer and how much risk they face – or are prepared to face – when riding are not homogenous.¹⁸

For example, some cyclists feel the need to protect their heads, so willingly buy and wear helmets. They are thus more likely to be inherently ‘risk averse’, tend to ride cautiously, take quieter routes, obey rules etc. Introducing mandatory helmet laws may therefore not

injuries among the control group for the whole population (which included road users and ladder climbers etc) declined to a similar extent. Perry’s graph is reproduced at cycle-helmets.com/helmet-curse.pdf.

¹⁴ Robinson, D. [Changes in head injury with the New Zealand bicycle helmet law](#). Accident Analysis and Prevention vol. 33 pp. 687-691. 2001.

¹⁵ Karkhaneh, M, et al. [Trends in head injuries associated with mandatory bicycle helmet legislation targeting children and adolescents](#). Accident Analysis & Prevention, vol 59, pp 206-212. 2013.

¹⁶ Dennis, J, et al. [Helmet legislation and admissions to hospital for cycling related head injuries in Canadian provinces and territories: interrupted time series analysis](#). BMJ 2013.

¹⁷ Adams J. Risk. UCL Press, London 1995.

¹⁸ Halliday, M et al. Attitudes to cycle helmets – a qualitative study. TRL report 154, 1996.

make much, if any, difference to their riding behaviour (i.e. not make them less averse to risk).

Conversely, those cyclists who choose to ride un-helmeted and will only wear a helmet if pressured into it or forced to do so by promotional campaigns, peer pressure or the law, are more likely to be and remain 'risk tolerant'. It may be that, if they continue to cycle and start to wear a helmet, they will 'risk compensate' and indulge in yet riskier behaviour.

Indeed, the difference between early (voluntary) and later (involuntary) helmet adopters might partially account for findings to suggest that, in casualty terms, helmet laws become less effective as time goes on (i.e. because, over time, helmet wearers may include a higher proportion of cyclists prepared to put themselves in hazardous situations).

As one author says: "Often, one would expect that technological innovation made a safety measure more effective over time. As far as bicycle helmets are concerned, however, the opposite appears to be the case."¹⁹

Given this, it is important for researchers not to conflate voluntary with involuntary helmet-wearers – unfortunately, some of them do exactly this.²⁰

Examples of risk compensation theory research

Research in the risk compensation field is based largely on computer simulation tasks or direct observation, usually as part of an organized experiment. The results are in themselves inconsistent:

- In 2016, researchers in the UK concluded that wearing a cycle helmet increases risk-taking and sensation-seeking in adults. This finding was based on an experiment in which participants wore either a baseball cap or a cycle helmet while completing a computer simulation of risk-taking activities (they were not told the real reason for their headgear).²¹
- An earlier paper found evidence of moderate risk-compensation among male cyclists, but not among females, and concluded this was "unlikely to offset helmet preventive efficacy"²² (Note that this research has been subject to (pro-helmet) criticism in another paper²³).
- Researchers, who asked 27 participants to cycle downhill with only one hand on the handlebars, observed whether wearing or not wearing a helmet changed their cycling behaviour and "psychophysiological load". There was no significant change in speed (the researchers' proxy for risk) among non-routine helmet users, but routine users "cycled more slowly and demonstrated increased psychophysiological

¹⁹ Elvik, R. [Publication bias and time-trend bias in meta-analysis of bicycle helmet efficacy: A re-analysis of Attewell, Glase and McFadden, 2001](#). Accident Analysis and Prevention, vol 43, issue 3, pp 1245-1251.

²⁰ For example, a paper published in Transportation Research Part F, [Bicycle Helmets and risky behaviour: A systematic review](#) (Esmaelikia, M et al, 2019), which reviewed 23 studies on the topic, fails to distinguish between voluntary helmet wearers and those who are forced to wear one.

²¹ Gamble, T & Walker, I. [Wearing a Bicycle Helmet Can Increase Risk Taking and Sensation Seeking in Adults](#). Jan 2016. Psychological Science, vol 27, issue 2. 2016.

²² Messiah, A, et al. [Risk compensation: a male phenomenon? Results from a controlled intervention trial promoting helmet use among cyclists](#). American Journal of Public Health. 2012 May;102 Suppl 2:S204-6.

²³ Radun, I. et al. [Risk compensation and bicycle helmets: A false conclusion and uncritical citations](#). 2018.

load” when riding helmetless. Given this, the authors could not rule out the possibility that “... helmet laws may increase cycling speed among certain cyclists”. They also found, however, that whether their participants normally wore helmets or not, “Cycling with a helmet did not lead to increased speed, or to changes in emotional reactions as would have been expected from a risk compensation perspective.” (This may have been because most of the subjects (23/27) were female and, arguably, more risk adverse than males – meaning that the authors could not be sure if their results would have been different had more males participated).²⁴

- Wondering whether non-routine wearers’ behaviour would change if given more time to get used to a helmet, the same researchers later asked a group of 30 of them to cycle downhill with and without a helmet and then, after 1-1.5 hours of helmet ‘habituation’, to do the same again. Although their speed did not decrease significantly when riding helmetless, they said they felt less safe. Despite this, and the fact that the habituation period was extremely short, the authors concluded that risk-compensation is irrelevant to the helmet legislation debate.²⁵
- A German study suggests that people who voluntarily wear helmets do take a precautionary attitude to risk. The researchers examined data from cyclists in ‘naturalistic’ conditions, all of whom were at liberty to decide for themselves if and when to wear a helmet. They did not find that their subjects rode any faster when helmeted, but that they were more likely to wear a helmet on longer trips, which were associated with higher speeds (possibly because they were cycling for sport or recreation). (Incidentally, the authors also speculated that it would be better to look at risky manoeuvres rather than speed in risk compensation studies).
- Risk compensation has been observed in people engaging in other physical activities: a randomised controlled clinical trial looking at American footballers concluded: “Helmetless tackling eliminates the false sense of security a football player may feel when wearing a helmet.”²⁶
- The phenomenon has also been observed in young children asked to run through an obstacle course once while wearing safety gear (helmet and wrist guards), and once without the gear. When wearing safety gear, they ran more quickly and behaved more recklessly.²⁷

d. Helmet design issues

‘Rotational force’ impacts

Some evidence suggests that for some users and in certain circumstances, use of standard cycle helmets may increase the risks of brain injuries due to ‘rotational force’

²⁴ Fyhri, A & Phillips, R. [Emotional reactions to cycle helmet use](#). Accident Analysis & Prevention, vol 50, pp 59-63. 2013.

²⁵ Fyhri, A, et al. [Risk compensation theory and bicycle helmets – Results from an experiment of cycling speed and short-term effects of habituation](#). Transportation Research Part F: Traffic Psychology and Behaviour, vol. 58, pp 329-338. 2018.

²⁶ Swartz, E, et al. [Early Results of a Helmetless-Tackling Intervention to Decrease Head Impacts in Football Players](#). Journal of Athletic Training. 2016.

²⁷ Morongjello, B, et al. [Understanding children's injury risk behavior: wearing safety gear can lead to increased risk taking](#). Accident Analysis and Prevention, vol.39(3) pp 619-23. 2007.

impacts (i.e. those which effectively cause the brain to rotate within the skull on impact, causing subdural haematoma or diffuse axonal injury, two of the most common causes of very serious brain injuries that may be fatal or result in permanent disability).²⁸

Various mechanisms for helmets have now come onto the market claiming to reduce the risk of rotational brain injuries, but the applicable standards do not make these mechanisms requisite. (Please see main briefing for more about helmets and rotational motion).

Incorrectly fitted helmets

Some consumers may be more interested in comfort and/or look than in buying a helmet that is designed to fit their size of head. This is important because people with heavier heads, for instance, need to buy a helmet that is capable of absorbing more energy.

Moreover, some cycle helmet 'retention systems' (i.e. straps and clips) may be poorly designed and/or fiddly, making it difficult to fit and wear helmets correctly.²⁹

The need to wear a helmet properly is widely recognised by all protagonists in the helmet debate (indeed it is one of the few issues on which there is universal agreement). Yet this is difficult to achieve in practice: one American study found that only 4% of the 478 children examined had fitted their helmet correctly, and not one parent out of 52 in the study was able to fit their child's helmet correctly.³⁰

Increased size and weight of helmeted head

The increased size, weight or even the temperature of the head may also be another factor that helps explain the lack of detectable net benefits from helmets. Indeed, it has been suggested that glancing blows to a head that has been effectively enlarged by a helmet could lead to some very serious brain or spinal injuries, in situations where an unhelmeted head would have suffered a mere glancing blow or not been hit at all.³¹

e. Loss of 'safety in numbers' effect

If fewer people cycle as a result of helmet laws (as is very likely – see main briefing), those who do continue to cycle may lose the benefits afforded by the 'safety in numbers' effect. Again, this might also help explain the possible link between increased helmet use and increases in the risks to cyclists of both head and non-head injuries.

For more, see Cycling UK's [Safety in Numbers](#) webpage.

²⁸ St Clair, V & Chinn, B. [Assessment of current bicycle helmets for the potential to cause rotational injury](#). TRL Project Report PPR213, 2007.

²⁹ Walker, B. [Helmet standards and capabilities](#). Bicycle Helmet Research Foundation, 2004.

³⁰ Parkinson, G/ Hike, K.E. [Bicycle helmet assessment during well visits reveals severe shortcomings in condition and fit](#). Pediatrics, vol. 112 issue 2, pp 320-323, 2003.

³¹ Curnow, W. [The efficacy of bicycle helmets against brain injury](#). Accident Analysis and Prevention, vol. 35 pp 287-292, 2003.

f. Drivers' behaviour towards helmeted/un-helmeted cyclists

Research implies that drivers who come across cyclists wearing helmets tend to leave less space when overtaking them than when they overtake those without a helmet.³² This could be a form of 'risk compensation', i.e. assuming that a helmeted cyclist is less vulnerable, so requires less care.

Later research (2023) even suggests that drivers tend to perceive cyclists with helmets as less human compared to those without. It is not impossible, the authors say, that this could alter their behaviour towards them, given the association between levels of cyclist dehumanisation and dangerous driving behaviour.³³

³² Walker, I. [Drivers overtaking bicyclists: Objective data on the effects of riding position, helmet use, vehicle type and apparent gender](#). Accident Analysis & Prevention, vol. 39, Issue 2, pp 417-425. 2007. Note: Walker's conclusion was disputed by Olivier and Walter in 2013, but defended by the author and Dorothy Robinson in February 2019 – see [Bicycle helmet wearing is associated with closer overtaking by drivers: A response to Olivier and Walter](#), 2013.

³³ Limb, M / Collyer, S. [The effect of safety attire on perceptions of cyclist dehumanisation](#). Transportation Research Part F: Traffic Psychology and Behaviour, vol 95, pp 494-509. 2023.

2. Critiques of particular evidence

a. Thompson & Rivara, 1989 (America)

Failing to account for different riding environments and different attitudes to risk is well-illustrated by a case-control study, Thompson and Rivara, 1989.

Based on data from five hospitals and a 'health maintenance organisation' in America, this research concluded that helmets could prevent 85% of head injuries and 88% of brain injuries.³⁴

Other researchers, however, pointed out that the helmet-wearers were more likely to be white, affluent and cycling in parks (i.e. a relatively low-risk environment), while the non-wearers were more likely to be from lower-income ethnic minority groups and riding on busy streets (i.e. a relatively high risk environment).³⁵

In short, it is not surprising that the latter were more likely to be hurt, but their helmet-wearing habits may well have little or nothing to do with it.

Also, in the USA context, people from affluent backgrounds are more likely to have health insurance, and thus more likely to go to hospital following relatively minor injuries, whereas groups without insurance are more likely to go to hospital only if their injuries are serious.

As discussed above, willing helmet-wearers are probably more safety-conscious, averse to risk and therefore try to avoid situations where more serious injuries might occur.

It is therefore very likely that the results of the Seattle study, and others like it, are due less to helmets than to the differences between the people who do and don't wear them, the types of cycling they do and where they cycle.

Nevertheless, Thompson & Rivara's paper was cited for several years in America, the UK and elsewhere, even though another researcher used the same data and methodology to demonstrate that it could equally (and implausibly) show that helmets prevent 77% of injuries to parts of the body other than the head.³⁶

³⁴ Thompson, R, et al. [A case control study of the effectiveness of bicycle safety helmets](#). New England Journal of Medicine, 1989 v320 n21 p1361-7. 1989. Commentary at www.cyclehelmets.org/1068.html and www.cyclehelmets.org/1131.html.

³⁵ Studies repeatedly confirm that people on lower incomes, living in deprived area or from racial minority groups are far less likely to wear helmets, while they – especially children – face significantly higher risks of road injury. See:

-Macpherson, A, et al. [Economic disparity in bicycle helmet use by children six years after the introduction of legislation](#). Injury Prevention, vol. 12, pp. 231-235, 2006. Commentary at cyclehelmets.org/1178.html

-DiGuseppi, C, et al. [Bicycle helmet use by children: evaluation of a community wide helmet campaign](#). Journal of the American Medical Association, vol. 262 pp2256-226, 1989.

-D, Kendrick D & Royal, S. [Inequalities in cycle helmet use: cross sectional survey in schools in deprived areas of Nottingham](#). Archives of Disease in Childhood, vol. 88 pp876-880, 2003.

-White, D, et al. [Road accidents and children living in disadvantaged areas: a literature review](#). Scottish Executive Research Unit, 2000.

-Edwards, P, et al. [Serious injuries in children: variation by area deprivation and settlement type](#). Archives of Disease in Childhood, vol. 93 pp485-489, 2008.

³⁶ Robinson, D. [Head injuries and helmet laws in Australia and New Zealand](#). Bicycle Helmet Research Foundation. 2012.

But, in 2013, following representations from the Washington Area Bicyclists Association (WABA), the US Department of Transportation (DoT) agreed to stop citing its 85% claim in materials disseminated through its website.³⁷

b. Macpherson, et al (Canada)

Countering claims that helmet laws put children off cycling, Macpherson (et al) suggested in 2001 that Ontario's helmet law for under-16s had increased helmet wearing rates without reducing cycle use: "Contrary to the findings in Australia, the introduction of helmet legislation did not have a significant negative impact on child cycling in this community."³⁸

This claim, however, was based on a study conducted in an affluent district of Toronto, i.e. amongst children who were more likely to be wearing helmets anyway.

It seems, moreover, that the law was not enforced,³⁹ which probably explains why a later study by Macpherson et al (2006), showed that helmet use had risen only temporarily, falling back to pre-law levels within two years of the law's passing, while cycle use had done the opposite (i.e. it had initially fallen, despite Macpherson's denials), then recovered as cycle helmet use fell back.⁴⁰

Macpherson's count data for the 2001 study were also criticised for being unreliable because they did not control for variations in the time of year, weather etc., thus compromising the validity of before and after comparisons.⁴¹

Furthermore, her team had also collected data, which they did not publish, for three years prior to the law. During this time, the population was subject to a strong helmet promotion campaign, which could have reduced cycle use in the run-up to the legislation itself – a possibility that the unpublished data may have demonstrated.

Macpherson's 2001 paper nevertheless made an impact on the British Medical Association's (BMA) policy on cycle helmets. In 2004, it reversed its decision to support helmet promotion but not laws and, in doing so, cited Macpherson's paper.⁴² The BMA has since withdrawn the paper which justified its change of policy, but (at the time of writing) has so far not reconsidered the policy itself.⁴³

Another paper appeared from Macpherson et al in 2002. After comparing head and non-head injuries to child cyclists hospitalised in Canadian states with and without helmet laws respectively, the authors concluded that laws were beneficial because, in states that had introduced them, head injuries had declined more steeply relative to non-head injuries.⁴⁴

³⁷ For more on this, see: [WABA blog](#) and [US DoT's letter](#) confirming the correction, 14/5/2013.

³⁸ Macpherson, A et al. [Mandatory helmet legislation and children's exposure to cycling](#). Injury Prevention, vol 7, pp 228-230. 2001.

³⁹ [cyclehelmets.org/1105.html](#)

⁴⁰ Macpherson, A et al. [Economic disparity in bicycle helmet use by children six years after the introduction of legislation](#). Injury Prevention, vol 12, pp 231-235. 2006

⁴¹ Robinson, D. [Helmet laws and cycle use](#). Injury Prevention, vol. 9 pp. 380-381. 2003.

⁴² BMA Board of Science. Legislation for the compulsory wearing of cycle helmets. BMA 2004, now withdrawn. For critiques see [cyclehelmets.org/1101.html](#).

⁴³ BMA. [Policy Book](#) (accessed 2023).

⁴⁴ Macpherson, A, et al. [Impact of mandatory helmet legislation on bicycle-related head injuries in children: a population-based study](#). Pediatrics, vol. 110(5), p60. 2002.

However, the proportion of cycling injuries which were head injuries continued to decline even after the downturn in helmet use recorded in her 2006 paper, while the differences in injury trends between states with and without laws were as evident for pedestrian injuries as for cycling injuries. Hence, Macpherson's attempt to link increases in helmet use with a reduction in the proportion of cyclist injuries which were head injuries cannot be considered valid.

Later findings from Canada

Research published in the British Medical Journal (BMJ) in 2013 concluded that making helmets compulsory in certain Canadian provinces had minimal impact on reducing the rate of admissions to hospital for cycling-related head injuries. Injury rates, the authors say, were already going down in the provinces that had introduced compulsion "and the rate of decline was not appreciably altered on introduction of legislation."⁴⁵

Similarly, a paper published in 2015, also in the BMJ, which looked at hospital admission rates (2006-2011) for cycle-related injuries in Canadian jurisdictions with different helmet laws found: "Helmet legislation was not associated with reduced hospitalisation rates for brain, head, scalp, skull or face injuries, indicating that factors other than helmet laws have more influence on injury rates."⁴⁶

c. LeBlanc, et al (Canada)

In 2002, LeBlanc (et al) published a paper claiming that Nova Scotia's helmet law had been success: "The rate of helmet use rose dramatically after legislation was enacted, from 36% in 1995 and 38% in 1996, to 75% in 1997, 86% in 1998 and 84% in 1999. The proportion of injured cyclists with head injuries in 1998/99 was half that in 1995/96 (7/443 [1.6%] v. 15/416 [3.6%]) (p = 0.06)."⁴⁷

Other authors, however, pointed out that this same paper presented cycle count data showing an initial reduction of 60%+ in the numbers of cyclists in the year the law came in, and a slight recovery to 40% the year after – by which time the number of cyclists hospitalised was higher than before the law.^{48, 49}

⁴⁵ Dennis, J, et al. [Helmet legislation and admissions to hospital for cycling related head injuries in Canadian provinces and territories: interrupted time series analysis](#). BMJ. 2013.

⁴⁶ Teschke, K, et al. [Bicycling injury hospitalisation rates in Canadian jurisdictions: analyses examining associations with helmet legislation and mode share](#). BMJ. 2015.

⁴⁷ LeBlanc, J, et al. [Effect of legislation on the use of bicycle helmets](#). Canadian Medical Association Journal, vol 166 no.5, pp 592-5. 2002.

⁴⁸ Chipman, M. [Hats off \(or not?\) to helmet legislation](#). Canadian Medical Association Journal, vol. 166 (5), p. 602. 2002.

⁴⁹ Wardlaw, M. [Butting heads over bicycle helmets](#). Canadian Medical Association Journal, vol. 167 (4), pp 337-338. Wardlaw remarks: "No reduction has occurred in the risk of head injury per cyclist, relative to this study's loose definition of head injury. However, a big increase has occurred in the risk of non-head injury per cyclist. Furthermore, there has been no material increase in the number of helmeted cyclists. Rather, cycling on a substantial scale has been deterred. The deterrence of the safest mode of urban transport will not contribute to overall road safety or public health."

d. Meta-analyses

As in most fields of research, it is common for academics to systematically assess the results of previous studies and, on the basis of this process, attempt to come to conclusions about the topic in question.

In the case of cycle-helmet research, this type of study, or meta-analysis, usually concludes that helmets are effective in preventing injury (or certain types of injury). Given the weaknesses and limitations of so much of the base material, however (as discussed above), meta-analyses themselves must be viewed with caution.

The following considers a few examples of meta-analyses, and points to some others.

[Cochrane reviews, 1999 & 2007](#)

Cochrane reviews are normally regarded as a benchmark of objectivity in meta-analysis of medical evidence, but two reviews examining the effectiveness of cycle helmets are not robust.

The first Cochrane review (1999),⁵⁰ which considered evidence on the effectiveness of helmets, was limited to ‘case-control’ studies, thereby eliminating any consideration of population-level evidence, such as that presented in papers by Robinson or Hewson (see above; see also section on the limitations of case-control studies). Moreover, it was conducted by the same authors who had produced four of the eight head injury studies they were reviewing.⁵¹

A second Cochrane review (2007),⁵² by Macpherson and Spinks, looked specifically at evidence on the impact of helmet laws and concluded that helmets were beneficial but found no reliable evidence to determine whether helmet laws might reduce cycle use. However, they omitted to consider Robinson’s 2006 BMJ paper, which would have provided that evidence.⁵³ (Note: Macpherson was not an unbiased commentator, having previously authored several papers advocating helmet laws).

[Attewell \(et al\), 2001 and Towner \(et al\) 2002](#)

Meta-analyses by Attewell (et al) 2001⁵⁴ and Towner (et al) 2002⁵⁵ (the latter being an evidence-review commissioned by the UK Department for Transport) likewise restricted their scope to ‘case-control’ studies, hence it is unsurprising that they too concluded that

⁵⁰ Thompson, D, et al. [Helmets for preventing head and facial injuries in bicyclists](#). Cochrane Database Syst Rev. 1999.

⁵¹ For further commentary on this Cochrane review, see. Curnow, W, [The Cochrane Collaboration and bicycle helmets](#). Accident Analysis & Prevention, Vol 27, issue 3 pp. 569-573. 2005, and www.cyclehelmets.org/1069.html .

⁵² Macpherson, A & Spinks A. [Bicycle helmet legislation for the uptake of helmet use and prevention of head injuries](#). Cochrane Database of Systematic Reviews, Issue 3. Art. No.: CD005401, 2007. For commentary see www.cyclehelmets.org/1181.html .

⁵³ Robinson, D. [Do enforced bicycle helmet laws improve public health?](#) 2006. (BMJ).

⁵⁴ Attewell, R et al. [Bicycle helmet efficacy: a meta-analysis](#). *Accident Analysis & Prevention*, vol. 33 no. 3 pp345-52, 2001.(Criticised by Curnow W, 2003 and by Elvik R, 2011).

⁵⁵ Towner, E et al. [Bicycle helmets - a review of their effectiveness: a critical review of the literature](#). Department for Transport, Road Safety Research Report RSRR30. 2002. For commentary see www.cyclehelmets.org/1067.html.

the evidence suggested helmets were beneficial – although Towner acknowledged that helmet laws could reduce cycle use.

However, a paper by Elvik found that early results – including the Attewell analysis and the Cochrane review of helmet effectiveness (and updates of it) – had significantly overstated the protective value of helmets. It also found that helmets may increase the risk of neck injuries.⁵⁶ (Note: Elvik’s findings have been questioned by Olivier ⁵⁷).

[DfT evidence review, 2010](#)

In 2010, the UK Department for Transport attempted to ‘settle’ the helmet question with another evidence review.⁵⁸

Having identified flaws in all the case-control evidence and hence the meta-analyses of that evidence, the researchers concluded that it was “impossible to definitively quantify the effectiveness or otherwise of cycle helmets based on the literature reviewed”.

They also identified weaknesses in the evidence of Robinson **Error! Bookmark not defined.** and Hewson,^{6,7} noting that they too had employed study designs which left open the possibility of confounding factors (and hence possibly to flawed conclusions). Hewson himself acknowledged this point in both his papers, noting that the absence of a detectable helmet benefit does not rule out the possibility that an effect may exist, perhaps for particular groups of cyclists and/or for particular types of cycling.

Notwithstanding, the authors of the DfT review did not explain why they assumed that helmets must have some benefits in preference to taking on board Robinson’s contention that there is lack of detectable benefits (e.g.: that reductions in head injuries might be due to reductions in cyclist numbers and the consequent loss of the ‘safety in numbers’ effect for the cyclists who remain; and/or that some helmet-wearing cyclists might be more prone to being involved in collisions in the first place e.g. due to ‘risk-compensation’).

The most notable feature of the DfT study, however, was a claim that: ‘A specialist biomechanical assessment of over 100 police forensic cyclist fatality reports predicted that between 10 and 16% of the fatalities could have been prevented if they had worn an appropriate cycle helmet’. This finding was strongly criticised by Cycling UK (then CTC), Sustrans and other members of the study advisory panel, on the following grounds:

- The 10-16% figure was based solely on notional estimates of the effectiveness of helmets in impacts with the ground (50%) and with motor vehicles respectively (10-30%). However, the authors noted that they had “no specific evidence to support these estimates” (p37).
- The fatalities considered were not randomly selected and were acknowledged not to be representative of cyclist fatalities in general (p34).
- The study focused on “whether cycle helmets reduce the frequency and severity of injury **in the event of a collision**” (page vi, emphasis in the original – n.b. this acknowledgement was only added at Cycling UK’s insistence). The

⁵⁶ Elvik, R. [Publication bias and time-trend analysis of bicycle helmet efficacy](#). 2011.

⁵⁷ Olivier, J, et al. [Anti-helmet arguments: lies, damned lies and flawed statistics](#). 2014.

⁵⁸ Hynd, D, et al. [The potential for cycle helmets to prevent injury - a review of the evidence](#). TRL research report PPR 446, 2009.

study, and especially the 10-16% estimate, took no account of the possibility that helmets may increase the risk to cyclists of having a head impact in the first place. (A paper from 2007⁵⁹ cited evidence of increased ‘accident risk’ per cycling-km for cyclists wearing a helmet, estimated to be around 14% in Australia and New Zealand. This would therefore approximately cancel out a 10-16% benefit even if it were to prove correct (despite the lack of evidence supporting it).

Note:

The DfT has no intention of making cycle helmets compulsory. For example, on 5 December 2022, Jesse Norman (then Minister of State for the DfT) stated in response to a parliamentary question:

“The Department considered this matter at length in a comprehensive cycling and walking safety review in 2018 and held discussions with a wide range of stakeholders as part of that review. The safety benefits of mandating cycle helmets for cyclists are likely to be outweighed by the fact that this would put some people off cycling, thereby reducing the wider health and environmental benefits. The Department recommends that cyclists should wear helmets, as set out in The Highway Code, but has no intention to make this a legal requirement.”⁶⁰

e. Other studies

For further meta-analyses, see:

- Bicycle Injuries and helmet use: a systematic review and meta-analysis published in the International Journal of Epidemiology (2016).⁶¹
- Recommend or mandate? A systematic review and meta-analysis of the effects of mandatory helmet legislation (2018).⁶²
- Effectiveness of bicycle helmets and injury prevention: a systematic review of meta-analyses (2023).⁶³

⁵⁹ Erke, A & Elvik, R. [Making Vision Zero real: preventing pedestrian accidents and making them less severe](#). TØI (Institute for Transport Economics) report 889/2007, p28. Oslo, 2007.

⁶⁰ [Hansard](#).

⁶¹ Olivier J & Creighton, P. [Bicycle injuries and helmet use: a systematic review and meta-analysis](#). International Journal of Epidemiology. Sept 2016.

⁶² Hoyer, Alena. [Recommend or mandate? A systematic review and meta-analysis of the effects of mandatory helmet legislation](#). Accident Analysis & Prevention, vol 117, pp 85-97. 2018.

⁶³ Büth, C, et al. [Effectiveness of bicycle helmets and injury prevention: a systematic review of meta-analyses](#). Scientific Reports 13, Article number: 8540. 2023. This study says that, on the basis of the papers examined: “The empirical evidence based on the real-world hospital and police data as well as biomechanical studies confirms that wearing a helmet while cycling is beneficial, regardless of age and crash severity, in collisions with others or not.” The authors also say, however: “Although the current study broadens the understanding of the effectiveness of bicycle helmets and evaluates the findings in the societally relevant contexts, the study has its limitation. First, because it has a strict review criterion it takes in consideration only a limited number of former meta-studies. Second, the studies included are not geographically representative and due to the data collection restrictions in some parts of the world, the availability of meta-analysis is scarce. Lastly, despite that fact that the authors attempted to investigate bicycle related crashes from multiple perspectives, the nature and the occurrence of cycling crashes and the role that helmet use plays is very complex, location specific and therefore difficult to capture.”