Cycle helmets: An overview of the evidence

This briefing sets out the case, backed by evidence, for not making cycle helmets compulsory in law or the subject of promotional campaigns. For Cycling UK's formal policy on cycle helmets, see: www.cyclinguk.org/campaigning/views-and-briefings

Key points:

- Cycling is hugely beneficial to people's health. Those who cycle regularly in mid-adulthood have a level of fitness equivalent to being ten years younger, and have a life expectancy two years above the average.
- By contrast, the risks of cycling are not exceptionally high, and are very small relative to the health benefits. You are in fact as unlikely to be killed in a mile of cycling as in a mile of walking. The Government has endorsed estimates that the health benefits outweigh the risks of cycling on Britain's roads by a factor of 20:1 (n.b. estimates from other countries place this ratio higher still).
- Given the 20:1 ratio, telling people to wear helmets would result in a net increase in early deaths (due to physical inactivity etc.) if more than one person were deterred from cycling for every 20 who continue, even if helmets were 100% effective at preventing ALL cycling injuries (i.e. not just head-only injuries).

  Once you factor in the proportion of serious and fatal cycling injuries that are not head-only injuries, and the at-best limited protection that helmets could provide (they are and only can be designed to withstand minor knocks and falls, not collisions with fast-moving cars or lorries), it can be shown that it only takes a fraction of a percentage point reduction in cycle use for pro-helmet policies to shorten a lot more lives than they could possibly save.
- In practice, the experience of enforced helmet laws is that cycle use typically falls by at least 30%, and more among teenagers. The resulting loss of cycling's health benefits alone (regardless, that is, of its environmental, economic and societal benefits) is very much greater than any possible injury prevention benefit.
- There is in any case a good deal of controversy about the effectiveness of helmets. As mentioned, they are (and can only be) designed for minor knocks and bumps, not collisions with fast cars or lorries. There is also evidence that: some cyclists ride less cautiously when wearing them; that drivers leave less space when overtaking helmeted cyclists than those without; that helmeted cyclists suffer 14% more collisions per mile travelled than non-wearers; and that helmets increase the risk of neck injuries. It is therefore entirely possible that helmet-wearing might have a net disbenefit even in safety terms (a point also suggested by some of the empirical evidence), not to mention the health and other disbenefits identified above.
- There is plenty of evidence that cycling gets safer the more cyclists there are. Denmark and the Netherlands are good examples of this 'safety in numbers' effect, yet very few people in those countries wear helmets. The emphasis should be on maximising the benefits of more as well as safer cycling, through measures such as 20 mph speed limits, better designed roads and junctions, good cyclist and driver training, tougher and better-enforced road traffic law, and tackling the threats from lorries. By contrast, telling people to wear helmets merely drives them into increasingly car-dependent and sedentary lifestyles. This would shorten far more lives than cycling does, while undermining the 'safety in numbers' effect for those cyclists who remain.

1. Introduction

Cycling UK is not 'anti-helmet', and does not take sides on whether or not it is a good idea for individual cyclists to wear them. However, there is strong evidence that enforced helmet laws result in a substantial loss of the health and other benefits of cycling, without compensating benefits for cyclists' safety that would justify this. We also believe that there are better ways to improve cyclists' safety, and that the police service has more important priorities, including a stronger emphasis on traffic policing to improve road safety for everyone.

The evidence below shows why cycle use is likely to fall if legislation is introduced. We also highlight key groups, including socially excluded groups, who could be adversely affected if legislation goes ahead. Compulsion could also discriminate against members of minority racial and ethnic groups and against those who hold certain religious beliefs.

This briefing also weighs up the potential health costs and benefits of compulsion, and examines whether helmet legislation is a proportionate measure in the light of the low actual risk of serious injury or death in a cycle collision.

Finally, this briefing reviews the evidence on the causes of cycling injuries, and concludes that cycle safety could be more effectively improved if high quality cycle training were available to all children, and investment made in measures that seek to create safe, attractive cycling conditions, including 20 mph speed limits on residential roads. These measures would also have the added benefit of increasing, rather than reducing, cycling levels.

2. Cycle helmet legislation: the impact on cycle use

a. The benefits of cycling

Cycling has a wide range of benefits for our personal health, our neighbourhoods, quality of life and the environment. It is also good for the economy. The health benefits specifically are discussed further in section 3 below. For more on the benefits of cycling for the economy, and local and national transport, see our series of briefings at: www.cyclinguk.org/campaignsbriefings

b. Reductions in cycle use due to helmet laws

Evidence from Australia and New Zealand suggests that large numbers of cyclists will be deterred from cycling by helmet legislation. In particular, there is specific evidence that helmet legislation has reduced cycling in the following groups of people:

- Cycle commuters
- Children cycling to school
- Teenage cyclists

Fewer cycle commuters and children cycling to school is of particular concern because utility cycle trips, if stopped, are unlikely to be substituted by other forms of exercise and, in addition, are likely to be replaced with car journeys. This will contribute to rising levels of obesity, and have an economic cost (in terms of increased congestion) and an environmental cost (through increased pollution).

Helmet laws, where enforced, have consistently led to substantial reductions in cycle use.[1] Reductions in the year following helmet laws include:

- a 36% reduction in New South Wales (29% among adults, 42% among children and as much as 90% among female secondary school pupils in Sydney);[2]
- a 36% reduction among child cyclists in Melbourne (including a markedly steeper reduction of 44% among teenagers);[3]
- a 20% reduction in Perth (continuing to 30-40% below pre-law levels after three years[4]) and more than a 60% reduction in Nova Scotia[5]).

Helmet laws elsewhere have had similar results.[6] Having looked at the evidence, NACTO (the National Association of City Transportation Officials) in the US, states: *"The impact of mandatory adult helmet laws on bike share and general bike ridership is large and negative."* It also says: *"In Seattle, the only U.S. city with a mandatory helmet law [i.e. city with a bike share scheme as well], bike share ridership has been well below expectations, less than one ride per bike per day."*[7]

c. Children and teenagers

The evidence also suggests a particularly strong deterrent effect among teenagers, a key target group for efforts to encourage physical activity. If children can be persuaded to keep cycling as teenagers, the habit will probably last into their adult years. Conversely, those deterred from cycling as teenagers are much less likely to pick up the habit again.

Recreational cycling, mainly amongst adults, has recovered in some countries or states, but where the law is kept enforced, cycle use remains low. This is particularly the case for children and/or for day-to-day journeys (e.g. for school or commuter travel).

Following the introduction of a helmet law in 1994, cycling trips in New Zealand initially fell by 26%, but continued falling to 51% below their pre-law levels by 2006.[8] Estimates suggest that around 136,000 adults and children there – nearly 4% of the total population – stopped cycling in the immediate aftermath of the legislation, 47,000 being teenagers (13-17 years).[9]

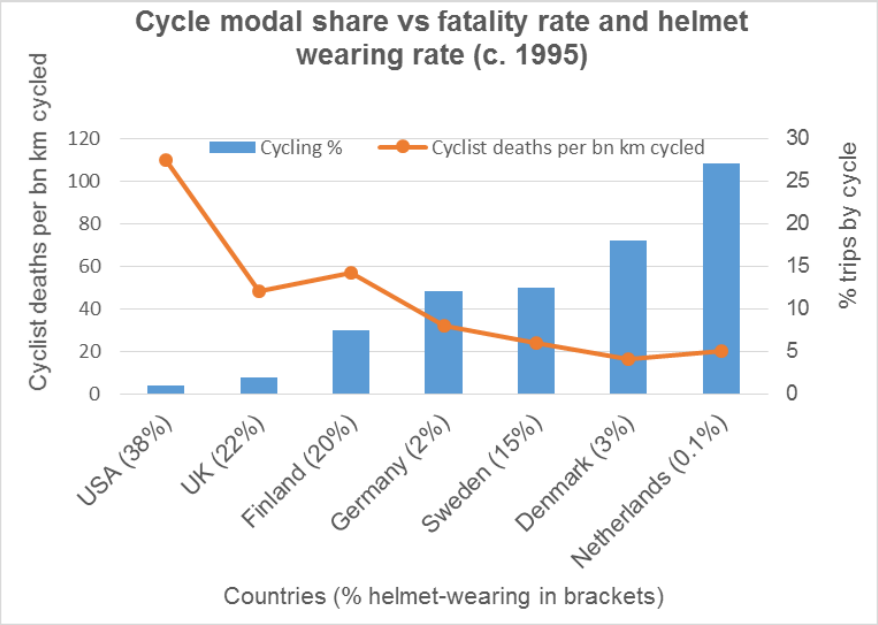
There is also evidence of sharp falls in cycle use among young people in the immediate aftermath of the introduction of legislation in New South Wales and Melbourne in Australia. In New South Wales, the law came into effect in January 1991 for adults and in July 1991 for children. Figures from a major study, involving pre-law and post-law counts at 120 locations, showed that there was a 49% fall in under 16-year-old cyclists counted at road intersections, and a 48% drop in child cyclists counted at school gates between 1991 (pre-law) and 1993. There was also a smaller but still significant 32% fall in recreational areas.[10] Thus, the greatest deterrent effect appears to have related to utility cycle trips made by children.

In Victoria State, which includes Melbourne, a cycle helmet law was introduced in July 1990. Another major study, involving counts at 64 locations in Melbourne, found that there was a 43% drop in cycle usage amongst teenagers (12 – 17 year-olds) by 1991, and 45% by 1992, despite the fact that their numbers had been rising prior to the introduction of the law.[11]

d. Safety in numbers

By contrast, three western countries with some of the highest rates of cycling have relatively low levels of cycle helmet wearing. In the Netherlands, 27% of all journeys are carried out by bike and less than 1% of cyclists wear helmets. In Denmark, the proportion of journeys made by bike is 18%, and less than 5% of adults wear helmets. In Germany, 10% of trips are carried out by bike, and just 2% of adults wear helmets.[12]

The graph below is one of many examples of the 'safety in numbers' effect – the more cyclists there are, the safer it is to cycle.[13] [14] There is also evidence that the converse is also true, i.e. reductions in cycle use are associated with worse cycle safety.[15]



High cycle use is related to a low cycle injury rate, despite low helmet-wearing rates in countries like Denmark and the Netherlands. The opposite applies in countries like the UK and USA. Note the similarities with the cycle use and obesity graph shown later.

e. The effects of helmet promotion campaigns

There is also evidence that even the voluntary promotion of helmet wearing may reduce cycle use. Research commissioned by the UK Department for Transport found that, in areas where a helmet campaign was held, *"a larger increase in helmet wearing was found than in the areas which had not held such a campaign. However, this increase was found to be strongly linked to a decrease in the numbers of cyclists observed: in those areas where a campaign had been held and the numbers of cyclists had increased, helmet wearing fell"*.[16]

Similarly, a report for the European Conference of Transport Ministers (ECMT) noted that: *"From the point of view of restrictiveness, even the official promotion of helmets may have negative consequences for bicycle use, and that to prevent helmets having a negative effect on the use of bicycles, the best approach is to leave the promotion of helmet wear to manufacturers and shopkeepers"*.[17]

Equally, any pre-law helmet promotion campaign might serve merely to reduce cycle use even before the legislation comes into effect, rather than afterwards. Indeed, this may well have happened in the case of Canada's helmet laws. As the next section shows, there could still be very serious negative public health impacts from such a campaign, far greater than any possible benefits.

Even picturing helmets on marketing materials designed to promote and encourage cycling appears to have an adverse impact too: Danish research found that images of cyclists wearing helmets had a negative impact on people's attitude to cycling, despite the apparently high public acceptance of bicycle helmets in Denmark. [18]

3. Is legislation a proportionate measure?

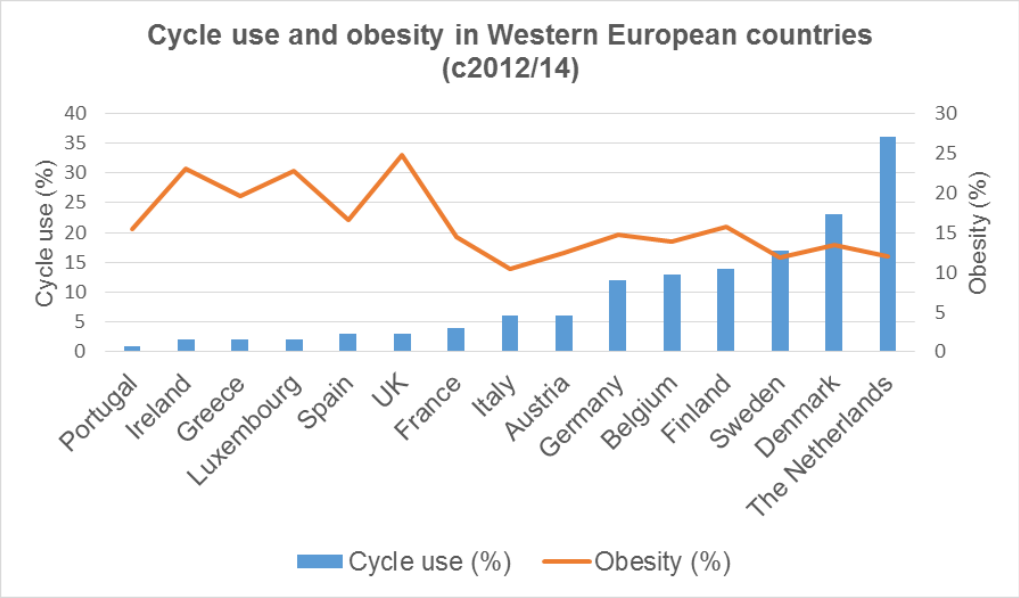
For anyone whose life has been affected by a fatal or disabling injury, it is a very understandable reaction to feel that anything that might have prevented the tragedy must be self-evidently desirable. Consequently, they might well welcome a helmet law.

However, the introduction and implementation of all legislation, not least that pertaining to public health and safety, needs to be based on available evidence. That must include examining the actual risks of serious head injury or death while cycling, vis-à-vis the health and other benefits lost if large numbers of people give up or are deterred from cycling as a result of any helmet legislation.

a. Health benefits of cycling

The health benefits of cycling are considerable. In particular, it can play a major part in counteracting obesity and physical inactivity, which is currently increasing at an alarming rate and draining the public purse. Physical inactivity costs the English economy c£7.4 billion a year,[19] while the direct costs of obesity to the NHS and its indirect costs to the wider economy (e.g. loss of productivity etc.) also run into £billions.[20] A *Foresight* report for the UK Government projected that, unless action is taken to address current trends, by 2050 the costs to society due to overweight and obesity could rise to £49.9bn annually (in today's prices).[21]

Also, cycling in mid-adulthood typically gives the fitness of a person 10 years younger,[22] and a life expectancy two years above the average.[23] People who do not commute regularly by cycle have a 39% higher mortality rate than those who do.[24] Thanks to these extra life-years, the health benefits of cycling far outweigh the risks involved[25] – by 20:1 according to one estimate.[26]



Although not demonstrably a causal relationship, international comparisons suggest an apparent link between cycle use and obesity rates.

Source: Cycle use (% of people who said they used a bicycle more often than any other mode on a typical day): EC *Special Barometer 422a - Quality of Transport* / Obesity: OECD *Obesity Update June 2014*

Physical inactivity also contributes to heart disease and stroke, type 2 diabetes, various forms of cancer and arthritis. Cardiovascular disease (CVD - an umbrella term for all diseases of the heart and circulation, including coronary heart disease (CHD), stroke and heart failure), causes more than a quarter of all deaths in the UK each year (around 160,000), while around seven million people are living with the condition. Nearly one is six men and one in ten women die from CHD.

Children are spending an increasing amount of time in cars. In England (2011-15), at 42% walking was the most common way for 5-16 year-olds to get to and from school – but this figure was 47% in 2005 (between c1990 and 1999, the proportion of journeys to school by car nearly doubled from 16% to 29%[27]). Car/van was the second most popular way (35%), compared to 2% for cycling.

Statistics for England show that:[28]

- In 2014, 58% of women and 65% of men were overweight or obese. The prevalence of obesity rose from 15% in 1993 to 26% in 2014.
- In 2014/15, more than one in five children in Reception, and one in three children in Year 6 were measured as obese or overweight. Children in most deprived areas are twice as likely to be obese than children in least deprived areas.

Many people find exercise easier and more palatable if they can incorporate it into their daily lives. Cycling is particularly useful in this respect because it acts as transport too. It also makes a positive difference quickly: a study commissioned by the UK Department for Transport found that, if people who start cycling haven't exercised before, they move from the least fit one third of the population to the fittest third of the population within just a few months.[29]

For more facts on cycling and health, see Cycling UK's briefing at
www.cyclinguk.org/campaigning/views-and-briefings/health-and-cycling

b. How safe is cycling?

The evidence clearly shows that the risks of serious injury or death from cycling are relatively low. In fact, you are about as unlikely to be killed in a mile of cycling as in a mile of walking.[30]

One calculation, based on Australian data, concludes that cycling without a helmet carries only slightly more risk of death or serious injury per hour than driving.[31] It has also been estimated that the risk of injury per hour when playing football, squash, basketball or soccer is much higher than when cycling.[32] Another study found that the injury risk per hour is lower for cycling than for gardening.[33]

Despite cycling being one of the most popular sports activities amongst children,[34] it typically accounts for just 7-8% of the head injuries for which children are admitted to English hospitals.[35] Of these injuries, it is estimated that just a quarter were to parts of the head that might be protected by a helmet – and it is likely that some of these injuries were suffered by children who were wearing helmets anyway.[36] Another UK-wide study found that cycling accounted for 10% of child traumatic brain injury admissions, but that pedestrians accounted for 36%, while falls accounted for a further 24%.[37]

Furthermore, cyclists' injuries are not particularly likely to be head injuries, or to be serious, or both: Australian data from 2003-04 suggested that the proportion of injuries requiring hospitalisation was about the same for cyclists (27.4%) as for drivers and pedestrians (28.5%);[38] a German Federal Highway Research Institute report from 2009 found that the rate of serious head injuries amongst cyclists, pedestrians and car occupants is similar;[39] among children admitted to hospitals in England in 2002-3, head injuries accounted for 37.6% of cycling injuries, but 43.6% of pedestrian injuries;[40] and Danish data has shown that, compared with pedestrian and car occupant injuries, cycling injuries result in the shortest hospital stays and are least likely to be serious.[41]

c. Helmet legislation: a net health benefit or cost?

In determining whether or not cycle helmet legislation is the right way forward, it is vital to factor in the health benefits of cycling, plus the cost to both the health of individuals and to the health service should cycle use fall as a result of the legislation.

Using the World Health Organisation's HEAT (Health Economic Assessment Tool) methodology,[42] Cycling UK estimates that a UK-wide law would result in 263 extra deaths annually due to increased physical inactivity, and that the net public health cost would be £304-415m, even based on the UK Department for Transport study's estimate of helmet effectiveness (n.b. Cycling UK does not accept this estimate). This excludes the costs to the remaining cyclists of purchasing helmets (we estimate this at around £180m initially, plus replacement costs of around £45m annually).

Interestingly, this is close to the $400m (or c£260m) disbenefit of a UK helmet law estimated by Australian statistician Professor Piet de Jong.[43] De Jong has developed an algebraic model that, he states, shows that: *"Even with very optimistic assumptions as to the efficacy of helmets, relatively minor reductions in cycling on account of a helmet law are sufficient to cancel out, in population average terms, all head injury health benefits."*[44]

The slight possibility of a small positive health benefit depends on improbably optimistic assumptions about a very low reduction in cycle use, a very high level of risk due to cycling relative to its health benefits, and helmets providing very high levels of protection against those risks. This model is outlined more fully in **Appendix A.**

Another study (2014) that looked at the costs and benefits of introducing a cycle helmet law in Germany concluded that it would be a waste of the country's resources because analysis showed that the benefits of such a law would be about 0.714 of the costs.[45] The author took into account: the benefit of increased security when cyclists wear a helmet or use a transport mode that is less risky than cycling; the cost of purchasing helmets, reduced fitness when cycling is replaced by a motorized transport mode; the discomfort of wearing helmets; and environmental externalities.

d. How effective are cycle helmets?

Based on the information above, it will be apparent that the debate about whether helmets are effective or not is almost certainly academic. Nonetheless, the topic continues to be hotly disputed, and the following points are worth noting:

- Helmets are (and can only be) designed to withstand forces equivalent to falling from a stationary riding position[46] – i.e. they are not designed for impacts with motor vehicles, especially not heavy vehicles or those moving at speed.
- A four-year review of bicycle injuries (2009-12) published in the *European Journal of Trauma and Emergency Surgery* (2014) concluded that: *"Bicycle helmets may have a protective effect against external head injury but its protective role for intra-cranial hemorrhage is questionable."*[47]
- One study found that cyclists with helmets have a 14% higher injury risk per mile travelled than non-wearers.[48]
- A systematic review of the evidence from places with helmet laws (e.g. Australia and New Zealand) shows no link between increases in helmet-wearing and improvement in cyclists' safety.[49]
- Researchers who looked at hospital admission rates (2006-2011) for cycle-related injuries in Canadian jurisdictions with different helmet laws did not find a relationship between injury rates and helmet legislation. They therefore suggested that policymakers who want to reduce bicycling injury rates in the population should focus on other factors, such as increasing cycling mode share and infrastructure. The research was published in the British Medical Journal (BMJ). [50]

- Research from Canada, also published in the BMJ, concluded that making helmets compulsory in certain provinces has 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. [51]
- Similarly, UK evidence shows no detectable link between changes in helmet use and cyclists' safety, either for cyclists in general[52] or for children in particular.[53]
- A review of helmet evidence commissioned by the UK Department for Transport noted that it was *"impossible to definitively quantify the effectiveness or otherwise of cycle helmets based on the literature reviewed."* [54]

Appendix B provides a more detailed overview of the evidence on helmet effectiveness.

4. Enforcement

To increase helmet-wearing rates, countries have had to invest heavily in promoting and then enforcing their helmet laws. In Queensland, cyclists were three times more likely per mile travelled to receive a penalty for not wearing a helmet than all other road users for all other traffic offences put together.[55]

Meanwhile, in the Australian State of Victoria there were 19,229 Bicycle Offence Penalty Notices and 5,028 Bicycle Offence Reports issued in the first year of the state's helmet law alone. These represented 2.6% of all traffic offence notices, and the risk per km cycled of being cited for a helmet-related offence was higher than for all other traffic offence notices together.[55]

As the next section shows, it is people from lower income groups who are least likely to own or wear helmets. They are thus more likely to be penalised – and there are even suggestions that helmet laws give the police more excuse to stop and question them.

Arguably, enforcing a ban on cycling without helmets thus runs the risk of targeting minority groups simply because their chosen transport option/leisure activity is unreasonably perceived as 'hazardous'. In reality, the risks they face are mostly imposed on them by drivers.

Likewise, it would be a wrong and unpopular measure to penalise parents if, unbeknownst to them, their children are found cycling without helmets. For example, a child may leave the house wearing a helmet, but remove it when out of sight. Nevertheless, the parents would still be open to criminal prosecution.

5. Why legislation could exacerbate social exclusion

There is evidence that the following groups are less likely to wear cycle helmets, and therefore more likely to be deterred from cycling if helmet legislation is introduced:

- Children from socially-deprived areas
- Minority ethnic groups

In addition, there is evidence that cycle helmets already have a deterrent effect on women which would be exacerbated.

a. Children from socially deprived areas

There is evidence that cycle helmet legislation has little long-term impact on helmet wearing among children in lower income areas. A large study in Toronto, which examined the impact of cycle helmet legislation, found that children in lower and mid-income areas were consistently less likely to wear helmets than their counterparts in more affluent areas.[56]

A study in Quebec found that a four-year helmet-wearing campaign was less effective in more socially deprived areas, despite offering discount coupons to help buy helmets.[57] The researchers concluded that even with a subsidy, helmets were still beyond the means of families in these areas.

Researchers who looked at helmet wearing by Los Angeles children who had been involved in cycle crashes, found a significantly lower use of helmets among children of minority background and lower socio-economic status: Whites = 35.2%, Asians = 7.0%, Blacks = 6.0%, Hispanics = 4.2%.[58]

Similarly in Britain, a study carried out among over a thousand 9-10 year-old children in Nottingham found that those who lived in a deprived area were less likely to own a helmet.[59]

During its 'Bike It' programme in Northern Ireland schools, Sustrans observed that there was a marked difference between helmet-wearing rates at schools in relatively affluent areas and those in more socially deprived areas. For example, at one relatively affluent school in Newtownabbey, 103 of the 106 pupils arrived at school with cycle helmets. By contrast, at a school in a socially deprived part of west Belfast, just five of the 96 pupils turned up with helmets.[60]

Hence, helmet enforcement activities risk exacerbating tensions between police and deprived communities (see also next section). It could also increase health inequalities by making it unaffordable for people from deprived neighbourhoods to cycle in accordance with the law.

b. Minority ethnic groups

A major survey of cycle helmet-wearing rates in Great Britain, carried out by the Transport Research Laboratory for the Department for Transport in 2008, found that 'white' cyclists were more likely to wear a helmet than those of other ethnic origins.[61] Also, as mentioned above (5a), US research came to the same conclusion about children of minority and lower income status in Los Angeles.

One particular concern is the potential impact of the proposed legislation on migrant workers. Circumstantial evidence suggests that many migrant workers use bicycles, particularly to commute to and from work. However, helmet usage among this group appears to be low. Given that not all migrant workers speak or read English fluently, there is clearly a risk that some will be penalised for failing to obey a law of which they are not aware. Furthermore, some people wish to wear the headwear prescribed by their religions, e.g. Sikh turbans.

In the US, a review of court and police records in Dallas found significantly uneven enforcement of the city's helmet law, with 96% of citations outside 'downtown' being written in neighbourhoods of colour, and 86% in areas with large number of households below the poverty line. Findings were similar in New York City and in Tampa, Florida.[62]

On the above grounds, helmet laws would discriminate against members of minority racial and ethnic groups and against those who hold certain religious beliefs.

c. Women

While the proportions of men and women who cycle in mainland Europe are broadly equal, men are about three times as likely to cycle as women in Great Britain.[63] Women are also more likely to think cycling is dangerous, but seem to be encouraged if they see other people on their bikes: a clear correlation has been found between levels of cycle use in different areas and the proportion of cycle trips being made by women.[64] Conversely, the way to encourage more women to cycle is to promote it as a safe and/or stylish activity, possible in whatever clothes women feel comfortable wearing.

A survey of 1,099 women, carried out by YouGov for Cycling England, found that more than a quarter (27%) of respondents in the 18-24 year old age group said they were put off cycling by the fact that cycle helmets might mess up their hair.[65] Sustrans has found that concern about 'helmet hair' is frequently mentioned by women and teenage girls as a deterrent factor.

6. Tackling the causes of road danger to encourage more and safer cycling

We have already noted the 'safety in numbers' effect, i.e. that cycling gets safer the more cyclists there are. Cycling policy must therefore aim to achieve 'more' as well as 'safer' cycling, in order to maximise its health, environmental and other benefits.

This in turn means tackling the fears that deter people from cycling, through measures such as 20 mph speed limits, cycle-friendly road and junction design, stronger and better enforced traffic laws, and the provision of high quality cycle training for adults and children alike.

By contrast, measures such as helmet laws – or even helmet promotional campaigns – will merely increase those fears. This would reduce the number of cyclists and perhaps also undermine the 'safety in numbers' benefits for those who remain. As mentioned above, academics who analysed hospital admission rates for cycle-related injuries in Canadian jurisdictions where different helmet laws applied, found no relationship between injury rates and helmet legislation. They therefore suggested that policymakers were better off focusing on other factors to protect cyclists (e.g. increasing cycling mode share and infrastructure).[66]

Cycling UK's briefing on *Cycling and Road Safety* sets out the most effective ways to make cycling conditions safer and more attractive, whilst our briefing on *Smarter Choices* outlines measures that help encourage and incentivise people to take up cycling. Both can be found at www.cyclinguk.org/campaigns > views

7. Conclusion

The relatively small risks of cycling do not remotely justify banning any age group from cycling without a helmet, while mass helmet use has not in practice been found to materially reduce those risks. What is clear is that enforced helmet legislation would suppress cycle use, and that the lost health benefits alone would be a serious net cost to society.

As mentioned, a 2012 study showed that there would be a clear net loss to public health alone from a helmet law, even if one assumed that the law would reduce cycle use only marginally, that the resulting loss of cycling's health benefits was not particularly large relative to the risks involved, and that helmets were highly effective at addressing those risks.[67] In fact, none of these assumptions are realistic.

At a time of mounting concern over the twin crises of obesity and climate change, the last thing we should be doing is forcing yet more people, especially children, into car-dependent sedentary lifestyles. Instead, we recommend:

- Investment in measures that seek to create safe, attractive cycling conditions including widespread default 20 mph speed limits;
- Promotion of cycling as a healthy and enjoyable means of transport and recreation, both for the population in general, and for specific groups e.g. school and college pupils, employees, women, health patients, and various disadvantaged or minority groups;
- The introduction of high quality cycle training for all children in Year 6/7.

We are confident that these measures will have a tangible and positive impact on the numbers of cyclists involved in road traffic incidents, and in the levels of death and serious injury resulting from them. Moreover, these measures will help make cyclists and potential cyclists feel more confident, and are likely to lead to higher levels of cycling. By contrast, helmet legislation will lead to a significant reduction in cycling levels.

APPENDIX A

Weighing up the costs and benefits of helmet laws and promotion campaigns

A key issue in the helmet debate is the need to weigh up whether the possible injury savings due to helmet-wearing justify the likely reductions in cycle use and the consequent loss of its health, environmental and other benefits.

Just two attempts have been made to weigh up the costs and benefits of actual helmet laws. An analysis of Western Australia's helmet law suggested its net impact lay in the range from a 2 million AUS$ benefit to a 10 million AUS$ disbenefit.[68] An analysis of New Zealand's helmet law found a small benefit for child cyclists (aged 12 and under), but disbenefits for teens and adults.[69] A re-analysis of the latter study found no benefit for child cyclists either[70].

A study by Australian statistician Piet de Jong has attempted to address the question purely algebraically[71]. De Jong presents his central finding in the form of an equation, where a public health benefit can only arise if: $eq>\mu\beta$.

In this equation, e and q are both fractions, i.e. their value lies between 0 and 1 (or possibly between -1 and +1 in the case of e). q is the proportion of the health costs of helmet-free cycling which is due to head injuries, while e is the proportion of those costs which could be avoided if all cyclists wore helmets. So the left hand of the equation eq represents the total injury costs of (helmet-free) cycling which would be avoided if all cyclists wore helmets. It is clearly less than 1, it is probably closer to 0 and it might even be negative.

The right hand side of the equation consists of two ratios. β is the ratio of the health benefits of (helmet-free) cycling relative to its risks. As noted previously (see page 5), the Department for Transport has endorsed [72] the widely quoted figure of 20:1 as a value for β in the UK.[73] The other quantity, μ, represents the ratio of cycle use lost following a helmet law to cycle use retained (n.b. this is not quite the same as the percentage reduction – for instance a 33% reduction in cycle use can be thought of as 1 unit of cycling lost for every two that remain, hence the equivalent value of μ would be 0.5).

It will be clear that, if there is to be a net health benefit, the two ratios μ and β need to counter-balance one another so that, when multiplied together, the result is less than the fractional quantity eq. In other words, if 20:1 is a correct value for β, then a helmet law can only yield a net health benefit if μ is less than 1:20 (i.e. there is no more than 1 unit of cycling lost for every 20 which remain), even if head injuries accounted for all of the injury costs of cycling and if helmets were 100% effective at addressing these risks (i.e. if e and q both equalled 1). So even under these implausible assumptions, a disbenefit occurs if the reduction in cycle use is any more than 4.7% (i.e. 1/21). This figure then has to be reduced further still, in proportion to the values of e and q. The value of e is much debated (see *Appendix B* below). However, q is likely to be about 0.5, given that c40% of cyclist injuries serious enough to merit admission to hospital and c80% of fatalities involved head injuries (although by no means all of these were head-only injuries, particularly in the case of fatalities).[74] On this assumption, the allowable reduction in cycle use drops to just 2.4%. It falls by another whole order of magnitude (i.e. to 0.24%) if the effectiveness of helmets is only 10% rather than 100%.

As shown earlier (see page 5), the experience of enforcing helmet laws typically results in reductions in cycle use of the order of a third (i.e. μ = 1:2), and sometimes more than this. On that basis, and again assuming that head injuries amount to about 50% of the injury costs of cycling (i.e. q = 0.5), a helmet law would have disbenefits unless the health benefits outweighed the risks of cycling by less than about 1 to 1 – not 20:1 as estimated – even if helmets were 100% effective.

In short, as De Jong (see above) states: "*Even with very optimistic assumptions as to the efficacy of helmets, relatively minor reductions in cycling on account of a helmet law are sufficient to cancel out, in population average terms, all head injury health benefits*."

Finally, it should be noted that these calculations take no account of cycling's wider benefits for tackling congestion, air pollution, quality of life, equality of opportunity and the climate.

APPENDIX B

Helmet laws and effectiveness: contradictory evidence

The evidence-base regarding the effectiveness or otherwise of helmets is extremely complex, with vast amounts of ink having been spilled on both sides of the debate. This appendix attempts a brief summary of the territory. It also responds to claims that the experience of helmet laws in Canada shows that helmet laws can be introduced without reducing cycle use.

1. 'Case-control' and population-level evidence

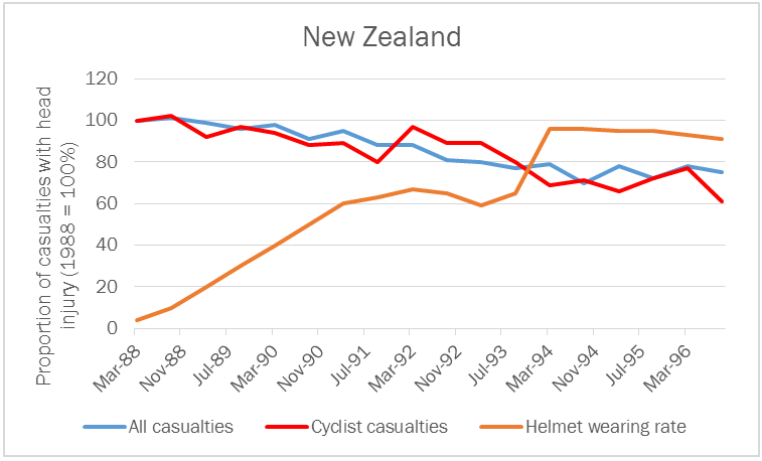
A number of early studies on the effectiveness of helmets reported substantial safety benefits from helmet use.[75] These were predominantly hospital-based 'case-control' studies, where a 'case' group (e.g. cyclists with head injuries) are compared with a 'control' group (e.g. cyclists with non-head injuries) to show whether the use or non-use of a helmet might have made a statistically significant difference to the probability (or the severity) of head injuries between the two groups.

However, the findings of these studies are contradicted by a systematic review of the evidence from places with helmet laws (e.g. Australia and New Zealand), which found no link between increases in helmet-wearing and improvement in cyclists' safety.[76] They are also at odds with the evidence of two papers by Hewson that found no detectable link between changes in helmet use and cyclists' safety, either for cyclists in general[77] or for children in particular.[78] Many of the findings of case control studies themselves are contradictory or, frankly, implausible (e.g. that helmets provide greater protection against more serious impacts than minor ones).[79]

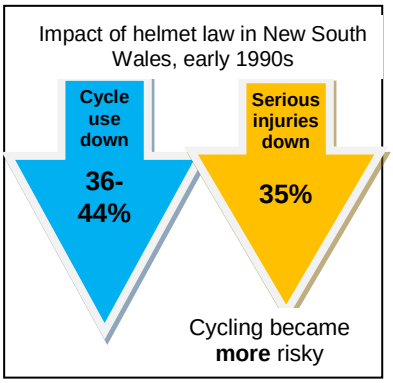
Whilst helmet laws have undoubtedly reduced the numbers of cyclist head injuries, the available evidence suggests this has been wholly or largely due to reduced cycle use, rather than improvements in cyclists' safety.[80]

In the case of New Zealand, it seems that other road safety improvements also played a part. The percentage reduction in cyclists' head injuries differed very little from the reduction in head injuries overall (road users and others), with no effect detectable in 1994, the year the law was introduced, despite a very sharp increase in adult and teenage helmet wearing rates that year (see chart right).[81], [82]

Similarly, reductions in cyclists' head injuries in Western Australia were *matched those gained by pedestrians* – and again, there was no particular effect at the point when helmet use rose sharply as a result of making it compulsory in 1992.[83]



This graph shows the change in the ratio of head injuries in New Zealand, relative to March 1988 (the reference date). Cycle helmets were made compulsory in 1994. Reproduced from *The bicycle helmet legislation, curse or cure?* By N. Perry, 2001. www.cyclehelmets.org/1234.html



In some places, cycle safety for the remaining cyclists even seems to have worsened, even though most of them were now wearing helmets.

For instance, in New South Wales a 44% reduction in children cycling was observed two years after the law, but only a 32% decline in serious and fatal injuries.[84]

In Nova Scotia, the initial 60% reduction in cycle use recovered to a 40% reduction in the second year of the law; however the initial 50% reduction in cyclist hospitalisations bounced back up and, in the second year of the law, total admissions were 6% higher that they had been in the year prior to the law.[85] There were similar instances of cycle use apparently falling by more than cyclist casualties in Victoria, South Australia and Vermont.[86]

A review of helmet evidence for the UK Department for Transport by the Transport Research Laboratory (TRL) found 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). Similarly the Parliamentary Advisory Council on Transport Safety notes that *'it is not possible to predict accurately expected injury reduction from increased rates of helmet use; estimates range between 0 and 85%'*.[87]

Faced with this contradictory evidence, one has to weigh up the plausibility of the evidence suggesting higher or lower values for helmet effectiveness respectively. This cannot be settled with any certainty. However, we next set out why Cycling UK believes the more plausible explanations point towards a lower value for helmet effectiveness – or even the possibility that helmet use might increase the risks to cyclists of injury impacts occurring in the first place, potentially undermining any protective effect helmets might have in the event of those impacts.

2. The lack of detectable net benefits from helmets: possible explanations

a. What helmets are designed to do

Cycle helmets are – and can only be – designed to withstand low impact forces, equivalent to falling of a bike from a stationary riding position. The old British Standard for cycle helmets (BS6863, 1987) stated that they were: *"intended to give protection in the kind of accident in which the rider falls onto the road without other vehicles being involved."* Subsequent standards (including the current EU standard EN 1078) have been progressively weakened due to lobbying by the manufacturers themselves.[88] [89]

Cycle helmets are inevitably a design compromise between the desire to provide protection, and designing helmets which are light, aerodynamic, well-ventilated, stylish and cheap. Yet all of these design criteria are at odds with the aim of making them strong. There is also an inevitable trade-off between designing a helmet to protect against impact with flat surfaces (e.g. car windscreens) and angular ones (e.g. the corners of kerbstones).[88] Helmet manufacturers themselves are typically very cautious about the safety claims they make for their helmets, stating only that they meet the relevant European or other standards.

Nonetheless, the lack of a detectable relationship between helmet wearing rates and cycle safety may still appear counter-intuitive to many people. So too is the evidence suggesting that helmet-wearers may have a 14% higher risk than non-wearers of being involved in collisions in the first place[90]. There are, however, many possible explanations for these phenomena.

b. Risk-compensation

It is known that some cyclists ride less cautiously when wearing a helmet.[91] [92] This is an example of what is known as 'risk-compensation':[93]

- The results of an academic study published in 2016 found clear evidence that wearing a cycle helmet can increase risk-taking and sensation seeking in adults. The researchers asked participants to wear either a baseball cap or a cycle helmet, adding (falsely) that its purpose was to act as a mount for an eye-tracking device which would record their eye movements when taking part in a computer simulation of risk-taking activities. The head-gear's real purpose was to find out whether the helmet-wearers responded differently from the cap-wearers to the risk-taking activities they were asked to take part in on the simulator. The helmet-wearers started engaging in greater risk-taking and thrill-seeking behaviour than the cap-wearers, even though they weren't doing anything that involved a risk of head injuries. Furthermore, they then behaved less riskily when the helmet was taken off.[94]

- Another, earlier paper found clear evidence of risk-compensation among male cyclists, but not among females.[95] The phenomenon has also been observed in young children with helmets.[96]

- Risk-compensation has, in fact, been observed in people engaging in other physical activities: a randomised controlled clinical trial looking at American footballers concluded that: *"Helmetless tackling eliminates the false of security a football player may feel when wearing a helmet."* [97]

- Drivers may also 'risk-compensate', as they have been found to leave less space when overtaking helmet-wearing cyclists than those without.[98]

c. Increased size and weight of helmeted head

The increased size, weight or even the temperature of the head may also be factors. 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.[99]

d. 'Rotational force' impacts

There is evidence suggesting that helmet use increases the risks of neck injuries[100], or brain injuries due to 'rotational force' 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).[99] [101] Helmets could therefore be contributing to some of the most serious and permanently disabling spinal and brain injuries.

e. Incorrectly fitted helmets

Cycle helmet 'retention systems' (i.e. straps and associated clips) tend to be poorly designed, making it difficult to fit and wear helmets correctly.[102] 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.[103]

Fourteen children are known to have been killed through strangulation by their helmet straps.[104] [105] [106]

f. Loss of 'safety in numbers' effect

There is one other very important possible link between increased helmet use and increases in the risks to cyclists of both head and non-head injuries. This is the possibility that the reductions in cycle use due to helmet laws or promotional campaigns cause a loss of the 'safety in numbers' benefits previously enjoyed by the remaining cyclists (see page 4).

3. Contradictions between population and 'case-control' evidence: possible explanations

Cycle helmets are not the only subject that has led researchers to publish contradictory results. This is true, for example, of studies into hormone replacement therapy, vitamin supplements and the MMR triple vaccine, all of which have yielded what is now known to be false outcomes.[107] Some of these studies were based on 'case-control' methodology, which is inherently flawed and prone to spurious results.[108]

Similarly, the best known of the 'case-control' studies of cycle helmets, from Seattle (*Thompson & Rivara, 1989*), reported that helmets could prevent 85% of head injuries and 88% of brain injuries.[109] However, this finding has been repeatedly criticised on the grounds that it compared two unlike groups riding in different environments: the helmet-wearers were more likely to be white, affluent and to be cycling in parks, while the non-wearers were more likely to be from lower-income ethnic minority groups riding on busy streets. This is unsurprising: people from lower income and racial minority groups are far less likely to wear helmets,[110] [111] [112] and there is a vast literature showing that people (particularly children) from these groups face significantly higher risks of road injury.[113] [114] [115]

In fact, in 2013, the US Department of Transportation (DoT) agreed to stop quoting the *Thompson and Rivara* claim[116] (i.e. that cycle helmets are up to 85% effective in mitigating head injuries) in materials it disseminated through its website. This decision followed representations from the Washington Area Bicycle Association who challenged the figure under the *Data Quality Act* and proved to the DoT that the claim was not sound.[117]

A second factor may be that willing helmet-wearers take a different attitude to risk. Those who readily take up helmet use (i.e. the 'early adopters' of helmets, who would have featured in the helmet studies of this period) are more likely to be safety-conscious people, who are averse to risk and therefore avoid the situations where more serious injuries might occur. By contrast, the 'later adopters' – i.e. those who only wear helmets reluctantly in response to laws or the peer-pressure that comes from helmet promotion campaigns, or who simply 'follow the trend' in adopting helmets – may be more risk-accepting. This in turn might at least partly explain why there has been a progressive decline in the estimates of helmet effectiveness from these studies.[100]

A third factor is that, in the USA context, people from more affluent backgrounds are more likely to have health insurance, and thus are 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.

It is therefore very likely that the results of the Seattle study, and others like it, are in fact due to differences between the people who do and don't wear helmets, the types of cycling they do and the environments where they cycle, rather than due to helmets themselves. To reinforce the point, it has been shown that the data and methodology used in the Seattle study could also be used to show that helmets prevent 77% of injuries to parts of the body other than the head.[118]

4. Effect of helmet laws on cycle use/injury: the case of Canada

In recent years, Canadian helmet advocates have mounted a concerted effort to argue that helmet laws there have been successful in improving cycle safety, without reducing cycle use. This followed criticism of a paper by LeBlanc *et al*[85] which claimed that Nova Scotia's helmet law had been successful, when the cycle count data presented in that paper showed an initial reduction of 60% in the numbers of cyclists counted one year after the law, and that by the time cycle use had recovered slightly (to 40% of pre-law use), the numbers of cyclists hospitalised was higher than before the law.[119] [120]

A paper by Alison Macpherson and others in 2001 suggested that Ontario's helmet law had increased helmet wearing rates without reducing cycle use, based on a study conducted in an affluent district of Toronto.[121] However Macpherson is recorded as having subsequently acknowledged that the law had not been enforced;[122] [123] while a later study by Macpherson et al (published in 2006[110]) 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.

Macpherson's count data for the 2001 study was also criticised as unreliable as it had not controlled for variations in the time of year, weather etc.[124] Finally, her team had also collected data, which they have not published, for three years prior to the law, during which time a strong helmet promotion campaign was conducted. It is therefore possible that the unpublished data might have shown a fall in cycle use during the three years of the pre-law helmet promotion campaign.

Macpherson's 2001 paper was subsequently cited by the British Medical Association as the reason for deciding to support helmet legislation.[125] They had previously supported helmet promotion, but not laws. The BMA has since withdrawn the paper which justified its change of policy, but has so far not reconsidered the policy itself, as far as we are aware.[126]

In 2002, Macpherson and other colleagues published a study comparing head and non-head injuries to child cyclists hospitalised in Canadian states with and without helmet laws respectively.[127] The paper claimed to show a benefit from helmet laws because head injuries had declined more steeply relative to non-head injuries in the helmet-law provinces, compared with the non-law provinces. However, the proportion of cycling injuries which were head injuries continued to decline even after the downturn in helmet use recorded in Macpherson's 2006 paper[128], while the differences in injury trends between states with and without laws were as evident for pedestrian injuries as for cycling injuries.[129] 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.

Finally, research published in the British Medical Journal (BMJ) in 2013[130] concluded that making helmets compulsory in certain Canadian provinces has 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. 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, did not find a relationship between injury rates and helmet legislation.[131]

5. Re-examining the evidence: Cochrane reviews and other meta-analyses

More recent helmet studies have attempted to bolster the evidence for helmets and helmet-laws by re-analysing it. There have, for instance, been two Cochrane reviews, a process normally regarded as a benchmark of objectivity in meta-analysis of medical evidence.

However, the **first Cochrane review**,[132] which considered evidence on the effectiveness of helmets, was limited to 'case-control' studies, eliminating any consideration of population-level evidence, such as that presented in papers by Robinson or Hewson. Moreover, it was conducted by the same authors who had produced four of the seven case-control evidence they were reviewing.[133]

Subsequent **meta-analyses by Attewell *et al*[134] and Towner *et al*[135]** (the latter being an evidence-review in 2002 commissioned by the UK Department for Transport) likewise restricted their scope to 'case-control' studies, hence it is unsurprising that they too concluded that the evidence suggested helmets were beneficial – although Towner acknowledged that helmet laws could reduce cycle use.

A **second Cochrane review**, by Macpherson and Spinks,[136] looked specifically at evidence on the impact of helmet laws (n.b. it will be noted that Macpherson was not an unbiased commentator, having previously authored several papers advocating helmet laws). It concluded that helmets were beneficial, but found no reliable evidence to determine whether helmet laws might reduce cycle use. However, it omitted to consider Robinson's 2006 BMJ paper[76] which would have provided that evidence.

DfT evidence review, 2010

In 2010, the UK Department for Transport attempted to 'settle' the helmet question with a second evidence review, *The potential for cycle helmets to prevent injury - a review of the evidence.*[137]

The researchers identified flaws in all of the case-control evidence and hence the meta-analyses of that evidence, reaching the conclusion 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[76] and Hewson,[77] [78] 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.

However, the DfT review authors did not put forward any reasons for assuming that helmets must have some benefits, in preference to the possible alternative explanations suggested by Robinson for the lack of detectable benefits from helmets (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 helmet-wearing cyclists might be more prone to being involved in collisions in the first place e.g. due to 'risk-compensation').

However, the most notable feature of the DfT-commissioned study 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 has been strongly criticised by Cycling UK, Sustrans and other members of the study advisory panel, on the following grounds:

- The 10-16% figure is 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 focuses 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 study, and the 10-16% estimate in particular, takes no account of the possibility that helmets may increase the risk to cyclists of having a head impact in the first place. We have previously noted that another study found helmet-wearing cyclists have a 14% higher risk of injury per mile travelled.[90] This would therefore approximately cancel out a 10-16% benefit even if it were to prove correct (despite the lack of evidence supporting it).

Finally, the most recent meta-analysis found that early results – including the Attewell analysis and the Cochrane review of helmet effectiveness (and subsequent updates of it) – had significantly overstated the protective value of helmets. It also found that helmets may increase the risk of neck injuries.[100]

Other studies

Inevitably, meta-analyses that conclude that helmets are effective in preventing injury (or certain types of injury) are simply reflecting the fact that most individual helmet studies ignore the negative impact that making them compulsory or promoting them is likely to have on public health (as discussed in Appendix A above). A prominent recent example of this is *Bicycle Injuries and helmet use: a systematic review and meta-analysis published in the International Journal of Epidemiology* (2016).[138]

Conclusion

From the evidence available, it is possible that helmets might perhaps provide some limited protection in the event of certain types of impact occurring (e.g. minor falls). However, any such benefits may also be undermined or even outweighed by a variety of ways in which helmet-wearing may increase the likelihood of such impacts occurring in the first place.

There are some places (e.g. New South Wales and Nova Scotia) where increased helmet-wearing appears to have been associated not only with reduced cycle use, but also with an increased risk of injury for those cyclists who remain.

There is also some evidence that helmet use increases the risks of neck injuries, and of brain injuries due to 'rotational force' impacts. Helmets could therefore be contributing to some of the most serious and permanently disabling spinal and brain injuries.

A number of children are known to have been fatally strangled by their helmet straps.

We reiterate the observation from the helmet evidence-review commissioned by the Department for Transport (see p20), which noted that it was *'impossible to definitively quantify the effectiveness or otherwise of cycle helmets based on the literature reviewed.'*

REFERENCES

[1] Robinson D. *No clear evidence from countries that have enforced the wearing of helmets.* British Medical Journal vol. 332, p722, 2006. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1410838/
[2] Smith N & Milthorpe M. *An Observational Survey of Law Compliance and Helmet Wearing by Bicyclists in New South Wales - 1993 (4th survey)*. 1993 NSW Roads & Traffic Authority ISBN0-7305-9110-7.
[3] Finch C et al. *Bicycle use and helmet wearing rates in Melbourne, 1987 to 1992: the influence of the helmet wearing law*. Monash University, Accident Research Centre report no. 45, 1993, pp. 35, 36, 43
http://www.monash.edu/muarc/research/our-publications/muarc045
[4] Electronic count data from Main Roads Western Australia, reproduced at
www.cycle-helmets.com/bicycle_numbers.html. See also www.cyclehelmets.org/1113.html.
[5] LeBlanc et al. *Effect of legislation on the use of bicycle helmets*. Canadian Medical Association Journal, vol. 166 no.5, pp592-5, 2002. www.cmaj.ca/cgi/content/full/166/5/592
[6] See www.cyclehelmets.org/1122.html and www.cyclehelmets.org/1194.html
[7] NACTO. *Equitable bike share means building better places for people to ride*. July 2016.
http://nacto.org/wp-content/uploads/2016/07/NACTO_Equitable_Bikeshare_Means_Bike_Lanes.pdf
[8] Land Transport New Zealand. *Sustainable and safe land transport,* 2007.
www.cycle-helmets.com/nz-ltsa-2006.pdf. See also Land Transport Safety Authority data summarised at
www.cycle-helmets.com/zealand_helmets.html.
[9] Taylor M & Scuffham P. *New Zealand Bicycle Helmet Law – Do the Costs Outweigh the Benefits?* Injury Prevention vol. 8 pp. 317–320, Table 2, 2002. http://injuryprevention.bmj.com/content/8/4/317.full In the 1996 New Zealand census, the total population was 3,681,546.
[10] Smith F & Milthorpe N. *An observational survey of law compliance and helmet wearing by bicyclists in New South Wales*. Roads Traffic Authority, 1993 ISBN0-7305-9110-7.
[11] Finch et al. *Head injury reductions in Victoria two years after introduction of mandatory bicycle helmet use*. July 1993.
http://www.monash.edu/__data/assets/pdf_file/0006/217464/muarc051.pdf
[12] Pucher J & Buehler R. *Making Cycling Irresistible: Lessons from the Netherlands, Denmark and Germany*. iTransport Reviews, vol. 28, no. 4, pp. 495 – 528, 2008. http://www.vtpi.org/irresistible.pdf
[13] Jacobsen P. *Safety in numbers: more walkers and bicyclists, safer walking and bicycling.* Injury Prevention. vol. 9, pp. 205-9, 2003. http://injuryprevention.bmj.com/content/9/3/205.abstract
[14] Cycling UK's evidence of the "safety in numbers" effect in England is available as a brochure, a presentation and a Word document containing the full data, all downloadable from www.cyclinguk.org/safetyinnumbers.
[15] Robinson D. *Safety in numbers in Australia: more walkers and bicyclists, safer walking and bicycling*. Health Promotion Journal of Australia, vol. 16 pp. 47-51. https://www.ncbi.nlm.nih.gov/pubmed/16389930
[16] Bryan-Brown K & Taylor S. *Cycle helmet wearing in 1996*. TRL, Report 286.
https://trl.co.uk/reports/TRL286
[17] European Conference of Transport Ministers. *Implementing Sustainable Urban Travel Policies: Moving Ahead - National policies to promote cycling*. ECMT, 2004.
http://www.oecdbookshop.org/browse.asp?pid=title-detail&lang=en&ds=&ISB=9282123251
[18] Hjuler, Sidsel Birk & Krag, Thomas. *Measuring the impact of bicycle marketing messages.* Proceedings from the Annual Transport Conference at Aalborg University. 2013. http://thomaskrag.com/trma/20130708opinionImpact.pdf . For other documents relating to this project, http://thomaskrag.com/trma/index_en.htm
[19] Sport England infographic. https://www.sportengland.org/our-work/health-and-inactivity/why-tackling-inactivity-matters/
[20] Public Health England. The economic costs of obesity. http://www.noo.org.uk/NOO_about_obesity/economics
[21] Foresight: *Tackling Obesities: Future Choices*. 2007.
www.bis.gov.uk/foresight/our-work/projects/current-projects/tackling-obesities/reports-and-publications
[22] Tuxworth W et al. *Health, fitness, physical activity and morbidity of middle aged male factory workers*. British Journal of Industrial Medicine vol 43. pp 733-753, 1986.
[23] Paffenbarger R et al. *Physical activity, all-cause mortality and longevity of college alumni*. New England Journal of Medicine, vol. 314(10) pp 605-613, 1986 (for abstract http://www.nejm.org/doi/full/10.1056/NEJM198603063141003)
[24] Andersen L et al. *All-cause mortality associated with physical activity during leisure time, work, sports and cycling to work*. Archives of Internal Medicine, 160: 1621-1628, 2000. http://www.ncbi.nlm.nih.gov/pubmed/10847255
[25] British Medical Association. *Cycling: towards health and safety*. Oxford University Press, 1992.
[26] Hillman M. *Cycling and the promotion of health*. Policy Studies vol. 14 pp49-58, 1993.
[27] School Travel Advisory Group Report 1998-1999. (Not online)
[28] NHS. http://content.digital.nhs.uk/catalogue/PUB20562
[29] Boyd H et al. *Health-related effects of regular cycling on a sample of previous non-exercisers: resume of main findings*. Bike for Your Life Project and Cycling UK, 1998. Findings summarised in DETR (1999), Cycling for better health, Traffic Advisory Leaflet 12/99, DETR.
http://webarchive.nationalarchives.gov.uk/20120606202850/http://assets.dft.gov.uk/publications/tal-12-99/tal-12-99.pdf

[30] DfT. *Reported Road Casualties Great Britain*. 2015. Sept 2016. Table RAS 53001 (link above)
[31] Robinson D. *Head injuries and bicycle helmet laws.* Accident Analysis and Prevention, vol. 28, no. 4, pp463-475, 1996. www.cycle-helmets.com/robinson-head-injuries.pdf
[32] Roberts I et al. *Pedalling health – health benefits of a modal transport shift*. South Australia, 1996, p. vii. Available at: http://safety.fhwa.dot.gov/ped_bike/docs/cyhealth.pdf
[33] Parkkari J et al. *Active living and injury risk*. International Journal of Sports Medicine, vol. 25 no. 3, pp209-216, 2004. www.ncbi.nlm.nih.gov/pubmed/15088246.
[34] In 2015/16, when asked whether they'd cycled outside school hours in the previous four weeks, over 29% of 5-10 year-olds in England said they had done so, making it their third most popular sports activity, superseded only by swimming, diving or lifesaving (53.5%) and football (32.2%). 26.2% of 11-15 year-olds also said they'd cycled (over half of them had participated in football). July 2016.
www.gov.uk/government/uploads/system/uploads/attachment_data/file/539029/Taking_Part_2015_16_Child_Report_-_FINAL.pdf
[35] Franklin JA & Chapman G. *Quantifying the risk of head injury to child cyclists in England: an analysis of hospital admissions data.* Bicycle Helmet Research Foundation 2005. www.cyclehelmets.org/1148.html.
[36] Franklin JA & Chapman G. *Quantifying the risk of head injury to child cyclists in England: an analysis of hospital admissions data.* Bicycle Helmet Research Foundation 2005. www.cyclehelmets.org/1148.html.
[37] Parslow R et al. *Epidemiology of traumatic brain injury in children receiving intensive care in the UK.* Archives of Disease in Childhood, vol. 90 pp1182-1187, 2005. http://adc.bmj.com/content/90/11/1182.full.pdf
[38] Berry J & Harrison J. *Serious injury due to land transport accidents, Australia 2003-4.* Australian Institute of Health and Welfare, Flinders Uni., Adelaide, 2007. http://www.cycle-helmets.com/aihw-03-04.pdf
[39] Auerbach, Kerstin et al. *Medizinische Folgen von Straßenverkehrsunfällen: Drei Datenquellen, drei Methoden, drei unterschiedliche Ergebnisse? (Medical consequences of road traffic accidents: three data sources, three methods, three different results?)* Federal Highway Research Institute. Oct 2009.
http://www.bast.de/DE/Verkehrssicherheit/Publikationen/Download-Publikationen/Downloads/U-medizinische-folgen-von-unfaellen.pdf?__blob=publicationFile&v=1
[40] Franklin JA & Chapman G. *Quantifying the risk of head injury to child cyclists in England: an analysis of hospital admissions data.* Bicycle Helmet Research Foundation 2005. www.cyclehelmets.org/1148.html.
[41] Krag T. *Cycling, safety and health*. European Cyclists' Federation, (see http://www.copenhagenize.com/2011/04/cycling-safety-health-by-thomas-krag.html).
[42] See www.euro.who.int/HEAT
[43] De Jong P. *The health benefit of bicycle helmet laws.* Social Sciences Research Network, 2009 (since replaced by De Jong P. *The health impact of mandatory bicycle helmet laws.* Social Science Research Network, 2010.
http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1368064
[44] De Jong P. *The health impact of mandatory bicycle helmet laws* (as published in *Risk Analysis,* March 2012*).*
http://onlinelibrary.wiley.com/doi/10.1111/j.1539-6924.2011.01785.x/abstract
[45] Sieg, Gernot. *Costs and benefits of a bicycle helmet law for Germany*. Institute of Transport Economics Münster working paper No. 21. March 2014. http://ideas.repec.org/p/mut/wpaper/21.html
[46] Glanville H & Harrison N. *Cycle helmets*. British Medical Association, 1999.
[47] Joseph, B et al. *Rethinking bicycle helmets as a preventive tool: A 4-year review of bicycle injuries*. European Journal of Trauma and Emergency Surgery. 2014 (DOI 10.1007/s00068-014-0453-0)
http://link.springer.com/article/10.1007/s00068-014-0453-0
[48] Erke A & Elvik R. *Making Vision Zero real: preventing pedestrian accidents and making them less severe.* TØI (Institute for Transport Economics) report 889/2007. Oslo, 2007. www.toi.no/article19378-29.html
[49] Robinson D. *No clear evidence from countries that have enforced the wearing of helmets.*
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1410838/
[50] Teschke, Kay (et al). *Bicycling injury hospitalisation rates in Canadian jurisdictions: analyses examining associations with helmet legislation and mode share*. Oct 2015. Published in BMJ. http://bmjopen.bmj.com/content/5/11/e008052.full.pdf
[51] Jessica Dennis et al. *Helmet legislation and admissions to hospital for cycling related head injuries in Canadian provinces and territories: interrupted time series analysis.*
BMJ 2013;346:f2674 doi: 10.1136/bmj.f2674.14/5/2013). http://www.bmj.com/content/346/bmj.f2674
[52] Hewson P. *Cycle helmets and road casualties in the UK. Traffic Injury Prevention, vol. 6 no. 2 pp127-134, 2005* (see http://journalsonline.tandf.co.uk/openurl.asp?genre=article&id=doi:10.1080/15389580590931590).
[53] Hewson P. *Investigating population level trends in head injuries amongst child cyclists in the UK*. Accident Analysis & Prevention vol. 37 no. 5 pp807-815, 2005. http://dx.doi.org/10.1016/j.aap.2005.03.020
[54] Hynd D et al. *The potential for cycle helmets to prevent injury - a review of the evidence*. TRL research report PPR 446, 2009. https://trl.co.uk/reports/PPR446
[55] King M & Fraine G. *Bicycle helmet legislation and enforcement in Queensland 1991-3: Effects on helmet wearing and crashes.* Road User Behaviour Section, Queensland Transport, June 1993.
[56] 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. http://injuryprevention.bmj.com/content/12/4/231.full.pdf.

[57] Farley C et al. *The Effects of a 4-Year Program Promoting Bicycle Helmet Use Among Children in Quebec*. American Journal of Public Health, vol. 85, pp. 46-51, 1995. www.ncbi.nlm.nih.gov/pmc/articles/PMC1380359/
[58] Sullins, Victoria et al. *Race/Ethnic and Socioeconomic Disparities in the Use of Helmets in Children Involved in Bicycle Accidents.* Oct. 2013. https://aap.confex.com/aap/2013/webprogrampress/Paper21869.html
[59] 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, no. 10, pp. 876–880, 2003. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1719320/pdf/v088p00876.pdf.
[60] Sustrans/CTC evidence to the Northern Ireland Assembly Environment Committee Hearing on Cyclists (Protective Headgear) Bill. 10 March 2011. http://archive.niassembly.gov.uk/environment/2007mandate/reports/2010/Report_59_10_11R.htm
[61] Transport Research Laboratory (2009) *Cycle Helmet Wearing in 2008* Department for Transport TRL Report PPR420.
[62] Cited in NACTO. *Equitable bike share means building better places for people to ride*. July 2016. http://nacto.org/wp-content/uploads/2016/07/NACTO_Equitable_Bikeshare_Means_Bike_Lanes.pdf. NACTO comments: "Reports from around the United States suggest that such [mandatory helmet] laws often give police an additional reason to stop and question people and are disproportionately enforced against low-income people and people of colour."
[63] According to the DfT's *National Travel Survey*, in 2015, males of all ages made just under three times as many cycle trips as females (25 as opposed to nine). https://www.gov.uk/government/collections/national-travel-survey-statistics. The fact that more men cycle than women is also borne out by data gathered by the 2011 Census in England & Wales, and in Scotland. See: http://www.cyclinguk.org/resources/cycling-uk-cycling-statistics
[64] London Analytics. *Gender and critical mass.* LA Research Journal, 2005 http://londonanalytics.info
[65] http://cyclehelmets.org/1207.html?NKey=37
[66] Teschke, Kay (et al). *Bicycling injury hospitalisation rates in Canadian jurisdictions: analyses examining associations with helmet legislation and mode share*. Oct 2015. Published in BMJ. http://bmjopen.bmj.com/content/5/11/e008052.full.pdf
[67] De Jong P. *The health impact of mandatory bicycle helmet laws* (as published in *Risk Analysis,* March 2012*).* http://onlinelibrary.wiley.com/doi/10.1111/j.1539-6924.2011.01785.x/abstract
[68] Hendrie D et al. *An Economic Evaluation of the Mandatory Bicycle Helmet Legislation in Western Australia*. Road Accident Prevention Research Unit, University of Western Australia. http://research-repository.uwa.edu.au/en/publications/an-economic-evaluation-of-the-mandatory-bicycle-helmet-legislation-in-western-australia(51a30fbc-64ca-4fde-82b4-ee688c298749)/export.html
[69] Taylor M & Scuffham P. *New Zealand bicycle helmet law-do the costs outweigh the benefits?* Injury Prevention, vol. 8 pp317-320, 2002. http://injuryprevention.bmj.com/content/8/4/317.full
[70] Robinson D. *Cost and benefits of the New Zealand helmet law.* Bicycle Helmet Research Foundation, undated. http://www.cyclehelmets.org/1237.html
[71] De Jong P. *The health impact of mandatory bicycle helmet laws* (as published in *Risk Analysis,* March 2012*).* http://onlinelibrary.wiley.com/doi/10.1111/j.1539-6924.2011.01785.x/abstract
[72] Department for Transport. *Active Travel Strategy*, 2010. http://webarchive.nationalarchives.gov.uk/20130107105354/http:/www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_113102
[73] Hillman M. *Cycling and the promotion of health*. Policy Studies vol. 14 pp49-58, 1993.
[74] Knowles J et al. *Collisions involving pedal cyclists on Britain's roads: establishing the causes.* TRL report PPR 445, 2009. https://trl.co.uk/reports/PPR445
[75] A list of studies indicating positive results for helmet effectiveness is at www.cyclehelmets.org/1147.html.
[76] Robinson D. *No clear evidence from countries that have enforced the wearing of helmets.* British Medical Journal vol. 332, p722, 2006. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1410838/
[77] Hewson P. *Cycle helmets and road casualties in the UK.* Traffic Injury Prevention, vol. 6 no. 2 pp127-134, 2005. http://journalsonline.tandf.co.uk/openurl.asp?genre=article&id=doi:10.1080/15389580590931590.
[78] Hewson P. *Investigating population level trends in head injuries amongst child cyclists in the UK*. Accident Analysis & Prevention vol. 37 no. 5 pp807-815, 2005. http://dx.doi.org/10.1016/j.aap.2005.03.020).
[79] http://www.cyclehelmets.org/1052.html.
[80] Robinson D. *No clear evidence from countries that have enforced the wearing of helmets.* British Medical Journal vol. 332, p722, 2006. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1410838/
[81] Robinson D. *Changes in head injury with the New Zealand bicycle helmet law*. Accident Analysis and Prevention vol. 33 pp. 687-691. www.cycle-helmets.com/AAP2001DLRNZHI.pdf
[82] Perry N. *The bicycle helmet legislation, curse or cure?* University of Canterbury, 2001. http://archived.ccc.govt.nz/recreation/cycling/conference/2001/HeadsandHardSurfacesPresentation_Perry.pdf
[83] See http://www.cyclehelmets.org/papers/c2016.pdf
[84] Robinson D. *Head injuries and bicycle helmet laws.* Accident Analysis and Prevention, vol. 28, no. 4, pp463-475, 1996. www.cycle-helmets.com/robinson-head-injuries.pdf , table 3.
[85] LeBlanc et al. *Effect of legislation on the use of bicycle helmets*. Canadian Medical Association Journal, vol. 166 no.5, pp592-5, 2002. www.cmaj.ca/cgi/content/full/166/5/592. See also online comment from M Wardlaw: www.cmaj.ca/cgi/eletters/166/5/592#38.

[86] Robinson D. *Head injuries and bicycle helmet laws.* Accident Analysis and Prevention, vol. 28, no. 4, pp463-475, 1996. www.cycle-helmets.com/robinson-head-injuries.pdf
[87] Parliamentary Advisory Council on Transport Safety. *Cycle helmet use and effectiveness.* PACTS Parliamentary briefing PB05/04. http://www.pacts.org.uk/wp-content/uploads/sites/2/cyclehelmets.pdf
[88] Walker B. *Heads up.* Cycle magazine, June/July 2005. www.cyclehelmets.org/papers/c2023.pdf
[89] Walker B. *Helmet standards and capabilities.* Bicycle Helmet Research Foundation, 2004. www.cyclehelmets.org/1081.html
[90] Erke A & Elvik R. *Making Vision Zero real: preventing pedestrian accidents and making them less severe.* TØI (Institute for Transport Economics) report 889/2007. Oslo, 2007. www.toi.no/article19378-29.html
[91] Taylor S & Halliday M. *Cycle helmet wearing in Great Britain.* TRL report 156, 1996. https://trl.co.uk/reports/TRL156
[92] Halliday M et al. *Attitudes to cycle helmets – a qualitative study*. TRL report 154, 1996. https://trl.co.uk/reports/TRL154
[93] Adams J. *Risk*. UCL Press, London 1995.
[94] Gamble, T; Walker, I. *Wearing a Bicycle Helmet Can Increase Risk Taking and Sensation Seeking in Adults*. Jan 2016. Published in *Psychological Science OnlineFirst*. http://pss.sagepub.com/content/early/2016/01/05/0956797615620784
[95] 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. doi:10.2105/AJPH.2012.300711. http://www.ncbi.nlm.nih.gov/pubmed/22497201
[96] Morongiello B et al. *Understanding children's injury risk behaviour: wearing safety gear can lead to increased risk taking.* Accident Analysis and Prevention vol.39(3) pp619-23, 2007. http://linkinghub.elsevier.com/retrieve/pii/S0001457506001825
[97] Swartz, Erik (et al). *Early Results of a Helmetless-Tackling Intervention to Decrease Head Impacts in Football Players.* Published in the *Journal of Athletic Training*. 2016. http://natajournals.org/doi/pdf/10.4085/1062-6050-51.1.06
[98] 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, 2007, pp 417-425. http://linkinghub.elsevier.com/retrieve/pii/S0001457506001540
[99] Curnow W. *The efficacy of bicycle helmets against brain injury*. Accident Analysis and Prevention vol. 35 pp287-292, 2003. http://dx.doi.org/10.1016/S0001-4575%2802%2900012-X
[100] 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, article in press, 2011. http://dx.doi.org/10.1016/j.aap.2011.01.007
[101] St Clair V & Chinn B. *Assessment of current bicycle helmets for the potential to cause rotational injury.* TRL Project Report PPR213, 2007. https://trl.co.uk/reports/PPR213
[102] Walker B. *Helmet standards and capabilities.* Bicycle Helmet Research Foundation, 2004. www.cyclehelmets.org/1081.html).
[103] Parkinson G. *Bicycle helmet assessment during well visits reveals severe shortcomings in condition and fit.* Pediatrics vol. 112 issue 2, pp 320-323, 2003. http://pediatrics.aappublications.org/cgi/content/full/112/2/320.
[104] Byard RW et al. *Bicycle helmets and accidental asphyxia in childhood.* Medical Journal of Australia, MJA 2011;194(1):49. 2011. See also www.cyclehelmets.org/1227.html.
[105] Sydney Morning Herald, 3.1.2011. *Playing in helmets is dangerous.* www.smh.com.au/national/playing-in-helmets-is-dangerous-20110102-19d2h.html
[106] For listing of other sources, see www.cyclehelmets.org/1227.html.
[107] See www.cyclehelmets.org/1134.html for references and commentary.
[108] Ioannidis J. *Contradicted and initially stronger effects in highly cited clinical research.* Journal of the American Medical Association, vol. 294 no. 2, pp218-228, 2005. http://jama.ama-assn.org/cgi/content/abstract/294/2/218.
[109] 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. http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1405121/ . For commentaries see www.cyclehelmets.org/1068.html and www.cyclehelmets.org/1131.html.
[110] 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. http://injuryprevention.bmj.com/content/12/4/231.full.pdf. For commentary see www.cyclehelmets.org/1178.html
[111] Guiseppi 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. http://jama.ama-assn.org/content/262/16/2256.abstract.
[112] 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. http://adc.bmj.com/content/88/10/876.full
[113] 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. http://adc.bmj.com/content/93/6/485.abstract
[114] Road Safety Analysis. *Child Casualties 2010: A study into resident risk of children on roads in Great Britain 2004-08*. RSA, 2010. http://www.roadsafetyobservatory.com/Evidence/Details/10665.

[115] White D et al. *Road accidents and children living in disadvantaged areas: a literature review.* Scottish Executive Research Unit, 2000. www.scotland.gov.uk/Resource/Doc/156570/0042052.pdf.
[116] Thompson, Rivara and Thompson. *A case control study of the effectiveness of bicycle safety helmets*. New England Journal of Medicine, 1989 v320 n21 p1361-7. 1989. www.cyclehelmets.org/1068.html. Other studies indicating positive results for the protective effect of helmets are listed at www.cyclehelmets.org/1147.html.
[117] For more on this, see:
a) Report from WABA: http://www.waba.org/blog/2013/06/feds-withdraw-claim-that-bike-helmets-are-85-percent-effective/
b) Letter confirming correction from the US DoT to WABA, 14/5/2013.
http://bike.risingsea.net/docs/Legislation/helmet/NHTSA-response-to-Titus.pdf
[118] Robinson D. *Head injuries and helmet laws in Australia and New Zealand.* Bicycle Helmet Research Foundation, undated. http://cyclehelmets.org/1241.html.
[119] Chipman M. *Hats off (or not?) to helmet legislation.* Canadian Medical Association Journal vol. 166 (5), p. 602, 2002. www.cmaj.ca/cgi/reprint/166/5/602.
[120] Wardlaw M. *Butting heads over bicycle helmets.* Canadian Medical Association Journal vol. 167 (4), pp. 337-338. www.cmaj.ca/cgi/reprint/167/4/337-b.
[121] Macpherson A et al. *Mandatory helmet legislation and children's exposure to cycling*. Injury Prevention vol. 7 pp. 228-230, 2001. http://injuryprevention.bmj.com/content/7/3/228.full.
[122] Burdett A. *Butting heads over bicycle helmets*. Canadian Medical Association Journal e-letter, 2002. http://www.cmaj.ca/content/167/4/338.short/reply
[123] Wardlaw M. *Timely release of information is important*. E-letter, 2006. http://injuryprevention.bmj.com/content/12/4/231.abstract/reply#injuryprev_el_1600.
[124] Robinson D. *Helmet laws and cycle use.* Injury Prevention, *vol.* 9 pp. 380-381, 2003. http://injuryprevention.bmj.com/content/9/4/380.full
[125] BMA Board of Science. *Legislation for the compulsory wearing of cycle helmets.* BMA 2004, now withdrawn. For critiques see www.cyclehelmets.org/1101.html.
[126] BMA. *BMA Policy Handbook 2016 – 2017*. Policy no. 352. http://web2.bma.org.uk/bmapolicy
[127] 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. http://pediatrics.aappublications.org/cgi/content/full/110/5/e60.
[128] Canadian Institute for Health Information, 2003. http://www.cmaj.ca/content/168/10/1313.1.full.pdf
[129] Robinson D. *Timely reporting, concurrent comparisons and common sense*. E-letter, 2008. http://injuryprevention.bmj.com/content/12/4/231.abstract/reply#injuryprev_el_1600
[130] Jessica Dennis et al. *Helmet legislation and admissions to hospital for cycling related head injuries in Canadian provinces and territories: interrupted time series analysis.*
BMJ 2013;346:f2674 doi: 10.1136/bmj.f2674.14/5/2013). http://www.bmj.com/content/346/bmj.f2674
[131] Teschke, Kay (et al). *Bicycling injury hospitalisation rates in Canadian jurisdictions: analyses examining associations with helmet legislation and mode share*. Oct 2015. Published in BMJ. http://bmjopen.bmj.com/content/5/11/e008052.full.pdf
[132] Thompson D et al. *Helmets for preventing head and facial injuries in bicyclists*. Cochrane Database Syst Rev, 2002. www.cochrane.org/reviews/en/ab001855.html
[133] Robinson D, *Effectiveness of bicycle helmets in decreasing head and face injury*. BHRF, 2000. For other commentaries of this Cochrane review. http://dx.doi.org/10.1016/j.aap.2005.01.009 and www.cyclehelmets.org/1069.html .
[134] Attewell R et al. *Bicycle helmet efficacy: a meta-analysis*. Accident Analysis & Prevention, vol. 33 no. 3 pp345-52, 2001. http://www.ncbi.nlm.nih.gov/pubmed/11235796). It has been criticised by Curnow W, 2003 (ref 98) and by Elvik R, 2011 (ref 99).
[135] 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.
http://webarchive.nationalarchives.gov.uk/20100202152201/http://www.dft.gov.uk/pgr/roadsafety/research/rsrr/theme1/bicyclehelmetsreviewofeffect4726 For commentary see www.cyclehelmets.org/1067.html.
[136] 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. www.cochrane.org/reviews/en/ab005401.html). For commentary see www.cyclehelmets.org/1181.html .
[137] Hynd D et al. *The potential for cycle helmets to prevent injury - a review of the evidence.* TRL research report PPR 446, 2009. https://trl.co.uk/reports/PPR446
[138] Olivier J, Creighton, P. *Bicycle injuries and helmet use: a systematic review and meta-analysis*. Sept 2016. Published in the International Journal of Epidemiology.
http://urbactiv.com/wp-content/uploads/2016/09/IntJEpidemiol.-2016-Olivier-ije_dyw153.pdf