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THE CYCLE HELMET: FRIEND OR FOE?

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Many bodies, including elected authorities, the medical profession and road safety organisations all over the world seek to persuade cyclists to wear helmets as a means of reducing the incidence and severity of head injury among them. Some cyclists question this course of action, whilst others are opposed. At the end of the day, many people are confused. Without research aimed at reviewing and marshalling all the evidence, no clear way forward can be determined. This paper, drawn from a major report by the author, which has just been published by the independent Policy Studies Institute (Hillman, 1993), is aimed at doing just that.

It concludes first, that by wearing helmets, cyclists are at best only marginally reducing their chances of being fatally or seriously injured in a collision with a motor vehicle which is the predominant cause of these injuries, and that cyclists may be less likely to have an accident if they are not wearing a helmet and therefore ride with greater care owing to an enhanced sense of their vulnerability. Second, that tackling the source of accidents in which cyclists are involved has far greater scope for reducing head injuries than the arguable benefits of promoting helmet wearing among cyclists.

INTRODUCTION

Over 200 cyclists have been killed and over 80,000 injured in road accidents in Great Britain in each of the last few years. Children account for two in five of these casualties which typically occur without any vehicle being involved but by falling off their cycles after losing control. Injuries are rarely serious: admission to hospital usually reveals low severity, short-term concussion (Williams, 1991). However, the great majority of the fatalities and approximately half the injuries - most of them to adults - result from damage to the head following collision with a car or goods vehicle.

It might be assumed that greater protection of cyclists' heads would offer the possibility of lowering the number of fatalities and mitigate the worst effects of head injury, with the result that many injuries that would have been serious would be slight and many slight injuries would be prevented altogether. The case for encouraging cycle helmet wearing, and even for making it compulsory would appear, on the face of it, to be sound.

Such a judgement is widely shared. In the UK, it reflects the position of the government and politicians generally, road safety organisations, such as RoSPA (Royal Society for the Prevention of Accidents), PACTS (Parliamentary Advisory Committee on Traffic Safety), the Medical Commission on Accident Prevention, the Child Accident Prevention Trust, bodies involved in health promotion such as the Health Education Authority, and of surgeons, paediatricians and the medical press. All believe that wearing a cycle helmet provides a substantial measure of protection against brain injury and skull fracture.

STUDIES OF HEAD INJURY REDUCTION BY HELMET WEARING

A large number of studies have been undertaken in order to identify what effect helmet wearing has on the incidence and severity of head injuries. Some of the more important of these are set out in Table 1. As can be seen, most have concluded that it is highly beneficial. Claims range from that of a study suggesting that fatalities would be reduced by 90 per cent (Dorsch et al., 1987), another that there would be no reduction in cycle fatalities but about a 30 per cent in injuries (Mills, 1989), to a major study in the US which found '... no statistical evidence that hard-shell helmets have reduced head injury or fatality rates', and '... increasing helmet wearing is actually associated with an increase in injuries' (Rodgers, 1988).

Table 1. Estimates from various international studies of reduction in head injuries to cyclists by wearing helmets

	Injuries %				
Ref.	Fatal	Serious	Slight	All	Notes
1	90				hard-shell helmet with inner liner
2	80				only child cyclists considered
3	70			84	assuming 100% wearing rate
4	50				based on a review of studies
5	50				based on a review of studies

6	50				only for cyclists aged 5-19
7				85	also 88% of the brain injured
8			>50		also much reduced for serious injuries
9				20	with wearing rates up from 5% to 40%
10				13	assuming 100% wearing rates
11				< 1	assuming a low wearing rate
12	0	30		32	injuries to cranium only
13	0				based on statistical analyses

References: 1. Australia (Dorsch, op.cit.); 2. Ontario, Canada (Spence et al., 1993); 3. US (Sacks et al., 1991); 4. Quebec, Canada (Dussault, 1992); 5. Australia (Mathiesen, 1989); 6. UK (Lancet, 1988). 7. US (Thompson et al., 1989); 8. UK (Worrell, 1987); 9. Victoria, Australia (Vulcan et al., 1992); 10. Odense, Sweden (European Cyclists Federation, 1991); 11. UK (Downing, 1986); 12. UK (Mills, op.cit.); 13. US (Rodgers, 1988);

The wide variation in the estimates could be explained by a number of factors influencing the risk of accident in the first place such as personal characteristics - age, sex and the experience of cyclists and the mileage they travel; the comparability of data from 'before and after' surveys, including the level of reporting of injuries, the sample size, changes attributable to relevant legislation affecting cyclists' risk of accident, and varying weather conditions; the dangers of not comparing 'like with like'; the lack of consistency of classification of head injury; and the attention paid to the issue of risk compensation.

EVIDENCE FROM AUSTRALIA

In theory, the best source of evidence on the subject of helmet wearing is studies conducted recently in Australia where helmet wearing has

been made mandatory. In Victoria, Australia, a 40 per cent decrease in head injuries and a 24 per cent decrease in severe ones were recorded in a comparable period following introduction of a law on this (Vulcan et al., op.cit.). However, there are many factors other than helmet wearing that could account for this.

First, the legislation appears to have deterred many people from cycling - surveys have revealed 15 per cent fewer young children, over 40 per cent fewer teenagers, and 20 per cent fewer adults (ibid.). Second, danger on the roads has reduced generally over the last few years owing to a decline in traffic levels attributable to the state of the economy, and other legislation on drink-driving and speeding which is likely to have affected behaviour. In combination, these have contributed to a 50 per cent reduction in road accidents in a comparable period covered by the studies (Minerva, 1993), that is a sharper fall than the percentage reduction of head injuries following the new law, even discounting the reduction in the extent of cycling noted above.

Not surprisingly, one of the two main studies on the effect of the helmet legislation has concluded that it is 'almost impossible to isolate and measure the contribution of cycle helmets', that 'there are no reliable figures on which to base analysis' ... but that 'the law has led to an increase in helmet wearing rates' (Cameron, Heiman and Neiger, 1992)!

QUESTIONING THE BENEFITS OF CYCLE HELMETS

There are other grounds too for questioning the benefit afforded by wearing cycle helmets, in particular those relating to their strength - the BSI specification makes it clear that cycle helmets only provide that degree of protection for low speed impact, that is up to about 20 kph, which is required to reduce injury if someone falls off their bicycle and without a motor vehicle being involved (British Standards Institute, 1991) - and the effect of helmet wearing on the propensity to take risks.

Level of protection from cycle helmets

The protection afforded by cycle helmets falls well short of the heavier, more stoutly constructed and more complete coverage of motorcycle helmets which are better able to withstand the impact forces from collision with a motor vehicle. Table 2 shows the number of each type of road user who has died from head injury in an accident in the last five years for which the statistics are accessible for such analysis. It is salutary to note from this that, in spite of the fact that motorcyclists are obliged by law to wear a helmet with this enhanced level of protection at all times, 45 per cent of their fatalities still result from head injury, compared with 71 per cent of those of cyclists - only a minority of whom wear a helmet. It can be seen too that cycle fatalities account for only 1 in 17 of all road fatalities and 1 in 12 of those that are result from head injury.

Table 2. Fatalities due to head injury* according to road user group, England and Wales, 1987 to 1991

	All fatalities	Fatalities from head injury			
Road user type:					
	Number	% of all	Number	% of all	% of all fatalities
Pedestrians	7983	34.8	4432	39.1	55.5
Cyclists	1344	5.9	958	8.5	71.2
2-wheel motor riders	3009	13.1	1348	11.9	44.8
Vehicle drivers	6459	28.1	2824	24.9	43.7
Vehicle passengers	4159	18.1	1761	15.6	42.3
All	22954	100.0	11323	100.0	49.3

Source: special tabulations from the Office of Population Censuses and Surveys.
***** The percentages in the Table have been calculated on the basis of the numbers of head injuries for which a safety helmet is likely to have afforded some protection: the types of injury covered are fracture of skull, intracranial injury excluding skull fracture, other open wound of head, injury to blood vessels of head and neck, late effects of intracranial injury without mention of skull fracture, superficial injury of face, neck and scalp except eye, contusion of face, skull and neck except eyes, and injury to other cranial nerves.

It is clear that motor cycle helmets, let alone cycle helmets, can by no means be relied on to protect riders from head injury in road accidents. However, 90 per cent of serious injuries reported to the police and 94 per cent of fatalities in cycle accidents involve a motor vehicle. The weight and speed of the vehicle at the time of impact play a crucial role in terms of the degree of injury. This is not surprising given the evidence from research into 'safer' cars which shows that in each collision, its severity depends predominantly on the difference in the mass of the vehicles involved, and that the heavier the vehicle, the safer it is - for the occupants (Department of Transport, 1993)!

Table 3 shows that nearly three-quarters of serious injuries and two in three of fatalities result from collision with a car; and heavy goods vehicles account for a disproportionately high number of cycle fatalities - that is, 21 per cent - though representing only seven per cent of traffic (Department of Transport, 1992). Analysis of fatalities in road accidents in the last seven years in inner and outer London, with their relatively high traffic volumes, shows that HGVs (heavy goods vehicles) are involved in 56 and 30 per cent, and cars in 26 and 54 per cent respectively of all cycle deaths in these two areas of the capital (Gilbert and McCarthy, 1993).

Table 3. Cycle fatalities and serious injuries, according to vehicle involvement, Great Britain, 1987 to 1991

	Serious injuries	Fatalities		
Other vehicles involved:	number	%	number	%
None	2357	10.4	77	5.9

One or more*				
car	16323	72.2	748	57.6
heavy goods vehicle	1000	4.4	276	21.2
light goods vehicle	1525	6.7	108	8.3
bus	332	1.5	43	3.3
2-wheel motor vehicle	617	2.7	22	1.7
bicycle	249	1.1	6	0.5
other	215	1.0	21	1.6
Total	22619	100.0	1299	100.0

Source: Department of Transport, Volumes of Road Accident Statistics Great Britain: The Casualty Report, for the five years from 1987 to 1991.

Propensity to take risks

Most importantly, considerable caution must be exercised in drawing conclusions about the likelihood of cyclists reducing their risk of head injury by wearing helmets as it is clear that such a practice affects their risk-taking behaviour (Adams, 1985; Evans, 1991). Discussion of this subject of behavioural adaptation no longer centres on whether it occurs but on how complete it is (OECD, 1990). In the first place, it must be recognised that cyclists who choose to wear helmets are likely by nature to be more cautious people and therefore to have fewer serious accidents, irrespective of the use of the helmet. This could account for much of the observed differences revealed in studies of the incidence of accidents leading to head injury - rather than the protection afforded by the helmet.

Furthermore, the theory of risk compensation suggests that the wearing of helmets may cause cyclists, as with motorists acquiring cars with better brakes and improved acceleration, to modify their behaviour on the road (Adams, op.cit.). This proposition can be illustrated by considering how much more carefully a motorist will drive a car with defective brakes than in one with effective brakes. Thus, when a safety aid such as a helmet is actually used, some of its potential safety benefits may be 'consumed' as performance benefits in the form of faster or more carefree riding.

There can be little doubt that the very act of wearing a cycle helmet must encourage cyclists to feel more confident that, in the event of an accident, their risk of head injury will be reduced. Yet road safety campaigners, helmet manufacturers, and others persuaded of the benefits of helmet wearing, effectively imprint on cyclists' minds that they will be safer if they wear a helmet, but do not warn of the very limited benefit that it would offer following an accident involving a motor vehicle. This may lead cyclists to take marginally more risk as they feel less vulnerable and are thereby more likely to have accidents. A similar outcome is likely to follow if parents allow their helmeted children to cycle on the roads under the erroneous assumption that it is then sufficiently safe to do so. It could be argued therefore that cyclists who do not wear helmets exercise more vigilance because they feel more vulnerable.

Another source of evidence often cited in support of helmet wearing is that it led to a reduction in casualties among motorcyclists when that was made compulsory in 1973. However, the claim made that this would lead to a reduction in their injuries was not subsequently substantiated: motorcyclists' rate per kilometre travelled fell significantly less than did that of car drivers and that of all road users. Moreover, standing out against the general trend of road accident reduction was an increase in pedestrian deaths and injuries in collision with motorcycles in the years after this legislation, suggesting that this may have been accounted for by more careless riding by helmeted motorcyclists (Davis, 1993).

WHOSE RESPONSIBILITY FOR MINIMISING THE RISK OF INJURY?

It could be argued that it is unjust to shift so much responsibility for the safety of cyclists onto cyclists themselves because they are among the most vulnerable of road users and unable to markedly reduce the risk to themselves of being involved in a road accident - the prelude to head injury - other than by cycling less or giving up cycling altogether! The proposition that cycling is relatively dangerous overlooks the fact that few cyclists ride into motor vehicles. It is drivers of motor vehicles who are the source of most of the threat to their life and limbs.

Thus, it is unjust that solutions to the primary issue of the risk of injury among cyclists, namely the motor vehicle, should instead be focused on the secondary issue of how to minimise the injury in the event of an accident, for instance by wearing helmets. Moreover, it should be recalled that the great majority of cyclists' deaths and serious injuries result from collision with a motor vehicle, that is the type of accident in which helmets are largely ineffective.

WHO SHOULD WEAR HELMETS?

Most children own a bicycle but only one in four of them is allowed to use it as a transport mode and only one per cent use them to go to school (Hillman, Adams and Whitelegg, 1991). At present, their cycling is principally for recreation and takes place off the road where collision with

(Hillman, Adams and Whitelegg, 1991). At present, their cycling is principally for recreation and takes place on the road where collision with motor vehicles is very unlikely to occur. Indeed, it has been seen that, where children are injured, it is rarely serious: the accidents usually occur as a result of falling off at low speed. It is this type of accident for which helmets are specifically designed to limit the severity of injury. It could be argued therefore that, in the event of an accident, cycle helmets could contribute to reducing head injuries among children more obviously than among adults. But, again, there is no reason to believe that children, as with adults, are not influenced in their riding behaviour by the greater feeling of security afforded when wearing a helmet, and consequently take marginally less care.

It is salutary too to observe that, if the case for encouraging child or indeed adult cyclists to wear helmets were valid, then arguments could be put forward that, when children are playing, they should wear helmets given the risk of them falling and hitting their heads: a survey has shown that they are between two and three times as likely to have a head injury after climbing or jumping than as a result of a cycle accident (O'Rourke, 1987). They should also wear knee, elbow and shoulder pads as well for there are three times as many serious injuries to cyclists' upper and lower limbs as there are to their heads (Mills, op.cit.).

Similarly, logic would suggest that all other road users should be encouraged to wear helmets, especially pedestrians and vehicle drivers for, in theory, this would hold out far a more significant prospect of success in saving lives in road accidents. Table 4 shows that, compared with cyclists, nearly five times as many vehicle occupants and nearly five times as many pedestrians die as a result of head injury. And twice as many lives are lost by head injury to elderly pedestrians (over the age of 65) than to cyclists of all ages.

Table 4. Distribution of fatalities due to head injury according to road user group and age group, England and Wales, 1987 to 1991.

									%
	0-9	10-14	15-19	20-24	25-54	55-64	65-74	75+	All
Pedestrian	4.14	2.38	2.65	2.41	8.62	3.46	5.38	10.09	39.14
Cyclist	0.46	1.49	1.04	0.63	2.28	0.96	0.87	0.72	8.46
Motorcyclist*	-	0.06	3.73	3.53	4.04	0.22	0.24	0.08	11.90
MV driver	-	0.01	3.24	5.67	12.39	1.80	0.96	0.87	24.94
MV passenger	1.38	0.64	4.36	3.14	3.83	0.64	0.73	0.83	15.55
Total	5.99	4.58	15.02	15.38	31.16	7.09	8.19	12.60	100.00

*** including pillion passengers**
Source: special tabulations from the Office of Population Censuses and Surveys.

ENCOURAGEMENT VERSUS COMPULSION

Beyond the issue of the efficacy of pursuing a policy on exhorting cyclists to wear a helmet lies the more extreme proposition that wearing should be made compulsory. This is favoured by many surgeons who only see the head injuries and perhaps understandably assume that its severity would have been limited by wearing a helmet, but are unfamiliar with the issues of accident prevention (Davis, op.cit.). However, aside from questioning the benefits of helmet wearing, there are strong grounds, both practical and ethical, for opposing any proposal that would lead to it being an offence not to wear one. First, there are problems of enforcement. Second, compulsion would put civil liberties at risk. Third, if wearing a helmet were made compulsory, it would reinforce the idea that cyclists were responsible for injuries to their heads if they were not wearing one, whereas in accidents in which another vehicle is involved, it is the driver who is far more often at fault (Mills, op.cit.. Fourth, legislation requiring cyclists to wear helmets at all times might also reinforce public perceptions of the bicycle as an undesirably dangerous form of transport: as has been noted, the effect of such legislation in Australia has been to discourage it.

LIFE YEARS LOST VERSUS LIFE YEARS GAINED

Circulatory and respiratory diseases account for over half of the causes of death among both men and women. Thus, in determining policy on cycle helmets, there is the related issue of the promotion of health. A national survey in 1992 recorded that seven in ten men and eight in ten women in the UK fall below the 'age appropriate activity level' needed to achieve a health benefit (Allied Dunbar et al., 1992). And a series of studies has shown children's levels of habitual physical activity to be surprisingly low: few experience the intensity and duration of physical activity associated with health-related outcomes (British Medical Association, 1992; Armstrong, 1993). A most telling and supportive argument for cycling therefore, is that it is an ideal means of maintaining fitness from childhood through to old age (Hillman, 1992), particularly bearing in mind the fact that, compared with those who do not cycle, those who do so at least 25 miles a week halve their risk of heart disease (Morris et

in mind the fact that, compared with those who do not cycle, those who do so at least 25 miles a week halve their risk of heart disease (Morris et al., 1990).

The gain of 'life years' through improved fitness among regular cyclists, and thus their increased longevity exceeds the loss of 'life years' in cycle fatalities. An analysis based on the life expectancy of each cyclist killed in road accidents based on actuarial data, and the increased longevity of those engaging in exercise regimes several times a week compared with those leading relatively sedentary lives, has shown that, even in the current cycle-hostile environment in most of the UK, the benefits in terms of life years gained, outweigh life years lost in cycling fatalities by a factor of around 20 to 1 (Hillman, 1992). In these terms, a price is paid in not promoting cycling.

ALTERNATIVE APPROACHES TO REDUCING HEAD INJURIES

Helmet wearing does not address the principal issue, namely the source of the danger - traffic moving too fast and thereby posing a threat to vulnerable road users in particular. For road users, the difference between colliding and not colliding is measured in fractions of a second. For this reason, heightening awareness among motorists and lorry drivers of the need to exercise a high level of vigilance on the roads in view of the vulnerability of cyclists to injury, could be paramount and far more effective in lowering the number and severity of head injuries among cyclists than the protection afforded by a few millimetres of polystyrene after an accident has occured. There are also strong grounds for believing that public provision of cycle routes, traffic calming, 20 mph speed limit zones which have been shown to reduce casualties by more than 50 per cent (Carlisle, 1993) and for which 80 per cent of urban road networks are eligible (Chope, 1992), proper enforcement of existing speed limits, and improved road maintenance to minimise the risk of accidents caused by cyclists riding into potholes or swerving to avoid them, are effective ways of reducing the number and severity of head injuries among cyclists. It is worth noting that helmets are far less on the road safety policy agenda of countries such as Denmark and the Netherlands which give a much higher priority to cycling in their transport policies, where fatality rates per kilometre cycled are between a quarter and a third of those in Great Britain, and where perhaps a critical mass of cycling has been reached ensuring safer cycling because of sheer numbers (Mynors and Savell, 1992).

CONCLUSIONS

By wearing helmets, cyclists are at best only marginally reducing their chances of being fatally or seriously injured in a collision with a motor vehicle which is the predominant cause of these injuries. Even the most expensive ones provide little protection in these circumstances. Moreover, the argument in favour of helmets would have validity if there were proof that behaviour does not change in response to perceived risk. But there is no such proof. Safety devices encourage higher levels of risk-taking. As a result, cyclists are likely to ride less cautiously when wearing a helmet owing to their feeling of increased security. After all, the message of the advocates of helmet wearing is that such a practice will protect the cyclist's head adequately in the event of any accident, not just a minor one when cyclists are hit by very slow-moving vehicles or fall off and hit their heads on the ground. Cyclists may be less likely to have an accident if they are not wearing a helmet, and are therefore riding with greater care owing to an enhanced sense of their vulnerability.

Furthermore, people are discouraged from cycling if their perception is heightened that it is a 'dangerous' form of travel and that it is only safe to do so if a helmet is worn. The result of this is that the considerable latent demand for cycling - an ideal mode for the majority of the population for most of their journeys - continues to be suppressed. As cycling is also a convenient and routine way of maintaining fitness, a significant route to public health is prejudiced.

There remain then three questions to be answered. First, should helmet wearing be made mandatory? The report on which this paper is based has revealed no case for such a law. In addition to the absence of proof that helmet wearing reduces the risk of head injury, such a law would represent an infringement of civil rights. Moreover, where it has been introduced, it has led to a significant reduction in cycling.

The second question to address is whether, whilst not making it mandatory, cyclists should nevertheless be encouraged to wear helmets -in effect, obliged to do so by 'moral' persuasion rather than by law. However, other than concern on the civil rights issue, the approach to helmet wearing by this means rather than by coercion through legislation would appear to be equally invalid.

This then leads to the third question concerned with alternative and effective ways of reducing the risk of accidents, and therefore of head injury, among cyclists. The primary means of reducing serious head injury among cyclists is to create an environment in which accidents are less likely to occur. Such a strategy based on tackling the source of accidents in which cyclists are involved has far greater scope for reducing head injuries than the questionable benefits of promoting helmet wearing among cyclists.

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