Promoting safe cycling and helmet use

A briefing from the Board of Science
Updated January 2010

Why promoting safe cycling is important to doctors
The promotion of safe cycling is of importance to doctors for two key reasons:
Firstly, it is doctors who witness and treat the range of cycle related injuries after they occur.
Secondly, cycling plays an important role in the promotion of individuals’ and the nation’s health, of which doctors have a vested interest in.

The BMA’s work on cycling
The British Medical Association (BMA) has undertaken substantial work in relation to transport and health including, accident prevention and reduction, environmental and health impacts of transport, studies on drink and drug driving and seat belt legislation. Following previous research by the Board of Science on cycling, the BMA established specific policy at its 2006 Annual Representative Meeting (ARM) that the Association promotes cycling as a safe, healthy and sustainable alternative to car use.

Health promotion
The BMA believes that cycling has many advantages to the individual, in terms of improved health and mobility, as well as to society. It is a sustainable form of transport which has a minimal impact upon the environment and is the least polluting way of traveling after walking. Cycles also require fewer resources to manufacture and maintain compared to other modes of transport.

While a number of studies demonstrate the positive effect of cycling on lifespan, health and general well being, the majority of this research is indirect and based on the findings that moderate intensity physical activity of any kind produces health benefits. It is the fact that cycling is an effective form of exercise which confers these positive effects.
Safe cycling

Cycling statistics
The number of UK cyclists has been in decline since the 1950s. [reference 1] A 2008 Department for Transport (DfT) survey of almost 8,100 UK households found that eight per cent of individuals reported themselves as using a bicycle three or more times a week, 14 per cent reported using their bicycle at least once a week, and eight per cent using their bicycle at least once a month. [reference 2] Over two thirds (69%) reported using a bicycle less than once a year. [reference 3] Cycling was most popular among men aged 11 to 16, with males making more cycle trips than women. [reference 4]

UK statistics
Crashes involving cyclists are common and often also involve motor vehicles. It is estimated that 90,000 road related and 100,000 off-road related cycle crashes happen every year within the UK. Crash statistics are however assumed to be largely under representative of what is occurring. [reference 5, 6] The majority of road related traffic data are formulated using STATS19 police data. The STATS19 consists of all injuries reported to the police including slight injuries where a patient may not require hospitalisation. Typically these data are confined to crashes on public highways and exclude non collision crashes that do not involve another vehicle.

Cycle crashes are believed to be underrepresented in STATS19 data, especially in relation to off-road crashes. [reference 7] An alternate source of information is Hospital Episode Statistics (HES) which only covers patients admitted to hospitals. For the financial year of 2005/2006 cyclists’ crashes accounted for only eight per cent of all seriously injured STATS 19 casualties, whereas they accounted for 17 per cent of HES casualties.

The data reported below uses STATS19 figures.

Crashes
Recent figures from 2008 show that 2,565 cyclists were killed or seriously injured in road crashes and a subsequent 13,943 received light injuries. [reference 8] Cars presented the most substantial risks to cyclists in all types of setting and resulted in 52 cyclist fatalities and 1,813 serious injuries to cyclists. Cyclists admitted to hospital following collisions with motor vehicles are most likely to have injuries to the head or face (49%) or legs and hips (36%). Crashes in which there was no direct collision result in more injuries to the arms and shoulders (47%). [reference 9]

As will be discussed later, cycle helmets do not prevent all types of injury or death, however, they play a significant role in reducing head injuries. They are most effective at low impact speeds (approximately 13 mph or less), such as when a cyclist falls from a cycle without the involvement of other vehicles. [reference 10]
Improving cyclists’ safety

The 1999 BMA report *Cycle helmets* identified a number of measures to improve cyclists’ safety. [reference 11] These include:

- publicity and education campaigns in order to raise drivers’ awareness of more vulnerable road-users, including cyclists
- the creation of a safer cycling environment (eg improving cycle routes)
- reductions in vehicle speeds and traffic volume in urban areas
- the provision of cycling training for all children
- recognizing road safety, including cycling proficiency education, as part of the curriculum for all school children. This should include basic cycle maintenance, and safety precautions (eg lights, reflective clothing), information on the health benefits of cycling, as well as encouraging cycle helmet use
- ensuring the correct fitting of cycle helmets as poorly fitted helmets are less effective
- advertising standards officials should ensure that the public are protected against misleading safety claims from manufacturers
- cycle manufacturers and retailers should consider supplying a free cycle helmet (or helmet voucher) with every bike sold
- helmet costs should be reduced substantially (in the UK helmets are free of value added tax).

In January 2008, the DfT announced that they were developing a new research project to investigate a range of road cycling and safety matters. These will include; road user safety and cycling data; cycling infrastructure; attitudes and behaviours; and cycle helmets.

In 2008 the Government announced a record £140 million investment in cycling. This increase is intended to allow an additional 500,000 10 year olds to take part in Bikeability cycle training in England by 2012, as well as equip them to cycle safely and responsibly. Investment is being made on building cycle links to schools; schools with links already in place report the number of students cycling to school has doubled. The remainder of this investment will create a further 10 cycling demonstration towns in England, as well as the first large demonstration city. The government intends this latest rise in cycling funding to offer an additional three million people the opportunity to benefit from best practice and promotion of cycling.

For further information see the DfT website.
Charles, a senior orthopaedic consultant, fell from his bike following a collision with a car on an A-road. He was cycling off a roundabout onto a dual carriageway at just under 20 mph when the crash occurred. He suffered a grazed and fractured shoulder, grazing to the right side of his head and cuts to his chin. He strongly believes that the cycle helmet he was wearing saved him from sustaining more severe injury to his head.
Cycle helmets
In the UK individuals are not currently legally required to wear a cycle helmet. There is much controversy on whether cycle helmet wearing should be compulsory. A great deal of the controversy relates to whether cycle helmets reduce injuries, if so what type of injuries they reduce and further whether cycle helmet legislation discourages cycling.

The BMA, as a part of its policy to improve safe cycling supports compulsory wearing of cycle helmets when cycling for children and adults. The Association wants to see an increase in voluntary use prior to the introduction of cycle helmet legislation and supports initiatives that so increase such use.

There is extensive literature that reviews the case for and against the wearing of cycle helmets. The most reliable research comes from Cochrane Reviews which are based on the best available information about healthcare interventions. They explore the evidence for and against the effectiveness and appropriateness of treatments (medications, surgery, education, etc) in specific circumstances.

Rationale
Cycle helmets aim to reduce the risk of serious injury caused by impacts to the head. Injuries to the head generally take two forms; skull fractures and brain injuries. As doctors know only too well, while skull fractures can heal, injuries to the brain, unlike those to the rest of the body, generally do not and may sometimes have long-term consequences. Though not always visible and sometimes seemingly minor, brain injury is complex. It can cause physical, cognitive, social and vocational changes that affect an individual for a variable time period. In many cases recovery becomes a lifelong process of adjustments and accommodation for the individual and those caring for them. Depending on the extent and the location of the injury, impairments caused by a brain injury can vary widely. Among the most common impairments are difficulties with memory, mood and concentration. Others include significant deficits in organisational and reasoning skills, learning, cognitive and executive functions. See Appendix 1 for a list of the specific deficits resulting from damage to particular regions of the brain.

Function
Cycle helmets perform three functions. Firstly they reduce the deceleration of the skull and hence the brain by managing impacts. This is achieved by crushing the soft material contained within a helmet. Secondly a helmet acts by spreading the area of an impact. As it is impacted, the expanded polystyrene shell of the helmet dissipates the energy over a rapidly increasing area like a cone. This prevents forces from being localized to one concentrated small area. Finally a helmet plays a vital role by preventing direct contact between the skull and the impacting object.
Simon, in an effort to get fit for his 40th birthday, started a regular regime of cycling in the evening. Like many people, he didn’t wear a cycle helmet because he thought they looked stupid. On one occasion, for reasons unknown, he blacked out and fell from his bicycle, hitting his head on the pavement as he fell. He broke the base of his skull and sustained blood clots to either side of his head. Doctors operated on him to remove the blood clots. He now has metal plates in his head. He has tinnitus in both ears and has lost virtually all hearing in the right ear. He suffers greatly from fatigue and his head hurts constantly. He has no sense of smell or taste and has lost a significant amount of weight. He has also had to have therapy for a stutter acquired as a result of the accident and attends courses to manage his anger. Simon regrets not having worn a cycle helmet. The injuries he has suffered have impacted greatly on him as an individual as well as on his family.
Safety Standards

Safety standards are intended to give consumers confidence that the cycle helmet they own will provide an appropriate level of protection in the event of a crash. Many different standards governing helmet safety exist, however, some safety standards are more stringent than others. [reference 12] The BMA strongly recommend that all cyclists should wear proper fitting helmets which as a minimum are certified to the EN 1078 standard, but preferably certified to the Snell B95 standard which provides greater protection in the event of an accident. [reference 13] Under European legislation, there is no requirement for cycle helmet manufacturers to conform to the European Committee for Standardization (CEN) standard. This means a manufacturer only has to meet the essential safety requirements of the Personal Protective Equipment Directive, achieved by compliance to the EN 1078 standard.

It is essential that helmets are replaced following a crash.

"I have seen – in my practice and when working in A/E - quite a number of serious head injuries from children falling off bicycles. I have also seen a number of children who wore helmets who only suffered minor injury. I am convinced that helmets reduce injury."

GP
Effectiveness of helmets at reducing injuries

As part of its policy to improve the safety of cyclists, the DfT conducted an independent critique of evidence on the efficacy of cycle helmets. [reference 14] It concludes that:

- bicycle helmets have been found to be effective at reducing the incidence and severity of head, brain and upper facial injury
- bicycle helmets have been found to be effective in reducing head injury for users of all ages, though particularly for children.

In observational studies cycle helmets were found to be effective at reducing the incidence and severity of head, brain and upper facial injury for all ages. [reference 15] Cycle helmet legislation was also found to significantly reduce the number of head injuries. [reference 15]

Samuel’s Story

Seven year old Samuel was out cycling near his home when he collided with a car. The cycle helmet Samuel was wearing almost split in two as a result of the impact. While Samuel did suffer cuts and bruises he did not suffer any serious injuries to the head.

Research studies that signposts the relationship between cycle helmets and injuries to cyclists as well research not included within the 2004 DfT report are listed in Table 1 below. For an analysis of reviews pre-2004 please see the DfT report Bicycle helmets: review of the effectiveness (No. 30), DfT, November 2004.

<table>
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<tr>
<th>Author (date)</th>
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<tr>
<td>Thomspn et al (1999)</td>
<td>Cochrane review of five studies</td>
<td>To determine if cycle helmets reduce head, brain and facial injury for cyclists of all ages in event of a crash or fall</td>
<td>Systematic review</td>
<td>Incidence of head injuries, Incidence of facial injuries, Protective effect of helmet</td>
<td>Helmets reduce the risk of head injury by 85%, brain injury by 88% and severe brain injury by 75%.</td>
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* chronologically ordered
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<tr>
<th>Liller et al (2003)</th>
<th>United States of America</th>
<th>Observational study</th>
<th>Observations of helmet use</th>
<th>Helmet use significantly increased from 3% (pre legislation) to 67% (post legislation) at its peak and dropped to 50.1% at end of 8 year period</th>
<th>Observation of changes in children’s helmet use, changes in number of motor vehicle cycle related injuries, pre and post legislation (8 year period), children aged 5 to 13 and age specific rates of cycle related injury or death involving motor vehicles pre- and post-law obtained.</th>
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<td>Partial Statewide Legislation (65/67 counties)</td>
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<td>Unknown if effects seen resultant from legislation or concurrently running educational and outreach activities to promote helmet use</td>
<td>Changes in children's helmet use, changes in number of motor vehicle cycle related injuries, pre and post legislation (8 year period), children aged 5 to 13 and age specific rates of cycle related injury or death involving motor vehicles pre- and post-law obtained.</td>
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<td>Children under 16</td>
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<td>Changes in children's helmet use, changes in number of motor vehicle cycle related injuries, pre and post legislation (8 year period), children aged 5 to 13 and age specific rates of cycle related injury or death involving motor vehicles pre- and post-law obtained.</td>
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<td>Hillsborough County, Florida (population 948-998)</td>
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<td>Changes in children's helmet use, changes in number of motor vehicle cycle related injuries, pre and post legislation (8 year period), children aged 5 to 13 and age specific rates of cycle related injury or death involving motor vehicles pre- and post-law obtained.</td>
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<td>Cook &amp; Sheikh (2003)</td>
<td>England</td>
<td>Time trend study</td>
<td>Case Control</td>
<td>Head and brain injuries in hospital admissions among English cyclists and pedestrians 1995 to 2000</td>
<td>Cyclists admitted to hospital (ICD 10 V10- V14 or V17- V19) vs Pedestrians admitted to hospital (ICD 10 V0)</td>
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<td>Hynd et al. (2009)</td>
<td>Hospital data (HES data) Police fatalities files (STATS19 data)</td>
<td>Literature review</td>
<td>Literature review</td>
<td>Head injuries</td>
<td>A comprehensive review of the effectiveness of cycle helmets in the event of on-road crashes.</td>
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As is apparent from Table 1 wearing a cycle helmet can help reduce the risk of head injury from crashes, with one piece of research investigating cycle helmets and injury in the UK found they can reduce the risk of head injury by up to 60 per cent. While wearing a helmet does not reduce the risk of injury entirely, it does significantly reduce the extent of injury due to impacts to the head.
**Harry’s story**

Harry, a seven year old boy, was not wearing a cycle helmet when he hit a pothole. As the bike hit the pothole, Harry lost his balance and flew over the handlebars. At the time of the accident Harry appeared to have done nothing more than graze his hands, back, knees and head; an hour later Harry’s left eyelid started to swell and turn black. He was taken to hospital and by the time he arrived had become drowsy and had started to vomit. A CT scan revealed a small clot under a membrane near his brain. Harry underwent five hours of surgery that revealed he had a fractured skull. Harry spent a week in hospital and the surgery to remove the clot resulted in 62 stitches. Before the accident Harry was a happy, easy going boy who was popular and loved to go out on his bike; since suffering his head injury Harry suffers anxiety attacks, has trouble sleeping and cries for no reason.

**Current cycle helmet use**

On British roads observed cycle helmet use increased from 16 to around 25 per cent over the period of 1994 to 2002. This has been attributed increases in adult helmet wearing as child helmet wearing had remained relatively constant.

**Barriers and facilitators to cycle helmet use**

The 2004 DfT cycle helmet review identified a series of barriers and facilitators associated with cycle helmet ownership and use, including:

- age (teenagers report and are observed having lower rates of helmet use)
- social background (helmet use and ownership are positively associated with income and educational achievement)
- geographical background (helmet use is greater in urban compared to rural areas)
- cost
- discomfort.

If a cyclist is accompanied by helmeted companions they are more likely to wear helmets with helmet use in children strongly associated with parental helmet use. Attitudinal factors shown to influence rates of helmet use include low risk perception (with cycling not being viewed as a dangerous activity), peer pressure (which can either promote or constrain helmet wearing), as well as parental influence.

For a more in depth overview please see the DfT report Bicycle helmets: review of the effectiveness (No. 30), DfT, November 2004.
**Risk compensation theory**

Hypotheses on risk homeostasis and compensation are based on assumptions that individuals adapt their behaviour toward greater or lesser risk in relation to how they subjectively perceive risk. This has been one of the arguments used against the introduction of mandatory cycle helmet wearing. Some opponents to legislation believe that cyclists who opt to use a helmet may perceive less risk of being injured as a result of a crash, and this may lead them to use more careless cycling behaviours. Spanish research (where legislation exists for mandatory helmet wearing) did not find evidence of the existence of a strong risk compensation mechanism among helmeted cyclists.

“I would certainly support cycle helmet wearing for cyclists. I have seen far too many young lives ruined by head injuries.”

**Consultant in Emergency Medicine**
Legislative and non-legislative interventions

Non-legislative interventions
While the BMA advocates the compulsory use of cycle helmets, we believe that the first step before enacting this is to attain higher rates of voluntary use. Many authors have described cycle helmet programmes that aim to encourage cyclists to wear helmets (see below for details). These programmes have varied widely both in their effectiveness and the type of strategy employed. It is difficult to know from individual trials how effective cycle helmet promotion schemes have been, which elements of the programme contribute to their effectiveness, and whether the effect seen is similar for all jurisdictions.

Community-wide interventions include education campaigns, media campaigns, the distribution of free or subsidized helmets, counselling from GPs or emergency clinicians or, more frequently, combinations of all of these methods. A review of 22 promotional campaigns that encouraged children to wear helmets with the intention of determining the most effective format found that campaigns varied widely in terms of content where they were conducted, and as the target age of the children. [reference 20] Community-based studies that included the provision of free helmets alongside an educational programme produced the largest increases in observed helmet wearing. [reference 20] Researchers were unable to separate the effect of study setting from that of the provision of free helmets. There was evidence that interventions offering subsidised helmets increased observed helmet wearing, but to a lesser extent than those providing free helmets. [reference 20] There was also evidence that interventions set in schools increased helmet wearing, and given that studies demonstrating the largest positive effects were those that included the youngest participants; this may reflect a tendency for interventions to be most effective in younger children. [reference 22]

“I am an Emergency Department Consultant and a keen cyclist. I wholly agree…that we need to move to an environment where cycle helmet wearing is the norm, rather than the exception”

Emergency Department Consultant

The DfT cycle helmet review found that most helmet educational programmes increased helmet wearing. This was most effective among young children and especially girls. As well as these measures, reducing the cost of helmets through discounts or giving helmets away without charge was also found to increase helmet uptake. [reference 14]

A UK hospital-led community-based programme was initiated in 1992 to evaluate the effect of a cycle helmet promotion campaign on helmet wearing among cyclists aged 11 to 15. It consisted of school based talks; age specific information; true case scenarios/videos of head injured children; a demonstration using an egg and
small helmet to illustrate the effect of a head injury with and without a helmet; information on how to wear a helmet properly; and a low cost helmet purchase scheme. The programme also ran promotional and awareness events. After five years it was found that self reported helmet use increased from 11 to 31 per cent, with no change in controls. [reference 21] 21 Hospital casualty figures for cycle related head injuries also fell in the intervention group from 21.6 to 11.7 per cent of all cycle injuries. [reference 23] 23

It appears that a good watershed level for when to progress from non-legislative interventions to mandatory legislation is around 40 per cent voluntary wearing. Following the introduction of non legislative interventions in New Zealand, cycle helmet wearing increased to 43 per cent, at which point legislation was introduced and helmet wearing increased to 92 per cent. In Western Australia helmet wearing prior to legislation grew to 37 per cent at which point helmet wearing became mandatory. Subsequent to the laws introduction, cycle helmet wearing had more than doubled to 82 per cent. [reference 24] 24

Legislative intervention

Table 2 below highlights the most recent evidence of the efficacy of helmet legislation on increasing helmet wearing rates and reducing injury from crashes. A systematic review of 11 studies for cycle helmet use following legislation concluded that legislation increases helmet wearing, but that this effect is not proportionately equal across all jurisdictions. [reference 23] 23 Overall, initial helmet wearing before legislation varied between four and 59 per cent and subsequent to legislation increased to between 37 and 91 per cent. [reference 23] 23 Seven studies reported increases of more than 30 per cent; four studies reported 10 to 30 per cent increases; one study reported increased helmet wearing of less than 10 per cent. [reference 23] 23 The largest effects found were in communities where initial baseline helmet wearing was low and in those where the legislation applied to all ages. [reference 27] 27 In one study helmet wearing remained at constant 10 years post legislation. [reference 25] 25

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<tr>
<th>Author, date, and country</th>
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<th>Aims and content of intervention</th>
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<tr>
<td>MacPherson et al [reference 26] 26 (2002) Canada</td>
<td>Countrywide Comparison Provincial Legislation Children (5-19)</td>
<td>Impact of helmet legislation on cycle related head injuries among children Information</td>
<td>Case Control Intervention (I) Provinces that adopted legislation</td>
<td>Rate of cycle related head injuries Other cycle related injuries</td>
<td>Cycle related injuries reduced significantly more in provinces that introduced legislation (45% reduction)</td>
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<tr>
<td>Study</td>
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<td>Lee et al [reference 27] 27</td>
<td>USA</td>
<td>Assessed effects of helmet laws in California statewide 10 years of patient discharge records from all public Californian hospitals from 1991 to 2006; these include three years of baseline data and seven years of post legislation data</td>
<td>Case Control</td>
<td>Traumatic brain injury</td>
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<td>Other (below neck) injury</td>
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<td>Proportions of traumatic brain injuries decreased 18.2% among youths post legislation. Other head or facial injuries did not significantly change and other (below neck) injuries increased.</td>
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<td>Ji et al [reference 28] 28</td>
<td>USA</td>
<td>Assessing impact of state wide Californian helmet laws in San Diego county All cyclists aged 17 and under had to be helmeted Authors accessed data from the San Diego County Trauma Register from 1992 to 1996</td>
<td>Case Control</td>
<td>Serious injury, defined by anatomic region and abbreviated injury score (AIS) greater than three Helmet use as reported by the injured cyclist</td>
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<td>No statistically significant decrease in the proportion of head injuries post legislation compared to pre legislation for either children of adults Helmet use reported by injured cyclists post injury increased significantly</td>
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<td>Reference</td>
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<td>Robinson D. L (reference 29), (2006), 29</td>
<td>Review of jurisdictions that have introduced legislation and reported increased use of helmets by at least 40 per cent points within a few months New Zealand Nova Scotia (Canada) Victoria New South Wales South Australia Western Australia (Australia)</td>
<td>Review of efficacy of helmet legislation on helmet wearing and head injury reduction</td>
<td>Systematic review</td>
<td>Head injuries classified as admissions to hospital with head wounds, skull or facial fracture, concussion, or other intracranial injury</td>
<td>Case control studies suggest cyclists who wear helmets generally have fewer head injuries than non wearers Before and after data show enforced helmet laws discourage cycling but produce no obvious response in percentage of head injuries</td>
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<td>Macpherson &amp; Spinks [reference 30] 30 (2007)</td>
<td>Cochrane review Children only</td>
<td>To assess the effects of cycle helmet legislation</td>
<td>Systematic review</td>
<td>Cycle related head injuries and helmet use</td>
<td>Cycle helmet legislation 'appears' to be effective in increasing helmet use and decreasing head injury rates in the populations for amongst children post legislation. There was a smaller concurrent trend among adult controls for increased helmet wearing</td>
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which it is implemented, however, there are few high quality evaluative studies that measure these outcomes, and none that reported data on possible declines in bicycle use.

"As a regular commuting cyclist through twelve miles of heavy London traffic and as a Consultant Emergency Physician I whole-heartedly support the BMA’s stance on the introduction of legislation to make the wearing of helmets mandatory.”

Consultant and Honorary Senior Clinical Lecturer in Emergency Medicine

A case control study investigated the prevalence of cycle helmet wearing two years after legislation was introduced making it mandatory for children under 18 to wear cycle helmets in the Canadian province of Alberta. Helmet wearing increased significantly among youths post legislation but remained unchanged among adults to whom the law did not apply. [reference 31]  

An observational study evaluated the influence of socioeconomic status on the effectiveness of cycle helmet legislation for children (aged 5 to 14 years old) over an eight year period. [reference 30]  It was found that cycle helmet wearing increased steadily in the six years before legislation from four per cent to around 44 per cent and that it rose markedly in the first year following legislation to 68 per cent. [reference 30]  Girls were consistently more likely to wear helmets than boys; children who were riding to school wore helmets more than those that were not; and children in high income areas were consistently more likely to wear helmets compared with children in mid and low income areas. [reference 32]  

Studies from Western Australia and New Zealand, where cycle helmet wearing is mandatory for all ages have shown that among adults, legislation has the effect of increasing helmet wearing rates. [reference 14]  The Macpherson and Spinks 2007 Cochrane review found positive evidence that bicycle helmet legislation both increases bicycle helmet use and reduces bicycle related head injuries. [reference 28]  No evidence was found to either support or counter the possibility that legislation may lead to negative societal and health impacts such as reductions in cycling participation.


**Does it reduce the number of injuries?**

The DfT review on cycle helmet effectiveness found cycle helmet legislation has been associated with a reduction in head injuries and that when legislation is associated with educational programmes it is even more effective. [reference 14] Figures from the state of Western Australia (where wearing a cycle helmet is mandatory), found that around 13 per cent of all serious traffic injuries occurred to cyclists. Of these injuries around 42 per cent were to the shoulder and upper limbs, whereas only 27 per cent were to the head; suggesting that helmet legislation has a significant role in reducing injuries to the head. [reference 33]

Figures from New Zealand show that in 2006 there were 883 cyclists injured and nine killed. This corresponds to 20 people per 100,000 injured and 0.2 people per 100,000 killed. These figures are lower than those reported for 1994 when legislation was first introduced. [reference 34] Canadian reports for 2003 show that for cyclists there were 49 fatalities and 7,818 non fatal injuries. In Canada, where helmet wearing is mandatory for cyclists under the age of 18, despite helmet laws and education promoting helmets, cyclists aged between five and 14 were the most likely to be killed or injured. [reference 35]

“Over the [last] 16 years I have worked in A/E. I have dealt with hundreds of head and facial injuries, particularly in children, that could have been avoided had a cycle helmet been worn. I have also had the misfortune to deal with a number of fatalities that I believe would have been avoided by simply wearing a helmet. I firmly believe that legislation making cycle helmet usage mandatory is essential.’

**Emergency Medicine Consultant and Clinical Director**

**Does it discourage cyclists?**

The DfT report reviewing the effectiveness of cycle helmets found that overall 31 papers were in favour of helmet wearing of which 20 advocated the use of legislation. Thirty-two papers were against helmet wearing with the remaining papers taking no position. It concluded that compulsory helmet wearing may discourage some cyclists leading to decreased bicycle use. The most cited argument in the sample of anti helmet wearing/legislation papers was that helmet wearing leads to a decline in cycling and this then leads to a more sedentary lifestyle with consequent health risks. Much of this material is based on work in Australia.

As noted in Table 2 the Macpherson and Spinks 2007 Cochrane review found no evidence to either support or counter the possibility that legislation may lead to negative societal and health impacts such as reductions in cycling participation. The possibility that, in Britain, legislation might reduce cycling from its already low level is a concern. Evidence suggests that although there might be a transitory reduction in cycle use after the introduction of legislation for helmet wearing, in the medium term the effect is likely to be negligible. [reference 36] If legislation were to reduce the rates of serious injury and promote increased public
confidence in cycling, the effect might be to make cycling more popular. Clearly, there is a need for further research on this matter.

**Enforcement**

As with any other legislation enforcement is as important as the law itself. Without compliance the law is at best ineffective. To achieve maximum compliance the law should be complemented by non legislative interventions including mass educational and promotional campaigns.

At a practical level, enforcement of legislation can be achieved through on-the-spot fines or tickets issued by police and traffic wardens, while educational establishments can ensure children wear helmets on journeys to and from school. Cycle helmet legislation and other safe cycling promotions are not mutually exclusive, and there is a clear role for the simultaneous introduction of more primary prevention measures including cycle lanes, driver education and vehicle speed reduction initiatives. A safer cycling environment and infrastructure is vital to having safer cyclists. Germany and the Netherlands have significantly reduced the number of cyclist deaths by implementing a wide variety of policies improving safety. Between 1978 to 1996 The Netherlands almost doubled the mass of cycle networks and had a drop of 57 per cent in cyclist deaths. During the period of 1976 to 1995 Germany almost tripled their mass of cycle networks and this led to a 64 per cent drop in cyclist deaths. [reference 37]

**Kirsty’s story**

While training for a charity bike ride, Kirsty was struck by a car. The accident left her with a brain injury that has changed her life. Kirsty is now registered disabled and suffers from balance problems, fatigue, headaches, lack of concentration, short-term memory loss and has poor spatial awareness. Doctors believe that had she not been wearing a cycle helmet at the time of her crash, she would have died.
Conclusion

Best evidence supports the use of cycle helmets. They have been shown to reduce the risk of head injury and its severity should it occur. This does not apply to fatal crashes but in such instances the force of impact is considered to be so significant that most protection would fail. As has been illustrated by the case studies, the consequences of traumatic brain injury are significant not only to the individual involved, but to their families and to society as a whole. It is BMA members, and in particular accident and emergency staff who witness at first hand the devastating impacts cycling injuries can have. Therefore, as a part of a range of measures to improve cycling safety, the BMA calls for cycle helmet wearing to be made compulsory. The Association recognises that voluntary helmet wearing should increase before the law is enacted.

“I have worked in emergency medicine for the last twelve years. Personally I cycle around two and a half thousand miles each year and my family are rapidly becoming keen cyclists also. Prior to working in emergency medicine, I did not routinely wear a cycle helmet. I have seen numerous examples of patients sustaining severe head injuries from which they will never recover whilst cycling at low speed without a helmet. I have never seen this pattern of pathology in cyclists wearing helmets under these circumstances. I am aware of the recent Cochrane review on the subject. I firmly believe that all cyclists should wear helmets. I also believe that the only way to ensure this happens is through legislation. I can see no justification for allowing this entirely predictable pattern of head injuries to persist. I strongly support the BMA position…”

Consultant in Emergency Medicine
Editorial board
Chair, Board of Science                              Sir Kenneth Calman
Director of professional activities                    Professor Vivienne Nathanson
Project Leads                                         Nicky Jayesinghe, Head of Science
                                                      George Royncroft, Deputy Head of Science
Research and writing                                  Dr Andrew Curran, Consultant paediatric neurologist
                                                      Dr Heather Sage, Trainee, paediatric neurology
                                                      Thomas Ellinas, Research and Policy Executive
### Appendix 1

**Brain Injuries**

<table>
<thead>
<tr>
<th>Frontal Lobe: Forehead</th>
<th>Parietal Lobe: near the back and top of the head</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Paralysis</td>
<td>- Inability to attend to more than one object at a time</td>
</tr>
<tr>
<td>- Inability to plan sequences of complex movements</td>
<td>- Inability to name an object (anomia)</td>
</tr>
<tr>
<td>- Loss of spontaneity during interaction</td>
<td>- Inability to locate the words for writing (agraphia)</td>
</tr>
<tr>
<td>- Loss of flexibility in thinking</td>
<td>- Problems with reading (alexia)</td>
</tr>
<tr>
<td>- Persistence of a single thought</td>
<td>- Difficulty with drawing objects</td>
</tr>
<tr>
<td>- Inability to focus on a task</td>
<td>- Difficulty in distinguishing left from right</td>
</tr>
<tr>
<td>- Mood changes</td>
<td>- Difficulty with doing mathematics (dyscalculia)</td>
</tr>
<tr>
<td>- Changes in social behaviour</td>
<td>- Lack of awareness of certain body parts and/or surrounding space lead to difficulties with self care</td>
</tr>
<tr>
<td>- Changes in personality</td>
<td>- Inability to focus visual attention</td>
</tr>
<tr>
<td>- Difficulty with problem solving</td>
<td>- Difficulties with hand eye coordination</td>
</tr>
<tr>
<td>- Inability to express language (Broca’s aphasia)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Occipital Lobes: most posterior at the back of the head</th>
<th>Temporal Lobes: side of head above the ears</th>
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</thead>
<tbody>
<tr>
<td>- Defects in vision (visual field cuts)</td>
<td>- Difficulty in recognising faces (prosopagnosia)</td>
</tr>
<tr>
<td>- Difficulty with locating objects in environment</td>
<td>- Difficulty in understanding spoken words (Wernicke’s aphasia)</td>
</tr>
<tr>
<td>- Difficulty in identifying colours (colour agnosia)</td>
<td>- Disturbance with selective attention to what is seen or heard</td>
</tr>
<tr>
<td>- Production of hallucinations</td>
<td>- Difficulty with identification of, and visualization about objects</td>
</tr>
<tr>
<td>- Visual illusion – inaccurately seeing objects</td>
<td>- Short term memory loss</td>
</tr>
<tr>
<td>- Word blindness – inability to recognize words</td>
<td>- Increased and decreased interest in sexual behaviour</td>
</tr>
<tr>
<td>- Difficulty in recognizing drawn objects</td>
<td>- Inability to categorise objects</td>
</tr>
<tr>
<td>- Inability to recognize the movement of object (movement agnosia)</td>
<td>- Persistent talking (right lobe)</td>
</tr>
<tr>
<td>- Difficulties with reading and writing</td>
<td>- Increased aggressive behaviour</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Brain Stem: Deep within the brain</th>
<th>Cerebellum: base of the skull</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Decreased vital capacity in breathing (speech)</td>
<td>- Loss of ability to coordinate fine movements</td>
</tr>
<tr>
<td>- Swallowing food and water (dysphagia)</td>
<td>- Loss of ability to walk</td>
</tr>
<tr>
<td>- Difficulties with organization/perception of the environment</td>
<td>- Inability to reach out and grab objects</td>
</tr>
<tr>
<td></td>
<td>- Tremors</td>
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</tbody>
</table>

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<table>
<thead>
<tr>
<th>Problems with balance or movement</th>
<th>Dizziness (vertigo)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dizziness and nausea (vertigo)</td>
<td>Slurred speech</td>
</tr>
<tr>
<td>Sleeping difficulties (insomnia, sleep apnoea)</td>
<td>Inability to make rapid movements</td>
</tr>
</tbody>
</table>
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