1

Why are helmets needed?

Why are helmets needed?

THIS MODULE provides the user with background material on why helmets are needed. Such information is important in persuading political leaders and the public to support a helmet programme.

The sections in this module are structured as follows:

- **1.1 Many people around the world die in motorcycle collisions:** The module begins by describing the magnitude of the problem of motorcycle crashes, and resulting head injuries. It explains the global distribution of the problem, noting that if present trends continue, many low-income and middle-income countries are likely to experience an increase in the number of motorcycle crashes in the near future. The section describes how head injuries that result from motorcycle collisions are a leading cause of death and disability.
- **1.2 A helmet protects your head:** This section describes what can happen to the head in the event of a motorcycle or bicycle collision. It then goes on to explain the physical components of a helmet and the way in which they reduce the impact of a collision. This section also describes how helmets are designed to meet certain requirements.
- **1.3 Helmet use is effective at reducing head injuries:** This section summarizes the evidence from studies that have evaluated the effectiveness of helmets in reducing death and injury.
- **1.4 Helmet programmes are effective at getting helmets on heads:** Introducing legislation on helmet use has been shown to be effective in increasing helmet-wearing rates and reducing head injuries, as summarized in this section.

As mentioned in the Introduction, this manual is focused on how to increase helmet use among motorcycle users. The increasing use of motorized two-wheelers, and the high speed at which motorcycles can travel compared to bicycles, means that the primary audience of this manual will be those seeking to increase motorcycle helmet use. Nonetheless, it is assumed that much of the technical guidance that is provided in the text will be equally relevant, and can be applied easily, to those seeking to introduce a helmet programme for bicycle users.

1.1 Many people around the world die in motorcycle collisions

Road traffic injuries are a major public health problem and a leading cause of death and injury around the world. Each year nearly 1.2 million people die as a result of road crashes, and millions more are injured or disabled *(1)*. In many low-income and middle-income countries, where motorcycles and bicycles are an increasingly common means of transport, users of two-wheelers make up a large proportion of those

injured or killed on the roads. Motorcycle and bicycle riders are at an increased risk of being involved in a crash. This is because they often share the traffic space with fast-moving cars, buses and trucks, and also because they are less visible. In addition, their lack of physical protection makes them particularly vulnerable to being injured if they are involved in a collision.

In most high-income countries, motorcycle fatalities typically comprise around 5% to 18% of overall traffic fatalities *(2,3)*. This proportion reflects the combined effect of several important factors including the relatively low ownership and use of motorcycles in many developed countries, and the relatively high risk of these motorcycles being involved in crashes involving fatalities. Typically, these risks are much higher for motorcycle than for vehicle travel *(4)*.

In low-income and middle-income countries, car ownership and use rates are generally much lower than in high-income countries. However, the ownership and use of motorcycles and other two-wheelers is generally relatively high – for example, in India 69% of the total number of motor vehicles are motorized two-wheelers, considerably higher than in high-income countries *(3)*. Reflecting this difference, the levels of motorcycle rider fatalities as a proportion of those injured on the roads are typically higher in low-income and middle-income countries than in high-income countries (Figure 1.1). For instance, 27% of road deaths in India are among users of motorized two-wheelers, while this figure is between 70–90% in Thailand, and about 60% in Malaysia *(3,5,6)*. In China, motorcycle ownership between 1987 and 2001 grew rapidly from 23% to 63%, with a corresponding increase in the proportion of traffic fatalities sustained by motorcyclists rising from 7.5% to 19% over the same period *(7)*. However, in other low-income and middle-income countries, a lack of high quality road safety data means that precise levels of motorcycle rider fatalities are still not known.

1.1.1 Head injuries are a leading cause of death and disability

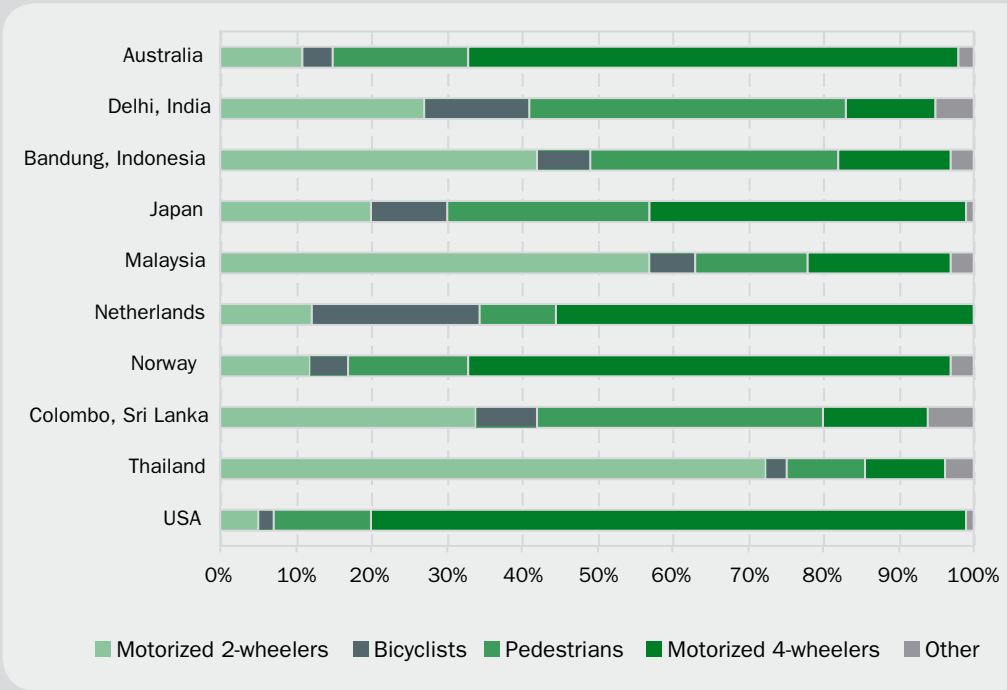
Injuries to the head and neck are the main cause of death, severe injury and disability among users of motorcycles and bicycles. In European countries, head injuries contribute to around 75% of deaths among motorized two-wheeler users; in some low-income and middle-income countries head injuries are estimated to account for up to 88% of such fatalities *(6,8)*. The social costs of head injuries for survivors, their families and communities are high, in part because they frequently require specialized or long term care. Head injuries also result in much higher medical costs than any other type of injury *(9)*, such that these injuries exert a high toll on a country's health care costs and its economy.

Globally, there is an upward trend in the number and use of motorcycles and bicycles, both for transport and recreational purposes. Indeed, most of the growth in the number of vehicles on the world's roads comes from an increasing use of motorized two-wheelers. Asian countries, in particular, are expected to experience a

considerable rise in the number of motorized two-wheeler vehicles on their roads. This rapid growth in the use of motorcycles in many low-income and middle-income countries is already being accompanied by a considerable increase in the number of head injuries and fatalities that will only continue to increase if present trends continue unchecked.

Helmet programmes will be important to policy-makers in Africa, where there is an increasing use of motorized two-wheelers.

Figure 1.1 **Road users killed in various modes of transport as a proportion of all road traffic deaths**



Adapted from reference 1

BOX 1.1: **The story behind the helmet**

Satien Luangpitak, 28, is a motorcycle taxi driver in northern Bangkok. As in much of urban Thailand, motorcycle taxis are a common means of personal transport. However, despite a national mandatory helmet law for taxis and passengers, enforcement is sporadic and it is common to see unhelmeted drivers and passengers.

In May 2004 Satien was involved in a crash while driving in heavy traffic. As he tried to overtake a car, he collided with another motorcycle taxi in front of him. Satien was travelling at 80 km/h and, upon impact, was thrown forward and landed on the pavement, striking his helmeted head and his left shoulder. He lost consciousness for about half an hour. Another motorcycle taxi driver stopped to assist him: rather than call and wait for the emergency services, this man lifted Satien and removed him from the roadway. He then moved him to a vehicle and evacuated him to a hospital – an action meant in good faith, but that he later learnt may have inflicted a spinal cord injury on Satien.

At hospital, Satien received treatment for trauma to his head and shoulder. He was discharged from the hospital after six hours with a neck brace and partial body brace. He received follow-up treatments and was able to return to a full work schedule a month later. Aside from the initial loss of consciousness, in the two years since his crash, he has suffered no ill effects from the trauma to his head. While his injured shoulder has regained "100 percent functionality", he still experiences pain in his neck and shoulder when lifting heavy objects with his left arm.

When interviewed, Satien pointed out that at no time did anyone, including the medical staff specially trained to deal with motorcycle crash victims, advise him to replace his helmet after the crash. Crash helmets offer little or no protection after having absorbed the impact of a crash.

Fortunately, all of Satien's medical costs were covered by Thailand's mandatory third-party liability insurance coverage. However, he incurred costs in repairing his motorcycle (15 000 baht, about US$ 390), and as a result of his lost income during his recovery period, which he estimates at 10 000 baht (US$ 260).

Satien explains that his experience has increased his awareness of the need to wear a helmet consistently.

The crash has also had an emotional impact: Satien constantly worries that he may eventually suffer a debilitating injury from a crash, is fearful of driving at higher speeds in traffic, and has become increasingly uneasy when his passengers refuse to wear a helmet. His experience has also altered his behaviour with regard to helmet use: prior to the crash, he admits he was inconsistent about using his helmet in areas where he knew enforcement was unlikely, but that now he wears a helmet at all times. He also explains that since the crash, he has taken out disability insurance.

Source: In May 2006 Satien Luangpitak was interviewed by Daniel Brod, ASIRT

1.2 A helmet protects your head

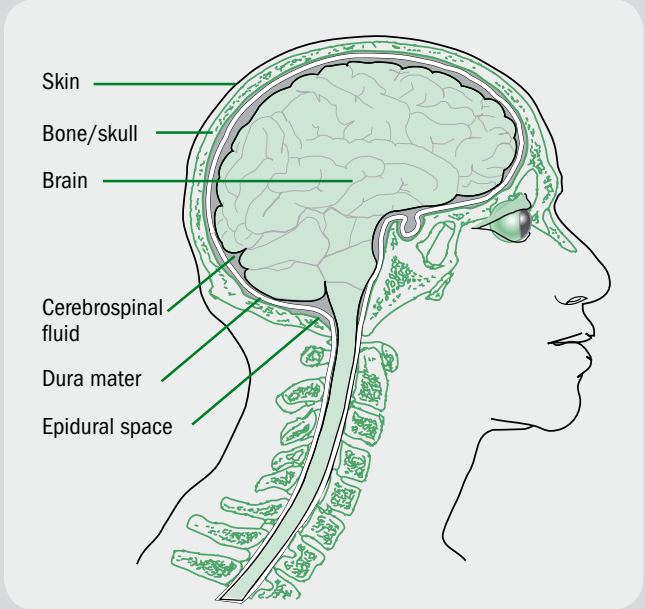
The technical expertise behind the design of high quality helmets is based on an understanding of what happens to the head in the event of a motorcycle crash. This section describes what happens in the event of a motorcycle crash, and then explains how a helmet works to reduce this effect.

1.2.1 The mechanism of head injuries

An appreciation of the anatomy of the head is important in understanding the mechanism of injuries to the head and brain (Figure 1.2). Briefly, the important anatomical information about the head to note is the following:

- The brain is enclosed within a rigid skull.
- The brain "sits" on bones that make up the base of the skull.
- The spinal cord passes through a hole in the underside of the brain.
- Under the skull, adhering to the bones, is a tough tissue called the dura that surrounds the brain.
- Between the brain and the dura is a space containing cerebrospinal fluid that protects the brain tissue from mechanical shock.
- The brain "floats" in the cerebrospinal fluid but it can only move about 1 millimetre in any direction.
- The skull is covered by the scalp, which provides some additional protection.

Figure 1.2 Structure of the head and brain

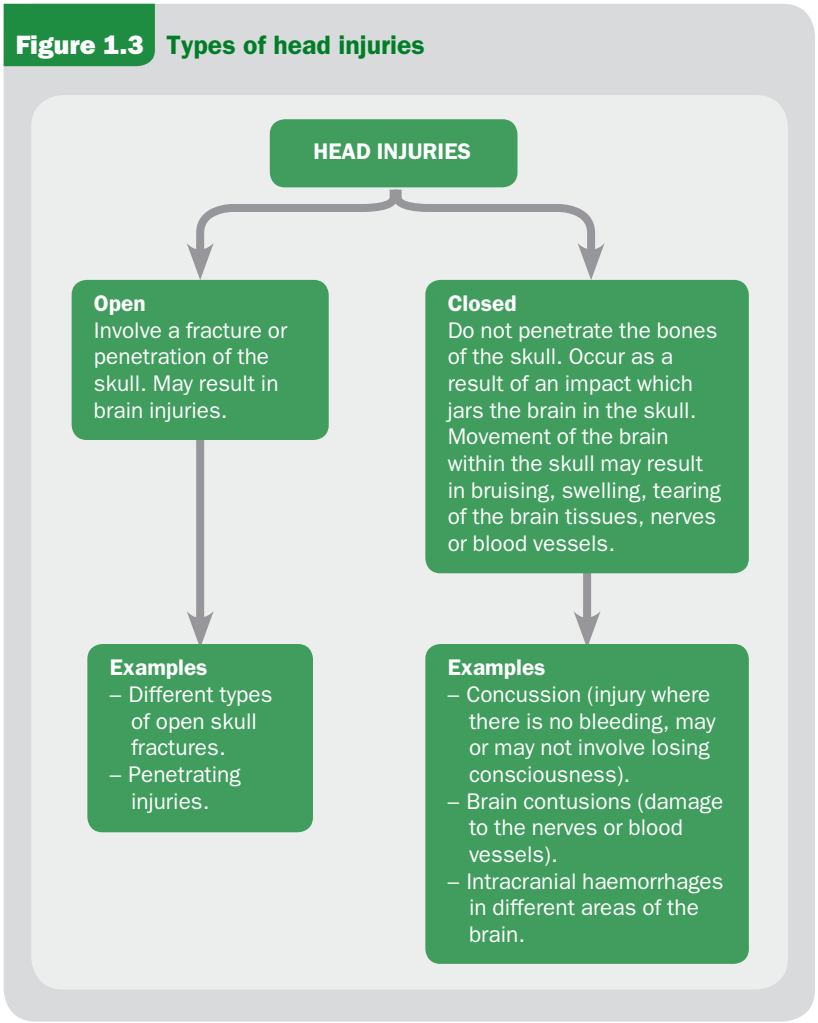


During a motorcycle or bicycle crash there are two principal mechanisms of injury to the brain: through direct contact and through acceleration–deceleration. Each mechanism causes different types of injuries.

When a motorcycle or bicycle is involved in a collision, the rider is often thrown from the cycle. If the rider's head hits an object, such as the ground, the head's forward motion is stopped, but the brain, having its own mass, continues to move forward until it strikes the inside of the skull. It then rebounds, striking the opposite side of the skull. This type of injury can result in anything from a minor head injury, such as concussion, to a fatal head injury.

Head injuries that result from either contact or acceleration–deceleration injuries are themselves divided into two categories: open or closed head injuries. Most traumatic brain injuries are the result of closed head injuries – that is, there is no open wound to the brain. Figure 1.3 describes the two broad types of head injuries and gives examples of the types of lesions in each category – from the mildest to the most severe.

Figure 1.3 Types of head injuries



Motorcycle riders who do not wear a helmet run a much higher risk of sustaining any of these head and traumatic brain injuries, or a combination of them. Helmets create an additional layer for the head and thus protect the wearer from some of the more severe forms of traumatic brain injury.

1.2.2 How a helmet works

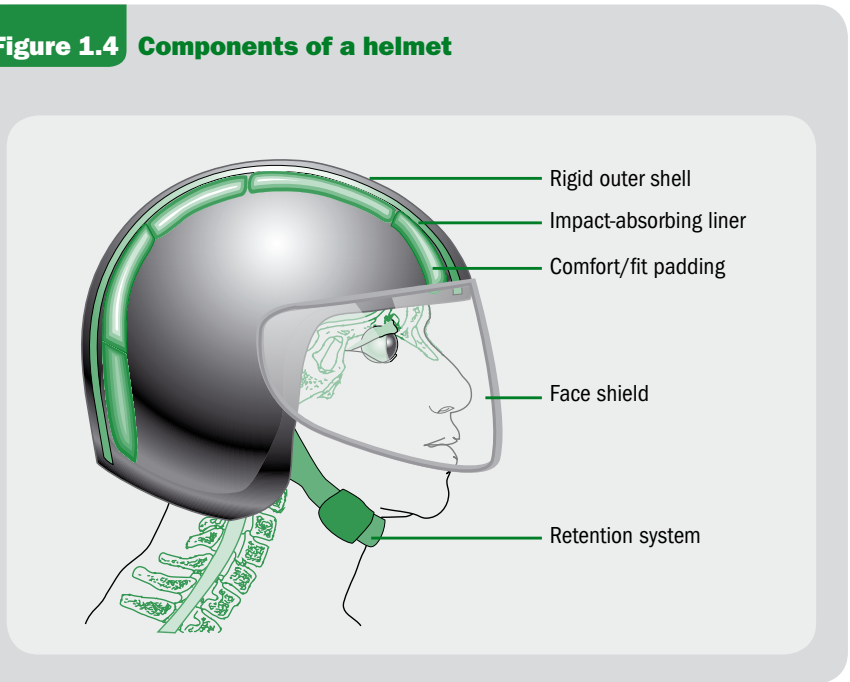
A helmet aims to reduce the risk of serious head and brain injuries by reducing the impact of a force or collision to the head.

A helmet works in three ways:

- It reduces the deceleration of the skull, and hence the brain movement, by managing the impact. The soft material incorporated in the helmet absorbs some of the impact and therefore the head comes to a halt more slowly. This means that the brain does not hit the skull with such great force.
- It spreads the forces of the impact over a greater surface area so that they are not concentrated on particular areas of the skull.
- It prevents direct contact between the skull and the impacting object by acting as a mechanical barrier between the head and the object.

These three functions are achieved by combining the properties of four basic components of the helmet that are described below (Figure 1.4).

Figure 1.4 Components of a helmet



The shell

This is the strong outer surface of the helmet that distributes the impact over a large surface area, and therefore lessens the force before it reaches the head. Although the shell is tough, it is designed to compress when it hits anything hard. It provides protection against penetration by small, sharp and high speed objects and it also protects the padding inside the helmet from abrasions and knocks during daily use. These requirements mean that the shell must be hard, usually with a smooth exterior finish.

The impact-absorbing liner

This is made of a soft, crushable padded material – usually expanded polystyrene, commonly called "styrofoam". This dense layer cushions and absorbs the shock as the helmet stops and the head tries to continue moving.

The comfort padding

This is the soft foam-and-cloth layer that sits next to the head. It helps keep the head comfortable and the helmet fitting snugly.

The retention system, or chin strap

This is the mechanism that keeps the helmet on the head in a crash. A strap is connected to each side of the shell. Chin and neck straps, which are specifically designed to keep the helmet on during an impact, must be correctly used for the helmet to function as it is designed to (see box below).

NOTE

Using helmets properly

A study in Malaysia examined the compliance of helmet use in a typical Malaysian town. Of the 5000 motorcyclists studied, only 54% used helmets properly, 21% used them improperly, and 24% did not wear them at all. Younger people, men and those with less formal education were more likely to not wear helmets properly *(10)*.

Many helmet users do not secure their helmets properly – and sometimes not at all – thereby rendering the helmet of little – if any – value in the event of a collision.

NOTE

What helmets *don't* do

Helmets are designed to reduce the chances of *head, brain, and facial injuries* occurring, but are not designed to prevent injuries to other parts of the body. To reduce the likelihood of injuries to other parts of the body, the following strategies can be employed:

- Appropriate clothing can be helpful to reduce other types of injuries (for example, jacket and trousers of particular materials which cover arms and legs completely; sturdy shoes or boots; gloves which give a better grip and protect the hands in the event of a crash).
- Obeying the laws of the road, including adhering to speed limits and not driving while drunk are behaviours that will reduce the chance of a motorcyclist being involved in a crash, and thus their likelihood of incurring any type of injury.

1.2.3 Motorcycle helmet design

In addition to meeting the previously described functions and conforming to standards (to be discussed in Module 3), a helmet needs to be designed to suit the local weather and traffic conditions. The following are some of the considerations usually addressed by helmet designers:

- Materials used in the construction of a helmet should not degrade over time, or through exposure to weather, nor should they be toxic or cause allergic reactions. Currently, the plastic materials commonly used are Expanded Poly-Styrene (EPS), Acrylonitrile Butadiene Styrene (ABS), Poly Carbon (PC) and Poly Propylene (PP). While the material of the helmet shell generally contains PC, PVC, ABS or fibre glass, the crushable liner inside the shell is often made out of EPS – a material that can absorb shock and impact and is relatively inexpensive. However, helmets with EPS liners should be discarded after a crash, and in any case users should replace such helmets after 3–5 years of use.
- Standards often set the minimum coverage of a helmet (see Module 3). Half-head helmets offer minimal coverage. Full-face helmets should ensure that the wearer's peripheral vision and hearing are not compromised.
- To ensure that a helmet can absorb the shock of a crash, the crushable liner should be between 1.5 cm and 3.0 cm in thickness.

NOTE

Does the colour of a helmet matter?

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A light-coloured helmet has been shown to reduce the risk of a crash.

Research in New Zealand has examined whether the colour of a helmet affects the risk of a crash. The study compared motorcycle drivers who had been involved in motorcycle crashes that led to hospital treatment with those who had not (as a control group), while examining the colour of the helmets worn by all study participants. The results showed that higher proportions of drivers who had been involved in crashes reported wearing black helmets, while fewer reported white helmets. Compared with wearing a black helmet, use of a white helmet was associated with a 24% lower risk of crash. Similarly, having a "light-coloured" helmet – compared with a "dark-coloured" one – was associated with a 19% lower risk of a crash. The researchers concluded that some 18% of crashes could be avoided if non-white helmets were eliminated; similarly, 11% could be avoided if all helmets were not "dark".

Although the results of the study cannot necessarily be generalized to other settings or countries, it seems reasonable to assume that there is greater protection from white helmets as opposed to black ones, and from lighter-coloured ones generally as against darker ones. The study therefore suggests that policies encouraging white and lighter-coloured helmets can help prevent motorcycle crashes.

Source: 11

In addition to the previously mentioned design issues, there are also various styles of helmets which afford different protection. The four most common types are:

Full-face helmets (Figure 1.5a)
These helmets offer facial protection in addition to impact protection. Their principal feature is a chin bar that extends outwards, wrapping around the chin and jaw area. Extending above the jaw, there is a vision port that allows the wearer maximum range of sight, in line with the requirements for peripheral and vertical vision.

Open-face helmets (Figure 1.5b)
Open-face helmets give standard protection from impact with their hard outer shell and crushable inner liner. Compared to the full-face type, they offer only limited

protection for the jaw and chin area. They may or may not have retractable visors to protect the eyes.

Half-head helmets (Figure 1.5c)
These helmets provide protection by means of a hard outer shell and a crushable inner liner. They do not offer protection for the chin or jaw area and are rarely equipped with visors. The half-head helmet may or may not have ear flaps attached to the retention system.

Helmets for tropical use (Figure 1.5d)
These are helmets specifically designed for South Asian and South-East Asian countries with extremely hot and humid climates. They are actually half-head helmets with ventilation holes to provide a maximum flow of air so as to reduce the heat. Their extreme lightness of weight is achieved by using semi-rigid vacuum-forming PVC material.

Figure 1.5 Helmet styles

a. Full-face b. Open-face c. Half-head d. Tropical

NOTE

Children: what type of helmet?

Few countries have helmets specifically designed for children, which results in children either not wearing helmets or else being force to wear adult-size helmets. In some countries, for example Viet Nam and Thailand, however, children's helmets are now being designed.

Helmet developed in Thailand for children aged 2.

1.3 Helmet use is effective at reducing head injuries

Wearing a helmet is the single most effective way of reducing head injuries and fatalities resulting from motorcycle and bicycle crashes. Motorcyclists who do not wear helmets are at a much higher risk of sustaining head injuries and from dying from these injuries. In addition, riders who do not wear helmets place additional costs on hospitals (see boxed example below), while the disability that results from these head injuries incurs costs at an individual, family (or carer) and societal level.

There is considerable research that has been conducted on the effects of wearing a helmet on the risk of a head injury as a result of a collision. The results show slightly different effects, depending on the study type, population, situation etc. Consequently it is useful to examine this research collectively – in what is known as a *systematic review* on the topic of interest. Systematic reviews of studies are a means of objectively examining the evidence for a particular claim (in this case, helmet use in preventing head injury) and combining the results in a way that minimizes any bias. Reviewers conducting such reviews search widely for all the studies on the topic and include those of a sufficiently high methodological quality. When the data from all the studies included in the review are summarized, the result should provide a more accurate estimate of the effect of the intervention than is possible from individual studies.

Hospital costs are reduced by helmet use

Researchers in Michigan, USA, studied the impact of motorcycle helmet use on patient outcomes and cost of hospitalization. Despite Michigan's mandatory helmet law, 19% of the 216 patients included in the study were not using helmets when they crashed, allowing the researchers to compare costs among helmeted and unhelmeted riders.

On average, helmet use led to average hospital costs that were about 20%, or US$ 6000, less than costs for those who did not wear helmets. For patients who were treated on an inpatient rehabilitation floor after leaving the trauma unit, average costs for unhelmeted riders were nearly twice those of helmeted riders, in part due to the fact they were kept in hospital longer. The results also confirmed earlier findings that riders without helmets were younger, suffered more head and neck injuries, and had higher overall injury severity scores.

Failure to wear a helmet adds to the financial burden created by motorcycle-related injuries. The authors concluded that individuals who do not wear helmets should therefore be required to pay higher insurance premiums.

Source: 12

Systematic reviews have been published examining the effectiveness of both motorcycle helmets and bicycle helmets *(13,14)*. The review on motorcycle helmets included 53 studies, and summarized the current available evidence on helmets and their impact on mortality, as well as on head, face and neck injuries, following motorcycle crashes. Table 1.1 provides a summary of the main results of this review.

Table 1.1 Summary of systematic review of effectiveness of motorcycle helmets

Not wearing a helmet	Wearing a helmet
increases the risk of sustaining a head injury; increases the severity of head injuries; increases the time spent in hospital; increases the likelihood of dying from a head injury.	decreases the risk and severity of injuries by about 72%; decreases the likelihood of death by up to 39%, with the probability depending on the speed of the motorcycle involved; decreases the costs of health care associated with crashes.

Source: 13

The following are the main conclusions of this research:

- Motorcycle helmets reduce the risk of mortality and head injury in motorcycle riders who crash, although the effect on death may be modified by other factors surrounding the crash, such as the speed the motorcyclist was travelling at when the crash occurred. Crashes at higher speeds may result in multiple injuries likely to cause death, regardless of how well the head is protected.
- There was not enough evidence to determine the effect of motorcycle helmets on face or neck injuries, although some studies suggest that helmets have no effect on the risk of neck injuries but are protective for face injuries.
- There was insufficient evidence to demonstrate whether differences in helmet types (full-face versus open-face) confer more or less advantage in injury reduction. Further research should be conducted to determine the effectiveness (and cost effectiveness) of different helmet types – especially those used in low-income and middle-income countries – on mortality and on head, neck and face injuries.
- Increasing motorcycle helmet use in countries where such use has been low is likely to dramatically reduce head injury and death. Policy-makers would do well to consider measures to increase helmet use, such as legislation for compulsory helmet use and its enforcement, along with community education campaigns.

A systematic review has also been conducted on bicycle helmets. The review on the effectiveness of bicycle helmets in reducing head and facial injuries found them to be effective at reducing head and brain injury for all ages of bicyclists (see Box 1.2). However, there is a broader debate about whether helmet use is the best way to

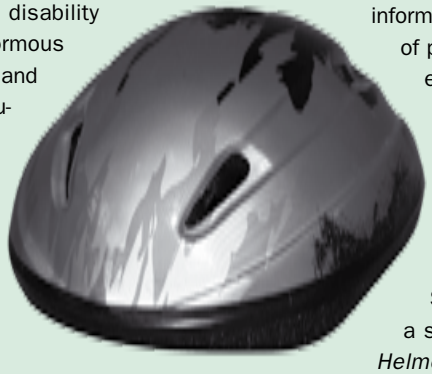
improve the safety of cyclists, and Box 1.3 illustrates an alternative approach to this issue, adopted in the Netherlands.

Two further reviews are currently underway examining the impact of motorcycle helmet legislation, and the impact of bicycle helmet legislation, in reducing head injuries and death *(15, 16)*. Final results for these reviews will be published in late 2006.

BOX 1.2: **Bicycle helmets decrease the risk of head and brain injuries**

Bicycles are an important means of transportation in many parts of the world. They are accessible, economical and non-polluting. With a growing recognition of the problem of obesity and lack of physical activity in many countries, bicycling offers an enjoyable means of recreation and vigorous physical activity. The promotion of bicycle use is therefore to be encouraged widely.

Bicycling, though, does have associated risks. Approximately two-thirds of serious injuries to cyclists requiring hospitalization and three-quarters of cyclists' deaths are due to head injuries. These injuries can occur from falls following a loss of control, from hitting a hole in the road, or from colliding with another bicycle or a motor vehicle. Head injuries are a major source of disability everywhere, and create an enormous burden on the victims' families and on society. Prevention of head injuries is thus an important goal.



Studies over the last 15 years in the United States, Europe, Australia and New Zealand indicate that bicycle helmets are very effective in decreasing the risk of head and brain injuries. There have been five case-control studies of helmet effectiveness, in which individuals who sustained head or brain injuries through a bicycle crash were compared to those who received injuries not involving the head. Taking all the studies together, it was found that wearing a helmet decreased the risk of a head injury by 69%. Head injury is a broad term and includes injuries to the scalp, the skull and the brain. Considering brain injury alone – the most serious type of injury – helmets decrease the risk of brain injury also by 69%, and the risk of severe brain injury by 79%. Helmets appear to be similarly effective for all age groups, including young children and older adults *(14)*.

One concern expressed is that helmets might not be effective for people hit by motor vehicles while riding their bicycles. The studies, though, indicate that helmets are equally effective for crashes involving motor vehicles as for those that do not.

Helmets are also effective in preventing injuries to the middle and upper portions of the face – the area above the upper lip. Helmets decrease the risk of injuries to this part of the face by about two-thirds, probably because of the "overhang" of the helmet.

The fact that helmets are effective in preventing a potentially devastating injury should inform public policy. Different types of programmes have been found effective in promoting helmet use, especially among children. These consist of educational programmes, programmes to reduce the cost of helmets, and legislation mandating helmet use. Such programmes should carry a single, clear message – *Wear Helmets* – and be disseminated widely to people in many different settings. Helmets can usually be provided at a reduced cost through bulk purchases or through arrangements between nongovernmental organizations, manufacturers and retail outlets. Legislation has been shown to be effective in increasing helmet use in a number of countries, including the United States and Australia.

All injuries should be considered to be preventable. This is clearly the case with head injuries related to bicycling.

Photo: John Foliot, stock.xchng

BOX 1.3: **Steering clear of mandatory helmet use: the Dutch approach to cycling safely**

In the Netherlands, four out of every five citizens own a bicycle and cycling – a tradition for more than 80 years – is generally considered an everyday, safe activity. Reflecting the fact that cyclists are seen as important road users, the road environment includes features such as bicycle paths, bicycle lanes, bicycle crossings – as for pedestrians – and bicycle traffic lights.

Research conducted in the 1980s on the relative impact of these different facilities showed that cycle paths alongside urban through-roads were safer for cyclists than cycle lanes, and that cycle lanes were not less safe than where there were no separate bicycle facilities. It was also found that at through-road intersections, separate paths were less safe for cyclists than lanes or no facilities at all. This led to the recommendation to terminate cycle paths some distance from an intersection.

In the early 1980s, Delft, a medium-sized town with a higher rate of bicycle use than in other Dutch towns of similar size, was one of the first cities in the world to introduce a dedicated bicycle route network, at a cost of 13 million Netherland Guilders. As a result of this network, cyclists in Delft gained more choice of cycle routes and could choose more direct routes. The average yearly distance cycled increased from 420 km to 620 km, while the number of crashes per bicycle kilometre decreased. Evaluation of the performance of the network, however, showed that the absolute numbers of cyclist casualties did not significantly improve as a result of the network measure.

Despite its safety-enhancing cycle facilities, Dutch crash and injury data indicate that cycling in the Netherlands is not without risk. This is especially the case for young children, whose basic motor skills are still developing. Children in the 4–8 years age group are particularly likely to be involved in bicycle crashes, and as a result to suffer head injuries requiring admission to hospital.

Since the mid-1990s, the proportion of Dutch children wearing a bicycle helmet has grown considerably. There are several reasons for this:

- Parents have become increasingly aware of the protective benefits of bicycle helmets for children.
- Retailers increasingly offer bicycle helmets when selling children's bicycles.
- Campaigns in schools and in the media, launched by the Dutch Traffic Safety Association, have promoted bicycle helmet use among children.
- Helmets have become increasingly popular among skaters and mountain bikers, and this has had a spin-off effect on their use in road traffic.

Research shows that Dutch children up to seven years old easily accept the wearing of a bicycle helmet, but that beyond this age the perception of wearing a bicycle helmet as something "cool" or fashionable diminishes. As a result, children over the age of eight years are less likely than younger children to use bicycle helmets.

On the use of bicycle helmets among adults, the Dutch government, private safety organizations and cyclists' groups all tend to agree on the following propositions:

- Promoting the use of bicycle helmets runs counter to present government policies that are aimed at the primary prevention of crashes (as opposed to secondary prevention) and at stimulating the use of the bicycle as a general health measure.
- Attempts to promote bicycle helmets should not have the negative effect of incorrectly linking cycling and danger. Nor should the promotion of helmets result in a decrease in bicycle use.

Because of these considerations, a mandatory law for bicycle helmet use has not been thought an acceptable or appropriate safety measure in the Netherlands.

1.4 Helmet programmes are effective at getting helmets on heads

Laws making helmet use compulsory are important in increasing the wearing of helmets, especially in low-income and middle-income countries where helmet-wearing rates are low, and where there are large numbers of users of motorized two-wheelers.

There have been many studies that have evaluated the impact of motorcycle helmet laws on helmet-wearing rates, head injury or death (see Box 1.4). When mandatory helmet laws are enforced, helmet-wearing rates have been found to increase to 90% or higher *(17–19)*; when such laws are repealed, wearing rates fall back to generally less than 60% *(20–22)*.

The pattern is similar with regard to the effects of such laws on head injuries. A number of studies have shown that the introduction of helmet laws reduce head injuries and death, while many studies demonstrate that an *increase* in head injuries and death results when helmet laws are repealed (see Box 1.5). For example, a number of studies in Texas, USA, have shown that introducing comprehensive motorcycle helmet legislation is associated with a decrease in injuries and fatalities. In one of these studies there was a decrease in injury rates of between 9–11% *(23)*, while another showed more striking reductions of 52–59% in head injuries and fatalities *(24)*. Conversely, repeal of helmet legislation in Florida led to increases of between 17.2%–20.5% in both fatalities and fatality rates *(25, 26)*.

It is clear that introduction of full legislation (that is, applying to the whole population) is associated with a significant decrease in head injuries and deaths. There is a clear imperative for policymakers to legislate and enforce motorcycle helmet wearing at a population level. Weak or partial legislation that mandates helmet wearing for those less than 21 years, without medical insurance or only on certain types of roads does not effectively protect those at risk and should be upgraded to comprehensive coverage.

However, it is important to note that most studies that examine the impact of motorcycle helmet laws have been conducted in high-income countries where legislation when introduced is heavily enforced, and motorcycle helmet quality is high. Although it seems very likely that the introduction of motorcycle helmet-wearing legislation in low-income or middle- income countries will decrease fatality rates among motorcyclists at a population level if helmet-wearing rates are high, there are several unknown factors. Availability of high-quality helmets is not widespread across such countries and the effectiveness of the available helmets is also unknown. Enforcement is also a factor that must be considered. In low-income and middle-income countries where police resources are constrained and community attitudes to helmet wearing are not supportive of legislation, effective enforcement requires widespread government support.

Legislation is most likely to work where high-quality helmets are accessible and affordable, where enforcement is comprehensive and there is widespread community education on the benefits of helmet use.

It is therefore important that when motorcycle helmet wearing legislation is introduced in low-income and middle-income countries, there is effective enforcement, a ready supply of affordable helmets of appropriate quality (which meet international or country standards), and widespread education campaigns for both community and police. It is also imperative that the evaluation of such legislation is planned prior to implementation, so that evaluation of the effectiveness of the intervention may be carried out.

BOX 1.4: **Italy's motorcycle helmet law and traumatic brain injury**

Until 2000, Italian laws on the use of helmets applied only to drivers of motorcycles, while moped drivers over the age of 18 were exempt from wearing a helmet. In 2000, Italy adopted a much more comprehensive law aimed at reducing the effects of motorcycle crashes, requiring the use of helmets for all motorcycle and moped drivers and their passengers, irrespective of age.

A study carried out to assess the impact of the new law looked at: the effect on rates of helmet wearing; changes in the number of hospital admissions of traumatic brain injury; and the type of brain injuries admitted to hospital as a result of motorcycle crashes. The assessment revealed:

- a considerable rise in helmet-wearing rates across the country, by up to 95% in some regions;
- the highest increase in wearing rates occurring in areas where the adoption of the law was combined with a public media campaign and strong police enforcement;
- no decrease in the number of two-wheeled motorized vehicles in use throughout the country;
- a 66% decrease in admissions of traumatic brain injury for motorcycle and moped crashes;
- a 31% decrease in traumatic brain injury admissions to neurosurgical hospital units;
- a fall, to almost zero, in the number of blunt impact head injuries (epidural haematomas) among injured moped riders admitted to hospital.

The study demonstrates the effect of police enforcement of helmet use for all riders of two-wheeled motorized vehicles. It underlines the fact that mandatory helmet use is an effective measure to prevent traumatic brain injury.

Source: 19

NOTE

International support for helmet wearing

International recommendations provide strong support for countries to implement programmes that legislate for mandatory helmet use. Some countries may use the international policy environment and international law as a means of providing the necessary impetus for developing national policies on helmet use. International agreements can also be used by civil societies to advocate for helmet law reform in their own countries.

The *World report on road traffic injury prevention* recommends that all countries, regardless of their level of income, follow several good practices, including "setting and enforcing laws requiring riders of bicycles and motorized two-wheelers to wear helmets" *(1)*.

In 2004, the World Health Assembly adopted Resolution WHA 57.10, which recommends Member States "especially developing countries, to legislate and strictly enforce wearing of crash helmets by motorcyclists and pillion riders" *(27)*. The World Health Assembly resolution is an international agreement that can be used by those wishing to influence policy on helmet use as a basis for obtaining political support for this measure. In particular, such a resolution has direct relevance for ministries of health, who, by adopting WHA resolutions undertake to support the principles enshrined in them.

United Nations General Assembly Resolution A60/5 (2005) "Invites Member States to implement the recommendations of the *World report on road traffic injury prevention* including those related to the five main risk factors, namely the non-use of safety belts and child restraints, the non-use of helmets, drinking and driving, inappropriate and excessive speed, as well as the lack of appropriate infrastructure" *(28)*.

BOX 1.5: **Helmet laws: the effect of repeal**

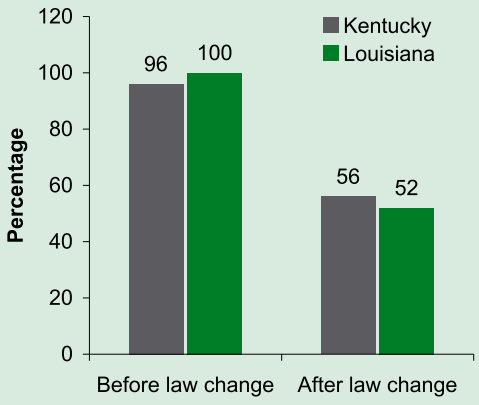
In the United States, the enactment of motorcycle helmet laws is under the jurisdiction of individual states, and has been the subject of ongoing debate on the balance between personal freedom and public health. Those opposed to mandatory helmet laws argue that such laws infringe upon their individual rights. On the other hand, those who support them argue that since society bears the burden of the financial costs of motorcycle crashes, there is a public interest in – and a justification for – legislating for helmet use. Over the years, states have variously enacted, repealed, and re-enacted "universal" motorcycle helmet laws – laws applying to all riders of motorcycles.

In 1996, a federal policy tying motorcycle helmet laws to the receipt of government funding led to 47 states enacting universal helmet laws. After this policy was withdrawn the following year, though, many states quickly repealed their helmet laws, or amended them so that they applied only to young riders.

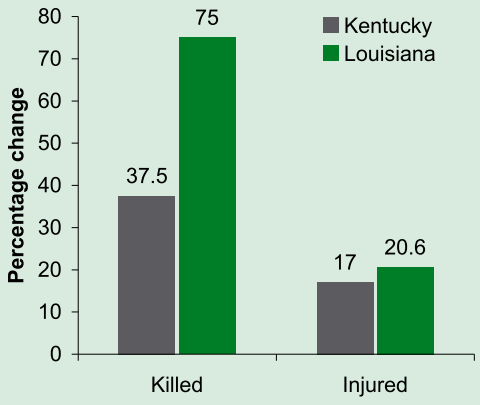
The consequences of these repeals of helmet laws have been as follows:

- Observed helmet use in a number of states dropped from nearly full compliance while the law existed, to around 50% after repeal.
- In several states, there were immediate and dramatic increases in the numbers of motorcyclists without helmets who were involved in crashes.
- Deaths of riders under the age of 21 increased even though the law still applies to these users. In Florida, deaths to these young riders increased by 188 percent.
- Increases were recorded in head injuries and fatalities among motorcycle users. For example, the rate of motorcyclist fatalities rose by 37% and 75% in Kentucky and Louisiana, respectively, following the repeal of their mandatory laws.
- Associated with the increase in severity of head injuries was an increase in the costs of treating them. For example, in Florida the total gross acute care costs charged to hospital-admitted motorcyclists with head, brain or skull injury more than doubled, from US$ 21 million to US$ 41 million, adjusted for inflation. The average costs per case rose from US$ 34 518 to US$ 39 877 in the 30 months after the law change.

The pattern of evidence from the states that have altered their laws on helmet use indicates that motorcycle helmets reduce the severity of injuries incurred in a crash; that the repeal of helmet laws decreases helmet use; and that states that repeal universal helmet laws experience an increase in motorcycle fatalities and injuries.



Observed helmet use before and after repeal of helmet law in Kentucky and Louisiana



Change in fatality and injury rates two years after helmet law repeal in Kentucky and Louisiana

Source: 26, 29

Summary

- The risk of being injured or killed in a traffic collision is much higher for motorcycle users than for users of four-wheeled vehicles.
- Motorcycle users make up a high proportion of overall traffic injuries and death, particularly in low-income and middle-income countries, where motorcycle ownership is high.
- Injuries to the head and neck are the main causes of death, severe injury and disability among users of motorcycles and bicycles. In some countries head injuries are estimated to account for up to 88% of such fatalities.
- Helmets aim to reduce the risk of serious head and brain injuries by reducing the impact of a force or collision to the head.
- The correct use of a helmet considerably decreases the risk and severity of head injuries.
- Programmes that set and enforce mandatory helmet legislation are effective increasing helmet-wearing rates and thus reducing head injuries and fatalities.
- There is strong international support for helmet-wearing programmes.

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