

Motorcycle and moped helmets

Summary

In the Netherlands, in 1972 compulsory crash helmet wearing was introduced for motorcyclists, and the obligation for moped riders followed in 1975. Wearing a crash helmet is an important contribution to road safety. In spite of this, about 30% of moped riders and 13% of motorcyclists admitted to hospital after a crash still have severe head/skull injuries. This may partly be caused by not having the helmet fastened properly.

Wearing a crash helmet became generally accepted after it was made obligatory. However, there is reason for concern: the percentage of especially moped riders not wearing a helmet, or not wearing it properly, has been on the increase during the last few years. We recommend a more intensive enforcement and an increase in public information.

Background

Before World War II many motorcyclists wore leather jackets and a leather hood helmet with ear flaps. A pair of goggles helped to protect the eyes. In those days it was more a matter of protection against the weather than a matter of safety. Safety was no issue then, and helmets were practically only worn during races.

Not until after the war, when there was a lot more traffic and also many more crashes, road safety gained importance. From the 1960s onwards, voluntary helmet use increased. This was also the case for the new light motorcycle that came to be known as the 'moped' and rapidly became popular. This fact sheet will discuss the use and necessity of crash helmets for motorized two-wheelers.

What is the road safety problem?

During the last five years about 60 moped riders and 80 motorcyclists are killed each year on the road in the Netherlands, and the trend is a decrease. The annual number of in-patients is about 1800 and 1100 respectively. Most of the moped rider casualties are of 15-19 years old and are mainly male. The casualties among the motorcyclists have a much broader age dispersion of 20-54 years old and a top of 25-34 year olds. There are also here more male than female casualties. What is striking is the fact that the proportion of in-patients among moped riders is larger than among motorcyclists, irrespective of age. The cause of this is unclear.

Which injuries do moped riders and motorcyclists incur?

To answer this question we can use the data from the hospital in-patient registration (LMR) because it is practically complete and thus representative for the whole of the Netherlands. A disadvantage is that it makes no distinction between moped and light-moped riders. The registered police data show the percentage of light-moped riders among in-patients to be approximately 20%.

Figure 1 shows several striking differences in the distribution of the most frequent injuries by body part and their severity between the group of moped and light moped riders, from now on referred to as '(light-)moped riders', and motorcyclists. There are far fewer head/skull injuries among motorcyclists (13%) than among (light-)moped riders (27%). Part of this difference can be explained by the fact the crash helmet is not compulsory for light-moped riders, thus inevitably increasing the percentage. A more detailed accident analysis shows that light-moped riders indeed incur head/skull injury more frequently (approx. 40%) than moped riders (approx. 25%). That is still considerably more frequently than among motorcyclists (13%). An explanation may be that moped riders do not always wear a helmet or do not always fasten the chin strap, which means that the helmet has little or no effect in collisions.

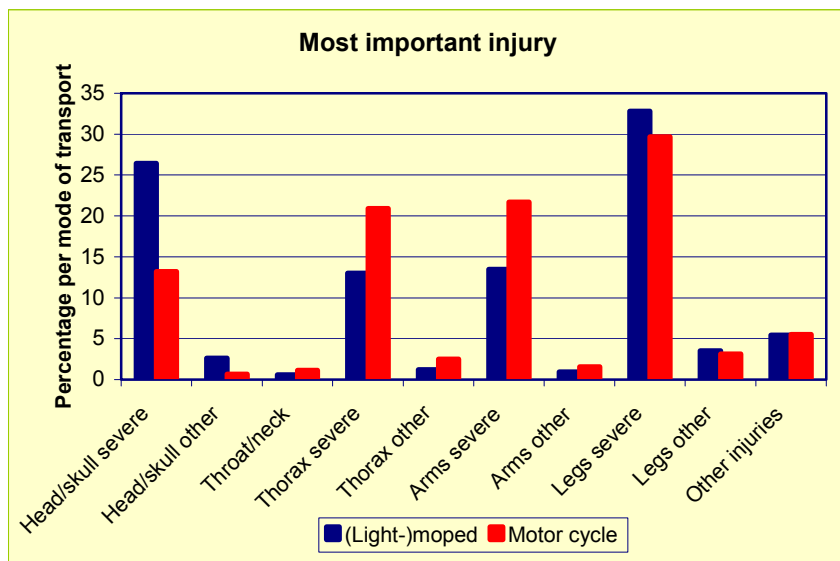


Figure 1. Injuries of moped-/light-moped riders and motorcyclist in-patients. (Source: LMR 2001-2005).

How does a crash helmet work?

A helmet prevents or reduces head injury and a well-fitting one makes riding a motorized two-wheeler more comfortable. This is also important for safety, particularly at high speeds.

A helmet consists of four basic components: outer shell, inner shell, protective padding, and chin strap. Furthermore, most types of helmet also have a visor. The task of the hard outer shell, usually made of fibre reinforced composites or thermoplastic fibres, is to prevent objects to penetrate, and to absorb and spread energy. The task of the soft inner shell, usually made of polystyrene foam in various densities, is to absorb the collision energy slowly and to spread it over a large area of the head. The protective padding, often made of polyurethane, ensures comfort of wear. The chin strap ensures that the helmet remains on the head no matter what happens. The helmet wearer's vision is guaranteed by the hinged visor. The shape of the helmet reduces wind noise to acceptable proportions, although turbulence can still raise the sound level.

What types of helmets are there?

There are various types of crash helmets. Here we will limit ourselves to those types which meet the requirements of regulation ECE R22-05:

- the integral helmet; this is a helmet that completely encloses the entire head and is equipped with a fixed jaw guard;
- the jet helmet; this helmet does not have a jaw guard but only a usually hinged visor in front;
- the system helmet; this is an integral helmet with a hinged jaw guard.

What are the legal requirements?

Since June 1st 1972, wearing an approved crash helmet has been made compulsory in the Netherlands for riders and passengers of motorcycles. This law has been extended to apply to moped riders since February 1st 1975. The helmet approval requirements are the same for both categories of transport mode, and they have been put down in the earlier mentioned ECE R22-05. However, these requirements only apply to newly bought helmets. ECE R22-05 sets minimum requirements for shock absorbance, penetration resistance, stiffness, protruding parts, surface friction, chin strap, and falling off.

How effective is a helmet?

Wearing a helmet considerably reduces the risk of head injury in a crash. In the early 1980s Huijbers & Van Kampen (1985) estimated the effect of wearing a helmet: the risk of being killed was 40% lower and that of severe injury went down with 30%.

More recent studies confirm this positive effect. For example, an Italian study among scooter riders (La Torre, 2003) showed that after helmet use was made compulsory, the risk of head trauma was three to four times smaller. A WHO report (2006) states that the risk of head injury and its severity is

72% less when wearing a helmet. In Taiwan a study by Keng (2005) showed that wearing a helmet reduced the risk of fatal head injury by 40%.

It has been studied whether wearing a helmet can have negative consequences and cause head and neck injury. In Switzerland, Konrad et al. (1996) found that wearing a helmet of 1500 grams or more was to be discouraged because of an increased risk of a skull base fracture.

Studies have also been carried out of any differences in effectiveness between the various helmet types, particularly the integral helmet and the jet helmet. It is clear that an integral helmet with a fixed jaw guard considerably reduces the risk of chin and facial injury. The jet helmet lacks this protection. Vaughan (1997) confirms this difference; this study also indicates that the risk of being involved in a crash is the same for the wearers of both helmet types. O'Connor (2005) does not confirm that the risk of neck injury with an integral helmet is higher than with a jet helmet. Lin et al. (2004) also find no difference between the helmet types for causing SCI (Spinal Cord Injuries).

According to Wells et al. (2004), the colour of the helmet can be important in preventing crashes. Wearers of a white helmet even have a 24% lower crash rate than those wearing a black helmet.

How many motorcyclists and moped riders wear a helmet?

When wearing a crash helmet was made compulsory for motorcyclists in 1972, wearing one was generally accepted by riders and passengers. It is, however, uncertain whether motorcyclists always wear an approved helmet. In the study of Huijbers (1988) 13% of the helmets worn had no approval hallmark.

In 1975 wearing a helmet became obligatory for moped riders, which initially was also generally accepted. In 1984 about 100% wore one, but in 1996 this had dropped to 98.5% for riders and 86% for passengers. This decline has continued since then; in 2002 the numbers were 90.6% for riders and 74% for passengers; it was striking that young riders wore the helmet less than the older riders. In 2004-2005 wearing increased to 93% and 85% respectively, because of stricter police enforcement, but in more recent measurements it has declined once more to 91% and 80% respectively (Ermens & Van Vliet, 2006).

When a helmet is worn without a fastened chin strap, the effectiveness of protection in a crash is limited. Therefore it is important to keep the chin strap well fastened, allowing no slack. Studies have shown that this is often not the case, among moped riders more than among motorcyclists. The most recent data on motorcyclists in the Netherlands is from the 1980s (Huijbers, 1988). It showed that 2% of helmet wearers did not have their chin strap fastened and that 13% wore it too loose.

In 2005, 90% of moped riders in the Netherlands had their chin strap fastened, 70% of which had no slack (Stipdonk et al., 2006). These percentages stand out positively compared to the 2001-2002 period, which then was the reason to intensify the enforcement.

Which developments are to be expected?

The helmet will remain the most important source of protection against injury for both motorcyclists and moped riders. This can, however, still be improved by, for instance, using better absorption materials and stronger outer shells. In a study by Eindhoven University of Technology (Van den Bosch, 2006) the rotational acceleration and deforming of the head in crashes is investigated. For this type of test a more natural flexible test head needs to be developed. A rotation test could be included in ECE R22-05, besides the existing acceleration requirements.

Conclusions

A helmet that meets the requirements of the ECE R22-05 guideline offers good protection for moped riders and motorcyclists. A crash helmet prevents or reduces the severity of head and neck injury in a crash. SWOV estimates that this causes a 40% reduction in fatal crashes and 30% fewer in-patients (Huijbers & Van Kampen, 1985). There are indications that the protective effect of the helmet can still be improved. Maybe this requires adapting the test procedure requirements so that advanced materials and constructions can contribute optimally.

The compulsory helmet can be regarded as socially accepted and providing a considerable contribution to reducing the number of road deaths and injured as a result of head injury. However, this requires correct wearing of the helmet, to which police enforcement together with public information can make an important contribution.

There is every reason for concern about helmet wearing habits of moped riders, because recent studies have shown that the percentage of *non* wearers and *incorrect* wearers may be increasing again.

Finally, the data used in this fact sheet indicates that light-moped riders would also benefit from head protection, because their percentage of crashes with severe head/skull injury is higher than that of moped riders.

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