

Seatbelts and child restraint seats

Summary

Seatbelts in cars can not only prevent severe injury, but also fatal injury in an accident in particular. Depending on which seat is occupied in a car, their risk is reduced by 20-40%. The effect is possibly even larger if we realize that seatbelt systems are becoming ever more 'intelligent'. Of course, they only are effective if they are worn. We estimate that in 2006 an extra 15 deaths and 85 severely injured would have been saved if everybody had worn a seatbelt. As well as every adult wearing one, every child should travel in an approved restraint seat or raised seat (known as booster seats). As of 1st January 2006, the law has again been intensified.

Background

Seatbelts and child restraint seats are the most important traditional restraint devices in cars. They form an indispensable link in what is known as the 'restraint chain': crumple zone–passenger cage–restraint device. During the 1970s, practically all European countries made wearing a seatbelt compulsory. This was after road safety researchers had brought their great safety effects to the attention (e.g. Van Kampen & Edelman, 1975). This fact sheet deals with the use/wearing and effect of seatbelts and child restraint seats, and the number of extra casualties that could be saved. The laws are also dealt with. In addition, the airbag is briefly considered in combination with seatbelts and baby seats in the front.

How often are seatbelts and child restraint seats used?

During the last decades, drivers in the Netherlands increasingly wore a seatbelt (see *Table 1*). This is apparent from periodic measurements along the road (AVV, 2006). On rural roads, wearing rose from 78% in 1990 to 94% in 2006. On urban roads wearing went up from 59% to 93%. The traditional difference between urban and rural roads has practically disappeared. The wearing percentage of front passengers is the same as that of drivers.

On the rear seats, wearing has shot up during the last few years, and is now about 73%, both on urban and rural roads. The method for measuring the use of safety devices by children has in the meantime been adapted to the new regulation. In this regulation children are distinguished into shorter and longer than 1.35 metres, instead of younger or older than 12 years (see *What are the laws in the Netherlands?*). Recent measurements have shown that most children shorter than 1.35 metres sit in a restraint seat; in 2004 they usually sat in a seatbelt on the rear seats. The number of children without any safety device has decreased strongly from 25% in 2004 to 10% in 2006.

Year	Drivers		Occupants on rear seats	
	Rural	Urban	Rural	Urban
1990	78	59	22	18
1995	77	64	21	20
1998	80	67	43	40
2000	86	74	36	28
2002	91	83	56	49
2004	92	88	67	71
2006	94	93	73	73

Table 1. *Seatbelt wearing percentage (urban/rural) in the period 1990-2006 of drivers and occupants on rear seats in cars (Mulder, 1998; AVV, 2006).*

The *Table 1* figures up to 1998 are from national representative measurements of both the presence as well as the use of seatbelts and child restraint seats. SWOV carried out these measurements from 1969 to 1998. Since 2000, the Traffic Research Centre of the Ministry of Transport carries them out

but only measures the use. This change of measuring organization possibly explains the quite abrupt change in the data between 1998 and 2000.

Seatbelt use in other countries

In three other Western European countries (Germany, Great Britain and Sweden) the seatbelt use of car drivers developed differently from the Netherlands. In these three countries the wearing percentage has for many years been stable at around 90%, whereas in the Netherlands this was achieved much more gradually (see *Figure 1*). However, in all four countries it has been compulsory for many years; since the 1970s in Germany, Great Britain, and the Netherlands, and since 1983 in Sweden.

Initially, the policy was different in all four countries. In Germany, the large percentage of wearers was only achieved after a fine was introduced in 1984. Only in Great Britain it was large from the very beginning. In Sweden, it only became obligatory when, in 1983, they were present in 100% of the cars, and from that moment onwards, its use reached an approximate 90% immediately. In the Netherlands, front seatbelts became obligatory in 1975 and for rear seats in 1992 when by no means all cars had them fitted in the rear as standard. All things considered, it is not completely clear why the wearing percentage in the Netherlands developed so differently from the other three countries.

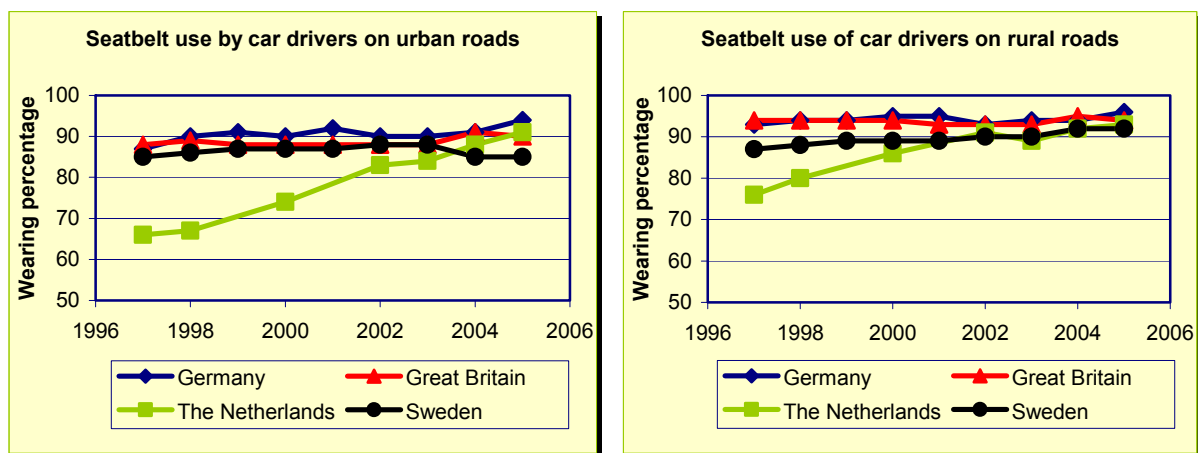


Figure 1. Seatbelt wearing on urban and provincial roads in Germany, Great Britain, the Netherlands, and Sweden between 1997 and 2005. Source: IRTAD.

How large is the effect of seatbelts and child restraint seats?

Research has shown that seatbelts considerably reduce the risk of severe or fatal injury (see *Table 2*). Front seatbelts have a greater effect than rear seatbelts because rear seats are themselves already safer than front seats.

In addition, seatbelts work better in preventing fatal injury than severe injury. This is because a fatal crash is closely associated with head injury and internal torso injury. It is mainly these types of injury that seatbelts prevent.

The effect of seatbelts is also partly dependant on the collision speed (Evans, 1996). At very high speeds, the effect eventually declines to zero, but at lower speeds the effect is very large. This is why it is also important to wear seatbelts on urban roads.

The effect of child restraint devices is even greater than that of seatbelts (Brown et al., 2002). In *Table 2*, no distinction is made between age, type, or place in the car.

The seatbelt effects in *Table 2* are based on the only study of seatbelts that has been carried out since the 1970s. The study in the United States at the end of the 1980s made the first use of the now famous method of double pair comparison. By analysing the seatbelt data of both drivers and those passengers sitting next to him/her (i.e. with the same crash circumstances), this method determined the effect of seatbelts in a more robust way (Evans, 1986; 1991).

Injury type	Seatbelt in front	Seatbelt at rear	Child restraint devices
Severe injury	25%	20%	30%
Fatal injury	40%	30%	50%

Table 2. *Estimated reduction of injury risk by seatbelts and child restraint seats in cars in the Netherlands (seatbelt data based on Evans, 1986 en 1991; child restraint seats from Schoon & Van Kampen, 1992).*

What are the laws in the Netherlands?

The history of legal obligations governing the presence and use of seatbelts is as follows:

1 st January	1971	Anchorage points and front seatbelts in new cars.
1 st June	1975	Wearing front seatbelts in cars.
1 st January	1980	Anchorage points rear seats.
1 st January	1990	Wearing rear seatbelts.
1 st April	1992	Wearing rear seatbelts where present in <i>all other vehicles e.g. vans, lorries, and buses.</i>
1 st March	2006	Intensification of the law for children's use of safety devices

The obligatory presence of anchorage points and seatbelts is laid down in article 5.2.47 of the *Vehicle ruling* (part of the Road Traffic Act of 1994). This conforms to the European guideline (77/541). The obligatory use by both driver and passengers is laid down in article 59 of the *Traffic Code 1990* (RVV 1990).

The rules for children are also in article 59 of the RVV. Until recently, the starting point was that children younger than 12 years old and shorter than 1.50 metres should make as much use as possible of restraint devices that have been approved for their weight class (according to European regulation ECE 44/03). This has been intensified as of 1st January 2006, based on the European regulations. The basic regulation is now that all children shorter than 1.35 metres (a new limit) must sit in an approved child restraint seat or booster seat, in front as well as in the rear of the car. It is no longer permitted to place the diagonal part of a three-point seatbelt behind the body, and comfortclips will be forbidden for children. For those children who have outgrown the usual child restraint seats, there are always booster seats. These ensure that the normal three-point seatbelt fits well over the shoulder of a child.

The new rules do have a few exceptions. Comfortclips are allowed if necessary for children and adults who are shorter than 1.50 metres but too heavy for normal child restraint seats or booster seats. There are also exceptions depending on the number of children on the rear seats. Children older than three years do not have to use a child restraint seat if two are already being used, but they do have to wear a seatbelt. It is also possible to sometimes have more than three children in the rear seats of a car, such as when bringing them to or from a party or sport.

Children older than three, when riding in a taxi or a privately rented bus or minibus, must each have their own individual seat; i.e. they may no longer share a seat. This has been set down per 1st January 2004 in a special *Seat Distribution Regulation*, as part of the Transportation Act 2002.

A detailed overview of the current obligatory seatbelt wearing can be found on the Ministry of Transport's website (www.verkeerenwaterstaat.nl). The intensified rules per 1st January 2006 can also be found at www.daarkunjemeethuiskomen.nl.

How do seatbelts work best?

It is important that seatbelts are positioned correctly over the body and that they are tight. The lap part of the seatbelt should be as low as possible, above the legs and not in the stomach area. The diagonal part must not run too close to the throat, but over the shoulder. In this way, the situation is achieved that the forces of a collision, which are transferred via the seatbelt to the body, can also be endured.

In order to ensure that the diagonal part fits as closely possible, the car front seats are nowadays equipped with adjustable (upper) anchor points. Of course, the user must adjust them correctly; some seatbelt systems adjust themselves automatically.

The user should also him/herself ensure that the hip part is as low as possible. This is probably even more important in the case of pregnant women because of the injury risk for an unborn child. How the

hip part is positioned depends on where the lower anchor points are and the shape and rigidity of the seat surface. The user cannot adjust them him/herself. A correct positioning helps prevent the lap belt moving upwards in a collision.

It is important that a seatbelt fits tightly because, during a collision, the slack in the seatbelt leads to too powerful forces on the body and, moreover, the body can be forced too far forward. In the first place, the retractors on the diagonal part of the seatbelt regulate the seatbelt tension. This tension force is a compromise between the desired safety (tighter) and the desired comfort (less tight) while driving. For greater comfort there are facilities that can lessen the tension. These mostly fasten the seatbelt temporarily and thus introduce extra tension. This is not safe, certainly not in systems without seatbelt pretensioners.

Seatbelt pretensioners are already present in many modern cars. They are 'intelligent' retractors that, during a collision, tighten many centimetres extra just in time, triggered by a signal at the beginning of the collision. There are also electronic aids that put the seatbelts in position just before the collision. An example of this is 'precrash sensing' that sends a signal a few seconds before the collision.

Work is also being done on force limiters that ensure that, during the collision, the seatbelt gives way again as soon as the force on the body is so great that injury would occur. The car industry is also experimenting with interactively regulating the seatbelt force during the collision phase, i.e. depending on the deceleration rate of the car.

Why special restraint seats for children?

Children are not adults. Apart from their smaller length and weight, children have a different distribution of body weight among the various parts of the body. It is because of this that seatbelts for adults are generally not suitable for children. The heads of babies are relatively heavy, meaning that they have to be cushioned well during a collision. This is best achieved by transporting them in a baby seat facing backwards, whereby the body is well cushioned in the case of a (frontal) collision.

In fact, such a cushioning is best for everybody, but for practical reasons, it is not easy to transport larger children sitting backwards. People are only prepared to do this in Scandinavian countries.

There is a quite refined test system (ECE 44/03) for child restraint seats and booster seats. This consists of a series of requirements and tests, in which five weight groups of children are distinguished (up to 36 kg, approx. 12 years old).

Just as in the case of adults, restraint devices are only effective for children if they are used correctly: the seatbelts must be as tight as possible and run along the correct parts of the body. More care is necessary for child restraint seats because besides being anchored tightly to the car, the child must sit tight in the restraint seat. There are often tuning problems between child restraint seats and the anchor system for them in the car. There is often too much slack when using existing seatbelt systems. To solve this problem, a great deal of time has been spent on an international standard for a special anchor system in cars and on child restraint seats (ISOFIX). This, however, has not made a good start even though various cars do indeed have ISOFIX anchorage points and there are special ISOFIX seats. The problem is the great diversity of car interiors and the fact that car manufacturers do not manufacture child restraint seats. This is why there are specific restraint seats for several car brands apart from the more universal ones that fit in more models and must use existing seatbelts.

How do airbags interfere with seatbelts and child restraint seats?

Airbags can strengthen the working of seatbelts and child restraint seats or actually undo it. Airbags for the front seats in a car are absolutely not compatible with backward facing baby seats on the front passenger seat. In countries that have already used airbags for a long time, (such as the United States) research has shown that this can be fatal. Within the European Union, this combination is forbidden; a baby seat must be on a rear seat, or the airbag must be switched off before the journey begins. This last option is only possible in a limited number of cars.

In frontal collisions, airbags provide additional protection to seatbelts, providing the occupants sit as far to the back as possible and their seatbelts are tight. In the US a minimum distance of 25 cm from the steering wheel/dashboard applies. The airbag is especially effective in heavy collisions in which, in spite of seatbelts, occupants can still hit parts of the interior. It is estimated that the combination of seatbelt and airbag provides 10% less chance of a crash being fatal than seatbelts only.

How do we save even more lives with seatbelts?

Although seatbelt wearing is increasing, it still makes sense to aim at 100%. If the final 7% of drivers and front passengers (see *Table 1*), and certainly the final 27% of rear passengers would wear a seatbelt, about 15 fatalities and 85 in-patients a year will be saved. This calculation is based on the

assumptions about seatbelt wearing in *Table 2* and the registered casualties in 2006. Because on average only half of all in-patients are registered, the real extra number of in-patients saved could be larger than the 85 calculated.

Because wearing a seatbelt is so important, various ways are being used to promote seatbelt and child restraint seat use. Since the 1970s this has been a spearhead of every national road safety plan in the Netherlands. SWOV supports facilities that warn driver or passenger if they do not have their seatbelt on. Some car manufactures already fit them as standard; the European Union is also trying to stimulate their use. (see for more details the fact sheet *Seatbelt reminders*; soon to be published). Seatbelt campaigns are held regularly in the Netherlands; initially they were national ones, but nowadays regional ones are frequent. In 1999 the first police regions started the implementation of regional enforcement plans. The plans were aimed at the five spearheads: speeding, alcohol, seatbelts, moped helmets, and red light running. SWOV, together with the Public Prosecution Service, has determined that the seatbelt enforcement by regional traffic enforcement teams was successful. In the regions with such a plan the numbers of deaths decreased by 21%, against 12% in the regions without one. Although this strong reduction was not quite significant, we determined that half of the reduction could be explained by an increased seatbelt use (Mathijssen & De Craen, 2004).

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