



# CHILDREN & CARS

A safety  
manual







## KNOWLEDGE SAVES LIVES

All parents want to give their children the best possible protection. In the car as well as everywhere else. Even so, children are still suffering injuries or even dying because of incorrectly fitted car seats, or because the type of child restraint they were using was wrong for their age, height and weight. Or – even worse – because they were travelling completely unrestrained in a car.

The cause of the problem is often simply a lack of knowledge. People sometimes think they have fitted a child seat correctly, when in fact they haven't. They may think that a child can safely switch from a rearward-facing seat to facing forwards when it is only one or two years old. When it shouldn't. They may think they have adjusted the safety belt correctly. When they haven't.

### EASY TO GET IT WRONG

One Swedish survey revealed that only one three-year-old in four was using a rearward-facing child seat. But *all* three-year-olds should still be using seats which face the back of the car. Only four out of ten parents knew how to adjust the diagonal section of the child's safety belt correctly.

The same survey found that it was not uncommon for some younger users of booster cushions to have the top end of the diagonal belt under their arm instead of across the shoulder. Many parents were unaware that the lap section of the safety belt should go across the tops of the child's thighs, not across the stomach.

**CHILDREN SHOULD  
STILL BE USING  
REARWARD-FACING  
SEATS AT THE AGE  
OF THREE**





Airbags were another area where serious gaps were found in parent knowledge. Over half of the parents interviewed were unaware that no one shorter than 140 cm (approx. 4 ft 7 in) should sit in a seat with a frontal airbag (unless the airbag has been switched off).

This publication has been devised to help parents to be better informed about the safety of children in cars. It should provide answers to many of the questions that new parents and parents-to-be often ask.

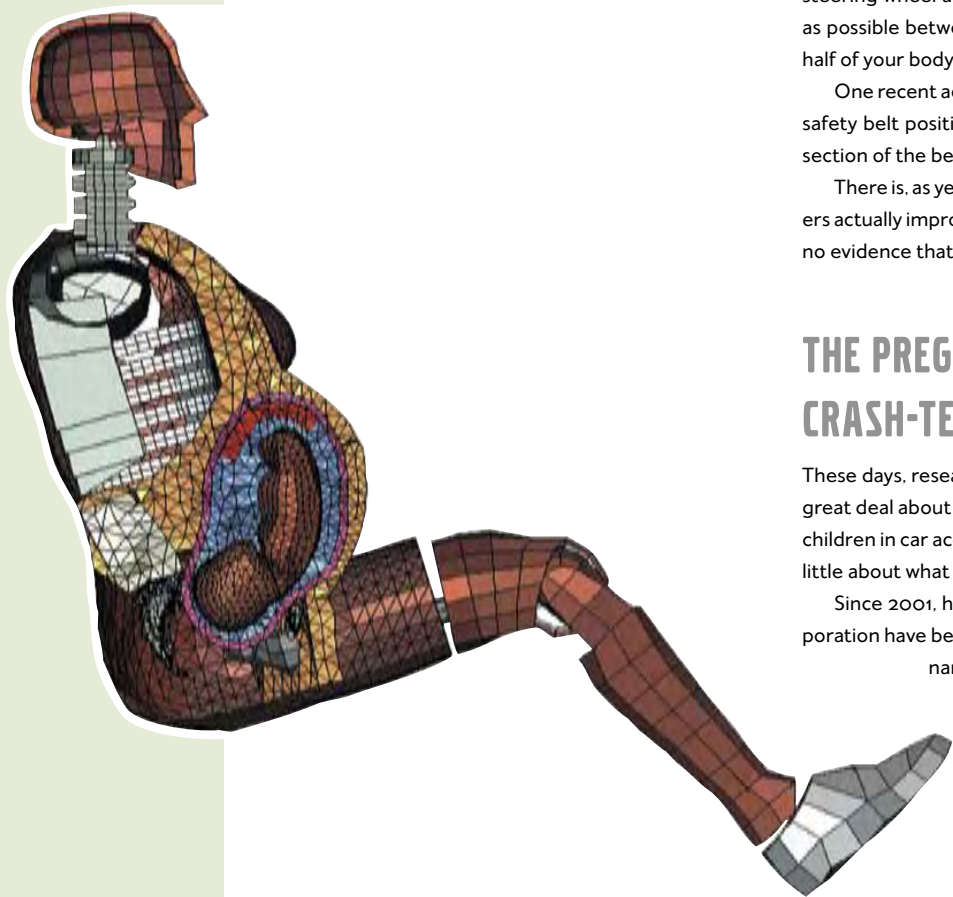
## THE MOTHER-TO-BE

Women sometimes ask whether it would be better not to use a safety belt when they're pregnant. They fear that the belt could harm their unborn baby in some way. The answer to this question is that they should definitely use a safety belt at all times, right up until the birth.

Equally important is the need to wear it correctly. The top of the diagonal belt should be taut against the front of the shoulder, crossing down between the breasts and then down the side of the tummy. The lap section of the belt should be flat against the thighs and below the tummy, as low as possible – it should never be allowed to ride up in front of the tummy. The belt must fit as snugly as possible against the body. Check, too, that there are no twists in the belt.

As always, make sure that the driver's seat and the steering wheel are adjusted to give you full control of the

**PREGNANT WOMEN  
SHOULD GO ON USING  
SAFETY BELTS, RIGHT  
UP UNTIL THE BIRTH**



car – you need to be within comfortable reach of the steering wheel and pedals, but allowing as much space as possible between the steering wheel and the upper half of your body.

One recent addition to the accessories market is the safety belt positioner. This is designed to keep the lap section of the belt below the user's tummy.

There is, as yet, no evidence that safety belt positioners actually improve user safety in accidents, but there is no evidence that they compromise it either.

## THE PREGNANT CRASH-TEST DUMMY

These days, researchers and car manufacturers know a great deal about the best ways of protecting adults and children in car accidents. But they still know surprisingly little about what happens to unborn babies.

Since 2001, however, researchers at Volvo Car Corporation have been studying the special needs of pregnant women in terms of safety and comfort in cars. As part of this research work, we have developed a unique computer model of a pregnant crash-test dummy. Her name is Linda.

Linda is being used to gain

a better understanding of the kinds of injuries pregnant women and their unborn babies can sustain in crashes. She has also been used to find out more about the optimum positioning of the safety belt when pregnant. The same computer model will continue to help us in the development of future safety systems.

With the help of over 200 female volunteers, we have also carried out detailed ergonomic studies of comfort factors for pregnant women in our cars.

Head injuries are one of the injury categories noted in unborn babies involved in car accidents, both fatal and non-fatal. The most frequently documented cause of death in the unborn, however, is the partial or total detachment of the placenta from the wall of the uterus, which prevents the foetus from getting enough oxygen.

The question is, why? Researchers think that the uterus itself is elastic enough to withstand the deformation caused by the crash forces, but that the placenta is not equally elastic and therefore not as resilient. The pregnant crash-test dummy is helping us to find out more.

What is perfectly plain, however, is the fact that pregnant women should always use their safety belts.

To recap on the advice above, the diagonal belt should fit snugly against the shoulder, crossing down between the breasts and down the side of the tummy. The lap belt should be flat against the tops and sides of the thighs and should stay as low as possible below the tummy – it should never be allowed to slip up in front of 'the bump'. The belt

needs to be in contact with the body as much as possible. And check, too, that it is not twisted anywhere.

It is important for all drivers to adjust both seat and steering wheel correctly, to give optimum control of the car.

## BABY'S FIRST JOURNEY

The first car ride for most babies will be the drive home from the maternity unit. It's an exciting but still rather jittery time for most. A new little person has come into the world. And a new life is beginning for the parents and any older siblings too.

Ahead of you is a new routine, punctuated by feeds, sleeps both short and long, and nappy changing. Most things will have been planned and prepared for, but there will always be a few details to iron out.

One thing which really must be planned for is that first journey home. Right from the start, your baby needs to have his or her own baby seat – properly anchored, correctly fitted and facing the rear of the car.

This baby seat will provide good protection for the first few months of the baby's life. Depending on the type you start with, the baby may be anything between nine and eighteen months old before you need to move on to the next seat.

The main thing is that the seat should always be the right size for the baby. When the baby has grown so its



head reaches the top end of its seat or beyond (depending on whether the seat has a hood or not), the time has come to change to a bigger one.

You can, of course, move your baby to a bigger seat earlier than this. There are other kinds of rearward-facing child car seat which provide equally good protection for a growing baby. But they must always be of a suitable size for your baby at the time.

#### TAILOR-MADE SEATS

Any parent who has ever chosen a car seat for a baby will agree that it is no easy task. Volvo is one of the few car-makers who design baby and child seats, made for and tested in their own cars. Most other seats are designed by child seat manufacturers. They will be suitable for some cars, but not for all. The methods used for anchoring car seats also vary.

This can result in parents buying the wrong kind of seat for their particular car. Or they may find that the seat they have bought is extra hard to fit correctly.

The car industry was long aware of this problem, realising the need for a single standard to ensure that all types of child seat could be used in any car. A working group was set up by the International Standards Organisation, ISO, to draft such a standard. After nine years' work, the fifteen or so nations represented in the group reached agreement on the Isofix anchorage system. The international standard defining it was published in 1999. In the following year, legislation was passed in the US requiring





all new cars to have Isofix anchorage points. Similar legislation was soon in place in Canada, and corresponding European legislation came into force in 2006. Several other countries have also introduced the Isofix standard or are about to do so.

## AN INTERNATIONAL STANDARD

The Isofix system can consist of three elements. Built into the car are two anchorage points between backrest and seat cushion. A seat base can be clicked securely into place on these anchorage points, and the baby or child seat can then be quickly and easily added or removed. Some types of Isofix seat do not require a separate base. Instead they slot straight into the car's anchorage points.

Isofix anchorage points are already to be found in many new cars. They can also be added to many Volvo models if they were not originally fitted as standard. The number of different child seats available with Isofix mountings is growing steadily, but there is still a wider selection of the seat types secured by the car's safety belts on offer.

## FAQS ON BABIES IN CARS

### What should I look for when choosing a baby seat?

The seat must be suitable for your car. There should be a list of car types on the seat itself. Some baby seats,

referred to as 'universally-approved', are suitable for all types of car.

### What do I need to think about when buying a second-hand baby seat?

Don't buy a second-hand baby seat unless it is a relatively new one. Baby seat design has evolved fast and modern seats are much safer than old ones. Make sure that any seat you buy is undamaged, has the right type approval label, and that all its fittings and instructions are supplied with it.

### What is Isofix\*?

A standardised anchorage system for baby and child seats.  
\*The Isofix system is known as LATCH in the United States.

### How do you fit a baby seat?

Follow the specific instructions carefully. If you encounter any problems, ask the seat retailer for help.

### Is a strapped-in carrycot a safe alternative?

No. The carrycot may be fixed in place, but the baby inside it will not be properly restrained.

### What is the best place in the car for a baby seat?

In a Volvo, all passenger seat positions are equally safe, but there will probably be other factors which will

influence your choice of location. Many prefer to have their baby within reach, i.e. on the front passenger seat. But if there is an activated passenger airbag in front of that seat, the baby seat must definitely not be installed there. So the back seat is the only option if the front seat has an activated passenger airbag.

In some cars, the passenger airbag can be switched off as required. Your car may have a switch for this purpose – check the owner's handbook for instructions. If there is no switch of this kind, one option is to have the airbag permanently disabled at an authorised dealership. In some countries, such as the United States, a special permit has to be obtained before an airbag may be disabled.

### Can you be sure that the airbag really has been switched off or disabled?

Yes, the Volvo Passenger Airbag Cut Off Switch (PACOS) is very reliable. But you do have to check carefully that the switch is definitely in the OFF position. If you have any doubts about whether the airbag is really disabled, contact your authorised dealership. Check the options for your brand of car and the regulations which apply in your country.

### Do side airbags pose any risk to the baby?

No. In a Volvo, the baby will not come into contact with

side airbags if it is correctly strapped into an appropriate rearward-facing child seat.

### Why must babies travel in rearward-facing seats?

A baby's head is large and heavy in relation to the rest of its body, and its neck is still far from fully developed.

If the baby were to travel in a forward-facing seat, its neck would be very vulnerable to the forces unleashed on it in the event of a frontal collision.

### How long should we go on using the baby seat?

The most important thing is that the seat used should be suitable for the size and weight of the baby at the time, to give it the support it needs. Depending on the type of seat chosen in the first place, most babies will need to move on to a larger child seat somewhere between the ages of nine and eighteen months, but it is also possible to switch seats earlier than this.

When the baby has grown so its head reaches the top end of its baby seat or beyond, the time has come to move it to a rearward-facing seat for a larger child.

### What should I do if my baby doesn't want to sit in its seat?

Stop and take a break. It can be a good idea to take a brand-new baby seat indoors and let the baby get used to it at home first.



## CRASH-TEST DUMMIES

The world's first crash-test dummy was called Sierra Sam. The size of an adult male of large build, he was made in 1949 to test ejector seats for the US Air Force.

In 1956 the air force shared its findings with the automotive industry. The first dummy to be developed specifically for research on car crashes appeared six years later.

Today's crash dummies have little in common with Sierra Sam. All of the early ones were rather rudimentary, built to confirm that safety systems such as safety belts were effective. They had few measurement points, and were not very much like humans at all.

### SOPHISTICATED ELECTRONICS

Modern crash dummies, however, are built to respond much more like humans. They have the same weight, size and proportions as the type of human they are made to simulate. Their heads are designed to react like real heads, as are other parts of their anatomy such as the neck, the knees and the thorax.

On the inside they have a lot of advanced electronic equipment, for measuring acceleration/deceleration, displacements and various loads and forces to which the body is subjected in a crash.

Crash-test dummies come in many sizes and types

these days. Most are used in frontal crash tests, but there are also some dummies developed for testing in side-on and rear-end collisions.

The type used most often was developed to represent a mid-sized adult male. There is also an extra tall and heavy variant of the male dummy, but the adult female dummy is remarkably small and petite. So petite that she is also used to represent an average twelve-year-old.

Besides this dual-purpose twelve-year-old/woman, there are other child dummies representing children aged ten, six and three years, and also babies of eighteen, twelve, nine and six months, and newborn babies.

### MEASURING WHAT HAPPENS

Deceleration (negative acceleration) is measured to find out how quickly something slows down, or, in crash-test dummies, to find out just how the human body is restrained and comes to a halt if a car stops abruptly or is shunted in a certain direction in a collision.

Displacement measurements are used, for example, to study compression of the human thorax. Twisting motions of various parts of the body are studied, as well as the loads they are subjected to.

Shear displacement measurements can be used to find out more about how vertebrae in the neck are affected in an accident.

Measurements like these allow researchers and en-

gineers to amass a broad spectrum of data and to draw conclusions on the probable effects of road accidents on humans.

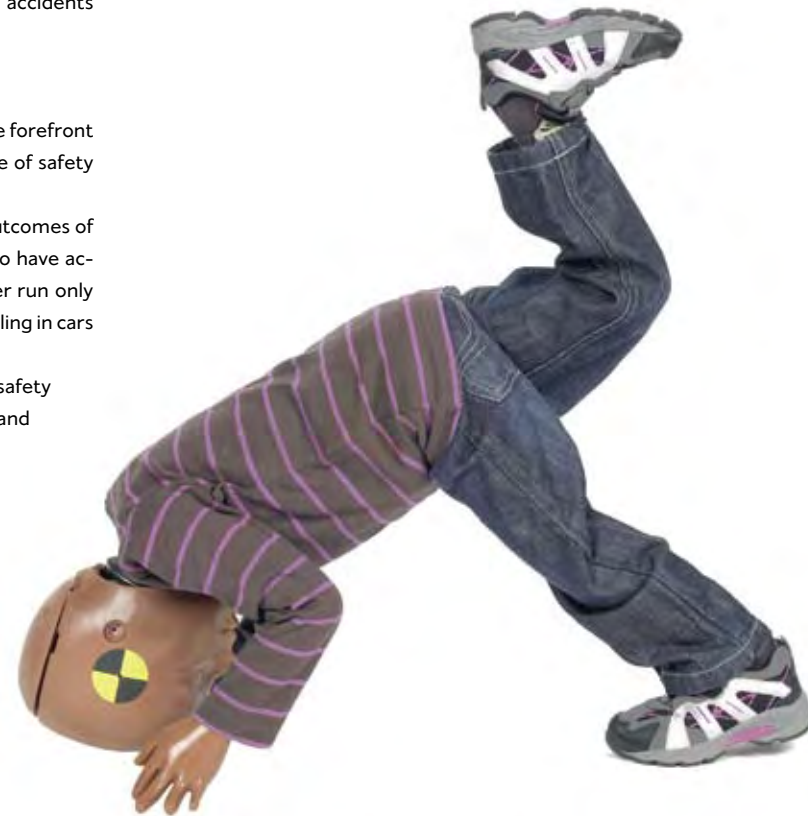
### NEW CARS SAFER

The automotive industry has long been at the forefront of crash dummy development. And the pace of safety research is increasing all the time.

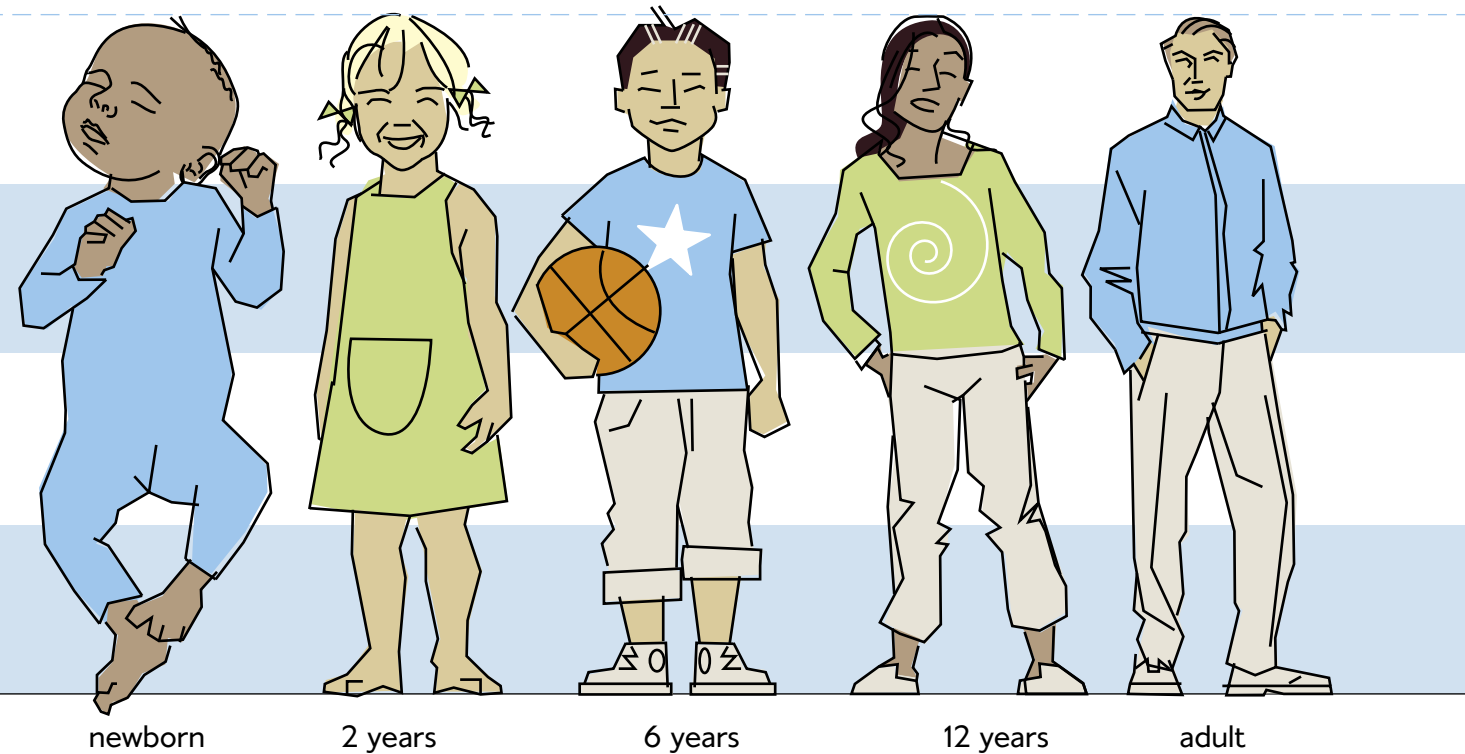
Volvo's own ongoing research into the outcomes of actual road accidents shows that people who have accidents in cars built in the late 1990s or later run only one-third of the risk of injury of people travelling in cars built 20 or 30 years earlier.

This is mainly because airbags and other safety systems have become standard equipment, and also because car cabins are now stronger than before and better able to withstand the forces unleashed in a collision.

None of these improvements would have been made without research. And crash-test dummies still have an important part to play in this research, as does all the knowledge gleaned from studying real-life accidents.



## Body proportions, birth to adulthood



Source: Burdi et al., 1968

## VULNERABLE PASSENGERS

Babies and children are especially fragile passengers. Relative to the rest of their bodies, their heads are large and heavy. The head of a nine-month-old baby, for instance, makes up a quarter of its total weight. By way of comparison, the head of an adult male is only six per cent of his total body weight.

A baby's head has quite different proportions too. Its face is relatively small compared with the rest of its head and brain.

If a baby or child suffers head injuries, this often means brain damage, which is usually much more serious than facial injuries. Head injuries in babies are frequently more severe because their skulls are thinner than an adult's, providing less protection for the brain.

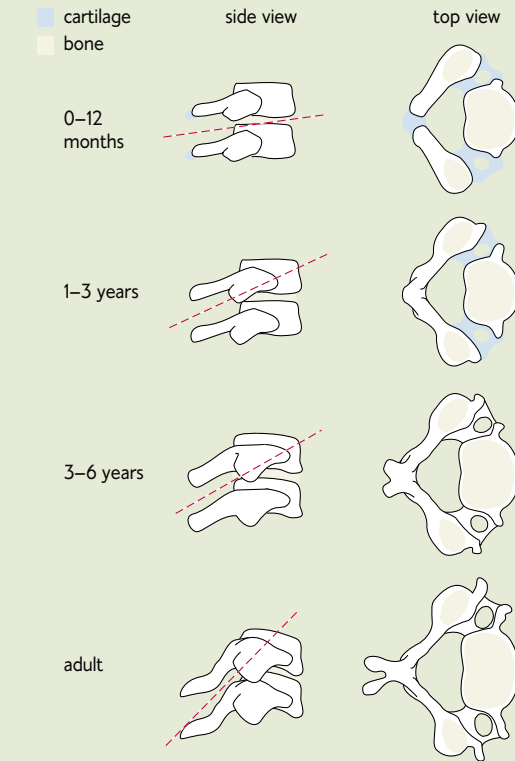
### SOFT SKELETON

The neck vertebrae of a new-born baby are composed of separate portions of bone joined by cartilage. In other words, the baby's skeleton is still soft. This cartilage turns into bone over the first three years of the baby's life.

The process of cartilage hardening into bone continues right up until puberty. There is similarly gradual development of the muscles and ligaments in the neck.

Human neck vertebrae also change shape progressively throughout the years when a person is growing, from the horizontal vertebrae of the small child to the saddle-shaped ones of the adult. Being saddle-shaped also means that the vertebrae will interlock and support one another if the head is thrown forward. The young child lacks this extra protection.

## Development of the neck vertebrae



Source: Burdi et al., 1968



Another factor which makes a child more vulnerable is the fact that its pelvis is still relatively undeveloped.

Apart from overall size, one key difference between the pelvis of a child and that of an adult is that the distinctive hip bone structure called the iliac crest is not fully developed in the child.

The size and shape of the wearer's hips have a direct bearing on the way that the safety belt will stay in place. The shape of the iliac crest in adult hips helps keep the lap belt low down in the event of a crash, preventing it from riding up and possibly damaging the internal organs.

The human pelvis remains relatively rounded in shape until the child reaches the age of about ten. The iliac crest does not develop its more angular adult shape until puberty.

### BACKWARDS SAFER FOR ALL

The safest way of travelling in a car is backwards. It would actually be better for all of us to sit facing the rear of the car, but given the existing designs of our cars, this is not feasible for adults. Young children, however, can and should travel facing the back of the car for as long as possible.

In a frontal collision, the head of a forward-facing car occupant is thrown forward with considerable force. Its momentum propels it downwards onto the breastbone and then back up again. An adult neck can withstand this strain relatively well, but a small child's neck cannot.

Given that frontal collisions are the commonest type of crash and often the most serious type too, it is par-

ticularly important for the youngest children to sit in rearward-facing seats.

## STRAIN DISTRIBUTED

The idea of rearward-facing car seats for children came from Sweden in the 1960s. It was the brainchild of Professor Bertil Aldman of Chalmers University in Gothenburg.

Professor Aldman took his inspiration from the special seats used by Gemini mission astronauts during take-off and landing, which were moulded to distribute G forces over the whole back. The principle behind rearward-facing child car seats is exactly the same. In the event of a front-end collision, the whole of the child's back takes the strain of the impact, not just its much weaker neck.

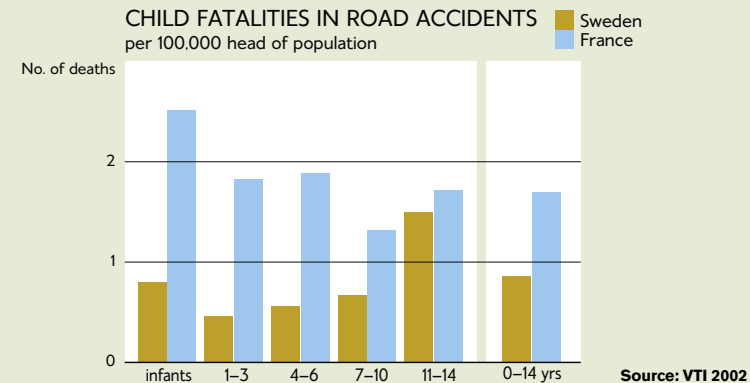
### SWEDEN FIRST

Thanks to Professor Aldman, rearward-facing child seats came into widespread use in Sweden much earlier than elsewhere. The benefits are reflected in accident statistics.

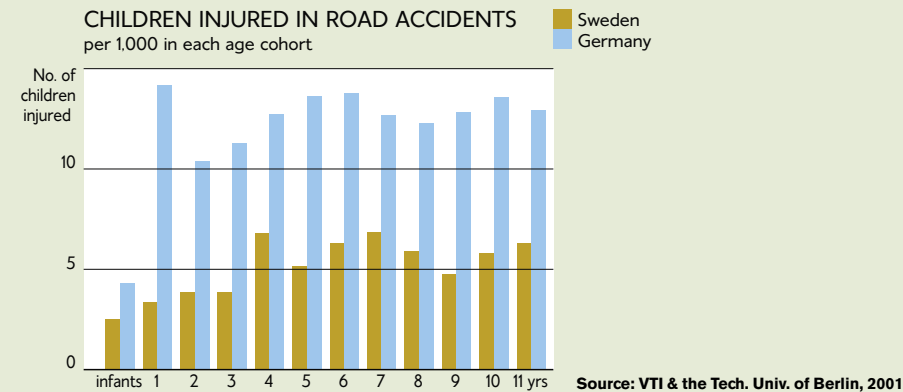
Research by the insurance company Folksam, for instance, shows that the risk of a young child being killed or seriously injured is five times greater in a forward-facing seat than in a rearward-facing one.

If you compare the Swedish accident statistics with those of countries where most children travel facing forwards, the differences are striking.

**One example is France:**  
**These statistics indicate that the risk of a child dying in a car accident in France is twice as high as in Sweden.**



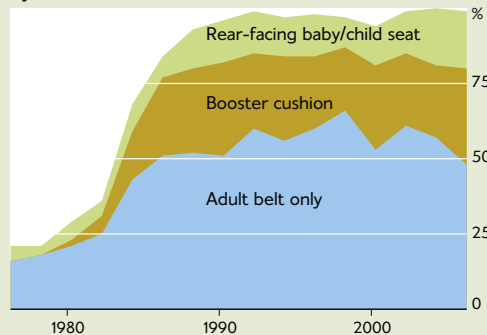
**The statistics from Germany reveal a similar pattern: Note in particular the differences from the age of one onwards. That is the age when German children start using forward-facing child seats, whereas more Swedish children travel in rearward-facing seats until the age of three or four.**





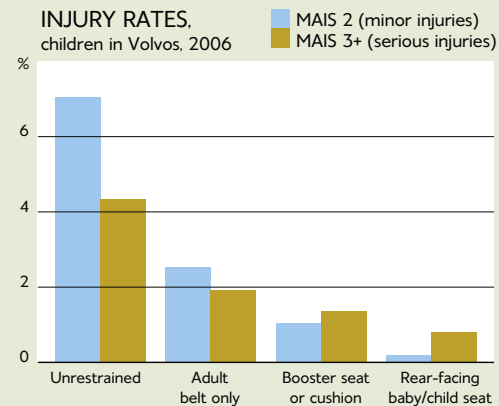


FORMS OF RESTRAINT USED  
by children in Volvos, 1979–2005



Source:  
Jakobsson et al., 2005

INJURY RATES,  
children in Volvos, 2006



Source:  
Volvo Car Corporation

## DOCUMENTING THE DIFFERENCE

Volvo has worked with Professor Aldman ever since he became involved with child safety. One of the fruits of this collaboration was the rearward-facing child seat which Volvo launched in 1972, a first in the car industry.

And ever since the early 1970s, the Volvo Traffic Accident Research Team has been investigating and collecting data on Swedish road accidents involving relatively new Volvos. The team's findings are added to a database which, to date, has documented almost 36,000 accidents, involving over 60,000 people in all. A unique resource for researchers wanting to establish more facts about child car seat safety.

### THOUSANDS OF CASES STUDIED

Between 1976 and 2006, 5,531 children aged 0–15 were involved in these accidents. Over the same period, the use of safety belts and child seats increased dramatically, from about 25 per cent in 1976 to almost 100 per cent by 2007.

The effects of this increased use are plainly reflected in the statistics on accident injuries.

For research purposes, injuries are classified on a scale (1 to 6) known as AIS – the Abbreviated Injury Scale.

On this scale, minor injuries such as bruising are classified as level 1. Moderate injuries are classed as level 2.

Level 5 is used for accident victims in a critical condition, and fatal injuries are classed as level 6. The most serious level of injury suffered by each individual is called the Maximum Abbreviated Injury and is assessed on the same scale of 1 to 6.

The statistics show that the risk of a child sustaining injuries of level 2 or higher on the Maximum Abbreviated Injury Scale (MAIS) has reduced to only a fifth of the level of 20 years ago. And the risk of injuries of MAIS 3 or worse is only a third of what it once was.

### HEIGHTENED PROTECTION

The type of restraint system used is obviously very significant. In terms of preventing injuries of level MAIS 2 or higher, using a standard adult safety belt provides approximately 60 per cent better protection than using no restraint at all. Using a forward-facing child seat or a booster cushion provides approximately 80 per cent better protection, and a rearward-facing child seat gives more than 90 per cent better protection against injuries of this severity.

Significantly, out of all the accidents documented in the Volvo database, there was only one fatality (arising through exceptional circumstances) among all the children recorded as travelling in rearward-facing seats.

It is also important for children to use a type of child restraint suitable for their current age, height and weight.





## FAQS ON REARWARD-FACING SEATS

### **How long should children go on using rearward-facing seats?**

Young children should continue to use rearward-facing seats for as long as possible. A child should only switch to a forward-facing seat when it has grown out of its seat or when its head extends beyond the top of the seat. It is recommended that children go on using rearward-facing seats until they are three years old, but preferably longer. The older a child is, the stronger its neck will have grown. In addition, the taller a child is, the smaller its head will be in relation to the rest of its body.

Not being able to stretch out its legs fully will not affect the child's safety.

### **Why is this so important?**

Because a child's vulnerable neck cannot withstand the strain involved if the head is flung forward in a frontal collision. In a forward-facing seat, the neck is subjected to high forces. In a rearward-facing seat, these forces are distributed over the whole of the child's back and head. The forces arising in rear-end collisions are generally not as high.

### **What do I need to think about when buying a child car seat?**







Firstly, the seat must be suitable for your car. There should be a list of car types on the seat itself.

Secondly, the seat must be labelled to show that it has the required type approval. See page 31 for more information on type approval standards and labelling.

#### **How do you fit a rearward-facing child seat?**

Follow the specific instructions carefully. Isofix is a standardised anchorage system which often makes it easier to fit child car seats.

If you encounter any problems, ask the seat retailer for help. Many Volvos have other forms of seat anchorage built into the floor.

#### **What is the best place in the car for a child seat?**

In a Volvo, all passenger seat positions are equally safe, but there will probably be other factors which will influence your choice of location. Many prefer to have their child within reach, i.e. on the front passenger seat. But if there is an activated passenger airbag in front of that seat, the child seat must definitely not be installed there. So the back seat is the only option if the front seat has an activated passenger airbag. In some cars, the passenger airbag can be switched off as required. Your car may have a switch for this purpose – check the owner's handbook for instructions.

The alternative is to have the airbag permanently disabled at an authorised dealership. In some countries, such as the United States, a special permit has to be obtained before an airbag may be disabled.

**FOLLOW THE  
INSTALLATION  
INSTRUCTIONS  
CAREFULLY**

### Can you be sure that the airbag really has been switched off or disabled?

Yes, the Volvo Passenger Airbag Cut Off Switch (PACOS) is very reliable. But you do have to check carefully that the switch is definitely in the OFF position. You can also have the airbag permanently disabled at an authorised dealership. If you have any doubts about whether the airbag is really disabled, contact your authorised dealership. Check the options for your brand of car and the regulations which apply in your country.

### Do side airbags pose any risk to my child?

No, Volvo side airbags are designed to keep your child from harm in a collision, as long as he or she is travelling in an appropriate rearward-facing child seat. So take care always to strap your child in correctly.

### What should I do if my child doesn't want to sit in its seat?

Stop and take a break.

### What should I do if my child falls asleep with its head hanging at a sharp angle?

If it appears not to bother the child, it probably looks worse than it is. If it bothers you, you can always stop and prop up the child's head with a pillow or cushion.

## TIME TO LOOK FORWARD

Sooner or later the child grows out of its rearward-facing child seat. This is generally at the age of three to four. Now it's time for him or her to travel facing forwards, seated on a booster cushion with or without a special backrest section. Make sure that the booster cushion has 'horns' or similar projections designed to keep the lap belt low down in front of the hips and across the tops of the thighs. These projections are also there to keep the booster cushion in place if there is an accident. Some cars, including a number of Volvo models, have their own integrated forward-facing booster cushions – a very useful form of child restraint.

In cars without head restraints, a booster cushion with a backrest or a forward-facing child seat will provide support for the child's head in the event of a rear-end collision. Child restraints of these types also generally make the legs of smaller children more comfortable, and any side projections built into the top of the backrest section will give the child's head lateral support. These projections also help the child to sit better and more securely, and less likely to fall asleep with its head dangling to one side.

### NOT TOO FAR OUT ON SHOULDER

Having a backrest section for the booster cushion also helps the belt to stay in place better by the neck and over the shoulder. When a child, sitting on a booster cushion

with or without a backrest section, is buckled in using a three-point safety belt, it is important for the belt to be positioned correctly. The main reason for using a booster cushion is not to help the child to see more, but rather to achieve the right belt geometry. The less slack there is, the better the belt will protect your child.

The booster cushion is there to raise the child up higher, to bring the belt into a better position across the hips and thighs. The lap section of the belt must always be worn as low down as possible, and not across the stomach. The diagonal section of the belt should sit firmly across the shoulder and chest. Remove any slack after you have fastened the child's safety belt. It doesn't matter if the belt is partly on the child's neck. It may not look very comfortable, but it certainly won't strangle the child if there is an accident. If the car were to stop abruptly, the child's head would move forward and the belt would move further out onto the shoulder. The risk is much greater if the diagonal belt is worn too far out on the shoulder. This could allow it to slip further down the arm in the event of an accident, when the child's head would be thrown forward. With the belt then too far down the arm, the child would not be restrained as well as it should.

### NEVER UNDER BOTH ARMS

Under no circumstances should the child travel with the diagonal belt under both arms. In a crash, the child would

be thrown further forward, with the risk of hitting some part of the car interior. There would also be a greater risk of chest or stomach injuries because the human skeleton is weaker, lower down the thorax.

Never use an ordinary cushion or telephone directory instead of a proper booster cushion. An ordinary cushion would be too soft and it would not be properly anchored as a booster cushion is. In an accident, a cushion would simply be flattened, while a telephone directory would slide forward. Using either of these could cause the child to slip forward, out under the lap belt.



## FAQS ON FORWARD-FACING CHILD RESTRAINTS

### When can I move my child to a forward-facing child restraint system?

When the child has grown out of its rearward-facing seat, i.e. when the top of its head is no longer within the child seat, or is touching the top, depending on the type of seat you have. The child should be at least three, and preferably older.

### What should I look for when choosing a booster cushion, with or without a backrest section?





One that is suitable for your type of car, comfortable for your child, and labelled with the correct type approval.

#### **Is a booster cushion just as good as a booster cushion plus backrest?**

Smaller children will generally find that a booster cushion with a backrest is more comfortable for their legs. In cars without head restraints, a booster cushion with a backrest will provide extra support behind the head. If there are side projections built into the top of the child's backrest, these can help a sleeping child to sit straighter and more securely. Otherwise, provided the safety belt is correctly positioned on the child's body, the level of protection will be the same, with or without a backrest section for the booster cushion.

#### **How do you position the belt correctly?**

The diagonal belt should go down across the shoulder, close to the neck. It doesn't matter if the belt is partly on the child's neck. What is dangerous is if the belt is worn too far out on the shoulder. If the worst comes to the worst, the top of the child's body could slide out over the belt in an accident. For the same reason, you should never let your child wear the diagonal belt under both arms. The lap belt needs to be worn in front of the hips, across the tops of the thighs. For most types of removable booster cushion, the belt needs to be held down by the projections on the booster cushion itself. If not, it could slip up in front of the child's stomach and cause internal injuries in a collision.

**DIAGONAL BELT  
NEVER UNDER  
BOTH ARMS**

There should be no slack present in either the diagonal or the lap belt. Remove any slack after you fasten the child's belt.

**Should a child ever use an ordinary cushion instead of a booster cushion, perhaps in someone else's car?**

No. An ordinary cushion is too soft. In an accident it could slip forwards or be flattened. The child would risk slipping out beneath the belt. Objects such as telephone directories are not an option either.

**Is it all right for the child to sit on an adult's lap instead?**

No. Children should never be allowed to travel on laps. Each child needs a place of its own in the car, and a suitable form of child restraint.

**Which seat in the car is safest?**

In a Volvo all seats are equally safe for children, provided they are using a suitable child restraint.

The only exception is when the front passenger seat has an airbag which has not been switched off or disabled. No child shorter than 140 cm (approx. 4 ft 7 in) should ever travel in a seat with an activated frontal airbag.

**If I have an estate model, can my children travel safely on an extra seat installed in the load space?**

Yes, the rearward-facing extra seat you can have installed in Volvo estate models comes complete with

its own safety belts and head restraints. It is designed for children who have outgrown their rearward-facing child seats, but only until they reach 140 cm (approx. 4 ft 7 in) in height. This extra seat is useful if you sometimes need to carry more than four passengers, but it is not intended as a permanent solution for those who need a seven-seater.

**How tall does a child have to be to travel in the front passenger seat with a frontal airbag which has not been switched off or disabled?**

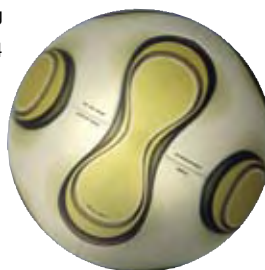
140 centimetres (approx. 4 ft 7 in).

**How long should children go on using a booster cushion?**

It is difficult to give a precise limit. Today's booster cushions have been tested and approved for children up to about 140 centimetres in height (up to the age of about ten and a weight of 36 kg or 79 pounds).

The official height recommendations vary from country to country. In Europe, a new directive\* due to come into force in 2008 states that children should continue to use an approved form of child restraint until they reach the height of 150 cm (approx. 4 ft 11 in). Most countries have their own specific rules and exceptions.

The most important thing in terms of crash safety is that the lap belt should be worn correctly across the hips, even after the child has been travelling in the car for a time and has moved about in the safety belt. There must be no risk of the belt slipping up in front of the



stomach in the event of a collision. Factors here will be the child's size (height and hip size), age (hip development) and the car's specific safety belt geometry. Our accident research shows that children aged up to ten should use a booster cushion, but that eleven and twelve-year-olds also benefit from travelling on one.

**What do I do if my child won't sit on the booster cushion?**

You must persuade him and her.

\* EU directive EEC 91/671

## WHAT IS REQUIRED BY LAW?

The regulations governing which seats children of various ages may use in cars vary from country to country, as do the prescribed types of child restraint.

Children travelling in cars should always use an appropriate type of child restraint, correctly fastened.

### TYPE APPROVAL AND LABELLING

Type approval standards and labels vary from country to country. In Europe and a number of other countries, child and baby seats must be marked with an E, which stands for ECE approval. This means that they comply with the appropriate UN ECE regulation for child restraints and are approved for use in countries which apply this standard.



FOR MORE  
INFORMATION  
ON VOLVO CHILD  
RESTRAINTS

Contact your nearest  
Volvo dealership.



## THE ELEPHANT IN THE BACK SEAT

Of course, there are always some who don't belt up, some of the time. Perhaps neglecting to put on their own safety belts, or to clip their kids in before they drive off. Maybe it doesn't seem a long journey at all. Perhaps the child is fractious and it seems impossible to make it stay in the child seat long enough to fasten the straps. Or perhaps they think... it's just around town, and we won't be driving very fast.

But... at a speed of only 40 km/h (just under 25 mph), a child who normally weighs only 30 kg (66 pounds) will suddenly weigh the equivalent of a tonne in the event of a collision with an unyielding object.

That's a metric ton – 2,204 pounds!

### DANGER TO OTHER OCCUPANTS

If that child is unrestrained in the back seat, he or she risks serious injury or even death if the car collides head-on. And anyone in the seat in front risks having this great weight unleashed on them from within the car, with equally serious consequences. Or the child could even go straight through the windscreen and hit the same object that stopped the car dead in its tracks – a scenario every bit as terrifying as the first.

A few more comparisons to bear in mind:

Travelling unrestrained and then crashing at just 15 km/h (9.3 mph) is rather like climbing up onto a dining chair and letting yourself fall headlong onto the floor.

But if the car is going at 20 km/h (12.4 mph), the severity of the crash is more like arranging four dining chairs one on top of the other before you let yourself fall.

To visualise a crash at 30 km/h (18.6 mph), imagine arranging eight chairs, one on top of another, before you take the plunge.

Eight chairs make quite a tower – and quite a fall. Yet 30 km/h doesn't seem very fast at all. It's less than the new 20 mph speed limit in some residential areas in the UK, for instance. Even 'just around town', most of us drive faster than that.

So... please use those safety belts and child restraints.

Always.

For everyone in the car.







## REFERENCES

Burdi, Huelke, Snyder and Lowrey, **Infants and Children in the Adult World of Automobile Safety Design: Pediatric and Anatomical Considerations for Design of Child Restraints**, Journal of Biomechanics, Vol. 2, 1968

Tarriere, **Children are not miniature adults**, Proceedings of the International IRCOBI Conference, 1995

Isaksson-Hellman, Jakobsson, Gustafsson and Norin, **Trends and Effects of Child Restraint Systems Based on Volvo's Swedish Accident Database**, SAE Technical Paper, Series No. 973299, 1997

**Comparison, Injured Children as Car Passengers**, Technical University of Berlin, 1999

**Säkerheten under Säkereken — En utvärdering av satsningen på trafiksäkerhetsinformation till småbarnsföräldrar** (a report on a safety information campaign for the parents of babies and young children, in Swedish), Bulletin No. 914, the Swedish Road and Transport Research Institute (VTI), 2001

Eriskin and Lund, **Seatbelt Comfort, Usage and Database Investigations for Pregnant Car Occupants in Sweden**, Volvo Car Corporation and the University of Halmstad (Masters thesis), 2002

Turbell, Thomas, **The Swedish Approach to Child Safety in Cars**, the Swedish Road and Transport Research Institute (VTI), 2002

Andersson and Sandberg, **Gravida kvinnors säkerhet i bil** (The Safety of Pregnant Women in Cars, in Swedish), Volvo Car Corporation and the University of Halmstad (Masters thesis), 2005

Jakobsson, Isaksson-Hellman and Lundell, **Safety for the Growing Child — Experiences from Swedish Accident Data**, 19th ESV Conference, Washington DC, 2005

Isaksson-Hellman and Norin, **How Thirty Years of Focused Safety Development Has Influenced Injury Outcome in Volvo Cars**, Proceedings of the 49th Annual AAAM Conference, USA, 2005

The descriptions and facts in this publication relate to Volvo Car Corporation's international model range. The cars, baby and child seats and other accessories available may differ from country to country. The manufacturer reserves the right to make changes at any time and without prior notice.

# CHILDREN & CARS

A safety  
manual

has been produced by Volvo Car Corporation  
to help all those who carry child passengers  
– parents, taxi drivers, or anyone else – reach  
a better understanding of child safety matters.  
Editor: Malin Persson, Volvo Car Corporation.  
Photography: Lars Ardarve.  
Graphics: Martin Gradén.  
Layout: Studio Desktop AB, [www.desktop.se](http://www.desktop.se)  
Printing: Eskils tryckeri AB, Borås 2007 Sweden.

PA/PV501030220 ENG

