VOLVO REPORT

The Child in the Volvo Car

Volvo research for greater child safety

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1. BACKGROUND

The intention of this report is to summarize the experience of Volvo research work in the child safety field and to provide basic material for continued development work as well as to provide recommendations about how children of different ages should travel as passengers in cars.

2. SUMMARY AND RECOMMENDATIONS

Each year in Sweden about 25 children are killed and about 200 children severely injured when travelling as passengers in cars.

Many of these injuries and deaths could have been avoided if the children had travelled in a safer way in the vehicles.

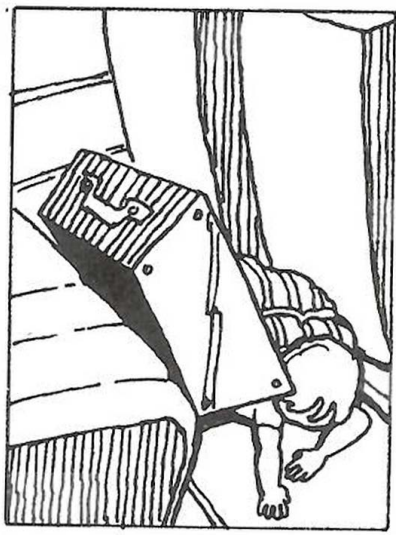
In our car safety work we have found it very important to find about the factors influencing safety and comfort for children in cars. On this basis during recent years we have carried out many surveys in the child safety field. These surveys have informed us about how children should travel in our vehicles, how their injury pattern is influenced by different locations and positions in cars and other problems concerning transport of children in cars.

Apart from our own surveys, we have followed up experience from others all round the world and studied test results from crash test with child dolls in our own laboratory and those operated by others.

On the basis of this experience we here recommend how children of different ages should travel as passengers in cars.

The age limits in the following recommendations are for guide-line purposes.

0 - 9 MONTHS (NEWBORN - ABLE TO SIT)



The anticipated proportion of children in this group, with respect to the length of the time period, makes up 6% of all children under 15.

In our accident survey, the proportion of children in this age group was 2%.

This under-representation in accidents can depend to some extent on the fact that many parents avoid transporting very young children in cars.

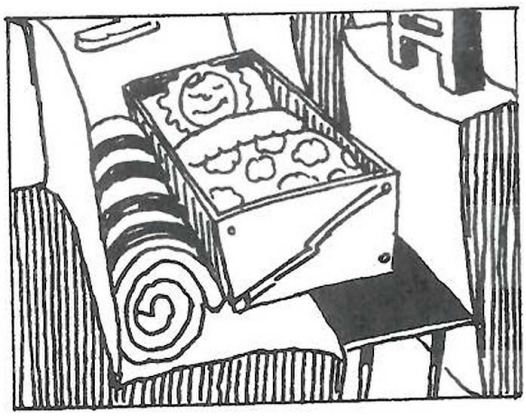
Most (75%) of the children in this age group travelled in pram inserts.

20% of these children were injured in connection with accidents

A contributory reason to the relatively high injury frequency was that the pram insert was thrown off the seat in most cases and the child fell out.

We consider that the best way today to transport children in this age group is to allow the child to lie in a pram insert (or similar) not on its own or on the knee of some adult. This makes it advisable, even if a pram is not otherwise needed during a journey, to still let the child lie in the pram insert during the car trip.

In order to prevent the insert from falling onto the floor, it can be placed on a Volvo bench just behind the front seat backrests. Furthermore, the pram insert should be stabilized with cushions, etc.



Child bench

The child bench prevents children from falling down onto the floor between the front and rear seats and also fills up the space between the front and rear seats level with the seat cushion height of the rear seat.

10 MONTHS - 3 YEARS (9 - 18 KG)

The anticipated proportion of children in this group is 21%.

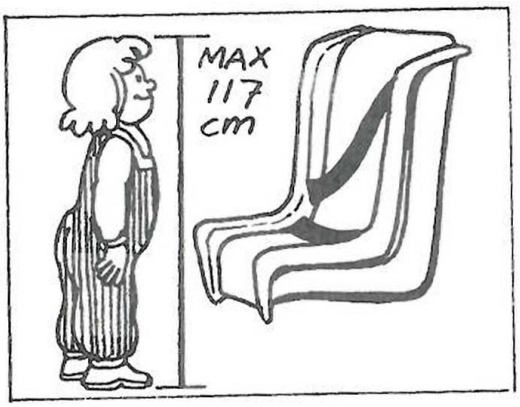
In our accident survey, the proportion of children in this age group was 18%, i.e. a certain under-representation.

Hardly 1/5 of the children in this group travelled in the child seat. Other children in the age group travelled in widely different ways varying from standing by the dashboard to lying on the hat shelf.

We believe that one cause of the low use frequency of the child seat depends on poor information concerning the injury-reducing effect of the child seat.

Of the children who travelled in the child seat (facing forwards or rearwards), 15% were injured in accidents. Other children in this group had an injury frequency of 24%. This means that the child seat has an injury-reducing effect of 38%, which strongly motivates a higher rate of utilization of the child seat.

Due to this we consider that children in this age group should travel in a child seat facing rearwards.



Child seat

The child seat can be fitted facing rearwards in the front or rear seats.
The child seat is intended for children up to about 6 years old.
The child seat has been approved by the Swedish Road Safety Office.

4 YEARS - 6 YEARS (15 - 15 KG)

The anticipated proportion of children in this age group is 20%. In our accident survey, the proportion of children in this group was 24%, i.e. a certain over-representation.

Most of the children in the age group have travelled without seat belts in the rear seat.

The injury frequency for children belted in position (child seat, seat belt) was 15%, while children who have not been belted in position were injured in 27% of the accidents.

This means that the use of a belt has implied an injury reduction of 44%.

Children in this age group use the child seat very seldom. One contributory reason is probably that only the Volvo seat is designed for children up to 6 years old.

Our recommendation for this age group is for children to utilize the child seat as long as possible since we consider this travelling position to be safest. When problems occur with the use of the child seat (for example when the child has grown out of the seat), then the child should use the three-point belt and a belt cushion. See the previous section concerning the child seat and the following section concerning the belt cushion.

7 YEARS - 10 YEARS (22 - 36 KG)

The anticipated proportion children in this group is 27% which largely corresponds to the proportion of children in the age group in our accident material (28%).

Most of the children in this age group have travelled without a seat belt in the rear seat.

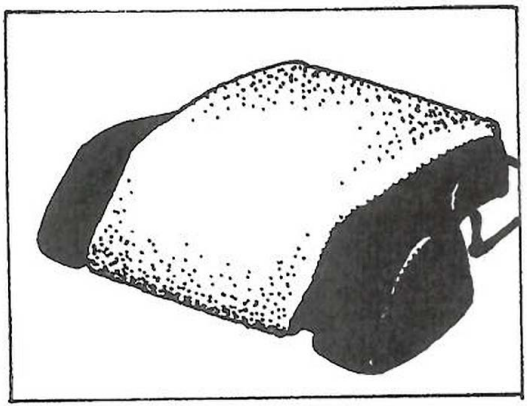
The injury frequency for children using a seat belt was 16% while children not using a belt have been injured in 27% of the accidents.

Children under 10 years old have not fully developed hip bone profiles. This implies, in theory, a greater risk of them sliding out under the seat belt.

Laboratory tests with specially designed child dolls concerning this sliding out has given indication in certain test situations that the child can slide out under the belt.

In our accidents, however, there are no tendencies to sliding out under the seat belt. Furthermore, as we can see from the result above, the belt has had an injury-reducing effect in 41% of the cases.

On the basis of this experience we recommend children in this age group to use the three-point belt in the rear seat. In order to increase comfort and eliminate possible risks of sliding out under the belt, they should also use the Volvo belt cushion.



Belt cushion

This belt cushion is designed for use with the existing belts in the rear seat. The belt cushion means greater comfort for younger children when using the seat belt and eliminates the risk of them sliding out from under it.

11 - 14 YEARS

The anticipated proportion of children in this age group is 27%, which on the whole corresponds to the proportion of children in the age group in our accident material (28%).

Most of the children travelled without seat belts in the rear seat. However, the older children in the group have started to sit in the front seat wearing belts.

The injury frequency for children using seat belts is 16% while children not using belts were injured in 27% of the accidents.

The use of the seat belt has thereby implied an injury reduction of 41%.

On the basis of this, we recommend that children in this age group should use a three-point belt.

Children in this age group are generally so large that they can use the three-point belt without combining it with the child cushion.

We are conscious of the fact that parents sometimes have difficulties in getting children to travel with the belt in use. We therefore recommend these parents to start using the child seat as soon as the child has the possibility of sitting in it and then always insist on the children wearing belts when travelling by car.

One usual cause of child accidents in cars is that the driver is distracted by the children. We do not recommend the driver to try to remedy any distraction phase while driving but he should wait for an opportunity to stop the car. Just a few seconds of insufficient attention to the road can have fatal results.

3. BASIC MATERIAL FOR ANALYSIS

The basic material for analysis consists of both internal and external surveys in the field of child safety. The internal surveys are the following:

a) Children suffering fatal injuries in cars, 1973-76 in Sweden.

(Reference no. 2).

This survey covers all accidents in which a child has died as a passenger in a car in Sweden during the years 1973, 1974 and 1975.

62 accidents involving the deaths of 65 children below 15 years old have been analyzed.

The analysis is mainly concerned with the type of injuries suffered by children of different ages travelling in different ways. These accidents have been sub-divided between different accident types.

b) Can children use seat belts?

(Reference no. 11)

This survey covers 683 accidents with 822 children below 15 years of age sitting in the front and rear seats respectively. 103 of these children used adult seat belts. The analysis concerns injury frequency and types of children wearing belts compared with those without and adults wearing belts in the same accidents. There is also consideration of the risk of neck injuries caused by the belt for passengers less than 106 cm tall.

c) Children in cars, (internal Volvo survey)

The analysis material is based on more than 6,000 of the most severe accidents in Volvo 140 and 240 cars during 1974 and 1975. Of these cars, selection has also been made of the cases - 556 - where at least one child travelled in the vehicle. A total of 1914 people were involved in these accidents of which 865 were children. The analysis considers the position of children in our accident vehicles and also the way in which their injury pattern was influenced by different locations, positions, ages, etc. The child injuries are placed in relationship to the injuries of adults in the same accidents.

d) Attitude survey - child safety (internal Volvo survey)

This survey covers 705 interviews with company car owners at Volvo who have had children less than 15 years old during the period 1971 - 76. The survey considers how children travel in our vehicles, problems occurring with different travelling positions and the utilization of different accessories as well as the attitude of parents to various protective systems in the cars.

Apart from our own accident surveys we have followed up experience of other surveys all rouhd the world (see the reference list). Furthermore, we have studied the test results from accident tests with child dolls in our own test laboratories and those of others.

4. AGE GROUPS - LEGISLATION

In the analysis the child group covers travellers up to and including 14 years old. The children have been sub-divided into age groups based on various weight groups.

- 9 months	(newborn - able to sit)
10 months - 3 years	(9 - 18 kg)
4 years - 6 years	(15 - 25 kg)
7 years - 10 years	(22 - 36 kg)
11 years - 14 years	

TABLE 1

These age and weight groups agree with the groups suggested by ECE.

In Sweden there are no regulations as to how or where a child should travel in a vehicle.

In certain other countries there are, however, such regulations. Some countries prohibit children below a certain age from travelling in the front seat. The regulations in Sweden today only concern child seats. Only rearwards-facing child seats are recommended by the Swedish Road Safety Office. Today there are 7 approved child seats, one of which is the Volvo seat.

From 15 years old and onwards, the seat belt law in Sweden today only applies to the front seats.

0 months - 9 months	No legislation
10 months - 3 years	Child seat regulations
4 years - 6 years	Standard F41-1975
7 years - 10 years	No legislation
11 years - 14 years	No legislation
15 years -	Seat belt law

TABLE 2

5. RESULTS

The results presented below are mainly concerned with the parameters shown in Table 3.

The results are mainly obtained from the Volvo surveys but are supported in certain respects by external results.

Analysis parameters

Travelling position
Injury frequency
Type of injury
Problem

TABLE 3

5.1 TRAVELLING POSITIONS

Children travel in cars in widely varying ways.

On the basis of the result of the Volvo survey "Children in cars", Part 2, here we make a study of the travelling position of children in different ages.

The location of children in vehicles with respect to age (STO 74-75)

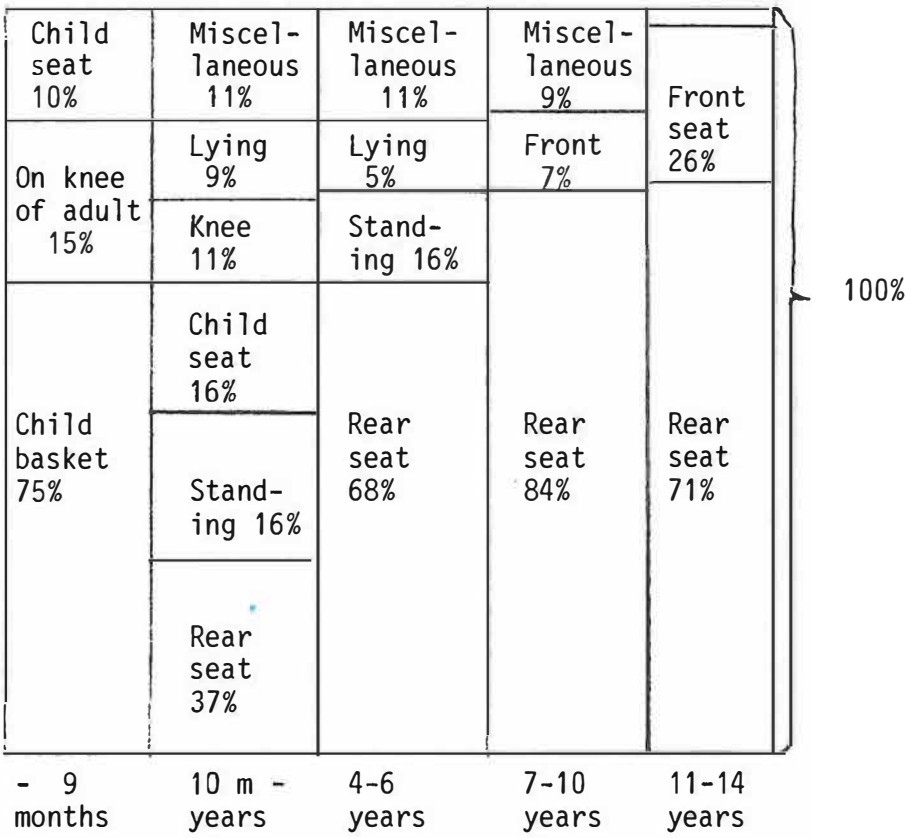


TABLE 4

No. of children	20	154	208	245	238
Anticipated proportion	6%	21%	20%	27%	27%
Proportion of children in accidents	2%	18%	24%	28%	28%

The anticipated proportion of children in the various age groups is determined by the length of the age group. This means that the first age group makes up 10 months of the total of 180 months (15 years), i.e. 6%.

We can see that, in the accident material, the two first age groups have a certain under-representation while the older groups are rather over-represented.

The children in the first age group (0-9 months) have mainly (75%) travelled in pram inserts.

Children in the age group 10 months - 3 years make up 18% of all children up to 15 years. We also call this age group the child seat group.

This age group travels in a wide variation of positions from standing at the dashboard to lying on the hat shelf.

In this survey, 10% have been in a child seat facing forwards and 6% in a child seat facing rearwards.

Of the children in the age group who have stood up in the car, more than half have stood in the middle of the car behind the front seats.

This is a very popular way of travelling for children.

11% of the children sat on the knee of an adult passenger.

The next age group, 4 - 6 years, making up 24% of the children, we also refer to as the child seat group since the Volvo child seat is designed for children of up to 6 years old.

None of the 280 children in this age group sat in a child seat when the accident occurred but were travelling mainly without seat belts in the rear seat, standing on the seat or standing on the floor between the front seats.

The rest of the children (56%), i.e. children of 7 - 14, were mainly seated in the rear seat without a seat belt.

The older children, however, are starting to travel in the front seat and often wearing a seat belt. In the case of children more than 10 years old travelling in the front seat, the belt use frequency was 77%.

Table 4 clearly shows the way in which the different age groups were travelling when the accident occurred.

An other way of showing how the various children were positioned is to specify the average age of the child for different travelling positions, see Diagram 1.

Average age for different travelling positions

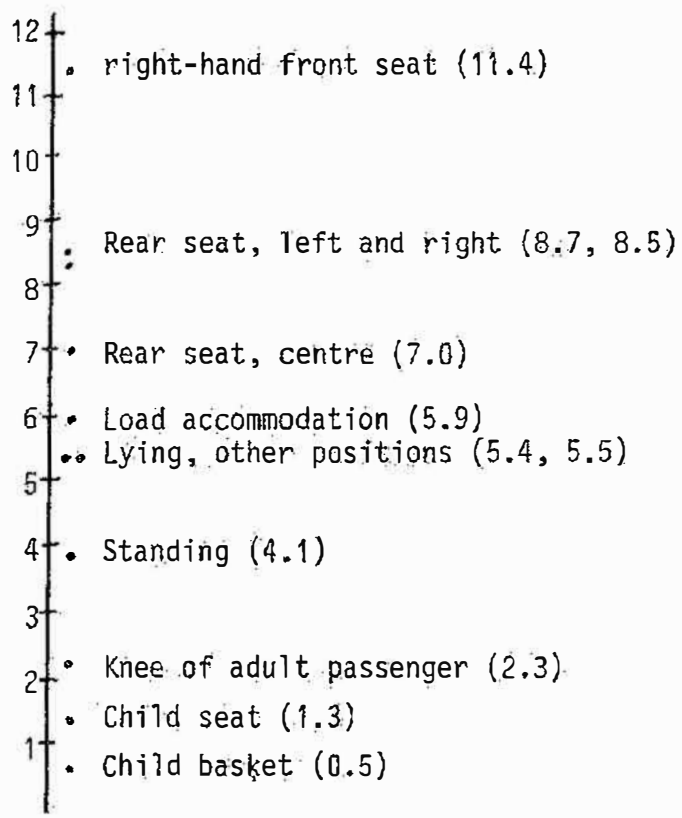


DIAGRAM 1

The children sitting in the rear seat or in the right-hand front seat are the oldest children travelling in the vehicles. Between these, however, there is a relatively large age difference.

The average age for children in the right-hand front seat is 11.4 years while for children travelling in the centre of the rear seat, the average age is 7.0 years.

Children sitting in the right and left sides of the rear seat respectively are 8.5 and 8.7 years old on an average. The youngest group naturally consists of children in child baskets who have an average age of 0.5 years.

Furthermore, we can see that the average age of children in child seats is 1.3 years.

A few more lines about the child seat

As we have seen earlier, the utilization of the child seat is low for children in the "child seat age".

Table 5 shows us more detail of the degree of utilization for different ages.

Degree of utilization of child seat

TABLE 5

Age	No. of children	Degree of utilization
10 months - 1 year	34	44%
2 years	52	17%
3 years	68	1%
4-6 years	208	-

In all cases - with one exception - the children travelling in the child seat were two years old or less. This gives an average age of 1.3 years.

During the first "child seat year" (10 months - 1 year) 44% of the children sat in the child seat. During the second year the frequency had decreased to 17% and practically disappeared with effect from 3 years of age.

We can compare this with the result of the Volvo attitude survey. The degree of utilization for different ages among those owning a child seat is shown in Diagram 2.

Degree of utilization, child seat - age

DIAGRAM 2

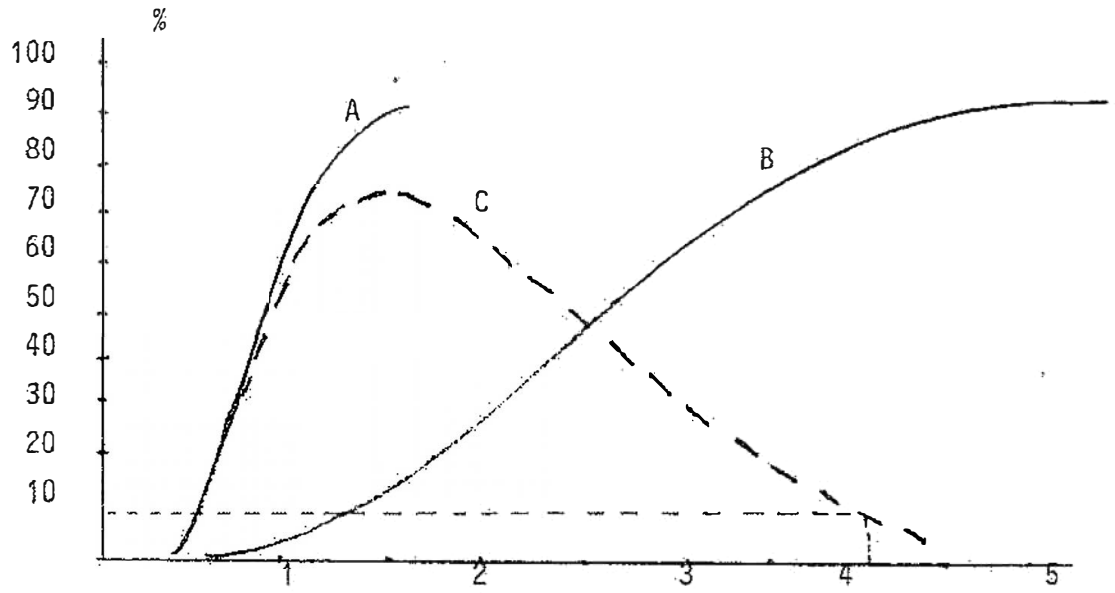


Diagram 2 shows the distribution for children who have used the child seat on some occasion. Graph (A) and (B) respectively show the cumulative frequency for the time when the child started to use the child seat and stopped using it. Graph (C) shows the percentage of children utilizing the seat at different ages.

Between 70 and 80% of the children in the 1-2 year age group sit in the child seat while about 10% of the children in the 4 year age group utilize the seat.

According to the appraisals presented, suitable travelling positions for different ages are considered to be: child basket, child seat and sitting with belt in rear seat (with or without child cushion).

Diagram 3 shows the extent to which children in our accidents have been travelling in one of these ways.

Travelling position for different age groups

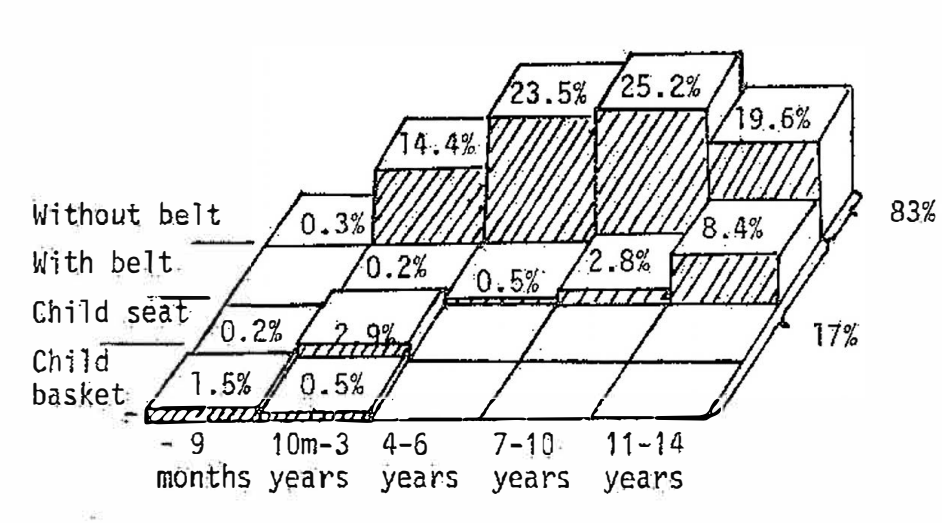


DIAGRAM 3

The diagram shows that only 17% of the children travelled in the position recommended by us.

The most neglected age groups are 4-6 and 7-10 years. These children have earlier been recommended not to use a seat belt.

5.2 INJURY FREQUENCY

This section, and the following (5.3), describes the injury frequency and type of injury for adults parallel with the results for children.

The following results are derived from the surveys: Can children use seat belts (11) and Children in cars.

The adults for which the results are presented are included in the accidents in which at least one child has travelled in the car involved.

The intention of presenting the result concerning adult travellers is to obtain a reference group when describing the injury frequency for children and the types of injuries.

Much more attention has been paid to details concerning the consequences to adult passengers in accidents than with respect to children.

What then is the injury frequency for children and adults?

Table 6 shows the injury frequency for children in child baskets, child seats and wearing belts as well as for children who have not been using belts.

Injury frequency - travelling position

	No.	Injury frequency, AIS 1-6
Child basket	20	20%
Child seat	27	15%
Using belt	103	16%
Not using belt	739	27%

TABLE 6

The injury frequency for children not using seat belts is higher than for children in one of the other travelling positions.

The use of belts (child seat, seat belt) has implied an injury reduction of about 44%.

Injury frequency in the case of children from the viewpoint of belt use

Child seat Seat belt	No belt used
15%	27%
Injury reduction 44%	

TABLE 7

In the accident material, 241 of the adults were using a belt and 217 were not (apart from drivers).

The injury frequency for these people was 35% for those using belts and 41% for those not using belts.

Injury frequency for adults

Using belts	Not using belts
35%	41%
Injury reduction 15%	

TABLE 8

This means that the injury frequency for children is lower than that for adults no matter whether they use belts or not.

Sub-division between location in the front and rear seats differs between children and adults. In order to clarify the difference in injury frequency between children and adults even more, Table 9 shows the injury frequency for children and adults with or without belts partly for the front seat and partly for the rear seat.

Injury frequency, children and adults - seat belt use, location

	Children				Adults			
	belt		no belt		belt		no belt	
	No.	% inj.	No.	% inj.	No.	% inj.	No.	% inj.
Right-hand front seat	59	15%	22	(50%)	229	34%	76	46%
Rear seat	19	(21%)	433	25%	12	(58%)	141	39%

TABLE 9

Table 9 above shows that the injury frequency is lower for children compared with adults even when respect is taken to seat belt use and location in the car.

The values in brackets are based on limited material and should not be included in the appraisal.

Children travelling without belts (Table 6) have suffered injuries exceeding AIS 1 in 23 cases.

In three of the remaining groups the children have suffered injuries more severe than AIS 1. The three cases are described below. (Child basket, child seat and seat belt).

a) The car ran off the road and turned over. To the left in the rear seat there was a 7-month old boy in a pram insert. The boy fell out of the insert when the car turned over and suffered a fracture of his right lower leg bone (AIS 2).

b) The car ran off the road into a pile of earth and turned over. A 1-year old boy was sitting in a "hanging" seat attached to the rear seat backrest. When the car turned over, the roof was dented inwards and the boy was jammed between the roof and the upper edge of the backrest. He suffered from fractured ribs and lacerations of the lungs and heart. (AIS 6).

c) The vehicle was involved in a frontal collision with a truck. A 13-year old boy wearing a belt in the left-hand rear seat suffered from a cracked left ankle (AIS 2) and grazes on his chin.

5.3 TYPES OF INJURY

Different travelling positions with respect to location, seat belt use, etc result in different types of injuries.

The general safety discussion has involved different injury patterns for children and adults.

Mention has also been made of the risk of children using seat belts.

The risks indicated have been based on discussions about the anatomy of children such as the relative size of the head, the weak neck muscles, the underdeveloped chest and incompletely developed hip bone profiles.

What then is the sub-division of injury types for children and adults?

First of all Table 10 shows the allocation of different injury types between children with and without belts in the rear seat and right-hand front seat.

Frequency of different body injuries for children with and without belts

TABLE 10

5%	Head	20%	
5%	Neck	1%	
1%	Arms	6%	
4%	Chest	1%	
-	Abdomen	1%	
-	Hips	1%	
8%	Legs	8%	

The most noticeable is the difference in head injury frequency between children with and without seat belts. Furthermore, we can note a rather higher frequency of neck and chest injuries in the case of children wearing belts.

However, none of these injuries is more severe than AIS 1, that is to say slight injuries such as bruises, slight pain, etc.

In case of other children, i.e. children travelling in other ways than sitting in the rear seat or front seat, the head injury frequency is shown in Table 11.

This group of other children thus concerns those who were lying, standing, etc.

TABLE 11

	Head injury frequency AIS 1-6
Child basket	10%
Child seat	7%
Others	20%

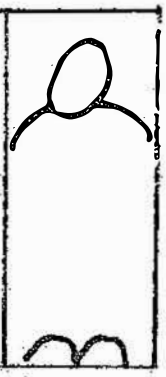
In the case of these children as well, we thus see a clear difference in head injury frequency. The children who travelle without any protection whatsoever have more than twice the head injury frequency compared with children using a child basket and child seat.

If we look as the distribution of injury types for adult passengers, we see first (Table 12) that the injury frequencies a higher than the corresponding injury frequencies for children.

Frequency of different body injuries for adults with and without seat belts

TABLE 12

10%	Head	23%
12%	Neck	9%
8%	Arms	13%
10%	Chest	6%
2%	Abdomen	1%
1%	Hips	1%
13%	Legs	19%



Exactly as in the case of the children, head injuries are considerably more frequent in the case of those without belts than those using belts. Furthermore, in agreement with the injury distribution among children, there is a higher frequency of neck and chest injuries in the case of those using belts than those without.

Apart from the fact that injury frequency in general is higher among adult passengers than children, the allocation of injury types is relatively similar for these groups with due respect taken to whether the person concerned used a seat belt or not.

Chest injuries

From the result above, we can see that chest injury frequency is higher among passengers wearing belts than those without. This applies to both children and adults.

This applies when all damages are considered from light to fatal (AIS 1-6).

Our experience is that the situation changes when the lighter injuries are excluded if we only study the severe and fatal injuries (AIS 3-6).

Since the children wearing belts in our accidents suffered no injuries in any case more severe than AIS 2, it is possible from the child accident material to show the effect of the seat belt in changing the type of injuries with a severity range of $\geq$AIS 3.

In order to clarify these effects, however, some results are given from the report "The effects of the Swedish seat belt law" (Reference no. 12). The following injury reductions are one effect of an increase in seat belt utilization from 51% to 93%.

When a person uses a seat belt in a collision, the force involved is deliberately concentrated via the belt to the chest to the advantage of the head, etc. This means that it is concentrated in a controlled way.

The result of this is, as we see in Table 13, that there is a marked decrease in the fatal chest injuries.

Reduction of chest injuries

TABLE 13

	Light Moderate	Severe Fatal
Drivers	2%	54%
Front seat passengers	-27%	50%

The light chest injuries mostly consisting of bruises and some pain in the chest are slightly reduced or increased by the force being concentrated to the chest and also through the fact that a considerable proportion of the severe or fatal chest injuries are reduced to light chest injuries.

Head injuries

Let us in a corresponding way study what happens to severe or light head injuries when the proportion of belt use changes (see above).

Reduction of head injuries

TABLE 14

	Light Moderate	Severe Fatal
Drivers	40%	60%
Front seat passengers	52%	75%

Table 14 shows that there is a considerable reduction in the severe to fatal skull injuries. Furthermore, passengers are prevented from coming into contact with structures ahead of them because they use seat belts.

This also considerably reduces lighter injuries.

With respect to the other similarities in the injury pattern, these experiences of adults would appear to apply mostly also to children.

Abdominal injuries

Finally we shall touch on abdominal injuries and the risk of sliding out from under the belt.

As has been mentioned earlier, it is considered that the risk of sliding out from under the belt and suffering abdominal injuries is greater for younger children ($\leq$ 10 years) than for elder children and adults. This would apparently depend on the fact that these children do not have fully developed hip bone profiles.

Laboratory tests have been carried out with specially designed child dolls concerning indications of sliding out and in certain test situations there are indications of sliding out from under the belt.

How are these sliding out tendencies noticeable in the actual accidents?

One way of deciding whether sliding out has occurred or not for a passenger in an accident is to study the occurrence of abdominal injuries.

Abdominal injuries are very unusual in our accidents.

As far as the children wearing seat belts are concerned, none of them suffered abdominal injuries in the accidents analyzed, see Table 10.

The basic material for appraisal, i.e. the number of children wearing belts in severe frontal accidents is, however, relatively small.

Table 12 shows that for adults wearing belts, the abdominal injury frequency is only 2%. The cases of more severe abdominal injuries noted (ruptured livers and spleens) have occurred in connection with the fracture of the ribs above. These fractures have been caused by the chest strap of the seat belt.

It is difficult to say whether sliding out actually occurs in our vehicles or whether the consequences of sliding out under the belt are not as severe as anticipated.

5.4 Driver distraction

A driver can be distracted by many things both outside and inside the vehicle. The source of distraction we shall mention here consists of different activities of children in the car.

Children have a continuous need of change and attention. This ranges from asking questions to the children hanging on to the driver.

The greatest problem, however, is when there are several children in a car. Fights between children can sometimes take relatively violent forms.

The driver wants to put an end to the fight, turns round and the accident happens.

There are also problems with children who stand, sit or lie in the car without seat belts. In connection with cornering or brake application, the child falls down, knocks itself and starts to cry. The driver wants to know what has happened and turns round.

Even if different protective systems for children are used (for example child baskets or child seats) there is still risk of the driver being distracted.

When a child is wearing a belt, however, the driver does not need to take any immediate action when the child distracts him or her but can wait for a suitable place to stop in order to clear things up.

Reference list

1. Aldman B
A protective seat for children
Proc. from 8th Stapp Conference 1964

2. Andersson A and Jonasson K
Fatal injuries to child occupants in automobile collisions
IAATM 6th International Conference 1977, Melbourne

3. Ashton, Mackay, Glyons
Trauma to children involved in road accidents
Proc. of the international meeting on Biomechanics
of Trauma in Children, 1974

4. Bohlin N, Norin H, Andersson A
Statistisk analys av trafikolyckor
AB Volvo, mars 1973

5. Garvil G
Children in injury level accidents
Safety Research Development Laboratory

6. Henderson, Herbert, Vazey, Stott
Performance of child restraints in crashes and
laboratory tests
Proc. of Seat belt seminar, Melbourne, March 1976.

7. Langwieder, Hybner, Gubitz
Kinderverletzungen in PKW
Proc. of the international meeting on Biomechanics
of Trauma in Children, 1974

8. Lowne
Injuries to children in road accidents
Proc. of the international meeting on Biomechanics
of Trauma in Children, 1974

9. Nielsen
Börn i bil
Retsmedicinsk institut ved Århus universitet

10. Nordisk Trafiksikkerhedsråd
Children in Cars, Report 11A

11. Norin H, Andersson B
The adult belt - a hazard to the child?
IAATM 6th International Conference 1977, Melbourne

12. Norin H
Bälteslagens effekt ur personskadesynpunkt
AB Volvo, mars 1977

13. Ryan
Child restraint requirements - a medical viewpoint
Seat belt seminar, March 1976 in Melbourne

14. Siegel, Nahum Appleby
Injuries to children in automobile collisions
Twelfth Stapp Car Crash Conference

15. Snyder, O'Neill
Are 1974 - 1975 automobile belt systems harzadous to children?
Am J Dis Child: 130 196-949, 1975

16. Turbell Tl Arnberg P
Skyddssystem för barn i bilar
Statens Väg & Trafikinstitut
Linköping, Sverige

16. Williams, Zador
Injuries to children in automobiles in relation to seating, location and restraint use
Insurance Institute for Highway Safety, May 1976