

Proceedings of the Sixth International Conference of the International Association for Accident and Traffic Medicine

Melbourne, Australia. January 31–February 4–1977



THE ADULT BELT -
A HAZARD TO THE CHILD?

HANS NORIN AND BRITTA ANDERSSON

DEPARTMENT OF TRAFFIC ACCIDENT RESEARCH
AB VOLVO, SWEDEN

FEBRUARY, 1977

1. Introduction

In the continuous work of Volvos Traffic Accident Research Group one of the aims is to gain experience about safety problems related to children in cars.

In the work on restraints system for the children, following question has been primary raised: To what extent can children utilise the existing seat belts of a vehicle?

Current seat belt legislation in Sweden states: "Persons travelling in the front seats of a car which is equipped with seat belts shall use the belts if they are of the age of 15 and above and have a height of at least 150 cm". There are certain exceptions to this rule.

At various times, fears have been expressed that due to their weaker neck muscles, relative to the size of the head, children are more susceptible to serious neck injuries than adults. Furthermore, there is a fear that belted children would receive serious injury to the neck from the belt.

In this report, we attempt to analyse seat belt usage by children from an injury viewpoint.

2. Material

The background data for this analysis consists of 683 accidents involving Volvo cars, models 140, 240, 164 and 264.

The accidents, which have been recorded by the Volvo PVG department's claim inspectors, are among the most serious accidents from a vehicle deformation viewpoint, involving the above models during the period 1974-76, and incurring a repair cost which in principle exceeds Skr.3,000.

These accidents are selected from a larger number of accidents. Selection criteria was that at least one child under the age of 15 was travelling in the vehicle.

Totally, 1,485 occupants (70 drivers, comparison 2) are included in the analysis, of which 822 are children. Of these, 103 had been using a seat belt.

Placing \ Age	Age										
	≤ 5	6	7	8	9	10	11	12	13	14	Total
RH, front	3	2	4	2	5	9	19	14	14	30	102
LH, rear	50	23	25	25	27	32	32	29	19	16	278
Centre, rear	70	20	18	15	19	13	15	7	4	7	188
RH, rear	50	23	25	19	15	25	18	28	25	16	244
Total	173	68	72	61	66	79	84	78	62	69	822

3. Summary

The analysed material does not indicate:

that belted children are injured more often or more seriously than belted adults.

that belted children sustain head, chest or neck injuries to a greater extent than adults.

that short occupants, including children, should sustain injuries to the neck from the belt.

The analysed material does indicate:

that older children use the seat belt to the same extent as adults and that children under the age of 11 use the seat belt somewhat less frequently.

that the belt has a protective/restraining effect on the belted children.

4. Results

Totally, 103 children had been belted. Their positioning in the vehicle is as follows:

Placing \ Age	Age									
	≤5	6	7	8	9	10	11	12	13	14
RH, front		2	2	1	4	6	16	13	9	23
LH, rear				2	2	1	3	3	1	
Centre, rear	1		1				1			
RH, rear			1		2	2	3	1	1	2

Table 2

26% of the belted children were 10 years of age or younger.

For rear seat passengers, both children and adults, seat belt utilisation is low.

In the front seat, 75% of children wore a seat belt.

79% of the children in the age group (11-14) inclusive travelling in the front seat used a seat belt. Seat belt utilisation for adults travelling in the RH front seat is 79%.

Here can be seen that the older children use the seat belt just as frequently as adults. Children younger than 11 years of age have a somewhat lower utilisation frequency.

One two-year old used a lap belt travelling in the centre rear seat of the car. Apart from this single case, utilisation (in this study) commences at 6 years of age.

4.1 HOW OFTEN ARE THE BELTED CHILDREN INJURED COMPARED WITH BELTED ADULTS?

Children have been compared with adult occupants in two ways.

1. Comparison between belted children and belted adults by positioning in the car (excluding driving seat) for all accidents.
2. Comparison between belted children in RH front seat and belted driver, same accident.

Comparison 1

This comparison concerns all belted occupants travelling in RH front seat as well as the three rear seat positions.

Placing	Children				Adults	
	≤ 10 years		11-14 years			
	No.	Injured	No.	Injured	No.	Injured
RH, front	15	2	61	9	295	99
LH, rear	5	1	7	1	9	5
Centre, rear	2	-	1	-	1	1
RH, rear	5	1	7	2	5	2

Table 3

The total injury frequency for belted children is 16%. Divided by age groups up to 10 years inclusive and 11-14 years, the injury frequencies are 15% and 16% respectively.

Belted adults in the equivalent positions have an average injury frequency of 35%.

In one case, a child (from the age group 11-14 years) sustained an injury severity of AIS 2.* All other injuries to children were of severity AIS 1 (slight).

Of the belted adults, on the other hand, three sustained injuries of severity AIS 2, one of severity AIS 4.

These results give no indication whatsoever that belted children are injured more often or more seriously than belted adults.

(Abbreviated injury scale)

The comparison also shows what type of injury the children sustained and adults sustained.

Table 4 shows the frequency of injury for body areas.

Type of injury	Children ≤ 10 years	Children 11-14 years	Adults
Head		5%	10%
Neck	4%	4%	11%
Back			3%
Chest	4%	4%	12%
Abdomen			3%
Hip			1%
Arm	4%	3%	7%
Leg	11%	4%	12%

Table 4

The number of belted children up to 10 years of age inclusive is relatively small (27) and therefore the frequency figures is not fully reliable.

However, the table shows that no type of injury is higher for children than it is for adults.

The analysed accident material thus does not indicate that belted children sustain head, chest or neck injuries to a greater extent than adults.

In order to add additional strength to the results, the belted child travelling in the front seat has been compared with the belted driver of the same car/accident.

Comparison 2

This comparison is between belted children in the RH front seat and the belted driver, same car and accident.

The comparison includes a total of 70 accidents in which both the driver and front seat passenger (the child) were using seat belts.

From earlier studies (Statistical analysis of traffic acc., March 1973, Bohlin, Norin, Andersson) we know that the injury frequency for belted drivers and front seat passengers is comparable, being, however, slightly higher for the front seat passenger. It is important to bear this in mind when making the following comparison between driver and front seat occupant (child).

Age of belted front passenger	Number injured		Number of accidents
	Driver	children	
≤ 10 years	6	1	14
11-14 years	16	9	56
Total	22	10	70

Table 5

In 31% of the accidents, the driver was injured while the child occupant of the front seat was only injured in 14% of the accidents.

In both age groups, the driver sustained a greater number of injuries.

Furthermore, none of the injured children included in this comparison sustained injuries of a severity exceeding AIS 1. Drivers, however, of age group 1 (+ children ≤ 10 years) have sustained injuries of severity AIS 2 in two cases; in age group 2 (+ children 11-14 years) injuries of severity AIS 2 in two cases and of AIS 3 in one case.

This comparison

This comparison does not indicate that belted children of age group 6-14 years travelling in the front seat are injured more often or more seriously than belted drivers.

4.2

DOES THE SEAT BELT HAVE ANY POSITIVE EFFECT FOR CHILDREN?

Children, RH, front	Belted		Not belted	
	No.	Injured	No.	Injured
≤ 10 years	15	2	6	3
11-14 years	61	9	14	8

Table 6

The number of non-belted children in the RH front seat is small. It is however possible to notice a tendency for unbelted children to be injured more often than belted children.

For rear seat child occupants the comparison has been done between belted and unbelted with all child groups combined.

Of the children, 19% belt wearers sustained injuries while 23% of the non-belted were injured.

Comparison between belted and non-belted children indicates that the seat belt has a positive restraining/protecting value for the belted child.

4.3 DO SHORT OCCUPANTS RUN A GREATER RISK OF SUSTAINING SERIOUS NECK INJURIES FROM THE SEAT BELT?

One of the factors often mentioned as a risk for short belted occupants is serious injuries to the neck by the belt.

Since this matter concerns children particularly, we have studied the injuries sustained by adults of a height of ≤ 160 cm in order to indicate the risk involved for belted children.

The material includes a total of 252 adult belted drivers and front seat passengers of this height. In 17 cases, the occupant sustained "pains in the neck" (whiplash) and in one case less serious lacerations of the neck (AIS 1).

There was one case of one-sided fracture of the second thoracic vertebra (AIS 3) and one case where a 21-year old passenger had a piece of the front corner of the seventh thoracic vertebra broken off.

None of these occupants sustained injuries to the neck caused by the seat belt.

A p p e n d i x 1

Case history of accidents with injured, belted children

(If not specially noted all the injuries given in the case history are of degree AIS 1)

What injuries did the belted children sustain?

The following is a description of those cases (16) in which a belted child was injured.

1.

no photo

On a wet and slippery street intersection, the car was hit on the right-hand side by another car.

VDI: 03 RFEW 20 and 03 RBEW 10^x

Belted 13-year old boy in RH front seat (inertia reel belt) sustained a bump above RH ear through impact with RH side window.

The belted driver sustained bruises on both knees through impact against the instrumentpanel.

2.

no photo

The accident occurred on a freeway which was icy. The driver released the accelerator suddenly causing the car to skid, left side foremost, into a second car.

VDI: unknown (side swipe)

Belted 10-year old boy in RH front seat (inertia reel belt) sustained muscle pains in neck and arms as well as across chest due to contact with belt.

The belted driver sustained fractured jaw, lacerations to the legs, diverse bruises and muscular pains in arms and neck.

3.



Car met fully loaded timber truck on blind right-hander, braked, skidded and slid left side first against the rear wheels of the truck.

VDI: 10 LFEW 15

Belted 12-year old girl in RH front seat sustained lacerations to the neck caused by the belt and scratched knees.

The belted driver sustained extravasations on the right arm and on the knees.

4.



Skidded on left-hander, ran off road and crashed head-on with a tree.

VDI: 12 FZEW 20

Belted 11-year old girl sitting in RH front seat (static belt) bit her lip and was generally shaken up (slight concussion) due to a poorly adjusted static three-point belt, the girl's head hit the windscreen.

Belted driver was uninjured.

5.



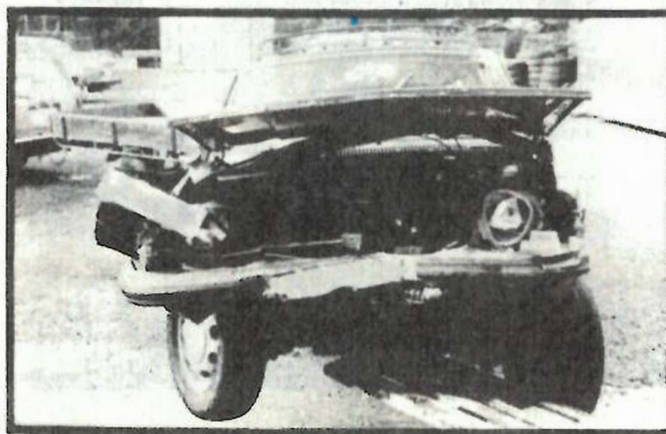
Saw car coming head-on on wet right-hander. Evasive action caused car to skid over to left-hand side and the oncoming car drove into the right front section.

VDI: 01 FREW 25

Belted 13-year old girl in RH front seat (inertia reel belt) sustained scratched left knee and stiffness in neck and between shoulder blades.

The belted driver sustained a stiff neck and a painful left arm.

6.



Two cars met on wet left-hander. The oncoming car drove over to the wrong side of the road causing the cars to crash head on.

VDI: 01 FDEW 25

Belted 14-year old boy in RH front seat (inertia reel belt) sustained painful chest as result of seat belt.

Belted driver sustained bruised forehead and pains in neck and back.

7.



Crashed into tail of stationary car (vehicle queue).

VDI: 12 FDEW 10

Belted 11-year old boy in RH front seat (inertia reel belt) sustained surface scratches to forehead caused by splintered glass.

Belted driver sustained bruises from belt.

8.



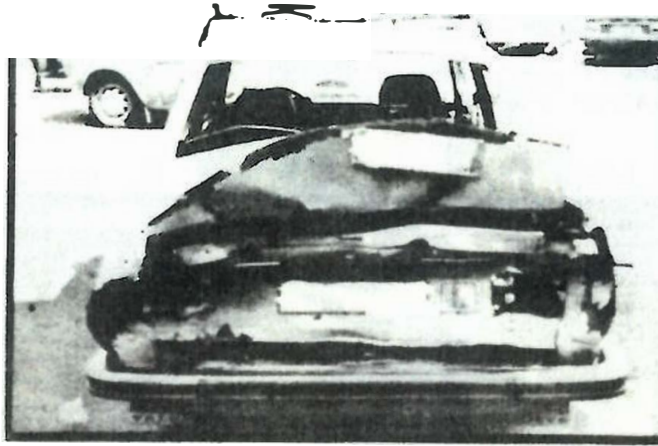
Punctured tyre caused car to run off road. Driver's recovery action brought car back onto road and into skid, rolled over and stopped lying on side.

VDI: 00 TPGO 15

Belted 9-year old girl in RH front seat (static belt) sustained bruise on right ankle.

Unbelted driver sustained bruise on right lower leg and left thigh.

9.



Run into from behind by truck and was thrown into the tail of the car in front.

VDI: 06 BDMW 15 and 12 FZEW 05

Belted 14-year old girl in RH front seat (inertia reel belt) sustained pains in neck and chest.

Belted driver sustained scratches to knees.

10.



Drove into car which entered threeway intersection.

VDI: 12 FDEW 15

Belted 8-year old girl in LH rear seat (static, three-point belt) sustained bruise on left shin.

Belted driver sustained stretched neck muscles. Belted front seat passenger sustained bruise on right elbow. Belted right rear seat passenger sustained bruise on right shin.

11.

Same accident as case 10 above.

Belted 11-year old girl in RH rear seat (static, three-point belt) sustained bruise on right shin.

12.



Crashed head-on on right-hander with car travelling on wrong side of road.

VDI: 12 FYEW 20

Belted 10-year old girl in RH rear seat (inertia reel belt) sustained lacerations to RH foot.

Belted driver and front passenger uninjured. Non-belted passenger in LH rear seat sustained bruise on RH cheek and RH thigh.

13.



Ran off road and collided with a tree (side swipe).

VDI: 01 RYES 15

Belted 12-year old girl in RH rear seat (inertia reel belt) sustained bruises all over body.

Belted driver uninjured. Belted front seat passenger sustained bruises all over body.

11.

Same accident as case 10 above.

Belted 11-year old girl in RH rear seat (static, three-point belt) sustained bruise on right shin.

12.



Crashed head-on on right-hander with car travelling on wrong side of road.

VDI: 12 FYEW 20

Belted 10-year old girl in RH rear seat (inertia reel belt) sustained lacerations to RH foot.

Belted driver and front passenger uninjured. Non-belted passenger in LH rear seat sustained bruise on RH cheek and RH thigh.

13.



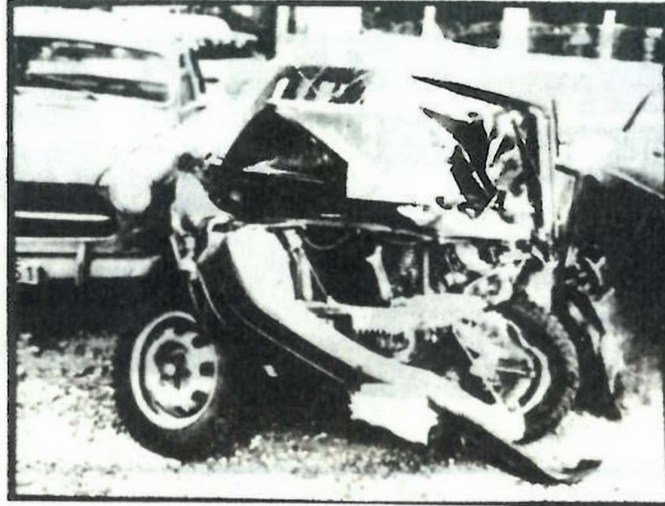
Ran off road and collided with a tree (side swipe).

VDI: 01 RYES 15

Belted 12-year old girl in RH rear seat (inertia reel belt) sustained bruises all over body.

Belted driver uninjured. Belted front seat passenger sustained bruises all over body.

14.



Collided head-on on straight road with another car.

VDI: 11 FLEW 55

Belted 14-year old boy in RH front seat sustained scrapes on chest and left knee and sprained big toe of right foot.

Belted driver sustained broken rib (AIS 2) and fracture of lower arm (AIS 2) as well as lacerations on both knees.

15.

no photo

Vehicle skidded on a slippery right-hander and collided head-on with a truck.

VDI: unknown

Belted 13-year old boy in LH rear seat sustained fissured RH wrist (AIS 2) and lacerations to the chin.

Belted driver sustained fractured ribs (AIS 2) caused by the belt and diverse small injuries. Belted front seat passenger sustained fractured ribs (AIS 2) caused by the belt. Unbelted occupant in centre rear seat and RH rear seat sustained diverse slight injuries.

16.



Vehicle ran off road and collided with rocks and tree.

VDI: 10 LFEW 20

Belted 13-year old girl in RH front seat sustained bruises on both legs.

Belted driver sustained bruises on left shoulder.

*Vehicle Deformation Index, SAE J244a