

Compact accident research

Misuse of Child Restraint Systems - A 2008 Observation Study in Germany

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1 Introduction

In Germany, the number of children killed and injured while travelling as passengers in cars has considerably decreased in the last few years (Table 1). Between 1995 and 2007 the number of children killed decreased by more than 75%, the number of children seriously injured dropped from 2,929 to 1,274 (-57%). However, the number of children killed annually while travelling in cars is still higher than for other forms of traffic involvement, e.g. as pedestrians or cyclists [1]. If we look back at the mandatory requirement to use restraints introduced in 1993, we can see that the child securing rate has continued to increase constantly [2], and since 1997 the figure has remained at 90 per cent and above (Table 2).

	Killed	Seriously injured	Slightly injured	Total
Year	Number	Number	Number	Number
1995	174	2,929	13,705	16,808
1996	149	2,823	12,887	15,859
1997	143	2,733	13,329	16,205
1998	127	2,486	13,562	16,175
1999	139	2,377	13,832	16,348
2000	103	2,057	13,202	15,362
2001	93	1,883	13,209	15,185
2002	104	1,705	12,711	14,520
2003	93	1,580	11,800	13,473
2004	80	1,462	10,817	12,359
2005	67	1,346	10,545	11,958
2006	52	1,167	9,095	11,172
2007	41	1,274	10,057	11,372

Table 1:
Number of children killed and injured (aged 0 to 14 years) as car occupants in Germany
Source: Federal Statistical Office [1]

Year	Restraint rate
1992	72 %
1993	83 %
1994	85 %
1995	87 %
1996	88 %
1997	90 %
1998	93 %
1999	94 %
2000	94 %
2001	96 %
2002	96 %
2003	96 %
2004	98 %
2005	97 %
2006	96 %
2007	97 %

Table 2:
Trend in the use of restraints (adult seat belt + CRS) for children in cars in Germany
Source: Federal Highway Research Institute [2]

The introduction of laws stipulating the mandatory use of restraints [7] has indeed had an influence on the number of children that are restrained, but not on the quality of restraint achieved. Previous studies in Germany [3, 4, 5] have clearly shown that child restraint systems are often misused and that children are thus incorrectly secured, which can be very detrimental to the level of protection afforded by child seats.

In order to assess the situation in Germany, the German Insurers Accident Research carried out a wide-ranging fundamental study on improving the protection of children in cars in 1995 (subsequently to be referred to as the 1995 GDV study [3]). An important focus of the study was „child safety and misuse“. In total, 250

vehicles were subjected to investigation and the securing of 354 children was checked. The basic findings were that two thirds of these children were incorrectly restrained or the child seat was itself incorrectly fitted. The 1995 GDV study was published in 1997 and distributed to automobile and child seat manufacturers as well as to interested organizations.

Following the 1995 GDV study [3], the German Insurers Accident Research carried out two new observation studies in the year 2000 (subsequently to be referred to as the 2000 GDV study [4]), and in the year 2008 (subsequently to be referred to as the 2008 GDV study). The most recent study was intended to allow comparative observations with respect to the 1995 and 2000 studies, as well as to record the situation as it stood in 2008. The most interesting questions were what changes might have occurred with regard to rates/frequency of misuse and the forms such misuse might take as well as to user behaviour.

To simplify the following observations, erroneous or incorrect securing is referred to by the common international term „misuse“, and the phrase „child restraint systems“ is abbreviated to „CRSs“.

2 Observation study

2.1 Investigative approach and methodology

The observations made and questions posed were based on the concept developed for the 1995 and 2000 GDV studies. It is described in [3] and [4]. To ensure that the study was realistic and representative, sites were selected for observations and questioning within Munich and its environs, where people could be found transporting children of up to 12 years of age

for various reasons as car passengers. In total, 252 observations and opinion surveys were carried out. To ensure that seasonal influences were also taken into account, the observations and questioning were carried out on a total of 16 weekdays (April to September 2008), at times of day which reflected the various reasons for transporting children. For this purpose, sites were selected outside shopping malls/supermarkets, kindergartens, motorway service areas and leisure facilities located within the Munich urban area and in small towns and communities in the Munich catchment area. Schools were not included, as whole classes are delivered or collected at the same time at the beginning and end of the school day, so extensive observation and questioning would be impossible. Adults were approached by the observation and questioning team (consisting of two people) and briefly informed about the project. In addition to information about the institution carrying out the survey and the reasons behind the investigation, an information brochure entitled „Securing children in cars“ („Kinder sichern im Auto“) was distributed. If the people approached agreed, first of all the securing of all the children in the car was investigated, with a detailed examination of the securing of the children in their respective child seats and of the fitting or fastening of the seats in the vehicle. Once the general data had been acquired, the person responsible for the children was asked about any features noted and their attitudes, knowledge and motives.

2.2 Results

Random sampling: Altogether, the investigation covered 252 observations and opinion surveys (in 252 vehicles) with information about 324 children aged up to 12. Of the people questioned, around 91% were the children's parents, mothers being most heavily represented at 76%. This is because the investigation

was carried out on weekdays (Monday to Friday) between 8 am and 5 pm. The age of those questioned was distributed as follows: around 54% under 35, around 37% 36 to 50, and around 9% older than 50. Of the 324 children observed, 305 (94.1%) were secured in a child restraint system belonging to Groups 0-III. Table 3 gives an overview of their age distribution. 6 children (1.9%) were secured using only an adult seat belt (three-point or lap belt) and 13 children (4.0%) were being carried by car without being secured in any way.

Age of child	Number
< 1	37
1	44
2	55
3	42
4	35
5	26
6	22
7	19
8	15
9	7
10	3
11	-
Total	305

Table 3:
Age distribution of children restrained in CRSs

It should be noted with regard to the distribution of types of restraint that these results cannot be compared with the surveys of restraint use carried out by the Federal Highway Research Institute [2], since the main focus of this study was the quality of securing in child restraint systems.

Results obtained from observing securing in CRSs: 62.6% of the 305 children secured in res-

traint systems were observed to be incorrectly secured, i.e. these cases displayed a slight to severe degree of misuse in the form of incorrect securing of the child in the child seat or incorrect seat fitting.

Table 4 shows the distribution of the rates of misuse among the various types of vehicles. It is noticeable that the rate is highest for the vehicle type „SUV“ (80.0%), followed by the vehicle types “saloon/cabriolet” (62.5%) and “estate car” (61.8%).

Vehicle type	Total	Misuse	
	Number	Number	%
Saloon/cabriolet	96	60	62.5
Estate car	89	55	61.8
SUV	20	16	80.0
Minibus	6	3	50.0
Motor caravan	-	-	-
People carrier/MPV	94	57	60.6
Total	305 (100 %)	191	62.6

Table 4:
Frequency of misuse as a function of type of vehicle used

An overview of how children were secured for journeys with different purposes and of what proportions of misuse arose is given in Table 5. Apart from leisure journeys, unrestrained children could be found for all purposes of journeys. The reasons for this vary. For instance, in the case of journeys to kindergarten or the shops, the reason is often given that it is only a short distance. For holiday journeys, the reasons are, firstly, that the journey has been long and, secondly, that the children are often carelessly unstrapped before a service area is reached. By far the main reason for securing only with an adult seat belt is transporting other people’s children, for whom no restraint system is immediately available, with the highest frequency in the case

Purpose of journey	Type of restraint									
	Unrestrained		Adult seat belt (misuse)		CRS (misuse)		CRS (correct)		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Kindergarten	7	9.2	3	3.9	48	63.2	18	23.7	76	100
Shopping	4	3.0	2	1.5	78	57.8	51	37.8	135	100
Leisure	-	-	1	1.4	43	59.7	28	38.9	72	100
Holiday	2	4.9	-	-	22	53.7	17	41.5	41	100

Table 5:
Misuse rates and types of restraint as a function of purpose of journey

of journeys to kindergarten. High rates of misuse of child restraint systems were observed, whatever the purpose of the journey, with the highest rate, around 63%, being observed again for kindergarten journeys, while the rate for holiday trips was markedly lower (around 54%). For shopping and leisure journeys, the rate of misuse of CRSs was nearly the same. Taking the various journey purposes as a whole, it is clear that only approximately one child in four is correctly secured on kindergarten journeys and only approximately one child in three is correctly restrained on other types of journeys.

By recording the body mass of the children, we can check how well the mass limits for different child restraint systems (mass groups classified according to ECE R 44 [6]) are complied with. Table 6 shows to what extent children were secured in restraints for which they were too light or too heavy, which was the case for only 7 of a total of 305 restraints. We observed that none of the children was secured in Group I restraint systems when it was too light for them, meaning that no baby had moved on too early from rearward-facing Group 0/0+ baby seats to forward-facing Group I seats. If full use is not made of Group I seats (up to 18 kg), children are secured too early on Group II-III booster cushions with backrest (5 cases) or on backless booster cushions (1 case).

ECE Group/ System type	Mass group	Child too light [No.]	Child too heavy [No.]
Group 0 Rearward-facing system	-10 kg	-	-
Group 0+ Rearward-facing system	-13 kg	-	-
Group 0/1 Rearward-facing system	-18 kg	-	-
Group I 4-point harness system 5-point harness system Impact shield system	9-18 kg	-	- 1 -
Group II -III 3-point belt system	9-36 kg	-	-
Group II-III Booster cushion + backrest	15-36 kg	5	-
Group II Impact shield system	15-25 kg	-	-
Group II-III Booster cushion (backless)	15-36 kg	1	-

Table 6:
Overview of cases where the child was too light or too heavy

2.3 System-related observations regarding misuse

The following observations examine to what extent and in what way misuse arises with different types of systems (for system overview see Appendix 1).

Table 7 shows an overview of the spread of system types and the misuse rates observed. The highest misuse rates, 80.0% and 73.2% respectively, are found for the 3-point

belt systems in Group I-III, and in Group I 5-point harness systems, followed by Group II-III backless booster cushions at 60.8%. The lowest misuse rates were observed for the booster cushions with backrest in Group II-III at 52.7% and for the Group 0+ (rearward-facing systems) at 51.7%. The number of instances of use of rearward-facing systems in Group 0, Group 0/I and of Group I impact shield systems was too small to be interpreted reliably.

A further criterion regarding potential misuse involves distinguishing between misuse when fitting the child seat and misuse when securing the child in the restraint (see Table 8). Those types of systems which have to be fitted or fastened separately in the vehicle were incorrectly fitted in 45.2% of the observed instances. The high misuse percentage with 5-point harness systems (Group I) and rearward-facing systems (Group 0+) show clearly the scope of opportunities open to ISOFIX.

Children were secured incorrectly in the CRS in 54.1% of the observed instances on average. Almost all types of systems showed high degrees of misuse here, in particular the 3-point belt systems in Groups I-III (80.0%) and the backless booster cushions in Group II-III (60.8%). Compared to the other CRSs positive trends were apparent in the rearward-facing systems of Group 0+ (44.8%).

Severity of misuse: To assess severity of misuse, the same categories (“slight”, “moderate”, “severe”) were used as described in [3] and [4]. Slight misuse means, for example, „harness twisted in seat“, moderate misuse for example „harness too loose in CRS (harness slack)“ and severe misuse „incorrect fitting direction (baby seat)“.

System type	Number	No. of instances of misuse	Misuse rate [%]
Group 0 Rearward-facing system	2	1	*
Group 0+ Rearward-facing system	29	15	51.7
Group 0/1 Rearward-facing system	1	1	*
Group I 4-point harness system	-	-	-
5-point harness system	123	90	73.2
Impact shield system	3	1	*
Group I -III 3-point belt system	5	4	80.0
Group II-III Booster cushion + backrest	91	48	52.7
Group II Impact shield system	-	-	-
Group II-III Booster cushion (backless)	51	31	60.8
Total	305	191	62.6

* No percentage stated due to too few cases

Table 7:
Frequency of misuse for the various system types

Fitting misuse		System type			Securing misuse	
%	No.	No.		No.	No.	%
*	1	2	Group 0 Rearward-facing system	2	1	*
24.1	7	29	Group 0+ Rearward-facing system	29	13	44.8
*	1	1	Group 0/I Rearward-facing system	1	-	*
-	-	-	Group I 4-point harness system	-	-	-
49.6	61	123	5-point harness system	123	67	54.5
Total	45.2	70	Impact shield system	3	1	*
			Group I-III 3-point belt system	5	4	80.0
			Group II-III Booster cushion + backrest	91	48	52.7
			Group II Impact shield system	-	-	-
			Group II-III Booster cushion (backless)	51	31	60.8
			Total	305	165	54.1
						Total

* No percentage stated due to too few cases

Table 8:
Comparison of fitting and securing misuse for different types of system

As Table 9 shows, in the random sample observed misuse was predominantly of moderate severity (52.4%), followed by slight and severe misuse at 26.7% and 20.9% respectively. The proportion of severe misuse is particularly very high in the case of rearward-facing systems (Group 0+), at 53.3%, followed by backless booster cushions of Group II-III (19.4%) and 5-point harness systems of Group I (17.8%).

Summaries of the forms of misuse observed for the different types of systems are attached as Appendices 2-5 and described below.

To be able to make differentiated observations, a distinction has been drawn between forms of misuse which are fitting-specific and those which are securing-specific.

Rearward-facing systems: The forms of misuse for these types of systems are presented in Appendix 2. In the case of systems of Group 0+, misuse was recorded in 15 out of 29 cases observed. It is striking that more than half of the cases involved severe misuse, which would most probably lead to severe injury in an accident situation. Fitting misuse included, in par-

System type	Severity of misuse							
	Slight		Moderate		Severe		Total	
	No.	%	No.	%	No.	%	No.	%
Group 0 Rearward-facing system	-	-	1	*	-	-	1	*
Group 0+ Rearward-facing system	4	26.7	3	20.0	8	53.3	15	100
Group 0/I Rearward-facing system	-	-	-	-	1	*	1	*
Group I 4-point harness system	-	-	-	-	-	-	-	-
5-point harness system	25	27.8	49	54.4	16	17.8	90	100
Impact shield system	-	-	-	-	1	*	1	*
Group I-III 3-point belt system	1	*	1	*	2	*	4	*
Group II-III Booster cushion + backrest	17	35.4	25	52.1	6	12.5	48	100
Group II Impact shield system	-	-	-	-	-	-	-	-
Group II-III Booster cushion (backless)	4	12.9	21	67.7	6	19.4	31	100
Total	51	26.7	100	52.4	40	20.9	191	100

* No percentage stated due to too few cases

Table 9:
Severity of misuse for different types of system

ticular, „incorrect belt path“, „incorrect fitting direction“ and „loose seat anchoring“, while securing misuse included „shoulder strap lying outside the shoulder area“. The most frequently occurring form of negligent securing is „harness slack in seat“ (13 cases).

5-point harness systems - Group I: The largest group in number is formed by the 5-point harness systems with 123 child seats in total (Appendix 3). Unfortunately, precisely in this group, the misuse rate is comparatively high. The most frequent severe fitting errors are „loose seat anchoring“ and „buckle of ancho-

ring belt open“. This group also included two US seats with „flexible LATCH“ where the top tether, which is absolutely necessary, had not been used. Concerning the securing of children in the seat, the principal severe errors found were „harness slack in seat“ and „shoulder strap lying outside the shoulder area“.

Impact shield systems - Group I: Among all child protection systems observed there were only three impact shield systems, however with a very grave and dangerous type of misuse in one case, namely „impact shield not used“ (Appendix 4). In the case of a head-on collision

this securing error may lead to most serious/life-threatening abdominal injuries.

3-point belt systems - Group I-III: This group included 5 child seats, with 2 serious types of misuse in total (Appendix 4). In the first case the “shoulder belt routed beneath the arm”, in the second case a child protection system was used which was no longer approved (tested according to ECE R 44/01 or 44/02).

Booster cushions + backrest - Group II-III: For the altogether 91 systems of this group the misuse rate was 52.7 % (see Appendix 5). The most serious errors observed were “shoulder belt routed beneath the arm” (2 cases) and “child too light for the child protection system” (5 cases). The most frequent errors were “incorrectly adjusted sleep support”, “lap belt not positioned in guides” and “loose securing/vehicle seat belt not tightened”.

Booster cushions (backless) - Group II-III: At first glance one would expect problems with securing children on booster cushions to be few and far between, since they are only used with the vehicle seat belt, i.e. the CRS is not anchored in the conventional sense. Correct securing on booster cushions depends on the height of the child, the design of the seat in the vehicle and belt geometry. Misuse, predominantly of moderate severity, was recorded in around 60% of the 51 cases observed (see Appendix 5). The most frequent form of misuse was “lap belt not positioned in guides”, followed by „belt route allowing neck contact“, which was caused, among other things, by an unfavourable belt geometry or by using this type of restraint too soon. “Incorrect shoulder strap route (too low/high)” and “vehicle seat belts not tightened” were the next most frequent forms of misuse. In three out of seven cases of severe misuse, the “shoulder belt routed beneath the arm of the child”. On the whole, 27 % of boost-

er cushions had no or not very distinct lap belt guides, as can also be observed, for instance, in the case of “cut-price booster cushions”. If such booster cushions are used, any dangerous sliding of the lap belt up to the abdominal region cannot be excluded.

2.4 Reasons behind incorrect fitting and securing

Reasons behind incorrect fitting and securing 150 people questioned gave responses relating to 183 (100 %) incorrectly restrained children	Frequency	
	No.	%
Unintentional mistake	92	50.3
Insufficient/incorrect information, lack of knowledge	79	43.2
Short distance	21	11.5
Intentional mistake	20	10.9
Technical cause	15	8.2
Time pressure	15	8.2
Clothing-related (change to thick/thin clothing)	13	7.1
Improving comfort of child	10	5.5
Resistance on part of child	10	5.5
Seat fitted by another person (father, specialist store, ...)	6	3.3
Travelling with friends	5	2.7
Second/unfamiliar car, change of car	4	2.2
Child secures itself	4	2.2
Ineffective guidance of lap belt	3	1.6
Complicated fitting/securing	3	1.6
Several children in car	2	1.1
Swapping seats between children	2	1.1
Other reasons	7	3.8

Multiple entries possible

Table 10:
Factors cited by those questioned as decisive with regard to misuse

The interviewees were asked how, in their opinion, the child came to be inadequately restrained and what were the crucial factors. Table 10 gives an overview of all the reasons given. All in all, information was obtained for 183 incorrectly restrained children. 311 causes were stated, which could be broken down into 18 different and wide-ranging reasons.

With a proportion of 50.3%, „unintentional mistake“ (mainly failure to check fitting and/or securing) was a decisive reason for misuse, followed by “insufficient/incorrect information, lack of knowledge”, “short distance”, “intentional mistake” and a lot of other different reasons.

3 ISOFIX

The 305 child protection systems of the present observation study also included 12 ISOFIX child seats. Table 11 specifies the respective types of systems and the form of misuse (fitting misuse and/or securing misuse) observed. Out of the 12 ISOFIX child seats all were correctly fitted and for the 3 systems of Group II-III no securing misuse was found either. Securing misuse in the form of too great belt slack was observed for the Group 0+ and Group I systems

in 3 out of 9 cases. Also, in a 5-point harness system of Group I, the straps were incorrectly adjusted to the shoulder height.

The 12 adults having an ISOFIX child seat were also asked whether they had had problems with fitting the ISOFIX seats. One person reported that he or she had faced initial difficulties with the initial fitting, 2 persons complained about the difficult access to the ISOFIX anchorages in the car.

Apart from the 12 adults having been found with an ISOFIX child seat in their vehicle, 7 other persons stated that they had an ISOFIX child seat which, however, was fitted in their second car. These 19 persons were questioned about the advantages and disadvantages of ISOFIX.

The answers are quoted in Table 12. The most frequently mentioned advantages were “easy handling” and “greater safety” while the most frequently cited disadvantages were the “high price” and the fact that not all passenger cars had ISOFIX anchorages. 6 out of the 19 interviewees did not see any disadvantages at all in ISOFIX child seats. The positive overall evaluation of ISOFIX is also reflected by the fact that 18 out of the 19 persons in total stated that they

Child seats with ISOFIX						
Fitting misuse		System type			Securing misuse	
%	No.	No.		No.	No.	%
-	-	3	Group 0+ Rearward-facing system	3	1	33.3
-	-	6	Group I 5-point harness system	6	2	33.3
-	-	3	Group II-III Booster cushion + backrest	3	-	-

Table 11:
Fitting and securing misuse for the 12 ISOFIX CRSs

Advantages and disadvantages of ISOFIX Responses given by 19 (100 %) interviewees	Frequency	
	No.	%
Advantages		
Easy handling	18	95
Greater safety	13	68
Straightforward handling - less misuse	7	37
Direct, rigid connection to vehicle/vehicle seat	7	37
Anchoring without vehicle seat belt	6	32
Disadvantages		
Not any	6	32
High price	6	32
ISOFIX anchorages not in all cars	4	21
Weight	3	16
Difficult to lock and to unlock into place	2	11

Multiple entries possible

Table 12:
Advantages and disadvantages of ISOFIX CRSs from viewpoint of those questioned

would opt for an ISOFIX child seat a second time when buying a new child protection system.

4 Comparative observations with respect to the 1995 and 2000 GDV studies

The results obtained from this observation study allow comparisons to be drawn with the 1995 and 2000 GDV studies, with interesting information expected in particular on misuse rates/frequencies, misuse forms.

Comparison of random samples: The three random samples were drawn, on the basis of a broadly similar observation and questioning

concept, from contact sites such as kindergartens, supermarkets/shopping centres, motorway service areas and leisure facilities within the Munich urban area and in small towns and communities in the area around Munich. The principal differences lie in the scope of the studies, i.e. 252 people observed/questioned in the year 2008, versus 300 in 2000 and 250 in 1995.

The types of vehicles used for journeys with children are listed in Table 13 and show marked changes between the studies. For instance, family-friendly types of vehicles have increased over 1995, with the use of „people carriers/MPVs“ having risen by around 22 percentage points and „estate cars“ by around 4 percentage points. Having more space and four doors makes it much easier for parents to fit child seats and secure children, which has a positive effect on the prevention of misuse. Over the same period, the use of “saloons/cabriolets” decreased by about 28 percentage points.

As shown by the overview provided by Table 14, the spread of the interviewees as regards responsibility was roughly the same, the only real difference being that the higher age groups (“36 to 50 years” and “over 50 years”) increased by about 12 percentage points in the more recent study over the 1995 study.

Observations: As Table 15 shows, the three studies revealed approximately the same proportion of misuse in around two thirds of the cases.

The comparison in Table 16 shows the severity of the observed cases of misuse. In the study carried out in 1995, around half of the cases of misuse were severe (52.5%) and impaired the level of protection considerably. In contrast, in the more recent study, it is pleasing to report a drop of 60% in this area. This positive trend continues over the different types of systems observed.

Vehicle type	2008 study		2000 study		1995 study	
	Number	%	Number	%	Number	%
Saloon/cabriolet	88	34.9	150	50.0	158	63.2
Estate car	73	29.0	95	31.7	62	24.8
SUV	16	6.3	3	1.0	6	2.4
Minibus	6	2.4	13	4.3	9	3.6
Motor caravan	-	-	1	0.3	3	1.2
People carrier/MPV	69	27.4	38	12.7	12	4.8
Total	252	100.0	300	100.0	250	100.0

Table 13:
Misuse frequencies as a function of vehicle type; comparison between 2008/2000/1995 studies

Interviewee	2008 study		2000 study		1995 study	
	Number	%	Number	%	Number	%
Father	38	15.1	62	22.1	50	20.0
Mother	192	76.2	205	73.0	176	70.4
Grandparent	22	8.7	11	3.9	17	6.8
Relative/friend	-	-	3	1.0	7	2.8
Age						
35 and under	128	53.6	166	63.9	164	65.7
36 to 50	90	37.6	83	31.9	69	27.6
Over 50	21	8.8	11	4.2	17	6.8

Table 14:
Overview of interviewees; comparison between 2008/2000/1995 studies

System type	2008 study			2000 study			1995 study		
	Number	No. of instances of misuse	%	Number	No. of instances of misuse	%	Number	No. of instances of misuse	%
Group 0 Rearward-facing system	2	1	*	25	17	68.0	18	10	55.6
Group 0+ Rearward-facing system	29	15	51.7	7	2	28.6	-	-	-
Group 0/I Rearward-facing system	1	1	*	2	2	*	-	-	-
Group I 4-point harness system	-	-	-	12	12	100	63	57	90.5
5-point harness system	123	90	73.2	134	111	82.8	62	41	66.1
Impact shield system	3	1	*	8	4	50.0	13	12	92.3
Group I-III 3-point belt system	5	4	80	24	11	45.8	24	6	25.0
Group II-III Booster cushion + backrest	91	48	52.7	67	32	47.8	-	-	-
Group II Impact shield system	-	-	-	5	1	*	5	1	*
Group II-III Booster cushion (backless)	51	31	60.8	67	40	59.7	107	56	52.3
Total	305	191	62.6	351	232	66.1	292	183	62.7

* No percentage stated due to too few cases

Table 15:
Frequency of misuse for the various system types; comparison between 2008/2000/1995 studies

		Severity of misuse																	
		2008 study						2000 study						1995 study					
		slight		moderate		severe		slight		moderate		severe		slight		moderate		severe	
System type		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Group 0 Rearward-facing system		-	-	1	*	-	-	3	17.6	2	11.8	12	70.6	1	10.0	-	-	9	90.0
Group 0+ Rearward-facing system		4	26.7	3	20.0	8	53.3	-	-	1	*	1	*	-	-	-	-	-	-
Group 0/I Rearward-facing system		-	-	-	-	1	*	-	-	1	*	1	-	-	-	-	-	-	-
Group I 4-point harness system 5-point harness system Impact shield system		-	-	-	-	-	-	-	-	7	58.3	5	41.7	-	-	18	31.6	39	68.4
		25	27.8	49	54.4	16	17.8	24	21.6	54	48.6	33	29.7	1	2.4	23	56.1	17	41.5
		-	-	-	-	1	*	-	*	-	-	3	*	2	16.7	2	16.7	8	66.7
Group I-III 3-point belt system		1	*	1	*	2	*	3	27.3	7	63.3	1	9.1	2	*	3	*	1	*
Group II-III Booster cushion + backrest		17	35.4	25	52.1	6	12.5	12	37.5	17	53.1	3	9.4	-	-	-	-	-	-
Group II Impact shield system		-	-	-	-	-	-	1	*	-	-	-	-	1	*	-	-	-	-
Group II-III Booster cushion (backless)		4	12.9	21	67.7	6	19.4	7	17.5	28	70	5	12.5	3	5.3	31	55.4	22	39.3
Total		51	26.7	100	52.4	40	20.9	51	22.0	117	50.4	64	27.6	10	5.4	77	42.1	96	52.5

* No percentage stated due to too few cases

Table 16:
Severity of misuse for different types of system; comparison between 2008/2000/1995 studies

System type and forms of misuse	No.	%	No.	%	No.	%
Rearward-facing systems - Group 0/0+	2008 study Basis: n = 31		2000 study Basis: n = 32		1995 study Basis: n = 18	
Incorrect belt path	4	12.9	5	15.6	5	27.8
Incorrect fitting direction	2	6.5	4	12.5	2	11.1
Belt webbing not positioned in guides	-	-	-	-	6	11.1
5-point harness systems - Group I	2008 study Basis: n = 123		2000 study Basis: n = 134		1995 study Basis: n = 62	
Harness slack in seat	53	43.1	79	59.0	21	33.9
Loose seat anchoring/vehicle seat belt not tightened	49	39.8	76	56.7	23	37.1
Incorrect belt bath	-	-	6	4.5	1	1.6
Shoulder strap outside shoulder area	3	2.4	5	3.7	1	1.6
Child too small for CRS (CRS not suitable for age of child)	1	0.8	3	2.2	3	4.8
Booster cushion + backrest - Group II - III	2008 study Basis: n = 91		2000 study Basis: n = 67			
Incorrectly adjusted sleep support (head position)	26	28.6	9	13.4		
Lap belt not positioned in guides	18	19.8	13	19.4		
Loose securing/vehicle seat belt not tightened	12	13.2	7	10.4		
Child too small for CRS (not suitable for age of child)	5	5.5	2	3.0		
Shoulder belt guide not used (sleep support)	5	5.5	6	9.0		
Shoulder belt routed under arm	2	2.2	-	-		
Booster cushion (backless) - Group II - III	2008 study Basis: n = 51		2000 study Basis: n = 67		1995 study Basis: n = 107	
Belt route allowing neck contact	14	27.5	16	23.9	16	15.0
Loose securing/vehicle seat belt not tightened	3	5.9	14	20.9	5	4.7
Lap belt not positioned in guides	19	37.3	12	17.9	16	15.0
Child too small for CRS (CRS not suitable for age of child)	1	2.0	3	4.5	6	5.6
Securing by means of lap belt	-	-	1	1.5	8	7.5
Shoulder belt routed under arm	3	5.9	-	-	10	9.3

Multiple entries possible

Table 17:
Forms of misuse for selected types of system; comparison of 2008/2000/1995 studies

Table 17 juxtaposes the most frequent and/or most serious forms of misuse observed for the three studies. Depending on the type of

system very different developments become apparent. Concerning the rearward-facing systems of Group 0/0+, the most serious forms

Reasons for incorrect fitting and securing	2008 study n = 183 = 100 %	2000 study n = 239 = 100 %	1995 study n = 216 = 100 %
Responses of those questioned	%	%	%
Unintentional mistake	50.3	47.7	11.9
Insufficient/incorrect information, lack of knowledge	43.2	14.6	41.3
Short distance/long distance	11.5	8.4	12.0
Intentional mistake	10.9	4.6	-
Technical cause	8.2	18.8	25.4
Time pressure	8.2	4.2	6.0
Clothing-related (change to thick/thin clothing)	7.1	12.6	-
Improving comfort of child	5.5	17.6	18.4
Resistance on part of child	5.5	4.6	7.5
Travelling with friends	2.7	2.5	-
Child secures itself	2.2	13.8	11.4
Second/unfamiliar car, change of car	2.2	7.5	14.0
Complicated fitting/securing	1.6	4.2	8.0
Several children in car	1.1	11.7	15.6
Swapping seats between children	1.1	2.1	-
Space shortage/luggage/people	-	3.3	13.4
Insufficient skill in dealing with child seats	-	-	8.0
Other reasons	3.8	3.3	6.1

Multiple entries possible

Table 18:
Factors cited by those questioned as decisive with regard to misuse; comparison of 2008/2000/1995 studies

of misuse, “incorrect belt path” and “incorrect fitting direction”, have markedly decreased over the past 13 years – a most encouraging trend. For the 5-point harness systems of Group I a continuously positive trend can be observed as well, at least since the 2000 study: for instance, the misuse form “harness slack in seat” has decreased by 16 percentage points and the misuse form “loose seat anchoring/vehicle seat belt not tightened”

from 57% to 40%. For the booster cushions with backrest of Group II-III no comparison is possible between the three studies because these seats were not yet on the market in a comparable form in 1995. However, between 2000 and 2008, it is clearly apparent that the frequency of the misuse form “incorrectly adjusted sleep support” has more than doubled. The very dangerous misuse form “shoulder belt routed under arm”, though being very

rare also in 2008, could yet be observed in two out of 91 cases. For the backless booster cushions of Group II-III both positive and negative trends became apparent: on the positive side, it could be observed that the misuse form “loose securing/vehicle seat belt not tightened” has greatly decreased between 2000 (20.9%) and 2008 (5.9%); on the other hand, “lap belt not positioned in guides” has more than doubled between 2000 and 2008. Like for the booster cushions with backrest, the very dangerous misuse form “shoulder belt routed under arm” could be observed here as well (three cases in total).

Reasons for incorrect securing: As already stated in Table 10, the reasons leading to incorrect fitting and securing are very diverse. Table 18 juxtaposes the reasons stated by the securing persons in the three studies. Although no homogeneous trend from “bad” towards “good” is apparent, there is a clear tendency towards the better for many reasons stated. In fact, the reasons stated for incorrect securing “technical cause”, “improving comfort of child”, “child secures itself” and “several children in car” were stated much less often than in the earlier studies.

However, there are negative observations as well: The reasons “unintentional mistake” (50.3% in 2008), “insufficient/incorrect information, lack of knowledge” (43.2%), “short distance/long distance” (11.5% in 2008), “intentional mistake” (10.9% in 2008) and “time pressure” (8.2% in 2008) have remained high over the years or have increased markedly. This means that the education of parents (the persons securing) is still of very high significance and that the efforts towards greater understanding of the correct securing of children in cars should not be reduced.

5 Short summary

The present study includes information about 324 children in 252 cars – 305 children were restrained in special child restraint systems. The high level of misuse noted in the surveys of 1995 and 2000, i.e. child seats being incorrectly fitted or children being incorrectly secured in the seats in approximately two thirds of cases, was repeated. However, the quality of securing had improved considerably, with the proportion of severe errors having decreased from 52.5% in 1995 to 20.9% in 2008.

This positive development is surely due to the technical advancement of CRSs – precisely in connection with ISOFIX – but also to improved education of securing persons. These common efforts must be maintained to further improve the protection of children in cars also in the future.

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System Overview - Classification according to ECE R 44

Group 0: up to 10 kg



Carry cot ①

Group I: 9 to 18 kg

Group 0/0+: up to 10/13 kg



Babyseat ②

Group I: 9 to 18 kg

Group 0/I: up to around 15 kg



Reboard seat ③

Group I-III: 9 to 36 kg



5-point harness system ④

Group II: 15 to 25 kg



Impact shield system ⑤

Group II-III: 15 to 36 kg



3-point belt system ②

Group II-III: 15 to 36 kg



Impact shield system ⑤



Booster cushion + backrest ②



Booster cushion (backless) ②

- ① own anchorage straps
- ② only on seats with three-point belt
- ③ on seats with three-point or lap belt plus additional belt/support
- ④ some systems also on seats with lap belt
- ⑤ also on seats with lap belt

Rearward-facing systems - Group 0 (n = 2; misuse rate = 50.0 %)			
Code	Fitting misuse	Rating	Number
017	Loose seat anchoring/vehicle seat belt not tightened	Slight	1
Code	Securing misuse	Rating	Number
025	Harness slack in seat	Moderate	1

Multiple entries possible

Rearward-facing systems - Group 0+ (n = 29; misuse rate = 51.7 %)			
Code	Fitting misuse	Rating	Number
001	Incorrect belt path	Severe	4
004	Incorrect fitting direction	Severe	2
	Loose seat anchoring/vehicle seat belt not tightened	Moderate	1
Code	Securing misuse	Rating	Number
025/026	Harness slack in seat	Slight (5) Moderate (4) Severe (4)	13
031	Shoulder strap lying outside the shoulder area	Severe	1

Multiple entries possible

Rearward-facing systems - Group 0/I (n = 1; misuse rate = 100.0 %)			
Code	Fitting misuse	Rating	Number
005	Vehicle seat belt not positioned in guides	Severe	1
011	Own anchoring method	Severe	1

Multiple entries possible

5-point harness systems - Group I (n = 123; misuse rate = 73.2 %)			
Code	Fitting misuse	Rating	Number
006/007/017	Loose seat anchoring/ vehicle seat belt not tightened	Slight (21) Moderate (23) Severe (5)	49
016/084	Belt clamping function not used	Moderate	14
008	Buckle of anchoring belt open	Severe	3
081	Buckle lies across seat frame (risk of breakage, „buckle crunch“)	Moderate	2
177	Top tether not used (US system, „flexible LATCH“)	Severe	2
005	Vehicle seat belt not positioned in guides	Moderate	1
040	Incorrect ECE Standard (R44/01, R44/02)	Severe	1
083	Incorrect anchoring/securing (3-point belt)	Severe	1
048	CRS fits poorly in vehicle and with belt geometry	No misuse	2
049	Belt webbing/stalks too long	No misuse	3
052	CRS has no belt clamping function	No misuse	1
053	Belt clip worn out/damaged	No misuse	1
054	Inadequate stability (lateral stability)	No misuse	2
Code	Securing misuse	Rating	Number
025/026	Harness slack in seat	Slight (16) Moderate (32) Severe (5)	53
027	Incorrect adjustment of straps to shoulder height	Slight (5) Moderate (18)	23
028	Harness twisted in seat	Slight	7
031	Shoulder strap lying outside the shoulder area	Severe	3
023	Child too big/too heavy for CRS (critical head position)	Moderate	1
074	Incorrect type of securing (incorrect belt system used)	Severe	1
085	Incorrectly threaded straps	Severe	1

Multiple entries possible

Impact shield systems - Group I (n = 3; misuse rate = 33.3 %)			
Code	Securing misuse	Rating	Number
094	Impact shield not used	Severe	1

3-point belt systems - Group I - III (n = 5; misuse rate = 80.0 %)			
Code	Securing misuse	Rating	Number
140	Incorrectly adjusted sleep support (head position)	Moderate	2
034	Shoulder belt routed beneath the arm	Severe	1
040	Incorrect ECE Standard (R44/01, R44/02)	Severe	1
110	Belt webbing guide worn out/damaged	Slight	1
133	Lap belt not positioned in guides	Moderate	1

Multiple entries possible

Booster cushions + brackrest - Group II-III (n = 91; misuse rate = 52.7 %)			
Code	Securing misuse	Rating	No.
140	Incorrectly adjusted sleep support (head position)	Slight (10) Moderate (16)	26
133	Lap belt not positioned in guides	Slight (9) Moderate (9)	18
032	Loose securing/vehicle seat belt not tightened	Slight (4) Moderate (8)	12
021	Child too small/too light for CRS (not suitable for age of child)	Severe	5
139	Shoulder strap guide not used (sleep support)	Moderate	5
033	Vehicle seat belts twisted	Slight	3
034	Shoulder belt routed beneath the arm	Severe	2
108	Incorrect shoulder strap route (too low/high)	Moderate	2
134	Belt route allowing neck contact	Moderate	1
049	Belt webbing/stalks too long	No misuse	1

Multiple entries possible

Booster cushions (backless) - Group II-III (n = 51; misuse rate = 60.8 %)			
Code	Securing misuse	Rating	No.
133	Lap belt not positioned in guides	Slight (4) Moderate (15)	19
134	Belt route allowing neck contact	Slight (1) Moderate (13)	14
108	Incorrect shoulder strap route (too low/high)	Slight (2) Moderate (2)	4
032	Loose securing/vehicle seat belt not tightened	Moderate	8
034	Shoulder belt routed beneath the arm	Severe	3
033	Vehicle seat belts twisted	Slight	2
040	Incorrect ECE Standard (R44/01, R44/02)	Severe	1
021	Child too small/too light for CRS (not suitable for age of child)	Severe	1
041	CRS damaged (broken)	Severe	1
138	Belt webbing holder (shoulder strap) not used	Slight	1
144	Unfavourable belt geometry with high lap belt route due to absent/insufficiently prominent lap belt guide	No misuse	8

Multiple entries possible



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