

# Misuse of Child restraint systems: Additional aspects of the 2017 GDV field study

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## INTRODUCTION

Many people these days are highly dependent on cars to get them where they want to be when they want to be there, and it goes without saying that they also want to take their children with them. The safety features of vehicles are designed for adult occupants. Consequently, special safety equipment has to be used for children (child restraint systems – CRSs).

The protection offered by child seats has improved constantly since they became mandatory in 1993. Although a wide range of different models are available, it can reasonably be said that even the simplest and cheapest seats offer adequate protection in theory. The main problem in connection with child seats is misuse. Studies have repeatedly shown that around two-thirds of all child seats are used incorrectly [1–5], which can considerably reduce or even nullify the protection they provide.

The misuse of child seats and the associated problems should therefore be continually examined. Since the last major field study conducted in Germany and elsewhere in Europe [5], circumstances have fundamentally changed. The ISOFIX system is now a statutory requirement for affixing the child seat to the vehicle, and new legislation on the approval of child seats (ECE-R 129) has come into force.

Consequently, the purpose and goal of this study of misuse is both to give a current picture of the use of child seats and to ascertain whether the action taken in the past to improve child safety in cars has been effective. In terms of its scope, this study sets a new benchmark. With over 1,000 cases examined, it is significantly more comprehensive than all previous field studies on this issue in Germany.

In additions to the main results that had already been published in the 2017 GDV study [1], this paper presents additional new aspects with regard to the use of child restraint systems.

## DESCRIPTION OF THE FIELD RESEARCH ON MISUSE

This research project examined the frequency and seriousness of misuse in reality. In addition, brief interviews were conducted with the drivers of the cars. Depending on the willingness of the person interviewed, an in-depth telephone interview was conducted as well.

## RESEARCH TOOLS

In order to learn as much as possible about all the interesting aspects of misuse, data was collected on the frequency, seriousness, etc. of misuse as well as on the underlying knowledge, attitudes and capabilities of the users. Two research tools were developed to record forms of misuse, the motives underlying them and relevant contextual conditions in the field. Both of these tools – an observation sheet and a questionnaire for the subsequent survey – are based on the hypotheses developed in the course of systematizing the causes of misuse in previous studies.

### OBSERVATION SHEET

The observations, which were recorded at various locations (e.g. supermarket, leisure facilities, kindergarten, school), focused on misuse. The observation sheet documented the weather conditions and location and had a total of four sections: information on the vehicle and occupants, information on the person interviewed, information on the child, child restraint system (CRS) and misuse and, lastly, questions about the misuse identified.

### FORMS OF MISUSE

Any deviation from the intended way of using a child restraint system that could reduce the level of protection offered is interpreted here as misuse or incorrect use. The check list (further) developed in the previous projects was used to record the misuse observed. The seriousness of the misuse (minor, moderate, serious) was rated a priori only for selected forms of misuse; all others were rated subsequently.

The code book has three sections. The possible types of error for Group 0/0+ seats are listed in the first section, the error types for Group 1 seats in the second section and the error types for Group 2/3 seats in the third section. This also applies to the seat models approved after ECE-R 129.

### QUESTIONNAIRE

The subsequent survey once misuse had been identified for all the children in the vehicle was designed to record contextual conditions, the reasons why people did what they did and action-related elements of knowledge. The questionnaire for the subsequent survey included questions about the purchase and fitting of the child seat and about securing the child in the child seat.

The observation and survey tools were subjected to preliminary tests in advance of the field research in order to check them against the criteria of consistency, comprehensibility and acceptance. Based on experience in previous studies, the observation and survey components were separated. As a result of the time it took the subjects to complete the survey (approx. 30 minutes) in previous studies, there were considerable problems getting them to accept it, and this cast doubt on whether the research could be completed. Consequently, a subsequent telephone survey very soon afterwards (i.e. two to three days later) was suggested to the subjects as an alternative to an on-the-spot survey.

### Conducting the field research

The field study was started following the successful conclusion of the preliminary tests at the end of June 2016 and completed in June 2017. The data collected was evenly distributed throughout this period (figure 1).

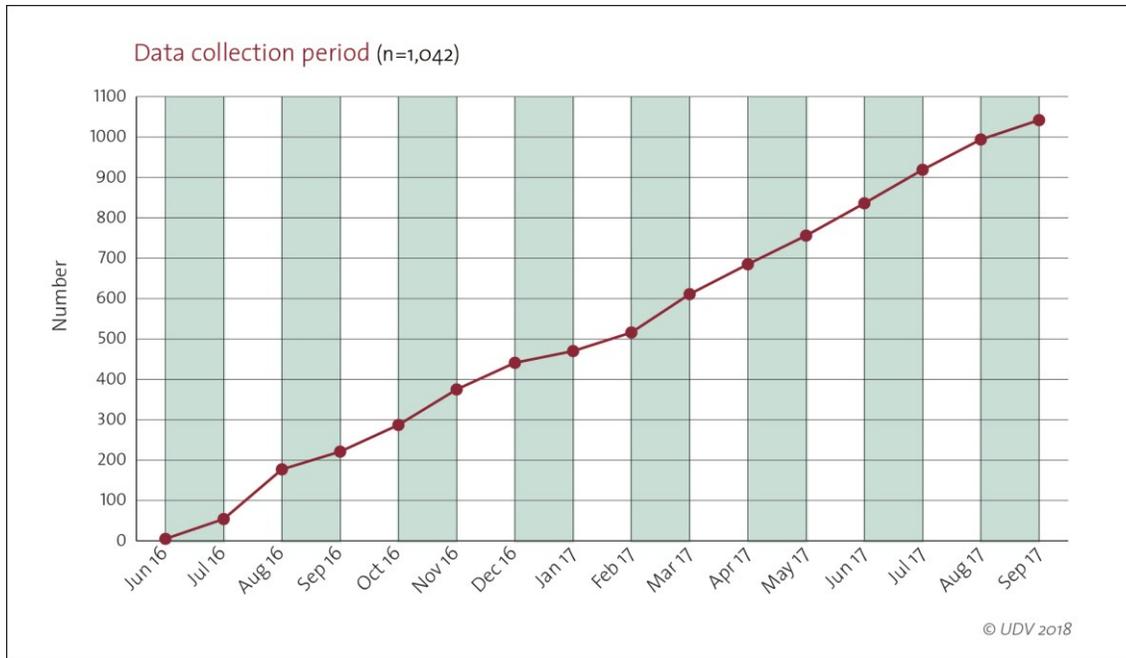


Figure 1: Research period

The securing or otherwise of a total of 1,076 children in cars was recorded. 1,042 of them were secured in a child seat, while 34 were not secured. The children were most often in Group 2/3 seats (n=472), followed by Group 1 seats (n=372) and Group 0/0+ seats (n=198). The study was conducted at selected locations in the greater Berlin and Munich areas. Figure 2 shows an overview of the survey locations. These included both urban areas and locations in the commuter belt as well as cities some distance away (e.g. Leipzig, Potsdam, Augsburg and Rosenheim). The selection of different locations ensured that different journey purposes were taken into account in the study (shopping, kindergarten and school runs, leisure).

The initial criterion for selecting the subjects was that people stopped at these locations at a given time and were driving with children aged up to 12 years old. The aim was to take a random sample and include all child restraint system types in the study. The drivers were generally approached by the observers, who then explained to them what the study was about. When the drivers declared that they were willing to take part, one of the observers collected the general information required by the observation sheet. At the same time, the second observer checked how well the children were secured in the child restraint system and how well the seat was secured to the vehicle. They then either conducted the survey on the spot for all the children in the vehicle or arranged a telephone appointment for the survey in the next few days. An average of 15 to 20 minutes per vehicle was required when the survey was conducted on the spot. This varied depending on the number of children secured in the vehicle.

Compared to previous studies, there were a significantly larger number of cases in the field research (figure 3). The large data set of 1,042 cases also permits a detailed analysis for specific lines of questioning, allowing reliable results to be obtained.

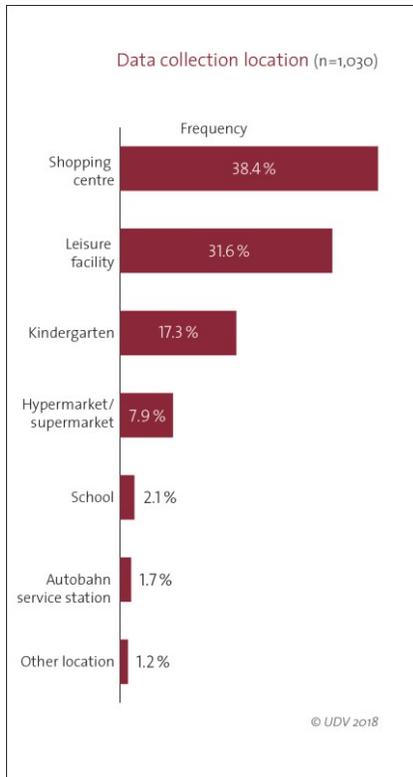


Figure 2: Location in the study

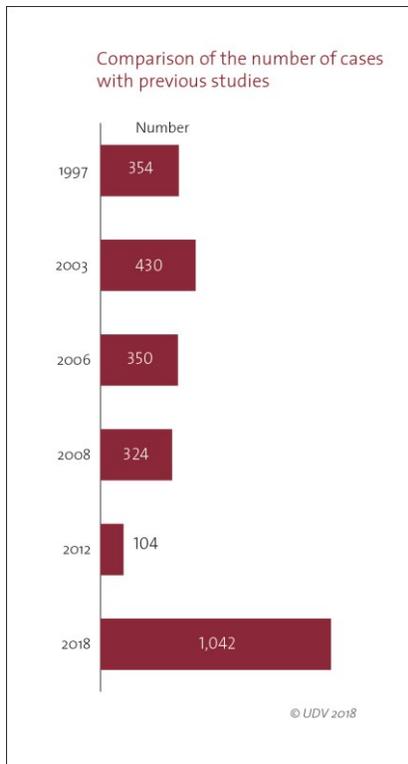


Figure 3: Comparison of the number of cases with previous studies [2–6]

## RESULTS OF THE FIELD RESEARCH

### ANALYSES REGARDING THE SWITCH TO THE NEXT HIGHER CRS GROUP

Previous studies have repeatedly shown that parents often switch too early to the next higher CRS group. This means that a change is already taking place although the child can still sit well in the current seat according to its height and weight. In some cases, the change takes place so early that the new CRS is not yet suitable for the child in accordance with its weight specification in ECE R-44.

The findings from a recent analysis [1] show a similar trend. Fortunately, this trend is less profound than in the earlier study (Figure 4). For a better understanding of this figure, it should be mentioned that this study had a low number of analyzed rearward facing child seats of Group 1. The number of seats that covered more than one CRS group was also very low. Therefore it can be assumed that the definitions for the different CRS stay the same: Group 0/0+ seats represent a baby shell, Group 1 describes a forward facing seat and Group 2/3 describes a booster seat with or without a seatback.

There were only a few cases with children weighing up to max. 8 kg who were seated in a Group 1 seat instead of being seated in a mandatory baby shell. In accordance with ECE-R 44, it is permissible to secure children weighing between 9 and 13 kg in a Group 1 seat. For this group, however, experts highly recommend the usage of a baby shell. Analyses of accidents involving small children with a body weight between 9 and 13 kg have repeatedly shown that rear facing seats offer a considerably better protection than forward facing seats [7]. For this weight group it could be observed that the majority of these children were seated in a Group 1 seat during the journey. According to the questionnaire, multiple reasons were named for switching to the next CRS group at that early stage. A frequently named reason was the fact that the child did not fit in the baby shell anymore. In these cases, the problem was less the height of the child and more the width of the baby shell in relation to the child's hip area. There is obviously a need for action in terms of adjusting baby shells in a way that they offer sufficient seating comfort even to children who weigh up to 13 kg.

It is also remarkable that within the weight group between 9 and 13 kg first cases were identified where the child was secured in a Group 2/3 seat. According to ECE-R44 this is not only forbidden but it also poses a danger to the child. Such a seat model is not suitable for adequately securing a child in the vehicle.

In accordance with Regulation ECE-R44, Group 2/3 seats are suitable for securing children with a body weight of 15 kg and more. Figure 4 shows clearly that this kind of protection was also the most frequent one found in the case material. In general, it is recommended to use a Group 1 seat as long as possible and to switch to the next CRS group as late as possible.

In the weight group above 18 kg, seats of Group 2/3 were used in almost all cases, as recommended.

Altogether it can be said that the problem of switching too early to the next higher CRS still exists, although the number of cases has decreased in comparison to earlier studies. However, the

situation can still be described as critical, especially when looking at the weight group between 9 and 13 kg.

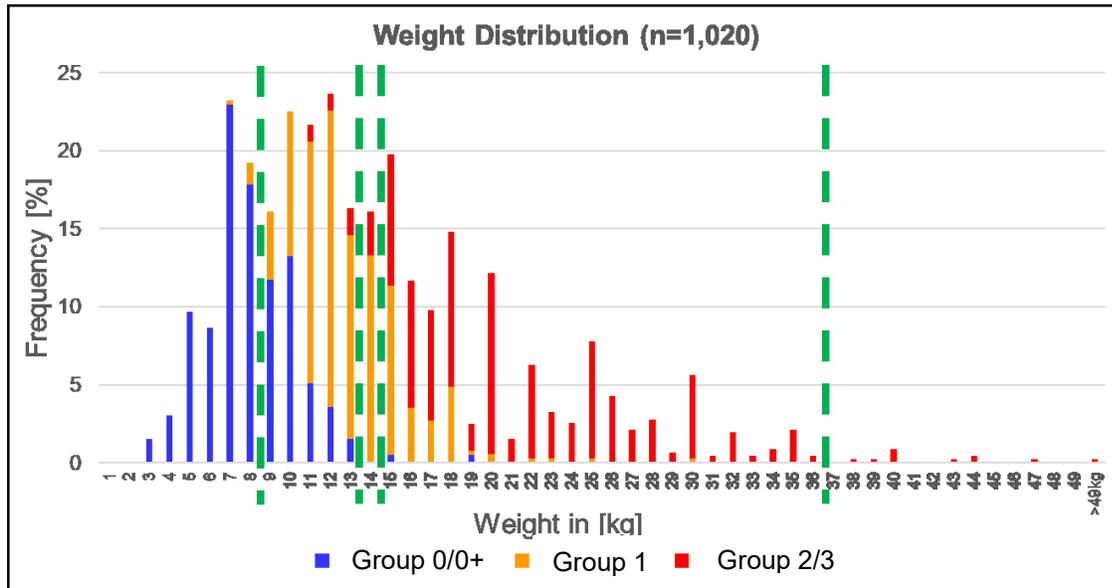


Figure 4: Weight Distribution compared with CRS-group

In the revised version of the ECE-R129 the classification of child restraint system groups is no longer based on the child’s weight. However, the rearward facing transportation of children with an age up to 15 months is an important requirement which is written down in this regulation. Figure 5 shows the distribution of the different groups of CRS broken down by the child’s age.

It can be observed that the majority of the children were seated in a Group 1 seat before they were 15 months old. But it should be mentioned again that most of the analyzed seats (98 %) had an ECE-R44 approval and therefore they were not necessarily designed for securing children younger than 15 months.

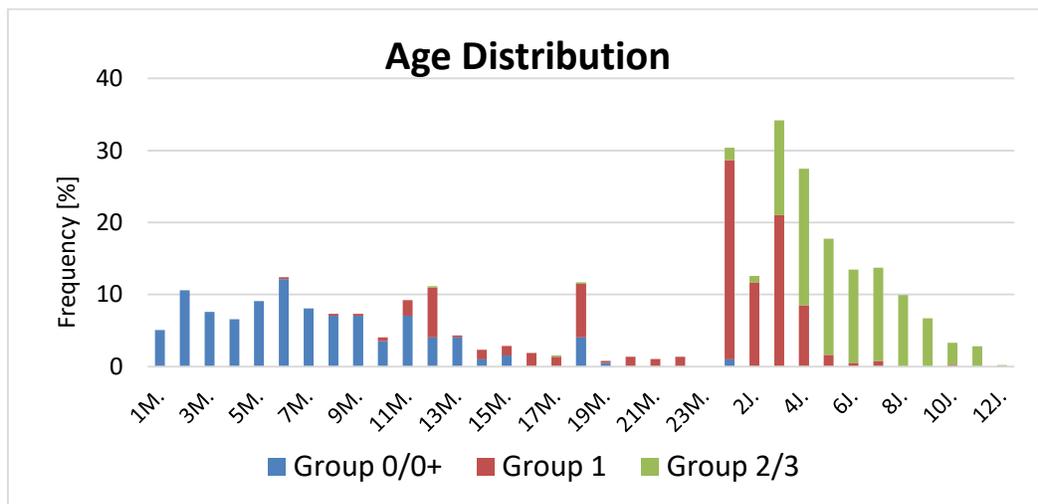


Figure 5: Age Distribution compared with CRS-group

## COMPARISON OF GROUP 1 SEATS WITH IMPACT SHIELD VS. INTEGRATED BELT SYSTEM

Approx. 20 % of the Group 1 seats analyzed in this study were fitted with an impact shield and 80 % were using an integrated belt system. Serious misuse could be repeatedly observed for seats with an impact shield during the analysis of the fitting quality. Sometimes, the impact shield was not used at all. In these cases, the child was seated in a Group 2/3 seat, i.e. it was using a completely inadequate seat in relation to its height. In other cases, the impact shield was used without applying the car's seat belt system. In consequence, the child was not secured (Figure 6).



Figure 6: Examples for misuse of shield systems

However, all these observations do not necessarily imply that the use of seats with an impact shield correlates with a higher misuse. Figure 7 shows a contrary picture.

The misuse rate is 36 % for seats with an impact shield and 55 % for seats with an integrated belt system. The comparison with regard to the seriousness of misuse shows no fundamental differences between the two systems (Figure 8).

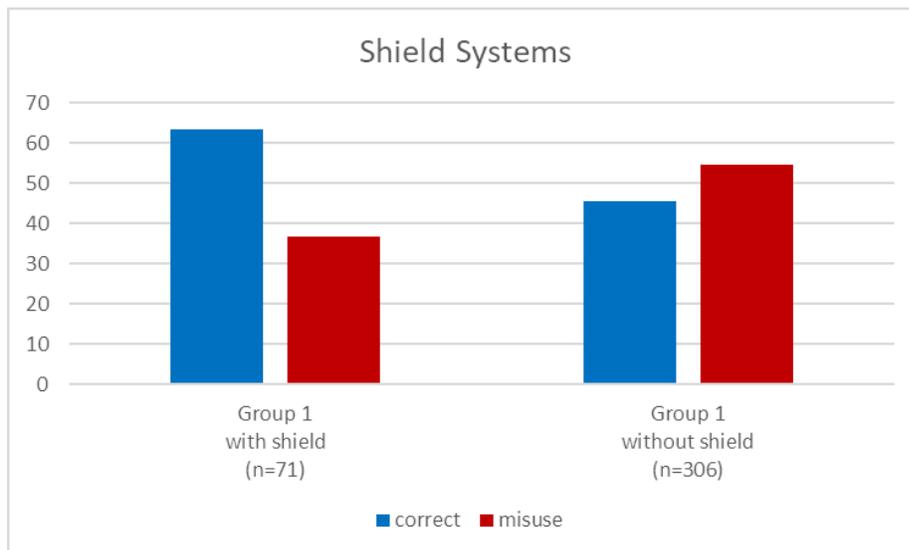


Figure 7: Misuse of shield systems

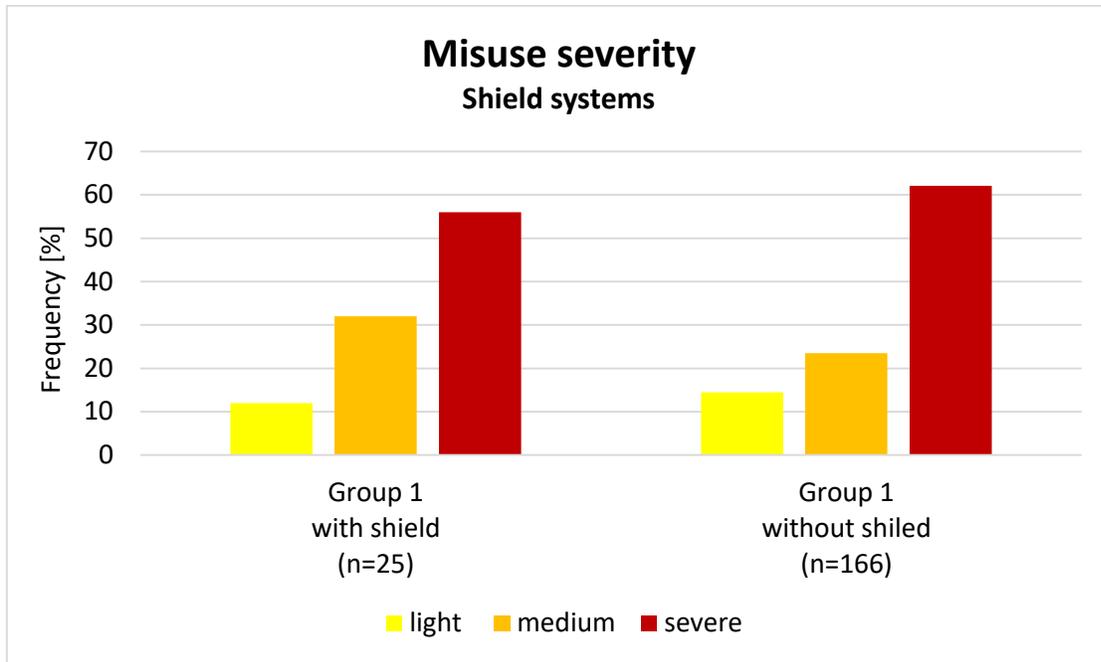


Figure 8: Misuse Severity of Shield Systems

These differences can be explained by the fact that a seat with an impact shield is less prone to fitting errors. This is because of its system design. Normally, child and seat are secured together with the car's belt. That means that the seat does not require a direct installation in the car and, in consequence, less errors can occur, like for example a wrong seat belt positioner or slack in the seat belt. Most of these errors can be reliably avoided by using ISOFIX, as shown in Figure 9. A comparison between different Group 1 seats shows a lower misuse rate for all ISOFIX seats, as expected. In this context, fewer misuse case were reported for seats with an integrated belt system than for seats with an impact shield.

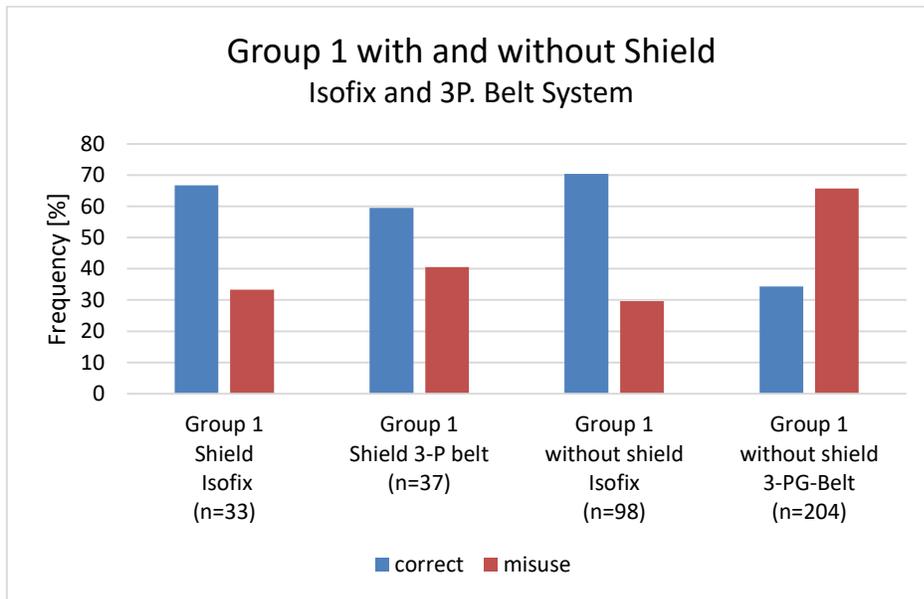


Figure 9: Misuse quote of group 1 CRS

## ADDITIONAL OBSERVATIONS FROM THE FIELD STUDY

A comparison between the height and the age of the children shows that the current legal regulation which describes the use of CRS for children not older than 12 years addresses quite well children with a height of 1.5 m. Very few children are taller and thus are exempt from the mandatory use of CRS (Figure 10).

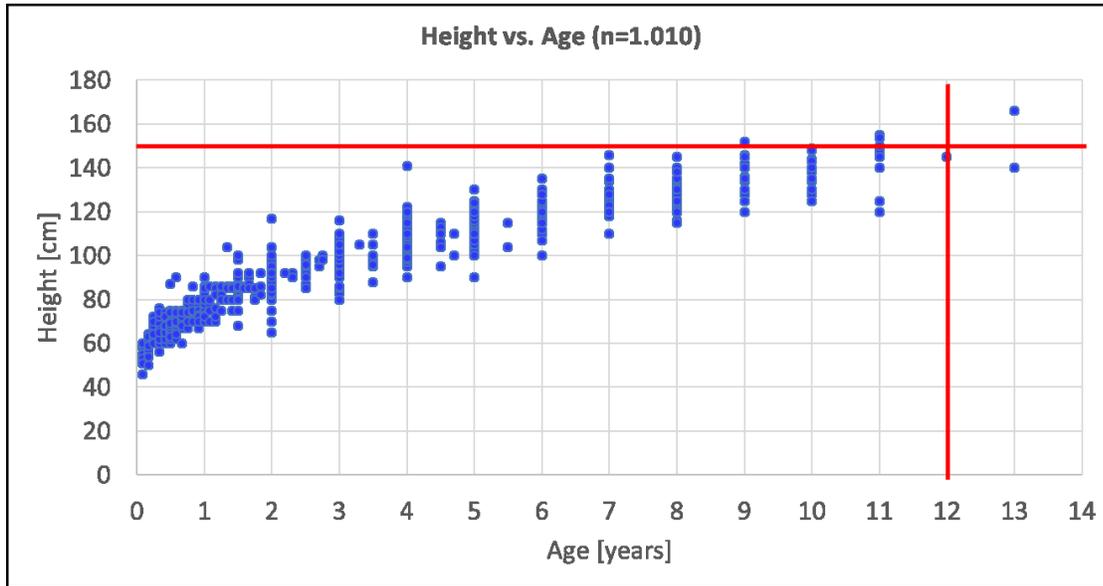


Figure 10: Comparison of Height and Age

The comparison between the age and the weight reveals a different picture. It shows that many children younger than 12 years have already exceeded a body weight of 36 kg, which is the upper limit of the body weight up to which child seats are licensed for (Figure 11). Generally speaking, the use of a Group 2/3 seat by heavy children is not a problem. Nevertheless, parents still might become insecure in this matter. FAQs to the authors of this paper confirm it.

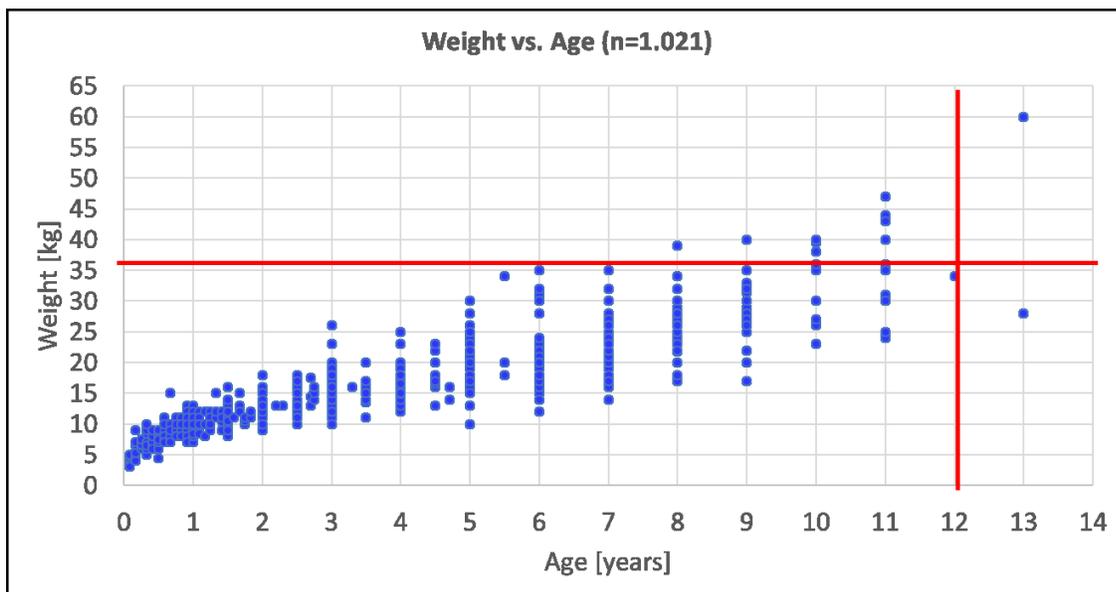


Figure 11 Comparison of Weight and Age

Unfortunately it could also be observed in the field study that baby shells were sometimes fitted in the driving direction. These cases make up 4 % of all analyzed baby shells (Figure 12, 13).

The passenger airbag was often not disabled, even though there was a baby shell mounted on the passenger`s seat. This could be observed in almost 15 % of the cases (Figure 14). This fitting error could have led to very serious injuries in case of an accident [8].

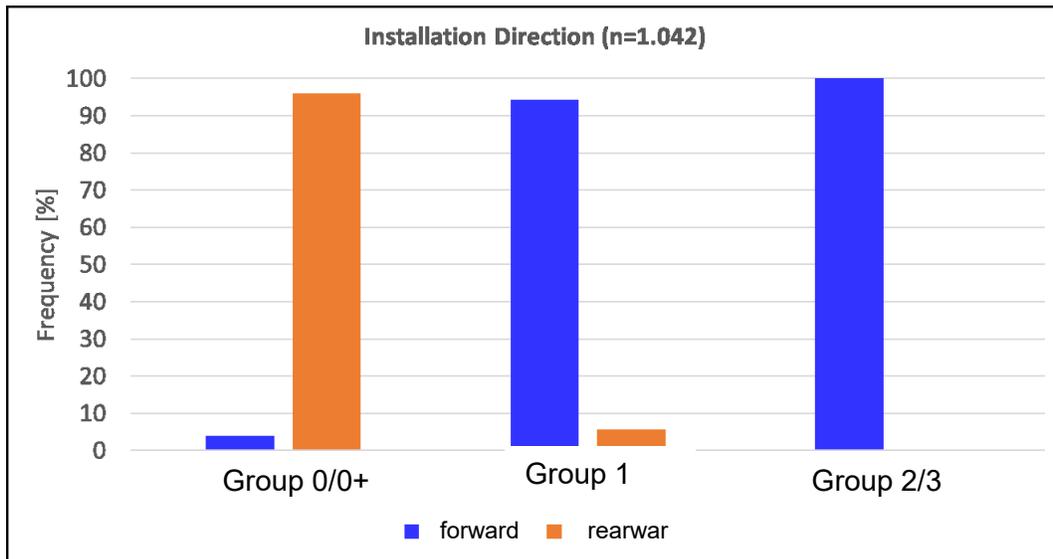


Figure 12: Installation Direction depending on CRS-group



Figure 13: Forward facing Baby shell

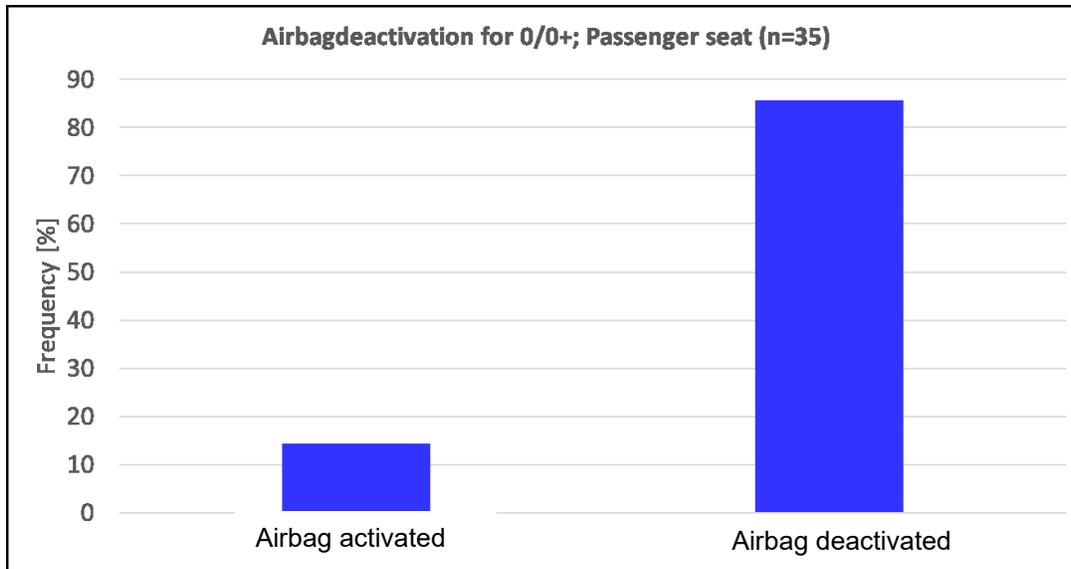


Figure 14: Airbag deactivation on Passenger Seat

## DISCUSSIONS

Based on the empirical results of the previous studies referred to above, systematic recommendations and demands have been made to those with key responsibility for the safety of children in cars. A number of these recommendations have been implemented over the years, and they have undoubtedly contributed to the reduction in the misuse rate found in this study. Nevertheless, some recommendations for dealing with the problem of misuse have not, or not yet, been implemented. These can be found in the GDV study from 2017 [1]. Furthermore, additional findings are stated below:

The interviewees often reported a lack of incompatibility between the width of baby shells and the child's hip area when the child exceeds a certain weight. It is therefore recommended to take measures in terms of adjusting these CRS in a way that they offer sufficient seating comfort even to children who weigh up to 13 kg. This will prevent parents from an unnecessarily early switch to the next CRS group. In this respect, the instruction videos should include recommendations to the parents in terms of using the adequate child seat as long as possible and to switch to the next CRS group as late as possible.

Children younger than 12 years often exceed a body weight of 36 kg, which is the upper limit of the body weight up to which child seats are licensed for. On the other hand, the use of CRS w.r.t. children not older than 12 years and with a height of not more than 1.5 m is quite well addressed by the current legislation. Very few children are taller and thus are exempt from the mandatory use of CRS

The comparison between shield systems and systems with integrated harness shows for Group 1 seats that for seats, which are installed in the car with the vehicle belt, systems with an shield are less prone to misuse than harness systems. However, the comparison of both systems when installed with ISOFIX shows, the shield systems tend to be more endangered for the occurrence of misuse.

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