National roadside survey of child restraint system use in Belgium

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Abstract

In September 2011 the Belgian Road Safety Institute (BRSI) conducted its first roadside survey of child restraint system (CRS) use and misuse. The aim of this study was to observe in real traffic conditions how children are restrained, to measure the rate of use and misuse of CRS, and to evaluate the main reasons for misuse.

The sample consisted of 1,461 children (under 135 cm) for whom the conditions of restraint were observed in detail and the driver was interviewed. The survey was conducted on randomly selected sites across the country and represented various types of journeys. Numerous parameters were analyzed: the characteristics of the children and the car drivers, type of journey, types of CRS and types of misuse.

At least 50% of the children were not correctly restrained and 10% were not restrained at all. Various factors influenced the CRS use. The most significant ones were the use of a seatbelt by the driver, awareness of road hazards by the driver, whether advice was provided in the CRS selling points and the length and frequency of the trip. The drivers minimized inappropriate use and/or misuse of the CRS and were rarely aware of their own errors. Moreover, the ISOFIX system reduced significantly misuses regarding the installation of the devices.

All together these results confirm the need to continue to inform the population on the necessity of correctly using the appropriate CRS to improve child safety and to enforce CRS use in Belgium.

Keywords: Child restraint system (CRS), CRS use, CRS misuse, unrestrained, inappropriate CRS use, ISOFIX, roadside survey

1. Introduction

In 2010 nearly 1,550 children aged between 0 and 10 years were involved in an injury accident as car passengers in Belgium. 71 of them were killed (4) or severely injured (67) in 1204 road accidents (source: Belgian Federal Public Service Economy DG SEI / BRSI). According to the national road safety survey conducted by the Belgian Road Safety Institute (BRSI) in 2009, 81% of the drivers declared that they always transported children safely while 7% confessed that they never or rarely restrained children in car.

Based on real-world crash data and recent field studies, the effectiveness of a child restraint system (CRS) is significantly dependent on the correct installation of the device in the vehicle, the correct securing of the child in the seat, and the use of an appropriate CRS. Results of studies have scientifically confirmed that incorrect and/or inappropriate fitment and use of restraints may reduce or nullify safety benefits and are sources of a higher risk of fatal or severe injuries for children. This rate depends on the type of CRS and the duration of the trip (Brown and Bilston, 2007; Brown et al., 2006; Brown et al., 2010; CASPER; CEDRE; Decina, 2005; Kahane, 1986; Lalande et al. 2003; Lesire et al., 2007).

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In September 2011 the BRSI conducted its first roadside survey of child restraint system (CRS) use and misuse. The aim of this study was to observe in real traffic conditions how children are restrained, to investigate the incidence misuse and/or inappropriate use of CRS, and to evaluate the main reasons for misuse. This study was run in partnership with the European project CASPER.

2. Methodology

2.1. The child restraints regulation in Belgium

In Belgium the use of seatbelts is compulsory for all vehicle occupants. Since 2006, the Belgian traffic law for children transport specifies that the under-eighteens smaller than 135 cm must travel in an adapted child restraint device. They can travel either in the front seat or in the rear if they are seated in an approved CRS conformed to the latest European standards: ECE R44/03 or R44/04. There are exceptions to the main rule (code de la route).

2.2. Definitions

In accordance with the Belgian traffic law, the study considers any person under the age of 18 and smaller than 135 cm as a child. The targeted vehicles are those carrying at least one child likely to be transported in a suitable CRS.

A child is considered as unrestrained when no restraint system is used (just sitting on the seat, sitting on the lap of another passenger, standing ...) or the CRS on which he is installed is not attached to the vehicle or the child is sitting in a CRS attached to the vehicle without the harness buckled.

Inappropriate use is manifest when children are not restrained accordingly to their height, age or weight. It could be a child restrained only by the seatbelt instead of using a CRS. Inappropriate use also includes the use of a CRS that is not corresponding to ECE R44. In Belgium, the seatbelt is considered as appropriate use for short trips when the child is older than 3 years and transported in a car with no parental links with the driver.

Misuse of a CRS means improper use of it considering the recommendations outlined in the instruction manual. The misuse detection requires an in-depth investigation and a good knowledge of CRS. It's possible to observe several misuses on the same device. Misuse can take different forms: incorrect fitting of the CRS in the vehicle (e.g. wrong routing of seatbelt), unauthorized seating position (e.g. forward facing for rearward facing device, active frontal airbag), incorrect restraining of the child in the restraint device (e.g. slack in harness system, seatbelt under the arm). A grid of the 6 major misuses per type of CRS was drawn up thanks to literature and CASPER project feedback, in order to facilitate the fieldwork of the observers.

A child is considered as correctly restrained when he is installed in an appropriate CRS without any misuse.

2.3. The sampling design

Observational surveys are the most common method used to assess restraint use (Decina, 2005; Snowdon, 2010; CEDRE; CASPER; NHTSA). There are two main methodologies for the data collection. The first one consists in trained observers stationed at roadsides in intersections (NHTSA, 2009a; NHTSA, 2010). The concern with this type of survey methodology is that child restraints are more complicated to assess quickly in a driving situation. Therefore it is inadequate for our objectives. The second one is a CRS inspection combined with a short interview of the driver conducted within a sample of selected locations by trained observers (NHTSA, 2009b).

The survey consists in investigating the conditions of child restraint in detail and conducting the driver interview. It is based on the voluntary participation of the drivers transporting children. The observations took place in randomly selected sites across the country and represented various types of journeys. The methodology and the form used make the results comparable with those of the CASPER project as the definitions, and the collected data are similar.
Sampling was carried out in several stages:

1) Stratification by region (Brussels, Flanders and Wallonia).
2) 4 investigating teams: 2 in Brussels, 1 in Flanders, 1 in Wallonia
3) For each region (Flanders and Wallonia), a random sample with replacement of 20 municipalities weighted by population was conducted. In the Brussels region, the 40 draws were randomly done from the 19 municipalities without weighting.
4) For a wide range of travel situations and times of the week, 20 sites of observations have been identified per team. Each site, corresponding to a type of journey, was visited once:
   - 8 primary schools (weekday afternoon)
   - 4 maternity hospitals (weekday morning)
   - 3 shopping areas (Saturday afternoon)
   - 3 recreational areas (Sunday afternoon)
   - 2 sport centres (Wednesday afternoon)
5) The assignment of the types of situation in each municipality was more or less randomly within the constraints of site traffic (day of the week and time) and the geographical coordination of the investigators on the same day. The selected sites were obtained randomly radiating in and/or around the selected municipality.

This area classification of data allows producing representative results regarding child safety.

2.4. Variables

The questionnaire and the investigators training session were designed to make the results comparable to other international misuse studies. This work was carried out in partnership with the CASPER project. Numerous parameters were collected in a standardized form for the analysis.

Socio-demographical variables about drivers and children: age, weight and height of the child. For the driver: age, education level, living place, link with transported children, type and age of the vehicle.

Explaining variables: travel duration and/or distance, restraint use of the driver, type of site, CRS purchasing place, experience and difficulties in using the CRS, number of children in the vehicle, seating position of the child, type of CRS (if restrained), reasons to explain observed misuses. For each child restraint use or misuse was recorded as well as the appropriateness of this usage (CRS used appropriately according to the age, weight or height of the child).

2.5. The data collection

16 trained students were required to collect the data. Observers worked as a duo: one interviewing the drivers, the other one checking in the meantime how children were restrained in the vehicle. Prior to performing the survey, the investigators participated in a full day training session. It included both classroom instruction to familiarize them with the interview method, safety procedures, types of CRS linked with the various misuses they may encounter in the survey, and a hands-on in-vehicle instruction on child restraint systems use and misuse.

The data were collected between the 3rd September and the 18th September 2011. We obtained an aggregate sample of 80 observation sites spread over Belgium (50% in Brussels). 1,674 vehicles carrying at least one child passenger (smaller than 135 cm) and 2,555 children were observed.

2.6. Data statistical analysis

The distribution of children included was weighted according to region, age, height and frequency of different types of journey (source: Belgian Federal Public Service Economy). According to the growth curves, 80% of the 8-year-old children, 50% of the 9-year-old children, 20% of the 10-year-old children and 5% of the 11-year-old children are less than 135 cm.

Using the Intercooled Stata 9.2 software, weighted point estimates, standard errors, 95%-confidence intervals, the adjusted Wald test and p-values were calculated, taking into account the complex sampling design. For the analysis, the Stata procedure survey (svy) was used with defined primary sampling unit (PSU): team, region, date, type of site and strata: region, type of site.
3. Results

The final sample consisted of 1,461 children (under 135 cm and transported in 924 vehicles) for whom the conditions of restraint were observed in detail, the driver interviewed and with complete data to apply weighting factors (children's age and size).

47% of children were observed during weekend activities (shopping and recreational areas), 35% at the school gate, 12% in sport centres and 6% in maternity hospital.

Drivers' characteristics

The drivers are the parents of the children transported in 86% of cases. 53% of drivers are women. The average age of drivers is 38 years and the median age is 37 years. 4% of drivers under 25 years, 41% between 26 and 35 years, 40% between 36 and 45 years and 15% over 45 years.

83% of the drivers are restrained. This result is quite similar to that obtained in roadside surveys (BRSI, 2011).

Regarding the level of education, 63% of drivers reported having a higher level of education and 28% a secondary level. The very high proportion of the higher level of education compared to national data shows an overrepresentation of this group in our sample (source: http://statbel.fgov.be/).

43% of drivers live in a large city, 33% in a small town, 22% in a village and 2% in rural area. In addition 74% of them reported living in a house versus 26% in apartments.

Children's characteristics

52% of children observed were boys. The average age of children was 4.1 years and the median age was 4 years. Children older than 7 years are underrepresented (table 1). This is explained by the methodology of data collection used where observers had to stop vehicles carrying children supposed to be less than 135 cm. Few children younger than 2 years were observed. This can be explained by a less frequent use of the car or unsuitable selected sites to observe them.

92% of children observed were seated in the rear row and 8% in the passenger front seat.

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Percent (raw data)</th>
<th>Percent (weighted data)</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>8.5%</td>
<td>11.7%</td>
</tr>
<tr>
<td>1</td>
<td>8.1%</td>
<td>10.5%</td>
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<tr>
<td>2</td>
<td>9.7%</td>
<td>10.8%</td>
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<tr>
<td>3</td>
<td>15.1%</td>
<td>11.0%</td>
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<tr>
<td>4</td>
<td>13.4%</td>
<td>10.9%</td>
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<tr>
<td>5</td>
<td>13.1%</td>
<td>10.6%</td>
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<td>6</td>
<td>12.3%</td>
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<td>7</td>
<td>9.9%</td>
<td>10.7%</td>
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<td>8</td>
<td>6.0%</td>
<td>7.4%</td>
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<td>9</td>
<td>2.7%</td>
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<tr>
<td>10</td>
<td>1.2%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
<td>100.0%</td>
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</table>

CRS' characteristics

Table 2 shows the distribution of children per types of restraint system. 79% of the children are seated in a CRS, 11% are only restrained by the seatbelt and 10% are not restrained at all. Rearward facing CRS have a relatively low frequency (8.5% combined) compared to other types of restraint. This is mainly because they are not used for a long time compared to other systems. Forward facing CRS and boosters (with backrest or cushion) represent each more than 20% of observed CRS. Carrycots, shield forward facing CRS and integrated systems were rarely observed. Indeed, these devices are not widespread.
84% of CRS were bought new and 12% second-hand. 60% of CRS were purchased in a specialized shop and 27% in a supermarket.

<table>
<thead>
<tr>
<th>Table 2: Distribution of children per type of restraint system (n=1,461)</th>
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</thead>
<tbody>
<tr>
<td>Type of restraint system</td>
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<tr>
<td>--------------------------</td>
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<tr>
<td></td>
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<tr>
<td>Carrycot</td>
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<tr>
<td>Rearward facing CRS</td>
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<tr>
<td>Forward facing CRS</td>
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<tr>
<td>Shield forward facing CRS</td>
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<tr>
<td>Booster with backrest</td>
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<tr>
<td>Booster cushion</td>
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<tr>
<td>Integrated system</td>
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<tr>
<td>seatbelt</td>
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<tr>
<td>unrestrained</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

Misuse of CRS

Figure 1 shows the distribution of children according to the quality use of restraint systems. In the sample, at least 48% of children are not correctly restrained (transported in an appropriate CRS with misuse or in an inappropriate device with or without misuse or not restrained at all). The rate of children improperly restrained (at least one misuse found, regardless of the appropriateness of the system) is 29%. Misuses were mainly observed in the appropriate restraint systems. However, if the system used is appropriate, 32% of children are improperly restrained versus 36% for inappropriate devices.

Quality use of restraint systems regarding type of devices

The average rate of misuse in the weighted sample is 29% and 52% of children are correctly restrained. These results differ regarding the type of restraint system. For rearward facing CRS and forward facing CRS approximately 1 child out of 4 is not correctly restrained versus 1 child out of 2 for booster seats (with or without backrest) and 3 children out of 4 for those only restrained by the seatbelt (Figure 2).
Quality use of restraint systems regarding purchasing place

60% of CRS were bought in a specialized shop and 27% in a supermarket. The analysis reveals that children installed in a CRS bought in specialized shop have a significantly lower rate of misuse compared with those purchased in a supermarket 27% versus 45% (p<0.001).

Quality use of restraint systems regarding observation sites

Figure 3 shows that the type of site has no influence on the rate of children being transported in an appropriate CRS (with or without misuse). However, it has an influence on the rate of unrestrained children (F (4, 55) =5.71, p <0.001) and the rate of children being transported in an inappropriate system with or without misuse (F (4, 55), p<0.01).

Sites with the highest rate of unrestrained children are schools (13%), shopping areas (9%) and sports centres (7%). Sites with the highest rate of children in an inappropriate device (with or without misuse) are recreational areas (19%) and shopping areas (17%).

Journeys offering the lower levels of safety for children are those to/from maternity hospitals, schools and shopping areas. However, trips to/from recreational areas are those in which children have the highest safety level. These results could be explained by the hypothesis that the length and frequency of the travel (travel not regular for leisure versus short and regular trips such as school) would determine the quality of the CRS use and the attention of parents for safety.

Quality use of restraint systems regarding the use of the seatbelt by the driver

Unbelted drivers have a significantly higher rate of unrestrained children than belted drivers with 31% versus 7% (F (1, 58) =7.40, p<0.01). Similarly, the rate of children correctly restrained was significantly lower for drivers unbelted compared to belted ones with 32% versus 54% (F (1, 58) =12.84, p<0.001). However, for the other quality uses there is no safety impact on child safety (Figure 4).
Quality use of restraint systems regarding the fixation system of the CRS

In the sample, 76 children were restrained in an ISOFIX CRS (7% of CRS observed). The comparison between the ISOFIX CRS and non-ISOFIX CRS (figure 5) reveals that the proportion of children correctly restrained is significantly higher for those installed in ISOFIX CRS (80% versus 60%) \((F(1, 58) = 14.99, p<0.001)\). Similarly, ISOFIX devices significantly reduce the rate of children not correctly restrained (CRS appropriate or not), with 6% versus 34% for conventional devices \((p<0.001)\).

![Figure 5: Distribution of children according to the quality use of restraint systems per CRS’ type of fixation ISOFIX/non-ISOFIX (n=1,106)](image)

**4. Discussion**

Investigators faced several challenges such as:

- Selecting vehicles carrying children expected to be smaller than 135 cm: children older than 7 years are underrepresented. It was easier for investigators to stop vehicles carrying younger children to ensure their inclusion in the study, thereby limiting canvassing.
- Stopping vehicles and convincing drivers to participate without the cooperation of the police.
- Overcoming the reluctance of drivers to allow observers to inspect the installation of children in restraining systems.
- Observing babies out of maternity hospitals: small numbers, busy parents.

In addition, one of the main limits is based on the variability of coding type of misuse among investigators. Investigators seem to have collected the main obvious misuses (safety belt under the arm or in the back, devices installed in the wrong direction ...), missing out on those requiring more detailed observation (slack in the harness, front passenger airbag not disabled ...). Consequently, we suspect an underregistration of misuses. The training session, even during a whole day, was not long enough to fully familiarize students with all aspects of the investigation. Moreover, motivation, interest and commitment of students in the investigation were probably decisive factors in the quality of data collected.

**5. Conclusion**

This survey is the first qualitative overview of child safety and restraint conditions conducted in Belgium. Key figures to retain are:

- 7 children out of 10 are restrained in an appropriate device (with or without misuse)
- At least 1 child out of 2 is not correctly restrained in Belgium
- 1 child out of 10 is not restrained at all

Explaining factors for child safety are:

- Belted driver,
- Purchasing the CRS in a specialized shop and receiving advices,
- The length and the frequency of the trip,
- The attention of parents/drivers to correctly restrain children and fix CRS.

The ISOFIX CRS significantly reduce the rate of misuse compared to non-ISOFIX devices.
Conducting regularly such measures allows us to assess the evolution of road users’ behaviour (drivers and children) regarding restraint systems and their real use.

The new challenges are to educate and inform parents/drivers and children on the importance of being correctly restrained in an appropriate CRS; to enforce police controls to radically change bad behavior. Improving the children’s safety cannot succeed without a strong and consistent political policy.

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