Swedish viewpoints on the ’centilong’ classification

Swedish CRS expert group, involving:

Swedish Road Administration, Volvo Car Corporation, Saab Automobile, Chalmers, Autoliv, Folksam, VTI, SIS

Contents

1. Swedish figures regarding stature and weight relationships to age, from newborn to 12 years old
2. Studies of rearward facing travelling, in age groups
3. Conclusions regarding desirable centilong classification
4. Comments on the centilong proposal from NL presented at the 6th informal meeting, 7 Oct 2008*

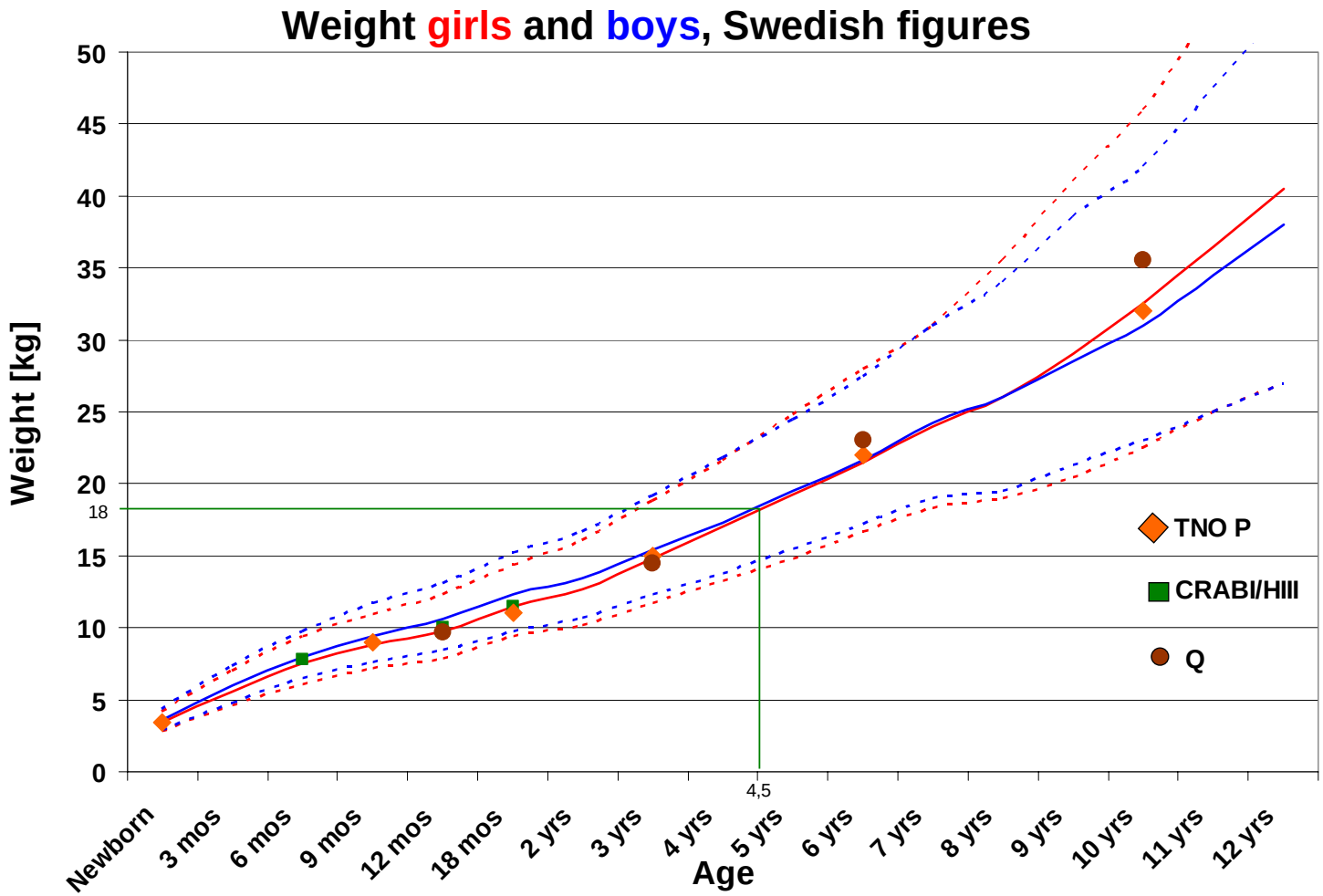
Attachments:

- VTI report ”Sizing a CRS by stature rather than weight?”
- Folksam report ”How are small children seated in vehicles?”

*) Not yet assigned a document number. NL classification proposal also reflected in the meeting report.

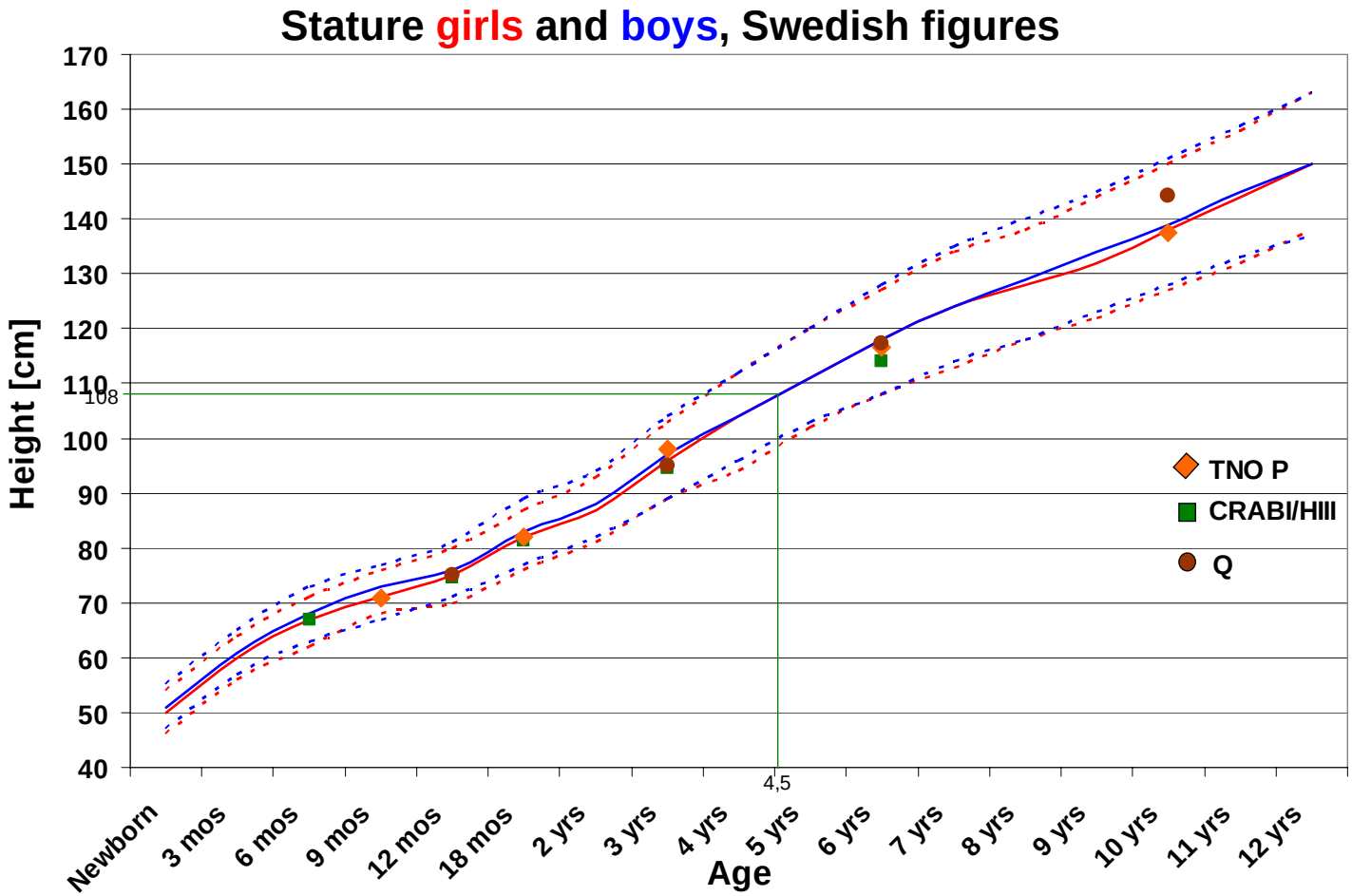
Mass as a function of age (median, 5 and 95 percentile)

Source: VTI report (attached, also included in EEVC/WG 18 report)



Stature as a function of age (median, 5 and 95 percentile)

Source: VTI report (attached, also included in EEVC/WG 18 report)

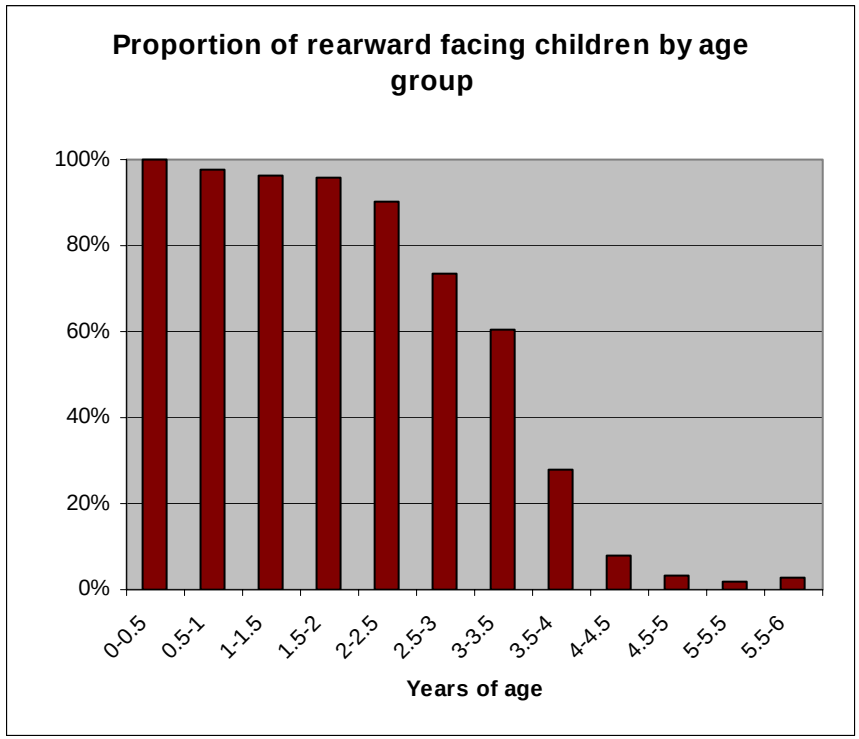


Observations/conclusions

- The upper limit for the current ECE Group 1 (18 kg), corresponds to a median age of 4,5 years (span from 3 to 6 years)
- The corresponding stature (Swedish data) is
  - median: appr. 108 cm
  - 5 percentile: appr. 98 cm
  - 95 percentile: appr. 115 cm
- These values match the CANDAT data well, e.g.:
  median for an 18 kg child is 4,5 – 5 years old, stature is 107-110 cm

Folksam study of rearward facing travelling in Sweden

(For more information, see attached excerpts of the report)



Main conclusions:

- Age 3 – 3,5 years: 60 % travelling rearward facing
- Age 3,5 - 4 years: 28 % travelling rearward facing
- Age 4 – 4,5 years: 8 % travelling rearward facing
- A few children of age 5,5 years are still rearward facing (!)

Comment to the NL contribution on conversion to ”Centilong groups”

- According to the NL proposal, the Centilong Group corresponding to ECE Group 1 (the largest group allowed with integral belts) is suggested to be in the range of 74 – 98 cm.
- This upper limit corresponds however to a child mass of only 15 kg, or the actual mass of a P3/Q3 dummy.
- The current ECE Group 1 limit is 18 kg, corresponding to a median stature of approximately 108 cm.
- 60 % of children 3 - 3,5 YO and 28 % of children 3,5 - 4 YO travel rearward facing in Sweden; their statures are up to approximately 108 cm. The restraint class must include these children as well.
- Consequently, the Swedish opinion is that the new ”integral centilong class” must cover a stature of at least 108 cm.

Attachments

- VTI report ”Sizing a CRS by stature rather than weight?”
- Folksam report ”How are small children seated in vehicles?”

Swedish National Road and Transport Research Institute
Crash Safety
Ylva Matstoms

2003-02-06

Sizing a CRS by stature rather than weight?

Discussion paper for EEVC WG18

Introduction

For marketing reasons, it has become popular among manufacturers to have a very wide weight interval for child restraints. Unfortunately there is no need for the dummy to actually fit into the seat. The test regulations are such that the integral harness is allowed to disappear well beneth the shoulders and the centre of gravity of the head may be well above the seat back. The chest measurements are not affected and the product will pass the test. Today, it is not uncommon that the largest dummy used to test the seat does not fit according to the manual. On top of that, a few extra kg:s are added to the largest dummy to get the seat maximum weight.

Figure 1. The P6 dummy does not fit into this group 2 seat. The P1,5 does not fit into this group 0+ seat either.

The instructions manual requires a correct installation of the child into the child restraint. In practice a child will often have to be considerably overweight to actually

reach the upper weight limit of the seat. Since the only information the parents have when they buy the seat is the weight limits they will feel mislead when the seat is outgrown much earlier than expected. It is also important that the seat type reflects the needs of the child. A newborn baby needs a lot of support but a one year old prefers an upright position. A first time parent often have difficulties to foresee that that their tiny frail little sleeping baby will be sitting without support half a year later. One of the basic ideas with the 0+ seats is to make sure that it is possible to have the child rearward facing during the first year. In practice, this is often not possible with a seat that only allows a baby inclination. The one-year-old toddler is simply too uncomfortable in the inclined position. A 0+ seat needs to be rather upright or have more than one possible inclination to be useful for the one year old.

Figure 2. William 18 months 10,5 kg should fit nicely into this 0+ seat (up to 13 kgs). William is far too tall to use this seat and he definitely prefers to sit upright.

Using the stature of the child rather than the weight will solve the problem that the seat is outgrown much earlier than expected. Children within the same age group also tend to vary less by height than by weight. The risk of misuse is also smaller if stature is used. The sizes of childrens clothing are often given in centimeters (stature of the child). If the child restraints are marked with stature sizes it is very easy for the parents to make sure that they are using the restraint properly. Today parents must remember how much of the head is allowed to be over the seat back and how the integral harness should fit the shoulders. Since most children are fairly proportional it is possible to give stature intervals for each pair of slots in the seat back as well as a maximum stature for the seat.

Dummies vs. children

The dummies are representative for normal sized children both in height and weight. There is no need for new dummies if stature is used instead of weight. The diagrams show the size of various dummies (dots) vs. the size of children (lines). Unbroken lines represent the 50-percentile children and 5-percentile and 95-percentile are represented by dotted lines. Girls are drawn in red and boys in blue colour.

The height is a good measurement also because most children will follow their “curve” rather well after a few months. This is not entirely true for babies that are

premature (born early) or born very small (multiple births for example). In most cases, however, the parents will have a good prediction from early on if they need a seat for a tall child or not. Since a high rearward facing seat can be more difficult to fit into a car the larger seat will not automatically suit all families.

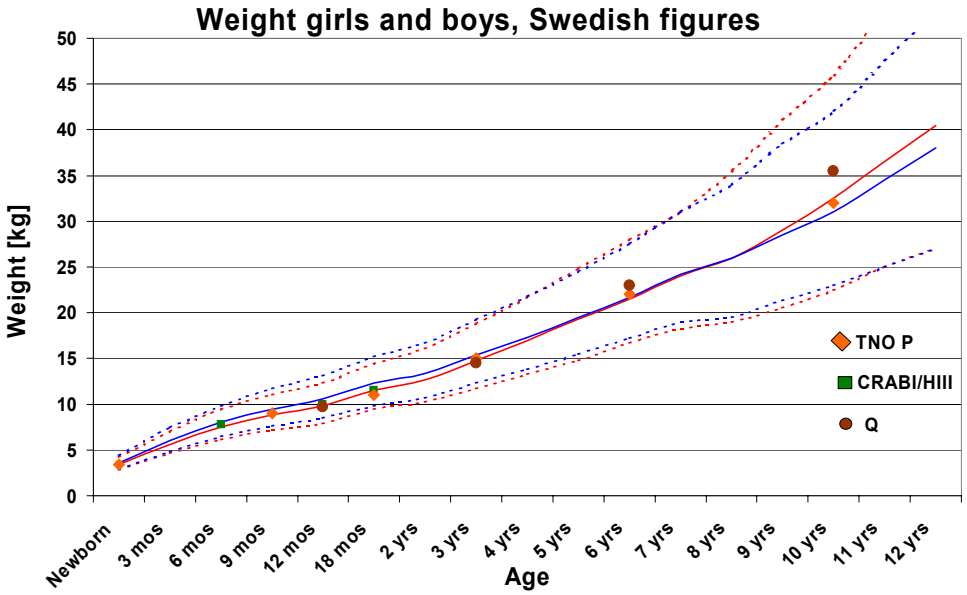


Figure 3. The weight of Swedish children compared to international dummies. The Swedish figures do not vary much from international figures. The 5- and 95-percentiles are the dotted lines. Note that the weight span is relatively large compared to the height span (figure 4).

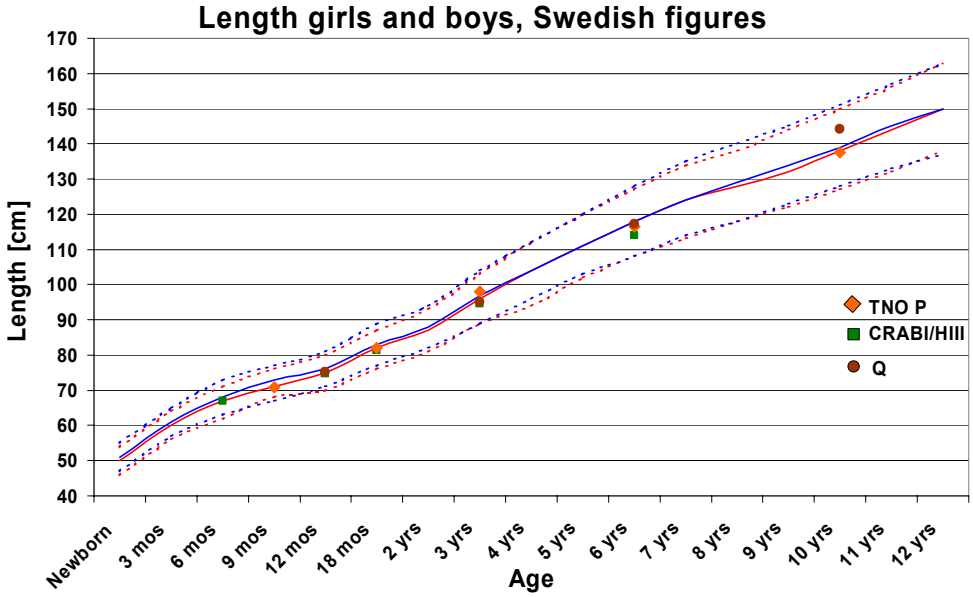


Figure 4. The height of Swedish children compared to international dummies. The Swedish figures do not vary much from international figures.

Test procedures

It is required that the tallest allowed child will fit the seat. There are two major limitations that can make a restraint too small for a child; the top of the head and the height of the shoulder. If either the integral harness or adult belt guiding drops below the shoulders or the top of the head is too far above the seat back the seat doesn't fit the child. From a sitting position, there is a good correlation both between the height of the shoulder and the top of the head to the stature. That is, we can measure the seat and calculate a stature.

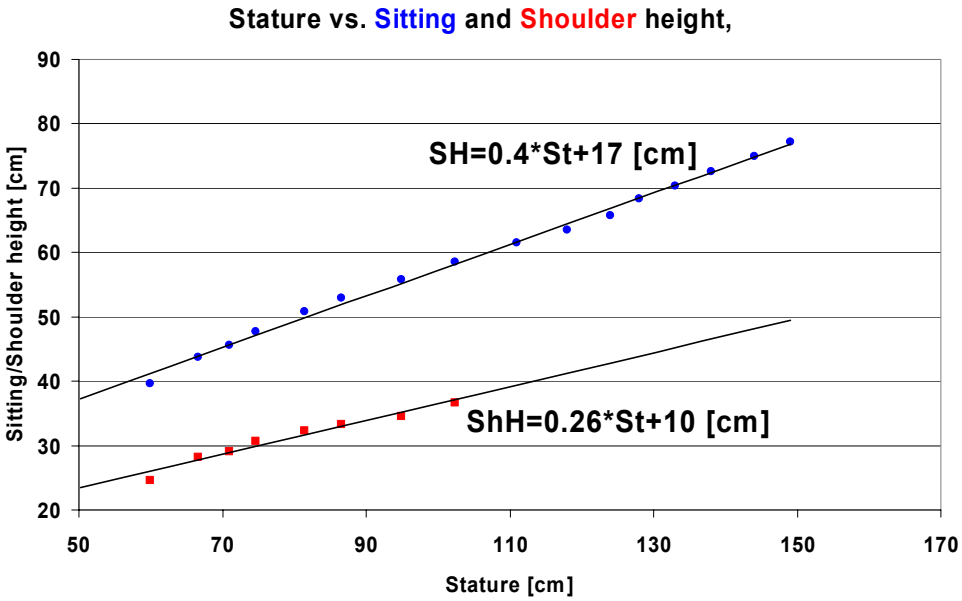


Figure 5. The sitting and shoulder height for a sitting child between 3 months and 12 years. The shoulder height is up to four years. More data is needed to validate the equations.

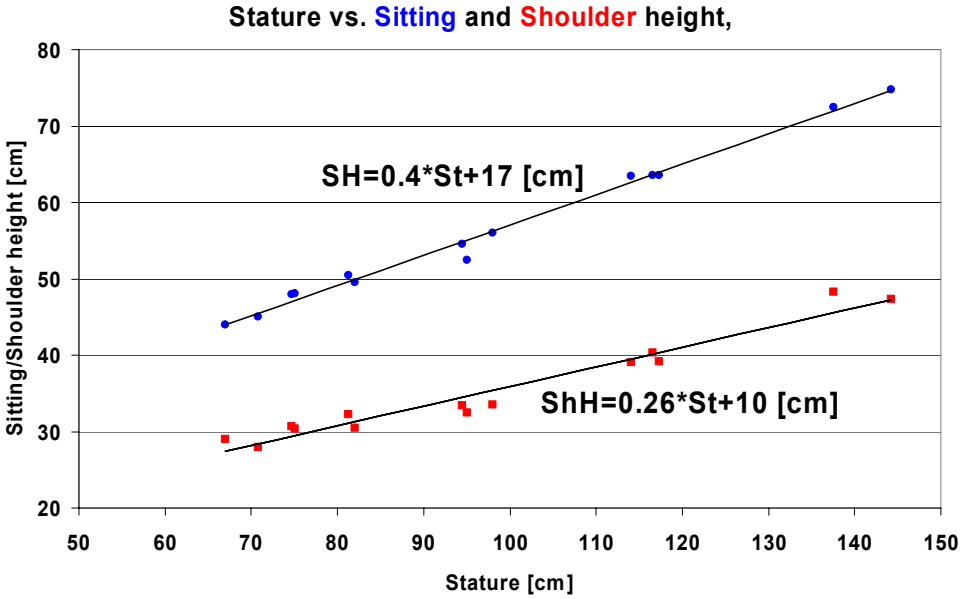


Figure 6. The sitting and shoulder height for a sitting dummy represting an age between 3 months and 10 years. Note that dummies and humans correspond as expected.

It is important to measure the slot heights and the seat height correctly. The height of the seat back is required to be measured in the R44.03. The measurements of the slot heights (shoulder heights) need to be rather precise as all errors will be multiplied by four (Stature [cm] = (Shoulder height [cm]-10)/0.26). The procedure for measuring the slot heights ought to be very similar to measuring the height of the seat back.

Figure 7 This VTI measuring device is used today to measure the seat back height. With minor modifications it can be used to measure the slot heights as well.

Once the heights are defined the dummies needs to be chosen. Today the following scheme is used for the mass groups:

Mass group	**Allowed weight of child**	**Test dummy**	**Max. weight of test dummy**
0	< 10 kg	9 months	P ¾, 9 kg
0+	< 13 kg	18 months	P1½, 11 kg
I	9-18 kg	3 years	P3, kg
II	15-25 kg	6 years	P6, 22 kg
III	22-36 kg	10 years	P10, 32 kg

If we allow the same weights and dummies as today, we get the following stature table:

Mass group	**Allowed max. stature of child**	**Max. weight/length of test dummy**	**Corresponding age to max. sized child**
0	75 cm	9 kg / 71 cm	11 months
0+	87 cm	11 kg / 82 cm	2 years
I	107 cm	15 kg / 98 cm	4,5 years
II	126 cm	22 kg / 117 cm	7 years
III	138 cm	32 kg / 138 cm	11 years

A seat up to 90 cm is tested with P3 which is too tall for the seat which is accepted as long as the chest accelerations are below the limits. If head acceleration measurements are introduced we suggest that the head accelerations for the largest dummy that fit is measured and in case a larger dummy is needed according to the above table only chest accelerations are measured in that dummy. As stated in R44.03 §7.1.2.1 all surfaces that can be hit by the head must be impact tested. That is, it is a minor problem not to measure head accelerations in the larger dummy.

Conclusions

Stature is more relevant than weight for the parents as they buy clothing for the children with length sizes. To increse safety even further, the stature intervals can be written between the slots for a seat with an integral harness or guiding for the adult belt. The seat can easily be measured to check that the stature intervals recommended by the manufacturer are correct. There is no need for new dummies if we choose to use stature instead of weight intervals. There is no obvious need for groups but it is important to emphazise that the seat **must** meet the needs of the children it is intended for. E.g. a newborn can't sit 90º upright whereas the one year old toddler prefers the upright position.

If the general principles of this paper are agreed it should be relatively easy to produce a set of amendments to ECE regulation 44. Furthermore, as there is no need to change either the dummies or any part of the test setup except for a minor modification on the seat height measuring stick it should be fairly easy to implement the amendments.

How are small children seated in vehicles?

(Translation of part of the report ”Hur åker små barn i bilen och vilka rekommendationer ger bilförsäljarna föräldrar?”, Folksam september 2008)

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Background

The proportion of rearward facing children decreased during the end of the nineties and the beginning of the 21st century. As the risk of sustaining a severe or fatal injury after a road traffic crash is five times higher for small children in forward facing child restraints compared to rearward facing child restraints (Tingvall , 1987), this was an alarming change. In 1998, 71% of the children between 9 months and 3 years of age were seated in a rearward facing restraint. In 2003, just under 60% were travelling rearward facing. (Anund et al, VTI 1998 and 2003) Right from the introduction of the large rearward facing child restraints in Sweden in the beginning of the seventies, parents have placed their small children in the front passenger seat. (Turbell, 1990) This has made it possible for children to use a rearward facing restraint up to the weight of 25 kg, because of sufficient leg space and sufficient load support by the instrument panel. Passenger airbags have made the use of the front passenger seat more complicated. As a result, children are more frequently seated in the rear seat where, in many cases, the available space for the legs is smaller. Consequently, the children are turned forward facing at an earlier age.

The trend that children are turned forward facing at earlier ages is unfortunate, bearing in mind that the structures of new vehicles are improved in order to keep the compartment intact which in turn requires the interior restraint systems to absorb more of the crash energy. However, small children do not profit from the energy absorption functions of those restraint systems. Forward facing children in stiff new vehicles face an increased head and neck loading. In rearward facing restraints, the frontal crash loading is distributed over a large part of the body.

Actions have been taken to break the trend and to increase the proportion of rearward facing children. The actions included a Swedish agreement on child safety, which vehicle manufacturers, vehicle retailers, authorities, traffic safety bodies, and child restraint retailers signed in 2006, (Svenska rekommendationer för små barn i bil, 2006) and a campaign at the child health centres and at the vehicle test centres. The campaign started in 2007.

Aim

In order to evaluate the effect of these actions, the current proportion of rear facing children need to be measured. The aim of this study was to measure the proportion of small children that are seated in rearward facing restraints in cars.

Method

A survey was conducted in 2008. Letters were sent to the caregivers of 3000 randomly picked Swedish children under 6 years of age, 500 children in each age group. The questionnaire included questions of seating position in the vehicle, the presence of passenger air bag and how the child is restrained, among others. Another corresponding Folksam survey was conducted in 2006 (Fakta om barn i bil. Enkät 2006)

Results

(Just a small part of the result presented in the report is translated)

There were 1765 responses to the 3000 distributed questionnaires, resulting in a response rate of 59%. The number of responses by age group is shown in table 1, indicating that the response rate by age group was similar. The total number of children and the number of children travelling rearward facing are shown in table 2.

Table 1. The number of responses by age group

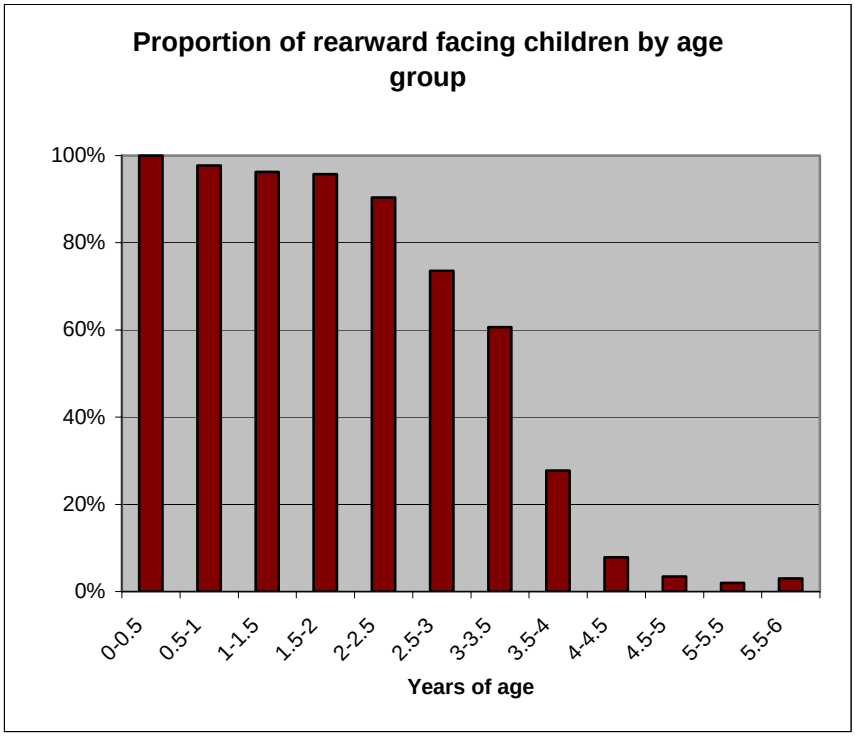
Years of age	No. of responses
0	278
1	275
2	290
3	311
4	297
5	282
Age not stated	32
Total	1765

Table 2. The proportion of rearward facing children by age group

Years of age	No of rearward facing	Total number	Proportion of age group rearward facing
0 - 0.5	50	50	100 %
0.5 - 1	216	221	98 %
1 - 1.5	103	107	96 %
1.5 - 2	157	164	96 %
2 - 2.5	113	125	90 %
2.5 - 3	117	159	74 %
3 - 3.5	77	127	61 %
3.5 - 4	50	180	28 %
4 - 4.5	9	115	8 %
4.5 - 5	6	173	3 %
5 - 5.5	2	102	2 %
5.5 - 6	5	167	3 %

The proportion of rearward facing children is shown in figure 1. The decline in usage occurs between 2.5 and 4 years of age. Among the age group 3 to 3.5 years, 61% are travelling rearward facing, and 28% of the children between 3.5 and 4 years old. There are also to some extent 4 year old children travelling rearward facing, 8% of the age group between 4 and 4.5 years.

Figure 1. The proportion of rearward facing children by age group



Summary

- The proportion of three year old children travelling in rearward facing child restraints were doubled between 2003 to 2008, from 20 % to 41 %
- Still 6 out of 10 children between three and four years of age are travelling forward facing, despite the fact that the risk of sustaining a severe or fatal injury after a road traffic crash is five times higher for small children in forward facing child restraints compared to rearward facing child restraints

References

Anund A. et al, Barns säkerhet i bil – En enkätundersökning i västra Sverige, VTI notat 20-1999

Anund A. et al, Barn i bil – Socioekonomiska faktorer, VTI report 496 2003

Fakta om barn i bil. Enkät 2006 (Facts about children in cars. Survey 2006) as found at the www as of Nov. 11th 2008 http://feed.ne.cision.com/wpyfs/00/00/00/00/00/07/82/F8/wkr0003.pdf

Svenska rekommendationer för små barn i bil April 25th 2006 (Swedish recommendations of small children in cars) as found at the www as of Nov. 11th 2008 http://feed.ne.cision.com/wpyfs/00/00/00/00/00/07/82/F9/wkr0004.pdf

Tingvall C. Children in cars, Acta Pædiatrica Scandinavica, 1987

Turbell T. Safety of children in cars- Use of child restraint systems in Sweden, Expertenhearing “Kindersitze” Wien 1990-10-11