

GRSP- 37th Session 23-27 May 2005

Agenda item C.2. Restraining of Children Travelling in Buses and Coaches

**SUMMARY OF UK RESEARCH ON WEARING OF ADULT BELTS ON
MINIBUSES AND COACHES BY CHILDREN UNDER 3.**

Introduction

The EU Directive on compulsory seat belt wearing (2003/20/EC) will require children over three years old to wear the seats belt provided in buses and coaches. There is currently an exemption from this requirement for children under three, but the European Commission has indicated that they may wish to review this exemption.

The UK Department for Transport has asked TRL and VSRC to examine issues relating to the use of adult belts on coaches by children under three, to see if there is any justification to extend the mandatory seat belt wearing requirements to children in this age group. In particular, three aspects have been examined:

- 1) The risk exposure of this age group (i.e, the number of children under three who actually travel on coaches and minibuses).
- 2) Accident data related to the above group (based on the STATS 19 UK accident database)
- 3) The suitability of adult seat belts for a child's body.

The attached Annex summarises the information obtained. What is apparent is the very low use of coaches and minibuses by children in the pre-school age group. This not only indicates very low exposure to risk for children in this age group, but also highlights the difficulty in estimating the effect of restraint wearing on casualties, since the overall accident database is very small.

The fitting trials indicated that children under three years old will all have a sitting shoulder height which is less than the 420mm that was considered the minimum for the satisfactory fit of the shoulder strap of a three point belt.

The results have revealed no evidence to support the mandatory wearing of seatbelts in coaches for children under three, where those seat belts are likely to be adult belts. Ideally, children in this age group should be supplied with an appropriate child restraint. However, there are major practicality problems associated coach manufacturers and operators supplying child restraints. One option would be to require parents to supply child restraints for a particular journey. However, there are likely to be major child restraint/seat compatibility issues, particularly with coach seats which tend to be fitted with lap-only belts.

The next phase of the project work will be to look at cost-effective solutions to allow children of all ages to be safely restrained in coaches.

ANNEX

1. Exposure of pre-school children to minibus and coach travel

A total of 22 out of 171 nurseries/playgroups contacted within two counties provided information in relation to children aged 0-3 years. From this, the annual travel by coach and minibus for these counties is presented in Table 1 below.

Age	Population	Passenger journeys by coach	Journeys/child by coach	Passenger journeys by minibus	Journeys/child by minibus
1	76	26	0.34	0	0
2	101	46	0.46	18	0.18
3	225	72	0.32	0	0

Table 1: Annual pre-school travel by coach and minibus

From this data it appears that coach and minibus travel is infrequent and indeed sporadic in the pre-school population.

Each nursery that took children on a trip was telephoned for additional information regarding the nature of any restraints used. The responses are summarised below.

- 2 trips where 1 year olds used lap belts in coaches
- 2 trips where 2 year olds used lap belts in coaches
- 3 trips where 3 year olds used lap belts in coaches
- 1 nursery used car seats and boosters in minibuses

There were no incidences where a child was restrained in an adult lap and diagonal system.

This information relates to travel within two counties. In order to make estimates for the amount of travel occurring within Great Britain as a whole, the results were weighted in order to reflect the national population within each age group.

The estimated number of coach and minibus journeys made by pre-school children is shown in Table 2 below.

Age	GB Population (1000's)	Nursery Population (1000's)	Coach journeys/child	Number coach passenger journeys	Minibus journeys/child	Number minibus passenger journeys
1	658	135	0.34	45,900	0	0
2	677	139	0.46	63,940	0.18	63,940
3	689	141	0.32	45,120	0	0

Table 2: Annual nursery/playgroup coach and minibus travel estimates

These passenger journeys are then, using the Census population counts, related back to the number of journeys per head of population, as shown in table 3 below.

Age	GB population	Coach journeys/child	Minibus journeys/child	Total journeys/child
0	638,000	0	0	0
1	658,000	0.07	0	0.07
2	677,000	0.09	0.09	0.18
3	689,000	0.07	0	0.07

Table 3: Annual journeys/child national estimates

Summary

Pre-school children make very few journeys on coaches and minibuses. The estimates are ≤ 0.09 coach journeys per child each year for children age 1, 2 and 3 and for minibus travel the 'calculated' estimates for 0, 1 and 3 year olds is 0. However, this calculated estimate is based on a sample in which there happened to be no recorded journeys, but it is reasonable to assume that there will be some travel within this age group on a national basis. These journeys will usually be made with the child's parent or carer and will rarely be organised trips with high numbers of children.

2. Crash conditions and child casualty analysis

2.1 Crash conditions

The STATS19 records for three year period from 1999 to 2001 were analysed to identify the crash conditions of minibuses and buses/coaches and to quantify the numbers of child casualties resulting from these accidents. There is no distinction between buses and coaches in the data.

The crash circumstances of minibuses and buses and coaches differ with buses and coaches being involved in more non-collision incidents (54%) than minibuses (18%). Less than 1% of buses and coaches overturn as opposed to 15% of minibuses. An important issue with restraint use in minibuses and coaches is the prevention of ejection in the event of an accident. The differing crash circumstances of minibuses and coaches may result in a differing level of restraint provision.

2.2 Casualty analysis

The STATS19 road accident data was analysed to determine the extent to which pre-school children are injured as passengers of minibuses and coaches. As stated previously there is no distinction possible between bus and coach occupants. However estimates suggest that 95% of all bus/coach incidents involve buses and 5% involve coaches.

In the period 1999-2001 there were 40 minibus and 10 bus/coach seated passenger fatalities. Only one of the fatalities was a child < 3 travelling in a minibus. Age distribution of serious and slight casualties show there is a slight increase in bus coach casualties in the under 4's compared to those aged 5-8 and it is believed these will generally involve pre-school children travelling on public transport buses.

Table 4 below shows the actual number of casualties during the period 1999-2001 in the category 'travel other than to and from school' for pre-school children.

Age	Minibus			Bus/Coach		
	Fatal	Serious	Slight	Fatal	Serious	Slight
0		1	10		2	47
1	1	1	7		5	159
2			9		2	187
3			15		4	178

Table 4: Frequency of casualties – travel other than to and from school

Table 5 below shows the frequency of multiple infant casualties. It is clear that events resulting in many infant casualties are extremely rare. During the three year period considered in this data analysis the greatest number of infants injured in a single incident was 3 and this occurred in one minibus accident and two coach accidents. There were no multiple KSI (killed or seriously injured) infant incidents during this time period.

	No. of infants			No. KSI infants	
	Minibus	Bus/Coach		Minibus	Bus/Coach
1	32	532	1	3	13
2	3	26	2		
3	1	2	3		

Table 5: Multiplicity of Infant 0-3 Seated Casualties 1999-2001

Summary

In summary relatively few children are injured in coaches or minibuses. For children aged three years and younger, there were no fatalities and 13 serious injuries in coaches in the 3 years 1999, 2000, 2001. In the same period there was 1 fatality (to a 1 year old) and 2 serious injuries in minibuses. Similarly, events resulting in many child casualties are infrequent. From the STATS 19 data it is not possible to confirm whether these children were wearing a restraint or not. It is not, therefore, possible to determine from the accident statistics whether adult seatbelts are reducing or causing injuries to children in these accidents. However such restraints have been shown to be inappropriate for young children as car passengers and it is likely that this will also be the case for bus/coach and minibus travel.

Overtipping of the vehicle, known as a rollover accident, often results in occupant ejection with a high rate of serious or fatal injury. Restraint use is an important means of reducing the likelihood of partial or complete ejection of occupants. In particular, younger children, who because of their size are not afforded a particularly good fit of the seatbelt, have an increased risk of ejection due to this poor fit. This is particularly the case for children < 3 years using only the adult seatbelt. This is true for bus/coach and minibus accidents although the likelihood of such an accident is considerably less for buses and coaches than for minibuses.

2.3 Accident risk for child passengers of minibuses and coaches

The results of the previous two sections are now collated in order to quantify the risk of injury for child minibus and bus/coach occupants. The casualty rates/million journeys are given, both for casualties of all severities and for those killed or seriously injured (KSI).

The data presented in tables 6 and 7 below represent three years worth of travel and casualties in minibuses and coaches. Whilst the casualties are a true count for the

years 1999 to 2001, the travel has been calculated simply by multiplying the exposure data collected by three. Despite efforts to collect exposure data for pre school children, this did not prove profitable. It would appear that nurseries and play groups rarely take children on trips, whilst commercial organisations such as the National Express coaches do not currently distinguish the relevant ages in their ticket sales. Thus the journeys presented in Table 6 are possibly a large underestimate of the amount of travel for this age group, which coupled with the informed assumption that the majority of the casualties presented are likely to be bus occupants, leads to unrealistic casualty rates for pre school children.

Age	Population (1000's)	Passenger journeys (millions)	Casualty Count over 1999-2001				Casualty rate / million journeys	KSI rate / million journeys
			Fatal	Serious	Slight	Total		
0	638	0	0	2	47	49	N/A	N/A
1	658	0.138	0	5	159	164	118.41	36.23
2	677	0.192	0	2	187	189	984.38	10.42
3	689	0.135	0	4	178	182	1348.15	29.63

Table 6: Casualty rate for 0-3 year olds travel by coach/bus

Again, it is difficult to say anything conclusive for the pre-school age children regarding minibus travel since in the sample of nurseries there was very little reported minibus travel.

Age	Population (1000's)	Passenger journeys (millions)	Casualty Count over 1999-2001				Casualty rate / million journeys	KSI rate / million journeys
			Fatal	Serious	Slight	Total		
0	638	0	0	1	10	11	N/A	N/A
1	658	0	1	1	7	9	N/A	N/A
2	677	0.025	0	0	9	9	360.00	0
3	689	0	0	0	15	15	N/A	N/A

Table 7: Casualty rate for 0-3 year olds travel by minibus

Whilst best estimates have been calculated for the child casualty risk for minibus and bus/coach occupants, there are a number of inaccuracies that should be discussed as the net result on the rates presented lead to some misleading and unrealistic results. For travel 'other than to and from school', considering the pre school age children, the lack of exposure data together with the inability to distinguish between bus and coach occupants has led to unrealistic casualty rates for coach travel. In the case of minibuses, the lack of exposure data means that no conclusions can be drawn for the under 4's. This is a disappointing outcome with regard to children < 3 years in relation to the current exemption from the seat belt wearing directive.

Summary

Whilst it is difficult to quantify casualty rates and accident risk from the information obtained, some conclusions can be drawn. With regard to coaches, children do not travel often and are not injured in any numbers. There may be rare events, such as more serious frontal or rollover crashes, in which the seatbelt fails to provide the level of protection that users would expect. This is particularly the case for children < 3 years for whom the adult seatbelt will offer little protection. The additional use of appropriate child restraints would improve the level of protection in these rare events. With regard to minibuses, children do not travel often and are not injured in large numbers. As minibuses have more in common with cars than coaches, the use of adult seatbelts by children will have a positive injury mitigation effect. However, the experience with passenger cars suggests that the protection afforded by the adult belt diminishes for the younger children and this is particularly the case for children < 3 years. The additional use of appropriate child restraints would improve the level of protection in these rare events.

2.4 Collection of new accident data

Potential new cases involving minibuses and coaches were investigated but very few came to light during the course of the project. One case did raise points for discussion in respect of possible accident injury outcomes involving pre-school children. In this case a minibus was in a relatively low energy frontal impact with a car and then suffered a partial rollover into a ditch. The 3 child occupants, aged between 3 and 4, were restrained either in forward facing child seats (2) or a special restraint (1). The injuries sustained by the children were AIS 1 injuries of bruising or abrasion to the neck from the harness/seatbelt. If this had been a high energy frontal impact, these children wearing only an adult seatbelt may have suffered serious, possibly fatal injuries. These may have arisen due to ejection from the seatbelt or from the actual seatbelt, both as a consequence of poor fit. Again if the impact had involved a more violent rollover, the outcome of serious or possibly fatal injuries associated with ejection from the adult seatbelt would have been possible.

3. Issues of fit

Fitting trials were conducted to investigate how well current seatbelts installed in coaches and minibuses fit the child population. The fitting trials involved 80 children aged up to 11 but included only 5 pre-school children due to participant recruitment difficulties.

Analysis of the data from the fitting trials found that additional child restraints were required at various cut of points based on a child's weight, age or sitting shoulder height.

The trials suggested that weight may not be the best indicator for determining when different types of restraints should be used in coach and minibus seating.

Average weight for 3 year old children (UK)			
	Gender	Mean (kg)	SE Mean
3	m	15.9	0.60
3	f	14.9	0.23

Table 8: Average weight of children aged 3 (Health Survey for England, 2003)

Table 8 shows that the average weight for 3 year old children ranges from 14.9 to 15.9 kg. In the fitting trials, the mean weights of children who achieved a good fit from the booster cushions and seats were all in excess of 15.9 kg. From this it can be suggested that children aged 3 and below require infant carriers or child seats when travelling in coaches and minibuses.

From further analysis sitting shoulder height was found to present a clearer means of indicating at what points the standard seats provided a good fit rather than use of a child's age or weight.

From the study it was found that none of the pre-school children achieved a good fit on any of the seats with only the standard seat belt. A supplementary restraint is required in addition to the seat and seatbelt for all children whose sitting shoulder height is less than 420mm.

Table 9 below shows that the sitting shoulder height for 3 year old children ranges from 295 mm to 390 mm which is lower than the minimum sitting shoulder height where an additional restraint is required.

Sitting shoulder height for 3 year old children					
	Gender	Mean (cm)	SD	5 th %ile	95 th %ile
3	m	35	2.3	31	39.0
3	f	33.5	2.3	29.5	37.5

Table 9: Anthropometric data of UK children aged 3 years (Childata)

The fitting trials and further analysis showed that coach and minibus seatbelts will not provide a good fit for children aged 3 years as their average sitting shoulder height, even considering children whose measurements fall into the 95th percentile, is less than that at which the standard seat and seatbelt provides a good fit. It can be concluded therefore that coach and minibus seatbelts will also not provide a good fit for children < 3 years, whose sitting shoulder height is less than that at which the standard seat belt provides a good fit.
