

## **Seatbelts: Requirements for Minibuses and Coaches**

### **Interim findings of Research funded by the UK Government**

The UK Department for Transport have commissioned a 3 year research programme to investigate the issues of minibus and coach occupant safety. A significant part of this research addresses the issues associated with children. This programme is being undertaken in 2 modules:

#### **Module 1** Child protection

**Phase 1** Child protection – exposure and accident data, seatbelt fit

**Phase 2** Child safety – recommend and develop cost effective measures

#### **Module 2** Anchorage evaluation

The research programme has been underway for over a year and module 1 phase 1 is drawing to a conclusion. The issues and early indications about child protection are summarised below.

Whilst it is intrinsically more advantageous to be restrained than to risk ejection from a vehicle in the event of a collision, this being often a cause of fatal injury outcome, the question remains of how suitable the adult restraint is for a child.

The experience with passenger cars suggests that it is likely that some children will require an additional form of tailored restraint system when travelling by coach or minibus. However it is has not previously been possible to evaluate the precise nature of such provision, due to a lack of information in three key areas; first the frequency with which children travel on minibuses and coaches, second the fit of the lap or lap to diagonal seat belt in coaches and minibuses, and third children's injury outcome in the event of an accident when restrained using an adult belt. This information is vital in order to evaluate both the risk of being involved in an accident and the effectiveness of the current restraint provision. Once this has been established an informed judgement can be made regarding not only the suitability of an adult restraint for a child but whether, and what sort of additional restraint might be necessary.

Thus, the aim of this work programme is to determine how often, and in what circumstances, child occupants travel in minibuses and coaches, how well the geometry of the current restraint system fits children of different stature, and if, and to what extent, they are being injured.

## Module 1 Phase 1 – exposure data

**Activity:** to collect and collate travel information for children travelling on coaches and minibuses to establish figures of exposure.

**Issues:** Little such information exists. A comprehensive data collection activity over a defined sample area was established. Information regarding travel to/from and within schools was requested and comparable information was collected from nurseries/pre-school groups. Sources of information relating to out of school activities and national travel were also identified.

**Findings:** Such travel data is not routinely collected and thus information was provided at additional effort from local authorities, schools, pre-school organisations, voluntary groups, etc. Response rates varied, but the information enables conclusions to be drawn and national estimates to be made with limited confidence. The national estimates are calculated by taking the journey information gathered locally for a known population which is then weighted in order to reflect the national population within each age group to give an annual child passenger journey estimate.

**Results:** All of the information collected and estimated is summarised below.

- Pre-school children (that is children 4 years of age or less) make very few journeys on coaches and minibuses. The estimates are  $\leq 0.09$  coach journeys/child each year for children age 1, 2 and 3, and 6.90 coach journeys/child for 4 year olds, of which the large majority are made by 4 year olds in school.  
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. For 2 year olds the estimate is 0.1 journeys/child and for 4 year olds, 0.9 minibus journeys/child. As with coaches the large majority of minibus journeys are made by 4 year olds in school.
- Primary school children (that is age 4 to 10 years and a proportion of 11 year olds) make more journeys by coach and minibus, as they get older.  
It is estimated that of primary school children only 1% travel to/from school by school bus, and that 87% of this travel is by coach and 13% by minibus.  
The number of coach journeys/child per year increases year on year from 6.9 for 4 year olds to 21.0 for 10 year olds. This increases to 51.6 for 11 year olds, as this year band includes those 11 year olds attending secondary school.  
The number of minibus journeys/child per year is much lower but also increases from 0.9 for 4 year olds to 2.86 for 10 year olds. This again increases to 7.2 for 11 year olds as this year band includes 11 year olds attending secondary school.  
The younger primary school children make most of their coach and minibus journeys in school. Children aged 7 – 11 go on more journeys within school but still do not travel to and from primary school by coach or minibus in significant numbers. Out of school they are beginning to travel as a consequence of organised hobby and group activities.
- Children 12 years of age attend secondary school, as do a proportion of 11 year olds. For this age group, travel to and from school by coach, minibus (or public transport bus) contributes significantly to their journey total. Also, the number of school trips increases, although no school trip estimate is made for 12 year olds as there was no response from secondary schools. The resulting estimate of coach journeys/child per year of 83.7 for 12 year olds does not, therefore, account for in school travel. Out of school associated travel was not recorded but is likely to

increase, as does travel on public transport buses, as these children become more independent.

**Conclusions:** the estimated travel rates for all children are relatively low, with the most travelled 12 year olds making an estimated minimum 83.7 coach journeys per year (which equates to 42 trips there and back). At less than 1 return trip per week, this is considerably less than the number of journeys made in cars. Children 3 years and younger travel only rarely on coaches and even more rarely on minibuses.

**Module 1 Phase 1 – accident data**

**Activity:** to analyse accident and casualty statistics for children travelling on coaches and minibuses.

**Issues:** National accident data for Great Britain is available from STATS19. Information can be obtained for minibuses, coaches and buses. The circumstances associated with use, accidents and injury causation vary between coaches and (public transport) buses, but it is not possible to distinguish between these two vehicle types in the statistics. Seatbelt wearing rates are not known for minibuses and coaches and the accident statistics do not include seatbelt use.

**Findings:** The national accident data were analysed. In addition, accident information was sought from all of the organisations approached within the exposure data sample area. It appears that accident records are not kept by a central organisation, but anecdotal records are held by schools. Very little additional information was obtained.

**Results:** Accident data for three years 1999, 2000 and 2001 were analysed. Of the 15,282 casualties (fatal, serious and slight) on buses and coaches 2,770 were children 12 years or younger. As previously indicated, the proportion of these casualties occurring on coaches cannot be determined. Of the 2,883 casualties (fatal, serious and slight) on minibuses 327 were children 12 years or younger.

Regarding children 12 years and under, in the 3 year period there were no fatal casualties on buses and coaches. Of the 41 serious casualties, 13 involved children aged 0 to 3 years. On minibuses there were 2 fatal casualties of children aged 1 and 6 years. Of the 19 seriously injured casualties 3 were within the age group 0 to 3 years. The distribution of age for all child casualties for buses and coaches, and minibuses, is shown below.

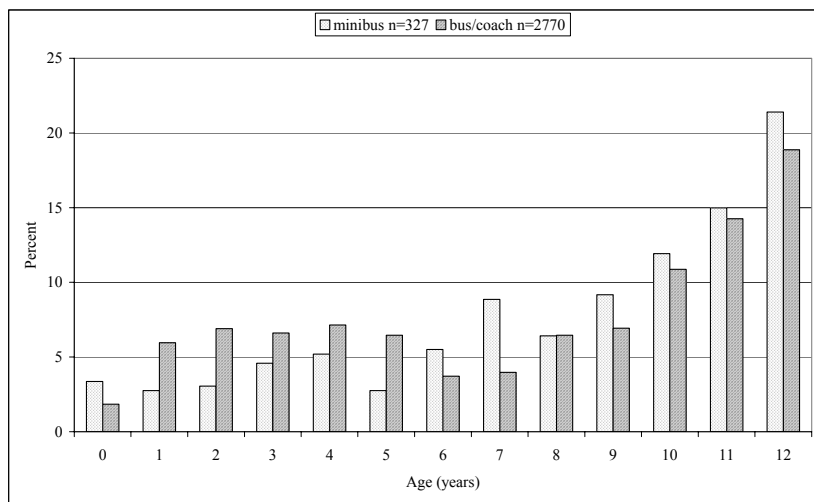


Figure 1 – Age distribution of all child casualties 1999-2001

The crash configurations, first point of impact and collision partners of bus and coach, and minibus, accidents were analysed.

Overturning of the vehicle, known as rollover accidents, often result 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. Rollovers are very rare events for buses and coaches, but are more frequent for minibuses. More than 50% of bus and coach injury accidents and 18% of minibus accidents do not involve an impact. In 43% of minibuses accidents the first point of impact is to the front of the vehicle. The mass of the collision partner affects the forces experienced by occupants in an impact. The majority of bus and coach impacts which involve a collision partner occur with an object of smaller mass, whereas a higher proportion of minibus accidents involve a collision partner of greater mass.

**Conclusions:** Bus, coach and minibus accidents resulting in child casualties are relatively infrequent events. The number of children injured is relatively small. 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.

### **Module 1 Phase 1 – seatbelt fit**

**Activity:** to evaluate how well adult seatbelts installed in coaches and minibuses fit the child population.

**Issues:** It is not known how well current seatbelts fit the child population. It is not known whether the issues of seatbelt fit in coaches and minibuses are the same as are known about in cars. It is not, therefore, possible to determine whether the level of protection afforded to children in coaches and minibuses is the same for children in cars. It cannot be assumed that the knowledge that exists about the need for additional child protection in cars applies directly to coaches and minibuses.

**Findings:** An anthropometric survey was undertaken of 167 children. Six anthropometric measures were recorded (stature, sitting shoulder height, upper and lower leg length, chest depth and weight). The most relevant measure to seatbelt fit is sitting shoulder height and so children were selected for participation in the assessment according to this measure. To help to ensure a representative spread across each age group, children whose measures fell into bands whose mid-points were: 5<sup>th</sup>, 10<sup>th</sup>, 20<sup>th</sup>, 30<sup>th</sup>, 40<sup>th</sup>, 50<sup>th</sup>, 60<sup>th</sup>, 70<sup>th</sup>, 80, 90<sup>th</sup> and 95<sup>th</sup> percentile values, were selected. In total 80 children have participated in the fitting trials.

A comprehensive market review of coach and minibus seat and seatbelt assemblies was undertaken. From this review a selection of coach and minibus seat and seatbelt assemblies was made. In total four seats were used within the assessment:

- Coach seat with lap and diagonal and lap only seatbelts,
- A coach and minibus seat with lap and diagonal seat-belt,
- Two minibus seats both with lap and diagonal seatbelts.

A comprehensive market review of child restraints was undertaken. From this review a selection of child restraints was made for evaluation in the fitting trials that included booster seats and cushions (Groups 2/3 and 3). In addition expert fitting trials were undertaken with child restraints, groups 0, 0+ and 1.

**Results:** Data have been added to the databases and analysis is just commencing, hence any results that can be reported must be considered as a ‘first look’ and will require confirmation.

- An acceptable spread of children across each year group was generally achieved.
- Data collected indicate that some form of supplementary restraint in addition to the seat and seatbelt is required for children whose shoulder height is less than 420mm.

This value equates to all 3 years olds, 96% of 5 year olds, approximately 62% of 7, 15% of 9 and 2% of 11 year olds.

- Seatbelts currently fitted on the range of coach and minibus seating assessed are long enough to permit fitment of the restraint systems.
- Seat contours meant that some restraint systems could not be fitted snugly into the seat.

**Conclusions:**

Data analysis indicates that some form of supplementary restraint in addition to the seat and seatbelt is required for children whose shoulder height is less than 420mm. This value equates to all children 0-3 years of age, 96% of 5 year olds, 62% of 7, 15% of 9 and 2% of 11 year olds.

**Emerging Conclusions**

With regard to coaches, children do not travel often and are not injured in any significant numbers. However, each year a small number of children are seriously injured, and the possibility remains that child fatalities will occur in coach accidents, both of which society considers to be unacceptable. Trials have found that seatbelts do not fit the majority of children under 12 years and as a result are unlikely to afford adequate protection. The consequences of poor seatbelt fit, such as ejection, abdominal injuries and excessive forwards movement of the head and neck, as known about in cars, are also relevant in coaches, particularly in rollover and high energy impacts. These may be rare events, but are ones in which a poorly fitting seatbelt will fail to provide children the level of protection that adult users would expect. Although the incidence of child fatal and serious injury accidents is low, it is likely that the use of poorly fitting adult belts in future accidents would provide less protection than a tailored system and could in some situations cause additional injuries. Therefore, as this is likely to be considered unacceptable by society it is suggested that for younger children for whom the seatbelt fit is particularly poor, and all children 0-3 years old, an additional form of child restraint is required in order to ensure that the seatbelt fits them. The additional use of appropriate child restraints would improve the level of protection in these rare events.

As with buses and coaches the exposure and accident data show that children do not travel often in minibuses and that each year only a small number are seriously injured. Occasionally child fatalities occur which, together with serious injuries, society considers to be unacceptable. The consequences of poor seatbelt fit, such as ejection, abdominal injuries and excessive forwards movement of the head and neck, as known about in cars, are particularly relevant in minibuses. This is because minibuses have more in common with cars than coaches, and the use of poorly fitting adult seatbelts by children will have a more significant adverse effect on injury mitigation. Trials have found that seatbelts do not fit the majority of children and are unlikely to afford adequate protection. Therefore, for younger children, for whom the seatbelt fit is particularly poor, and all children 0-3 years old, an additional form of child restraint is required in order to ensure that the seatbelt fits them.



