INJURY BULLETIN

Queensland Injury Surveillance Unit

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Children as Passengers in Motor Vehicle Crashes

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QISU collects and analyses data from emergency department injury presentations on behalf of Queensland Health. Participating hospitals represent three distinct areas of Queensland.

QISU publications and data are available on request for research, prevention and education activities.

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Summary

- On average, 13 children die each year as passengers in motor vehicles on Queensland roads.
- 1000 children are estimated to present to Queensland emergency departments each year following a motor vehicle crash.
- Children who wear an appropriate restraint are more likely to have no injury or only superficial injuries compared to unrestrained or inappropriately restrained children.
- Choosing a child restraint appropriate for your child and car model is complex.
- A nationally structured program should be developed to promote appropriate restraint choice and fitting.
- Premature graduation of children to a different seat or restraint device may account for the pattern of serious injury.
- Current Queensland legislation lags behind international best practice recommendations for child restraint use.

Introduction

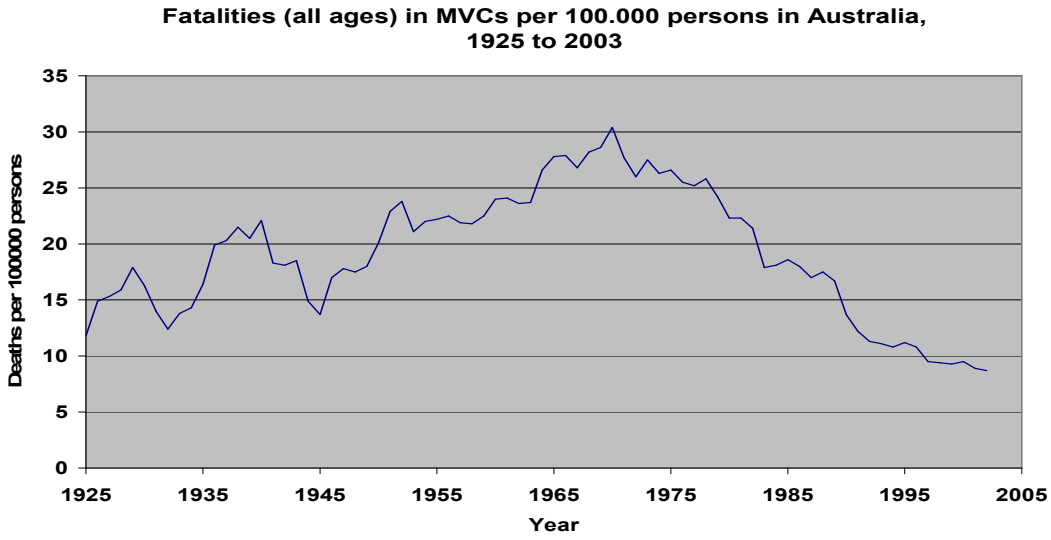
Despite the continued evolution of vehicle design and road safety strategies, death and injury due to Motor Vehicle Crashes (MVC) continues to be a common feature of modern life. The total number of road fatalities in Australia has dropped dramatically since the introduction of adult seat belt laws in 1967. The introduction in 1970 of an Australian Standard for child restraints and child car seats (AS1754) and subsequent adoption in State legislation has led to a further reduction in paediatric road deaths.[18] Victoria was the first state in Australia to reference AS 1754 in seatbelt legislation, requiring child restraint use for passengers aged 8 years and under. AS1754 was further improved with the introduction of a top tether strap in 1975.[19]

Australian seat belt laws were once the most progressive in the world. The law regarding restraint of children is currently however lagging behind international best practice. Since early 2000 the seat belt laws have been uniform in all states of Australia.

At present it is legal in Queensland and Australia to restrain children over the age of 12 months in an adult seat belt.[20] There is clear evidence[1, 1a, 1b] that child fatalities and serious injury can be prevented by appropriate use of restraints and appropriate seating position.[2,3] A recent Queensland study [15] showed that 60% of children under 12 years of age were front seat passengers. Australian law at present does not direct the seating position in the car.

MVC and road trauma remains a leading cause of death and

Figure 1 - reflects the continuous, steady decline of the deathrate since 1967



serious injuries for child passengers in Queensland. This bulletin describes the pattern of injuries sustained by child motor vehicle passengers under 15 years in Queensland.

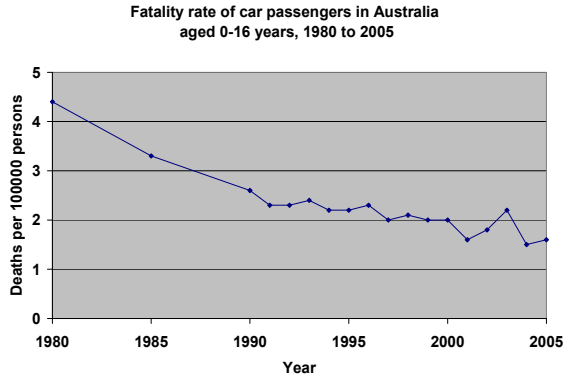
Methods

Data were gathered from two sources:

1. Death data were accessed from the Australian Transport Safety Bureau (ATSB) website for deaths occurring on the road to vehicle passengers aged 0-14 years of age, for the nine year period from January 1998 to December 2006. Paediatric fatality rates were obtained for children aged 0-16 for the period of 1980 to 2006. ATSB data is collected at the injury site by Queensland police. Delayed deaths that occur after the initial crash are also reported to the ATSB and are included in this data set.[21]

2. QISU data were gathered by searching the QISU database for motor vehicle crashes involving child passengers age 0-14 years of age, for the eight year period from 1998 to 2005. QISU collects data from participating Queensland Hospital Emergency Departments servicing approximately one quarter of the Queensland population. Motor vehicles include buses, taxis, four wheel drives, vans, and trucks but exclude motorbikes and cycles.

Figure 2 Fatality rate of car passengers in Australia age 0-16, 1980 to 2005



Results

Death data

There has been a continuous decline of the rate of deaths of children aged 0-16 years of age since 1980. In the last 5 years the absolute number of paediatric deaths in Queensland has fluctuated significantly, ranging between 7 and 17 deaths annually.[21] The number of deaths has also fluctuated within age groups. Over the 9 year period, almost twice as many children under 1 died compared to other ages. The lowest number of deaths occurred in the 5-10 year old age range (see Figure 3).

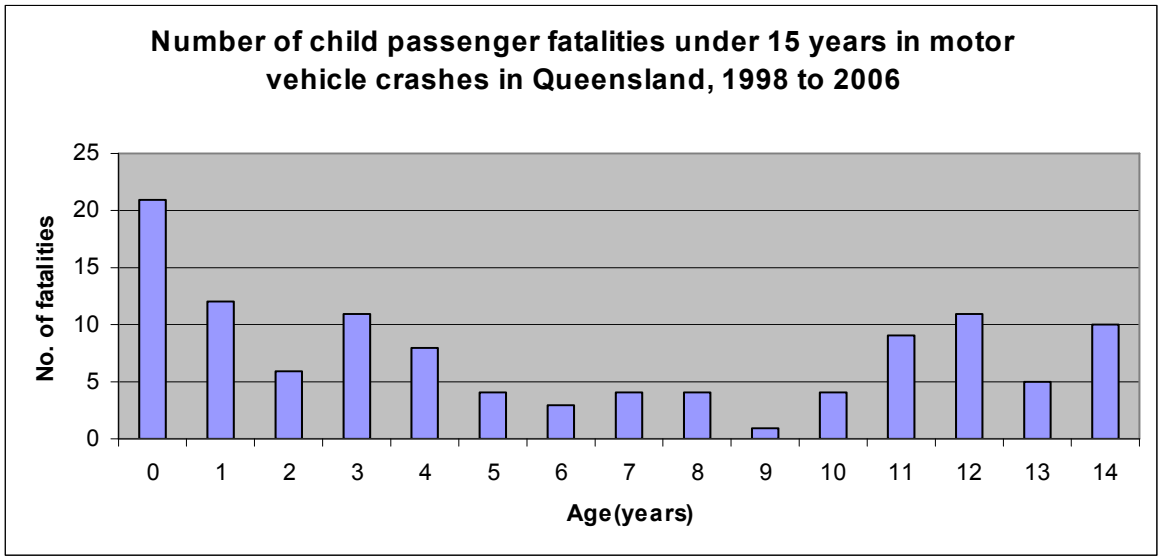
QISU data

Between 1998 and 2005, 1,949 children aged 0 to 14 years presented to a QISU participating Emergency Department (ED) following a Motor Vehicle Crash (MVC). We estimate that around 1,000 children each year, in Queensland, require ED treatment having been a passenger in a vehicle during a crash. Half of the presenting children were male (975). Usually child injuries show a significant male preponderance (apart from netball and equestrian sports). The equal distribution of gender in our series might reflect that children are passive recipients of parental control when passengers in a car. There was a consistent spread across all ages with a slight predominance of children under 12 months of age (160 or 8% of all presentations).

Severity of injuries

Triage Category 1 (TC 1) represents a child that needs immediate attention or has resuscitation in progress, whereas TC5 is the lowest triage category and does not require immediate

Figure 3 - demonstrates the child passenger fatalities per year of age over the time period of 1998 to 2006



attention. Overall, 18% of children that presented required urgent attention (TC1 or 2), with 3% or 65 children presenting as TC1 and 15% or 294 children as TC2. The majority of children presented with Triage Category 3 (598 or 31%) and 4 (903 or 46%). Only 4% or 79 children presented with TC5.
Overall 25% or 340 children required admission to hospital, the majority of which were TC 1 and 2 (195 or 57% of all admissions).

Serious injuries

Serious injury was common in our series with almost one third of all presentations (561) suffering serious injuries (open wounds, fractures, intracranial injuries, internal organ injuries, multiple injuries, crush injuries, eye injuries, spinal injuries, dislocations, burns, blood vessel injuries and traumatic amputations.
Overall the most common injuries were intracranial injuries (205 or 10% of all children in our series), open wounds (136 or 9% of all patients in our series) and fractures (105 or 5%).
When reviewed, according to age, there were a bimodal peak occurring at 3 to 4 and 7 to 8 years, with 40-45% of children presenting in those age groups suffering severe injuries. These peaks differed from the death distribution data which peaked in the first year of life.

Age distribution of serious injuries

Intracranial injuries

Ten percent of patients (205) sustained intracranial injuries following a MVC. Of those 58 % (117) were male. Intracranial injuries were most common in 4 year old patients (28 children or 21 % of all 4 year old children) followed by 12 year old children (21 children or 16% of all 12 year old children presenting).

Open wounds

Seven per cent of children (136) presented with open wounds of which 55% were male.

Fractures

Five per cent (107) children had fractures, of which 51(48%) were male.

Internal organ / abdominal injuries

Thirty children (1.5%) had internal organ injuries, half of whom were male. Abdominal injuries were most common in three and six year old patients (5% of all 3 and six year olds presenting with injury post MVC).

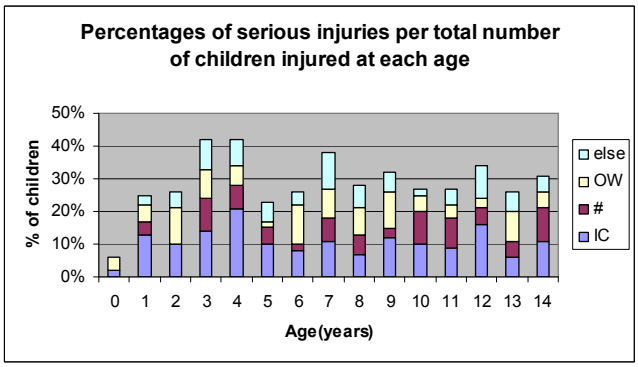
Multiple injuries

Thirty-three children had multiple injuries, 21 were male and 12 were female. Multiple injuries were most common in eight year old patients (7 or 5% of all eight year olds presenting) followed by three year old patients (4 or 3%).

Crush injuries

Thirty-three patients had crush injuries of which half were male. Crush injuries were most common in 12 year old passengers (3 or 4% of 12 year old

Figure 4 - demonstrates the distribution of serious injuries (intracranial injuries= IC, Open Wounds= OW, fractures= # and other specified serious injuries= else) as percentage of the total



passengers) and nine year olds (3 or 2%).

Eye injuries
Twenty-one patients had eye injuries, of which 15 were male. Eye injuries were most common in seven year old children (5 or 5% of all 7 year old children presenting) and two to three year old children (3% of children presenting in that age range). There were no eye injuries reported in children over nine years of age.

Spinal injuries
Five patients in our series had spinal cord injuries. Two patients were 14 years old; the others were ten, nine and five years of age. Three were boys and two were girls.

Dislocations
Three patients age 9, 11 and 12, all girls, had dislocations.

Blood vessel injury
Three patients presented with injuries to blood vessels. One was a four year old boy, two were girls aged five and ten years.

Traumatic amputation
One three year old boy presented with a traumatic amputation.

Where crashes happened

The majority of children in our series (78% or 1520) were injured during a crash on a sealed road. The remaining 22% occurred on unsealed roads.

Timing of Motor Vehicle Crashes

Slightly more crashes occurred on the weekend with 18% (354) of all children presenting on a Saturday and 16% (313) presenting on a Sunday.

With regard to the time of day there were 2 peaks, one during the morning and another during the afternoon peak traffic hours. The majority of crashes (35% or 677) occurred between the hours of 3pm and 6pm.

Few crashes (121 or 6%) occurred between 11pm and 4am, however these were more likely to result in serious injury with 22% requiring resuscitation/ immediate care (TC 1 and 2) on arrival in the Emergency Department compared to 16% between 4am and 10pm hours.

Type of restraint used and seating position

In our data set, 797 children (41%) had the type of passenger restraint used documented in the injury description. This is based on reported information given by parents at triage in the Emergency Department.

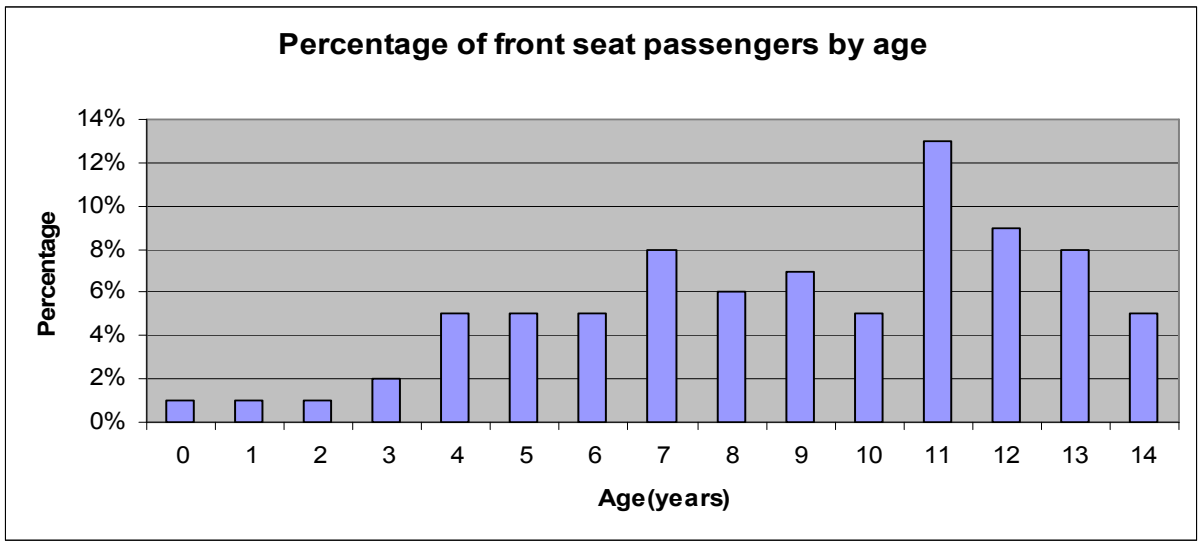
Under twelve months
Of the 160 children under 12 months who presented, 56 children (or 35%) were reported to be appropriately restrained in an infant restraint. Of those, 35(60%) had no or superficial injuries and 23 (or 41%) had an injury (1 head injury, 2 fractures, 1 open wounds, 19 minor injuries).

Older children
One quarter of children over 12 months of age (192 /741) were reported at triage to have been restrained in an appropriate restraint, with no further description of the type of restraint used. Of these children, 89 (46%) had no or superficial injuries, with 103 (54%) sustaining an injury (17 intracranial injury, 5 fractures, 10 open wounds, 1 crush injury, 2 multiple injuries and 68 other injuries).

Most children (455 children or 57%) were reported to have worn some form of restraint without clear assessment as to the appropriate-ness for the height, weight or age of the child. Of those 188 or 41% had no or superficial injuries , 267 or 59% had an injury (42 head injuries , 89 open wounds , 79 fractures , 1 spinal cord injury, 6 internal organ injury , 29 multiple injuries , 21 other injuries).

Nearly 3% of children (24/741) were restrained in an adult lap or lap-sash belt. Of these, 18 were between 2 and 12 years of age and 11

Figure 5- demonstrates the percentage of children travelling in the front seat



sustained injuries (1 internal organ injury, 2 fractures, 1 open wound and 7 others).
Overall 70 children or 9% were reported to be unrestrained (59 children were said to be "unrestrained", and another 11 were reported to have taken the restraint off by themselves).

Seat position

For 398 children (20% of all presentations) the seat position in the car was reported. Of the 398 children, 100 or 25% were seated in the front, and 298 or 75% in the rear of the car. Of the rear seat passengers 21% had no injury, where as of the front seat passengers only 9% escaped injury. Figure 5 demonstrates that many children under the age of 12 years were seated in the front seat during a motor vehicle crash.

Discussion

Data and current Law

QISU data reinforces data from other national and international sources on MVC child passenger injury. Our data shows that a slightly higher number of infants (children under one year of age) were involved in, and presented following a crash. This is likely to reflect high data ascertainment together with carer anxiety following crashes involving young children. There were relatively few children under the age of 1 year who sustained serious injuries (5% of all infants under 1 year of age). In contrast to this, in the ATSB data, there were almost twice as many deaths in the under 12 month age group as in any other group. No description of restraint use was given for these infants in the ATSB data. Unrestrained or inappropriately restrained infants are more vulnerable to serious injury than older children. It is possible that the high number of deaths in this group represents infants who were inappropriately restrained and were ejected from the seat and or car.
It has been estimated that the number of deaths and serious injuries can be reduced by 70% in children and 50% in adults if appropriate restraints are used (compared to unrestrained individuals).[11, 13] In a NSW study, only 18% children were correctly restrained in a weight appropriate restraint.[17]
Current Queensland law[20] requires that a child under the age of 12 months must be restrained in an ASA (Australian Standard Authority) approved restraint, which for children of this age is a rear-facing infant restraint until the child reaches the weight/size limits for the restraint. This may be 8kgs, 9kgs or 12kgs depending on the restraint. After that, the child must use a rear-facing or forward facing restraint until at least 12 months old.
This requirement is reinforced when parents are taking newborn babies home from hospital. Baby Capsules are readily available for hire through the Queensland Ambulance Service[38] and (in Brisbane) Kidsafe[42], or can be purchased through the RACQ or retail outlets. Capsules provide appropriate support until the child has reached a weight of 9 kg (around six months). Provided the capsules are fitted appropriately in the car (fitted rear facing and in the back seat with out catching the back of the front seat) and the child is appropriately restrained in the capsule, baby capsules provide excellent protection for young infants.[18] Baby capsules appear to be[23] widely used and accepted in the community.
Australian recommendations generally refer to different groups defined by weight.
However, there is significant overlap in these weight ranges which leads to confusion:

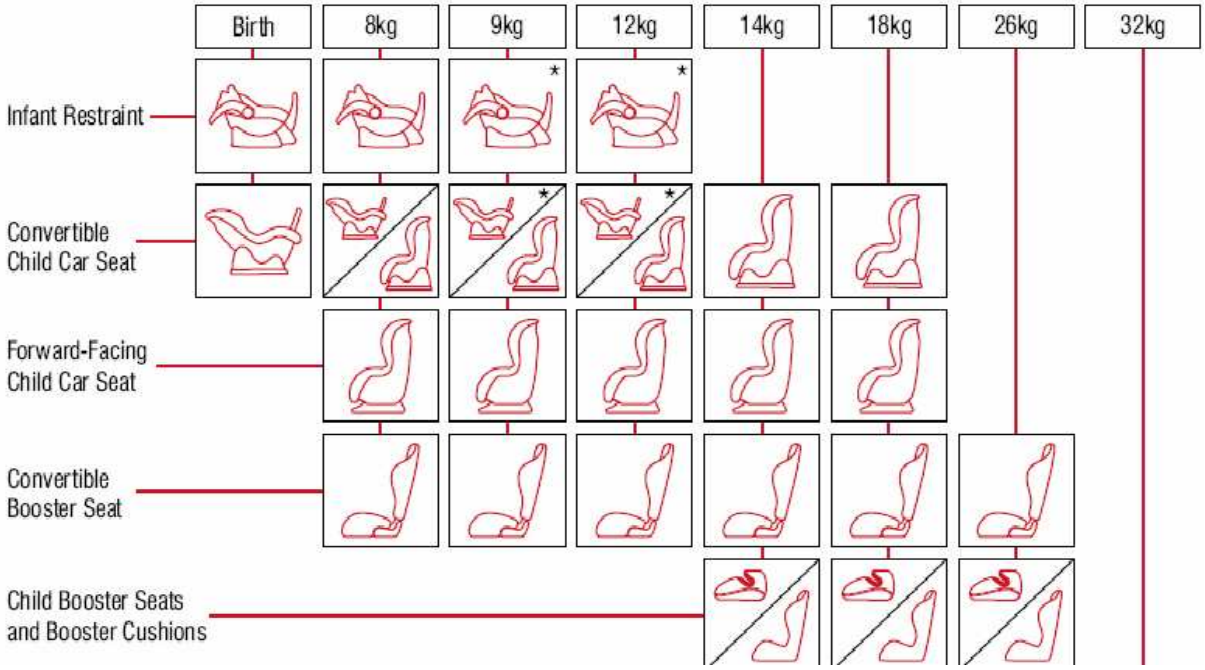


Figure5 (courtesy of Britax safe-n-sound child capsule information leaflet)

- 0-8 kg “baby capsule” (infant restraint) - supports head and neck, rearward facing, lying position, absorbs impact due to floating of seat in surrounding cage. Child is to be restrained in a harness. “ Baby capsule” is secured by seat belt and top tether strap
- 0-12 kg “Infant restraint” - either capsule or child car seat type, inclinable, rearward facing, with harness.
- 8-18kg “child car seat” – cushioned seat with upright seating, full back, side wings and head support. Forward facing, potentially inclinable (particularly important if used for small infants). Seat is secured by a top tether strap and seat belt; child is secured by a harness. Some evidence suggests that car seats should be inclined and rearward facing as long as possible, even if the children are heavier than 18 kg.
- 14-26kg “booster seat” with high back or backless High back versions provide some side impact and head protection for smaller children. Child and seat are restrained together with a lap/sash (adult type) seat belt. Where lap only belts are fitted boosters must be used with a child harness (purchased separately). Booster cushions (seat with no back) provide elevation without any further protection and are secured together with the child with an adult seat belt.
- Over 140cm- Adult type seat and seat belt guided by fit. Sash belt should cross shoulder (not face or neck) and the lap belt should cross over the pelvis or upper thigh. The child should have a mature pelvis (usually not before 6 years of age) and the thigh should be long enough so that the child’s knee bend over the edge of the seat when the child’s back is positioned securely against the back of the seat (Australian rear seats are constructed for the size of an adult male).

The need for protective seating and restraints arises not only because of the smaller size of children, but anatomical differences that make children more vulnerable than adults to injury.[43] Because of the significant overlap in weight ranges for different child restraints, we would like to propose simplified recommendations based on current best practice and supporting literature. (see figure 7)

Graduation

The number of seriously injured children in our series was proportionally higher in the 3-4 year old and 7-8 year old age groups than in other age groups. These two age groups coincide with an age were children might have “graduated” early from a child car seat into a less protective booster seat or from a booster seat into an adult type restraint. Our data also shows also that children who are appropriately restrained have a higher chance of leaving the crash site without an injury or with only superficial injuries when compared to unrestrained children (60% vs. 40%).

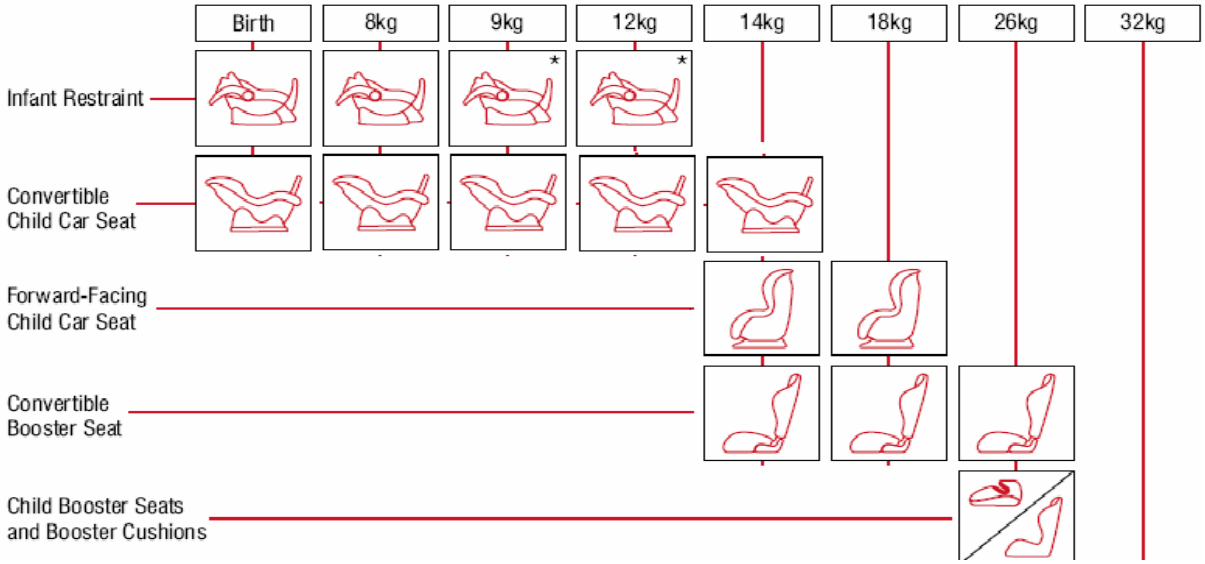
Airbags and children

Only children of adult size and weight, and height over 140 cm should sit in a seat that is protected by an activated front airbag**.** All other children can suffer considerable harm should the airbag explode.[44,45] (Cars become unroadworthy in Australia if a front airbag is deactivated).

Restraint Misuse

A NSW study[17] demonstrated that 2 out of 3 child car seats were inappropriate, inappropriately fitted or the restraint device (harness/seat belt) inappropriately fitted or done up. This confirms previous Australian and international studies that showed restraint misuse in up to 75% of cases surveyed.[39,40,41]

Figure 7- proposed child restraint recommendations



Seat Position

Seat position has a significant influence on the likelihood of injury as demonstrated in our data. In our series 21% of rear seat passengers left a crash uninjured, but only 9% of front seat passengers did so. Our data also showed that a significant number of children under the age of 12 years were travelling in the front seat during a motor vehicle crash. Several Australasian and international studies show the link between more severe injuries and inappropriate restraint or front row seating.[1, 2, 5, 7-11,31,32]

There is good evidence that children under the age of 12 years are at increased risk of sustaining injury when travelling in the front seat compared to the rear. Current recognised best practice recommends rear seat travel for children under 12 years of age.

ISOFIX / LATCH system

The European and American ISOFIX / LATCH systems attempt to make the fitting of child restraints more user friendly and consequently reduce human error. These rely on a static fitting system in the car that connects (universally) to car seats or capsules. Cars with these fitting devices are already available and it will be mandatory from 2008 for all new cars sold in Australia to have 2 solid anchorage points.[46] The corresponding seats are at present not covered by Australian standard. Even with the LATCH and ISOFIX systems misuse is still possible when the harnesses are not correctly adjusted or fitted.[39]

Prevention

In the older age group the use of restraints in the car often becomes a daily battlefield. Several studies have shown that children are more inclined to wear seat belts if the driver of the car is wearing a seatbelt.[30, 36, 35, 34]

Age guidelines alone are insufficient to inform choice of appropriate child restraints. Clear weight and height guidelines would make selection less confusing.

It is estimated that around 90% of parents intend to restrain there children safely[15], but only a proportion are aware of current recommendations and pitfalls in restraint use.

Community education will improve appropriate restraint use as demonstrated in previous studies.[22-26]

To facilitate easy access in rural and remote areas, a Queensland wide network of trained personnel who can advise on the appropriateness of restraint preferably PRIOR to purchasing, for all age groups, is required. This network needs to be tight enough to cover as many small communities as possible. For the same group, subsidised long term car seat or booster seat rental would be an option to improve community uptake. The WHO Safe Communities Program may be a good vehicle to deliver this information.

Recommendations:

- Legislation needs to be amended to require mandatory weight rules for use of child restraints until the child reaches a height of 140 cm and limit front seat travel to children 12 years and above.
- Development of a Queensland wide network to distribute and/or fit child car seats and booster seats as is currently available for baby capsules.
- Development of an ongoing community education program to reduce misuse of car restraints**.**
- We recommend that Standards Australia should test and approve ISOFIX/LATCH systems for Australian use.

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