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Restraint use and seating position among children in motor vehicles in Bloemfontein

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Background. Most child deaths from motor vehicle accidents (MVAs) occur in low- and middle-income countries. Effective measures to protect children involved in MVAs include wearing age-appropriate child restraints and being seated in the rear of the vehicle.

Methods. A descriptive study was used to assess use of child restraints, seating positions of children, driver restraint and vehicle overloading in Bloemfontein in 2007. Two pairs of observers stood at selected sites recording these findings. The study was done over a period of 1 month.

Results. A total of 512 children in 374 vehicles were assessed. Just over a third of the children were seated on the front seat of the vehicle, and 14.1% were seated on other people's laps (73.6% of these were on the front seat). Restraints were used by 8.8% of children and 17.4% of drivers; 10 times more children used restraints if the driver was restrained versus not restrained. Between 9.3% and 20.4% of vehicles were assessed as being overloaded with passengers.

Conclusion. The safety of child passengers in Bloemfontein in the event of an MVA is threatened by poor adherence to basic safety measures. Enforcement of correct seating position and use of child restraints will prevent unnecessary deaths, disabilities and suffering of child passengers injured in the event of an MVA. Driver motivation and responsibility is important in achieving safer seating of children in motor vehicles.

Motor vehicle accident (MVA) injuries are a leading cause of death and disability in children in both developed and developing countries and account for 22.3% of child injury deaths globally.[1] Globally, more than 85% of casualties and 96% of child deaths from road traffic accidents occur in low- and middle-income countries. The road traffic mortality rate in South Africa in 2000 was estimated to be 39.7/100 000 population. This is double the global rate and 26% higher than the aggregate figure for Africa.[2-4] The overall injury-related mortality burden in South Africa is between 11% and 13%. In this category, transport-related injuries account for 33% of all deaths.[5] Injuries from MVAs are the fourth leading cause of death in all age groups in South Africa.[2] In South Africa, being a child passenger in a motor vehicle ranks fifth as a cause of death from injury.[5] Reliable data on MVA-related disability in children are sparse.

After the first collision in an accident, a second collision occurs between the unbelted passenger or driver and the interior of the vehicle. This is responsible for the majority of injuries and can be prevented by seatbelts.[6] Toddlers are particularly vulnerable to injury because the mass of a young child's head, in relation to its body, causes the child to be hurled head first in collisions. The head absorbs the impact when it strikes the dashboard or windscreen, resulting in serious or fatal brain injuries. Children held on laps by a well-meaning adult will be dislodged by the huge gravitational forces in the case of an accident.

In a 50 km/hour collision, an unrestrained baby or child can be thrown forward with a force 30 - 60 times its body weight and could slam into the driver or front passenger. Child passengers who are not secured in their back seats increase other passengers' and the driver's risk of injury as they become a missile in an accident, with devastating effect.[7] Ejection from a vehicle as a result of an accident usually results in death.

Effective measures to protect children include using age-appropriate restraints and being seated in the rear of the vehicle.[6] Safety belts are the single most important life-saving device in a vehicle in the event of an accident and can reduce death and hospitalisation rates by more than 50%.[7,8] Children under 1 year of age (body weight <9 kg) should be secured in a child safety seat on the rear seat, facing the back of the vehicle to reduce the risk of cervical spine injury. A proportionally large head and weak neck predispose a young child to head and neck injuries when placed in forward-facing child safety seats ('Seat-belts and child restraints: increasing use and optimising performance', European Transport Safety Council, 1996, quoted in World Report on Road Traffic Injury Prevention[1]). Children aged between 1 and 6

years (10 - 18 kg) should be restrained in a safety seat in the rear of the car. The safety seat should be secured by a lap belt and a diagonal belt. Children aged 6 - 11 years (22 - 36 kg) can use booster cushions with safety belts, although child seats with a back rest are preferred. Children should ride with a seatbelt positioned as for an adult only when they can sit with their backs straight against the vehicle's seat with their knees bent over the edge of the seat, without slouching. The shoulder and lap belt should fit comfortably across the shoulder, lower abdomen and pelvic area. A child in a safety seat placed on the front passenger seat of a vehicle equipped with front or side airbags has an increased risk of injury and death in the event of a crash through impact with the airbags.[6]

Correctly installed and used, child safety seats can reduce the risk of death in the case of an accident by 71% in infants and 54% for children aged 1 - 4 years ('Seat-belts and child restraints: increasing use and optimising performance', European Transport Safety Council, 1996, quoted in World Report on Road Traffic Injury Prevention,[1] and Will and Geller[9]). Unrestrained children seated in the rear are 35% less likely to sustain fatal injuries than those seated in the front, and 44% less likely to sustain fatal injuries if they also use seatbelts.[8,10] The need for hospitalisation after an MVA among restrained children aged 4 years and younger is reduced by 69%.[11] Use of seatbelts by children seated on the rear seat will reduce injuries not only to the child but also to the driver and front passenger. Children seated on the back of a 'bakkie' (a light motor vehicle with a rear load area) cannot be appropriately restrained, and the practice of transporting children in this manner should not be condoned.

Many countries have legislated the mandatory use of child restraints. Yet, in an international study assessing seatbelt use in different countries, only 42% of respondents felt that the current level of seatbelt enforcement was 'very good'.[12] A study from the USA showed that 51% of 3 - 8-year-olds are inappropriately restrained in adult safety belts.[9] Despite the safety benefit of rear seating, 33% of children travelled in the front seat of motor vehicles; this increased to 56% when there were no adult or teenage passengers to sit in the front seat.[13]

A study done by the Medical Research Council of South Africa (MRC) reports that only 14.3% of learners always wear a seatbelt, and there is no significant variation by gender, 'race', age or grade.[5] In an invisible survey (the researcher remained unobserved and vehicles were not stopped) done by Arrive Alive in most provinces of South Africa, the percentage of drivers not wearing seatbelts ranged from 39.8% to 65.8%. Rates in urban areas were found to be even lower, possibly because urban road users believe that accidents at lower speeds are less perilous and seatbelts are therefore unnecessary.[14] Given the high rates of mortality and injury of children involved in MVAs, we investigated the seating position and use of child restraints in Bloemfontein, as well as possible associated factors.

Methods

A descriptive study method with a cross-sectional analytic component was chosen, and the study was carried out during a 4-week period in 2007. Bloemfontein was divided into more and less affluent areas. Using a random table, five 'more affluent' and three 'less affluent' sites were chosen. Selected observation sites had to have at least one pre-primary or primary school in the area. Stopping points both near and away from the schools were selected for all sites. Designated parking areas or stopping points on the school grounds were not used, as children might already have been released from their restraints. Four researchers (SFA, SB, PRD, JK) stood at each stopping point. They had enough time and a sufficiently clear view to record the assessments. The researchers worked in two pairs, one person observing the motor vehicles, the other recording the information. Only vehicles with children were included in the study. A child was defined as a person estimated by the observers to be 12 years or younger. Older vehicles with no rear seatbelts were included in the study, as the authors felt that car owners should have seatbelts fitted for optimal safety of passengers.[15] Vehicles were categorised as small (driver plus 3 passenger seats), medium (driver plus 4 passenger seats) or large (driver plus 5 or more passenger seats). A vehicle was judged to be overloaded if it was transporting more people than it was designed for. Minibuses, buses and trucks, as well as motor vehicles with tinted or covered windows, were excluded from the study.

The following observations were recorded by the researchers for each child in a motor vehicle: seating position of the child, whether child restraint was used and type of restraint, whether restraint was assessed to be appropriate according to the child's estimated age, driver's restraint, size of the vehicle, vehicle overloading, and whether the observation point was in an affluent or less affluent area.

It was estimated that the appropriate use of child restraints would be less than 10%. A sample size of 500 children would result in a confidence interval of 7 - 13%. Therefore 16 sites were chosen, to assess about 32 children per site.

A pilot study to test and refine the methodology was performed at two stopping points, observing 60 children. Approval for the study was obtained from the Ethics Committee of the Faculty of Health Sciences of the University of the Free State as well as from the Chief of Traffic of the Mangaung Municipality.

Results

A total of 512 children in 374 vehicles were assessed. Most vehicles carried only one (70.3% of vehicles) or two child passengers (25.1% of vehicles).

Sixty per cent of the children were seated in the rear of the vehicle, 39.6% were seated in the front, and 0.4% were seated in the back of an open bakkie. Of the 14.1% of children seated on other people's laps, 73.6% were on the front seat and 26.4% on the back seat.

Child restraint use in Bloemfontein was found to be 8.8% (95% confidence interval (CI) 6.6 - 11.6%) and appropriate restraint use to be 2.9% (95% CI 1.8 - 4.8%). None of the children sitting on laps were restrained. Of children seated in the front, 10.3% were restrained (only 2% appropriately), while in the rear only 7.8% were restrained (only 3.6% appropriately). There was an association between the affluence level of an area and child restraint use, with children in less affluent areas being less likely to be restrained than their counterparts in more affluent areas (1.0% v. 13.4% , $p<0.0001$) (Table I). A similar association was seen between area affluence and appropriate use of child restraints ($p=0.0023$). Driver restraint use was 17.4% (95% CI 13.9 - 21.5%). Twenty-four per cent of drivers in affluent areas were restrained, versus only 5.8% of drivers in less affluent areas.

TABLE I. CHILD RESTRAINT USE ACCORDING TO AREA

	Affluent (*N* (%))	Less affluent (*N* (%))	Total (*N* (%))
Not restrained	277 (86.6)	190 (99.0)	467 (91.2)
Restrained, but not appropriately	28 (8.7)	2 (1.0)	30 (5.9)
Restrained appropriately	15 (4.7)	0	15 (2.9)
Total	320	192	512

There was a strong association between driver restraint and child restraint ($p<0.0001$). (Table II). If a driver was restrained, the chance that all the children in the vehicle would be restrained was 10 times higher than when the driver was not restrained (95% CI 4.9 - 20.2).

TABLE II. ASSOCIATION BETWEEN DRIVER RESTRAINT USE AND CHILD RESTRAINT USE

	No children restrained (*N* (%))	All children restrained (*N* (%))	Some children restrained (*N* (%))	Total (*N* (%))
Driver not restrained	294 (95.1)	10 (3.2)	5 (1.6)	309 (100)
Driver restrained	38 (58.5)	21 (32.3)	6 (9.2)	65 (100)
Total	332	31	11	374

The percentage of overloaded vehicles was 13.4% (95% CI 10.3 - 17.2%). There was an association between area affluence and vehicle overloading ($p<0.05$); in affluent areas 9.3% vehicles were overloaded, while in non-affluent areas 20.4% were overloaded. In all of the 50 overloaded vehicles no child was restrained, while in non-overloaded vehicles 13% of children were restrained ($p=0.0227$).

Discussion

The limitations of the study are accuracy in estimation of the age and weight of the children (to assess appropriateness of child restraint) and affluence of the area. A similar study in Nigeria in 2005, which included 456 vehicles, showed that despite 95% of vehicles having seatbelts installed for drivers, only 48% of drivers were restrained and 4.1% of all children were restrained. Children were more likely to be restrained in vehicles where the driver was restrained (11.8% v. 3.5%). Twenty-eight per cent of children occupied the front seat, but only 10.8% of these were restrained. Most of these children were under the age of 4 years. Only 1.6% of children seated in the rear were restrained.[11]

An American study has also shown that children are 3 - 4 times less likely to be restrained if the driver is also unrestrained.[16] Drivers need to be buckled up and be held responsible for their passengers' safety. Driver restraint is consistently associated with higher use of restraints in children.[8]

In our study there was an association between child restraint use (and appropriateness thereof) and driver restraint use, vehicle overloading and 'affluence' of the area where these were observed. There is therefore a need to consider subsidising installation of safety belts in vehicles that do not have seatbelts. Child seats and booster cushions also need to be available at affordable prices. In the long term, the costs will probably be recovered from savings due to fewer injuries to child passengers.

Most developed countries have legislation to protect children travelling in motor vehicles. In South Africa, the wearing of seatbelts for passengers and drivers is compulsory in terms of regulation 213(4) of the National Road Traffic Regulation, under the National Road Traffic Act, 1996 (Act No. 93 of 1996). Regulation 213(5) also prohibits a person from occupying a seat that is not fitted with a seatbelt while a seat with a belt is unoccupied. Since 1995, all new cars in South Africa must have lap and shoulder belts on the front seats and at least lap belts on the rear seats.[17] For children aged between 3 and 14 years, the law states that 'The driver of a motor vehicle operated on a public road shall ensure that a child seated on a seat of the motor vehicle uses an appropriate child restraint where it is available in the motor vehicle or, if no child restraint is available, wears the seatbelt of an unoccupied seat which is fitted with a seatbelt, if available.'[18] However, there is no legal requirement for a child aged less than 3 years to wear a seatbelt unless there is a child seat or restraint, in which case the child must be seated and restrained in it. The general apathy of South Africans towards the use of child restraints begins with inadequate seatbelt laws for children. Despite high injury figures, there is 'an ambiguity about enforcement of safety measures', as well as an indifference of drivers to ensure the safety of their passengers.[2] The driver is liable for a fine should a passenger or child not be wearing a seatbelt.[19] Enforcement of seatbelt use in South Africa was given a score of 2/10 by the WHO.[4] Despite the availability of information, there is no culture of appropriate child seating and restraint use.

The process of reducing road traffic injuries and deaths by enforcing appropriate behaviour is not difficult.[20] In Finland the wearing of seatbelts increased drastically after law enforcement. Information and education campaigns were used only to emphasise the importance of the laws.[21] In a study from Cape Town on the reporting of paediatric trauma and safety, there was a plea for greater coverage by the media on the prevention of unintentional injuries. The media can assist with education and advocacy for child passenger and driver restraint in motor vehicles.[22]

The severity of child passenger injuries can be attenuated and deaths can be prevented by using childhood restraints correctly.[6] The 'four Es' of injury prevention need to be applied[23] (Table III).

We do not think that the problem is confined to Bloemfontein only; a similar pattern is probably present in the rest of South Africa. The World Health Organization recommends that member countries set and enforce seatbelt and child restraint laws for all vehicle occupants. A detailed manual has been published by the FIA (Fédération Internationale de l'Automobile: Foundation for the Automobile and Society). It is endorsed by four partner organizations (the World Health Organization, World Bank, FIA and Global Road Safety

TABLE III. PREVENTION OF INJURIES TO CHILD PASSENGERS IN CARS[1,5,20-25]

Education	• Awareness of legislation that drivers and passengers must wear restraints and children to be seated on rear seats • Teach older children • Use of media, pamphlets, road safety programmes in schools
Environment modification	• Infant seats available for sale or hire at lower cost • Availability and affordability of correct and age-appropriate child restraints
Engineering	• All cars to be fitted with seatbelts, front and rear
Enforcement	• Enforcement of legislation • Adding legislation for child restraints for children <4 years • High visibility of law enforcement

Partnership) and explains the planning and management of a seatbelt programme and how to develop, implement and evaluate such a programme. It is aimed specifically at policy makers and road safety practitioners and uses experience from countries that have succeeded in implementing high levels of restraint use. The manual is adaptable to the specific needs of a country.[6] South Africa should urgently tackle this problem to prevent unnecessary injuries, permanent disabilities and deaths as well as decrease financial losses. If the use of restraints is enforced, there would be a direct financial gain from less medical costs for the acute care and rehabilitation of victims.[15,17]

Safety as a human rights issue needs to receive priority attention.[2] Drivers, traffic authorities and politicians need to be convinced of the importance of wearing seatbelts.[1] Law enforcement of correct child restraint use will prevent much unnecessary suffering, and large financial savings will ensue. The New South Wales Centre for Road Safety (Australia) puts the message bluntly on an outside billboard and bumper sticker: 'No Belt. No Brains.'[26]

An American study has also shown that children are 3 - 4 times less likely to be restrained if the driver is also unrestrained.

Conflict of interest: None.

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