High levels of incorrect use of car seat belts and child restraints in Fife — an important and under-recognised road safety issue

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Abstract

Objective—To pilot data collection instruments and to make a preliminary estimate of the level of incorrect use of car seat belts and child restraints in Fife, Scotland.

Design—Cross sectional survey of cars containing adults and children at a number of public sites across Fife in 1995 to assess use of car occupant restraints. Trained road safety officers assessed whether seat restraints were appropriate for the age of the passengers and whether restraints were used correctly. These assessments were based on standards published by the Child Accident Prevention Trust.

Participants—The survey gathered data from 596 occupants in 180 cars: 327 adults and 269 children. Ten per cent of drivers who were approached refused to participate. Car occupant restraint was assessed in 180 drivers, 151 front seat passengers, and 265 rear seat passengers.

Main results—Three hundred and sixty one occupants wore seat belts, 68 were restrained by a seat belt and booster cushion, 63 in toddler seats, 25 in two way seats, and 18 in rear facing infant carriers. Ninety seven per cent of drivers, 95% of front seat passengers, and 77% of rear seat passengers were restrained. However, in 98 (52%) vehicles at least one passenger was restrained by a device that was used incorrectly. Seven per cent of adults and 28% of children were secured incorrectly. The commonest errors were loose seat belts and restraint devices not adequately secured to the seat. Rates of incorrect use were highest in child seat restraints, reaching 60% with two way seats and 44% with rear facing infant seats.

Conclusions—The incorrect use of car occupant restraints is an under-recognised problem, both by health professionals, and the general public. Incorrect use has been shown to reduce the effectiveness of restraints, can itself result in injury, and is likely to be an important factor in child passenger injuries. The correct use of car seat restraints merits greater attention in strategies aiming to reduce road traffic casualties. Areas of intervention that could be considered include raising public awareness of this problem, improving information and instruction given to those who purchase

child restraints, and encouraging increased collaboration between manufacturers of cars and child restraints, in considering safety issues.

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Keywords: road safety; road traffic accidents; car occupant restraints/seat belts.

Although the number of children killed or seriously injured in road traffic accidents has fallen in the last decade,¹ increasing use of child restraints has been found in the USA to be associated with an increase in the misuse of these devices.² In the USA rates of misuse of child restraints of over 60% have been documented.³ It has been proposed that misuse of car safety seats may now be an important factor in child passenger injuries.² One survey of children presenting to a paediatric emergency department found that 7% had injuries associated with misuse.⁴

The effectiveness of seat restraints in preventing injury is reduced when these are used incorrectly.^{5–10} In addition, certain injuries, such as chest and abdominal soft tissue injuries and whiplash injuries to the neck, have been described more commonly since the widespread use of occupant restraints. These injuries are thought to be due, in part, to incorrect use.^{5–11} Included among these are certain serious injuries, such as high cervical spine fractures in children and lumbar spinal dislocations ('seat belt syndrome'), which were previously rare but have become more common in recent years.^{9–10, 12–15} Adult seat belts have also been associated with increased reports of certain types of injuries, including bowel^{16–18} and lumbar spine^{19–20} injuries with lap belt use, and aortic,²¹ pancreatic,²² and cardiac²³ injuries with lap/shoulder belt use.

As the level of incorrect use of car occupant restraints was unknown in Fife and we could identify no relevant UK data published in the medical or public health literature, we carried out a survey to estimate the level of incorrect use of car seat belts and child restraints in Fife.

Methods

A literature search, contact with the Transport and Road Research Laboratory (TRRL) of the UK Department of Transport, and personal contacts within the road safety officer profession, failed to identify established data collection instruments or methods that could be applied in this survey. Accordingly, consultants with recognised expertise in in-car safety and

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Appendix

Five Health Board car occupant observation study questionnaire

Front seat passenger (3)		Centre passenger (2)	Driver (1)	
☐ Male	☐ Male	☐ Male	☐ Male	☐
☐ Female	☐ Female	☐ Female	☐ Female	☐
☐ 14 years +				
☐ Age in years if 1-13 years	☐	☐	☐ Age 17-29	☐
☐ Age in months if 0-1 year	☐	☐	☐ 30-59	☐
			☐ 60+	☐
☐ Unrestrained			☐ Unrestrained	☐
☐ Adult seat belt			☐ Seat belt	☐
☐ Booster cushion				
☐ 2 way seat (forward)				
☐ 2 way seat (backward)				
☐ Toddler seat (traditional)				
☐ Toddler seat (polystyrene)				
☐ Infant carrier (rear facing)				
☐ Carry cot (strapped)				
☐ Carry cot (unstrapped)				
☐ Occupant on lap				
Rear seat passengers				
(6)		(5)	(4)	
☐ Male	☐ Male	☐ Male	☐ Male	☐
☐ Female	☐ Female	☐ Female	☐ Female	☐
☐ 14 years +			☐ 14 years +	☐
☐ Age in years if 1-13 years	☐	☐	☐ Age in years if 1-13 years	☐
☐ Age in months if 0-1 year	☐	☐	☐ Age in months if 0-1 year	☐
☐ Unrestrained			☐ Unrestrained	☐
☐ Adult seat belt			☐ Adult seat belt	☐
☐ Booster cushion			☐ Booster cushion	☐
☐ 2 way seat (forward)			☐ 2 way seat (forward)	☐
☐ 2 way seat (backward)			☐ 2 way seat (backward)	☐
☐ Toddler seat (traditional)			☐ Toddler seat (traditional)	☐
☐ Toddler seat (polystyrene)			☐ Toddler seat (polystyrene)	☐
☐ Infant carrier (rear facing)			☐ Infant carrier (rear facing)	☐
☐ Carry cot (strapped)			☐ Carry cot (strapped)	☐
☐ Carry cot (unstrapped)			☐ Carry cot (unstrapped)	☐
☐ Occupant on lap			☐ Occupant on lap	☐
Vehicle details Registration ☐ E-M ☐ Front passenger airbag? Y/N Colour ☐ D or older ☐ Are head rests adjusted Y/N Other ☐ to correct height? (personal, Forces, etc)				
If there are unrestrained passengers in the car and seat belts available, please give details here Road safety officer.				

Guidelines for completion of questionnaire

If 'no' record details below	If 'no' record details below	If 'no' record details below	If 'no' record details below
Front seat passenger (3)	Centre passenger (2)	Driver (1)	
• Is restraint appropriate for weight/age of passenger? Y/N/D	1. Is restraint appropriate for weight/age of passenger? Y/N/D	2. Is seat belt correctly fitted to the car? Y/N/D	
• Is safety device correctly fitted to the car? Y/N/D	2. Is safety device correctly fitted to the car? Y/N/D	3. Is passenger secured correctly by seat belt or in a safety device? Y/N/D	
• Is passenger secured correctly by seat belt or in a safety device? Y/N/D	3. Is passenger secured correctly by seat belt or in a safety device? Y/N/D	4. Is seat belt/safety device in good condition? Y/N/D	
• Is seat belt/safety device in good condition? Y/N/D	4. Is seat belt/safety device in good condition? Y/N/D		
(6)	Rear seat passengers (5)		
• Is restraint appropriate for weight/age of passenger? Y/N/D	1. Is restraint appropriate for weight/age of passenger? Y/N/D	1. Is restraint appropriate for weight/age of passenger? (4) Y/N/D	
• Is safety device correctly fitted to the car? Y/N/D	2. Is safety device correctly fitted to the car? Y/N/D	2. Is safety device correctly fitted to the car? Y/N/D	
• Is passenger secured correctly by seat belt or in a safety device? Y/N/D	3. Is passenger secured correctly by seat belt or in a safety device? Y/N/D	3. Is passenger secured correctly by seat belt or in a safety device? Y/N/D	
• Is seat belt/safety device in good condition? Y/N/D	4. Is seat belt/safety device in good condition? Y/N/D	4. Is seat belt/safety device in good condition? Y/N/D	
If 'no' give details below	If 'no' give details below	If 'no' give details below	
Comments on incorrect use (from above)			
Car position 1 Comments.....			
Car position 2 Comments.....			
Car position 3 Comments.....			
Car position 4 Comments.....			
Car position 5 Comments.....			
Car position 6 Comments.....			
Where did you buy the safety device?			
☐ New (specify)	☐ Secondhand	☐ No answer	
Did anyone give you instructions on how to fit the safety device(s) or use the safety device(s)? Please give details			
.....			
If a problem is found, explore whether driver is aware of this:			
.....			
If they are aware of it, explore reasons, for example economic:			
.....			

experience in training were invited to run a two day course at which Fife road safety staff were trained in how to assess correct use of car restraints. Data collection instruments based on an established TRRL questionnaire were developed and piloted by road safety officers (appendix 1). Standards adopted for the assessment of correct use and definitions for appropriate age and weight for each device are those published by the Child Accident Prevention Trust (CAPT).²⁴

Seven sites were selected across all districts of Fife. These included car parks of supermarkets, leisure and recreation facilities, or outdoor centres. Observations took place on Saturday mornings and afternoons in August and September 1995. Two road safety officers carried out the survey by approaching cars as they entered the car park and stopping those that contained both adults and children. They invited the occupants to take part in a survey to assess correct use of seat restraints and to receive expert advice, as appropriate. Approximately 10% of drivers declined to take part, usually because of lack of time. Vehicle checks took between 10 and 25 minutes with the two officers working together. Assessment of correctness of use followed CAPT guidelines, recorded on a standardised recording form. Any problems identified were discussed with

the vehicle occupants. Once completed, the next suitable vehicle was stopped and invited to participate.

Data were entered into a dBase IV database (Ashton Tate) and analysed on SPSS for Windows (SPSS Inc) to produce frequency tables.

Results

Five hundred and ninety six occupants in 180 cars were surveyed. One hundred and thirteen vehicles were registered after 1 August 1987, 57 were registered before 31 July 1987, and for 13 the registration year was unknown. The fitting of rear belts became statutory in cars manufactured on or after 1 October 1986. The age of the car occupants, their position in the car, and the assessment of restraint use by position in the car and age of passenger, is shown in tables 1, 2, and 3.

DRIVERS

Six drivers (3%) were unrestrained, all in the 17–29 age category. On four (2%) occasions the drivers were recorded as being incorrectly secured by the seat belt.

FRONT PASSENGERS

Only five (4%) passengers were unrestrained, all above 14 years of age. Three children wore adult seat belts which were inappropriate for their age. Sixteen passengers were wearing a restraint device that was being used incorrectly. In four instances (3%) the safety device was not correctly fitted to the car, and in 15 cases (10%) the passenger was not correctly secured by the seat belt or safety device.

REAR PASSENGERS

Fifty (19%) passengers were unrestrained; 46 of these were travelling in vehicles registered before 31 July 1987 in which rear seat belts were not fitted. Only one passenger was travelling unrestrained in a car registered after 1 August 1987.

Of the 50 unrestrained passengers, five were aged 14 and over and 45 were aged between 1 and 13 years. A further 11 children wore adult seat belts inappropriate for their age. Fewer passengers (26) were sitting in the centre position than the right or left positions, but a much higher proportion of those in centre seats were unrestrained (54% compared with 15%).

Sixty five (25%) passengers were wearing a restraint device being used incorrectly: in 41 instances the restraint device was incorrectly fitted to the car, and in 45 cases the passenger was not correctly secured by the seat belt or safety device.

INCORRECT USE OF SAFETY DEVICES

Ninety eight occupants were incorrectly restrained. Of these, 13 were also inappropriately restrained, that is, an inappropriate age to use an adult seat belt, and the remaining 85

Table 1 Age categories of the drivers and passengers; results are number (%)

		Passengers			
		Front	Back left and right	Back centre	
Driver					
Age (years)	Age (years)				
17–29	60 (33)	14+	117 (78)	28 (12)	2 (8)
30–59	98 (54)	1–13	28 (18)	193 (81)	24 (92)
60+	22 (12)	<1	6 (4)	18 (7)	0
Total	180 (100)	Total	151 (100)	239 (100)	26 (100)

Table 2 Assessment of restraint use by position in the car; results are number (%)

	<i>Driver</i>	<i>Passengers</i>		
		<i>Front</i>	<i>Back left and right</i>	<i>Back centre</i>
Restrained — appropriately (for weight and age) and correctly	170 (94)	127 (84)	134 (56)	5 (19)
Restrained — appropriately (for age and weight) and incorrectly	4 (2)	16 (11)	60 (25)	5 (19)
Restrained — inappropriately for weight and age	—	3 (2)	9 (4)	2 (8)
Unrestrained	6 (3)	5 (3)	36 (15)	14 (54)
Total	180 (100)	151 (100)	239 (100)	26 (100)

Table 3 Assessment of restraint use by seat position and age of passenger; results are number (%)

	No	Unrestrained	Inappropriate restraint	Incorrect use of restraint
Drivers				
Adults	180	6 (3)	0	4 (2)
Front passengers				
Adults	117	5 (4)	0	12 (10)
Children (0–14 years)	34	0	3 (9)	4 (12)
Rear passengers				
Adults	30	5 (17)	0	2 (7)
Children (0–14 years)	235	45 (19)	11 (5)	63 (27)
Total				
Adults	327	16 (5)	0	18 (6)
Children (0–14 years)	269	45 (17)	14 (5)	67 (25)
Overall total	596	61 (10)	14 (2)	85 (14)

Table 4 Problems identified with restraints

Type of restraint used	No used	No (%) failed	Reasons for failing	No
Adults seat belts (13 of these occupants were an inappropriate age/weight for using an adult seat belt)	361	37 (10)	Twisted such that function impaired	15
			Belt not tight	10
			Diagonal strap crosses neck not shoulder	10
			Lap restraint crosses stomach not pelvis	5
			Clip buckle not fastened	1
Booster cushion	68	16 (24)	Frayed or worn webbing	1
			Booster cushion not attached to seat through hooks or ears	1
			Twisted such that function impaired	4
			Diagonal strap crosses stomach not pelvis	1
			Belt not tight	1
Two way seats (forward and backward)	25	15 (60)	Buckle does not work correctly	1
			Booster cushion not sitting securely on seat	1
			Safety device not secured tightly	10
			Retaining strap not tight	7
			Safety device not secured according to manufacturer's recommendations	3
Toddler seat (traditional and polystyrene)	63	22 (35)	Safety device not secured tightly	9
			Safety device not secured according to manufacturer's recommendations	8
			Retaining strap not tight	6
			Buckle not fastened	1
			Buckle not clipped	1
Infant carrier — rear facing	18	8 (44)	Retaining strap not tight	4
			Safety device not secured according to manufacturer's recommendations	3
			Safety device not secured tightly	1
			Buckle does not work correctly	1

Table 5 Child restraint devices: site of purchase and instruction given by retailer; results are number

Level of instruction given by retailer	Type of retailer			Total
	Motoring outlet	Baby outlet	Supermarket/ shop	
Demonstration and fitting	1	0	0	1
Demonstration	3	2	2	7
Instructions	8	8	1	16
No instructions	8	7	13	28
No answers	4	1	1	6
Total	24	18	17	59

occupants (16% of the 535 who were restrained) were using the restraint incorrectly. The most frequently identified problems are shown in table 4. The proportion of car occupants incorrectly secured by a restraint was much higher in children than adults (25% compared with 6%), and by restraint device used (60% of children in two way seats compared with 44% of infants in rear facing carriers, 35% of children in toddler seats, and 24% of children using booster cushions). In cars where a problem had been identified, only 19% of drivers were aware of these problems. Those who were aware of the problem either cited economic reasons for not correcting them or gave no explanation.

CHILD CAR RESTRAINTS

Seventy two child car restraints (80%) were purchased new. Details of the type of retailer and of instructions given at the time of purchase were asked in 59 cases and these are recorded in table 5. The level of correct use among those given some kind of instruction or demonstration and those not given any instruction is 60% and 53%, respectively. The degree of bias in these data due to selective recall of information over a period of several years is unknown.

Discussion

Properly used lap/shoulder seat belts are effective in reducing the risk of fatal and

serious injuries when car occupants are involved in accidents.²⁵⁻²⁸ The percentage reduction for fatalities has been estimated at between 18% and 45%, with the combination of shoulder plus lap belt being more effective than either individually.²⁹⁻³³ In addition, a 60% reduction in injuries has been documented.³⁴⁻³⁶ However, as car occupant restraint use reached high levels it becomes increasingly important to consider whether restraints are being used correctly.

Incorrect use of restraint devices lessens the protection they provide. Results from sled tests with belted dummies indicate the greater potential for serious head injury with as little as 25 mm slack in a seat belt.⁴ Investigations of severe or fatal injuries have shown excessive belt slack as an important contributor to injuries.^{5-6,8} Reports are predominantly from hospital based case studies and do not represent incidence data from which statements of risk can be inferred. They suggest, however, that further research to estimate risks associated with incorrect use is needed, and that health workers should be aware of the different pattern of injuries found among restrained passengers involved in accidents compared with those who are unrestrained.

In this study of 596 car occupants in Fife, in cars with seat belts fitted, 97% of drivers and 83% of passengers were travelling protected by a seat belt or other restraint device. The level of rear seat restraint use in cars with rear belts fitted as standard was significantly higher, at 96%. We therefore expect that rear seat restraint use will continue to rise as the proportion of cars without rear seat belts falls. The study population can be described in terms of two significant populations—one being occupants of older vehicles without seat belts in their rear seats, and people with newer cars with seat belts in the rear of the vehicle. Impressively, the majority of individuals in newer cars with seat belts in all seating positions had only 12 unbelted occupants. The large proportion of unbelted children in the study in older cars may arise from families in Fife having limited resources and driving

cheaper, less safety equipped cars. Individuals in these cars indicated that they could either not afford an appropriate restraint, or to get seat belts fitted would be too expensive on a car that is old and of limited value.

Approximately 3% of these passengers, however, use a method of restraint that is inappropriate, albeit not illegal (see table 6) for their age and weight. Most of these are 6–10 year old children using a seat belt that crosses their neck rather than their chest. Furthermore, in 52% of all vehicles surveyed there was at least one occupant using a restraint device incorrectly. The proportion of child car occupants incorrectly secured by restraint devices was 25%. The level of incorrect use was particularly high in children restrained in car safety devices, where 35% were used incorrectly. The proportions of the various devices used incorrectly were: two way seats 60%, rear facing infant seats 44%, toddler seats 35%, and booster cushions 24%.

A sample that only included cars containing both adults and children, the selection of supermarkets and lesiure/recreation/outdoor facilities as survey sites, and the conduct of the surveys on Saturday may all have biased the sample studied. Furthermore, the 10% of drivers who refused to participate may have been less likely to be wearing restraint devices and no comparison data were gathered from suitable cars that were not invited to participate. This, and the biased sample, may explain the finding of higher rates of car occupant restraint in this survey compared with those in previous surveys in Fife that used TRRL sampling methods and studied over 3500 vehicles.³⁶ The unusually high rates of restraint use in this survey may suggest that this sample is over-represented with safety conscious families. To the extent that these families also attend more closely to purchasing appropriate restraints and using them correctly, the sample may tend to *underestimate* the level of incorrect use of restraints.

Nevertheless, the high rates of incorrect use are consistent with a similar survey carried out by the British Standards Institution in 1990,³⁷ findings from vehicle safety checks carried out by the Royal Automobile Club in the UK (John Lyus, In-Car Safety Centre, personal communication), and data from the USA.³ Our precise definition of incorrect use was closely based on

accepted standards published by CAPT,²⁴ and we trained road safety officers in the practical assessment of restraints in relation to these standards. Thus the faults we report are serious in that they compromise the effectiveness of the restraint devices^{8 9} or may directly result in serious injury.^{12 13}

We were unable to distinguish between incorrect use resulting from misuse and that due to poor design of restraint systems. For example, it is considered that the increase in high cervical spinal injuries in children is due to the lack of top tethering because these injuries are rarely seen in Australia where top tethers are mandatory. It may be, therefore, that in some situations current child seat restraints simply cannot be tightened sufficiently when using an adult lap and diagonal seat belt with an inertia reel. Car manufacturers appear to give highest priority to the effectiveness of restraint of adults rather than children. Currently, seat belt anchorage points are being moved further forward to place the lap strap across adult thighs rather than the stomach. This makes it more difficult to secure child seats safely. Moreover, car seats and belts are rigorously tested to ensure adequate protection of adult occupants. Child seats, unlike adult car seats, are not made by the car manufacturers and thus car manufacturers do not test the performance of child restraints in their vehicles.³⁸

The level of incorrect use of seat belts in serious accidents that result in car occupant injuries or fatalities is not known. Data on seat belt use at the time of accidents has not been collected by the police during accident investigations since 1994. A study of fatalities among restrained children in UK road traffic accidents from 1979–94 carried out by Vehicle Safety Consultants, Silverdale, Lancashire, England on behalf of the TRRL has shown that, where information on correctness of restraint of children was recorded, 38% of these children were restrained incorrectly at the time of the fatal accident (SJ Rattenbury, personal communication). It is not known what proportion of these deaths would have been avoided if the restraint had been used correctly.

Implications for prevention

In summary, the levels of car occupant restraint use found in this survey in Fife are high in vehicles with seat belts fitted. In part this reflects the design of the survey, which selected vehicles in family use at weekends. Despite studying this safety conscious group, however, examples of incorrect use of restraints were found in 52% of vehicles surveyed. The rates of incorrect use were substantially higher in children and were particularly associated with specific types of child car restraints. Action to address this problem is required across a number of related areas. More attention should be given to child safety in car and car seat belt design.⁵ Efforts should be made to encourage car and car seat manufacturers to provide information that highlights common faults in restraint use and

Table 6 Car occupant restraint: summary of legal requirement in the UK in 1996

	Front seat	Rear seat	Responsibility
Driver	Seat bealt must be worn if fitted	–	Driver
Child under 3 years	Appropriate chid restraint must be used	Appropriate child restraint must be used if available	Driver
Child aged 3–11 and under 1.5m (approx 5ft)	Appropriate child restraint must be worn if available. If not an adult seat belt must be worn	Appropriate child restraint must be worn if available. If not an adult seat belt must be worn if available	Driver
Child aged 12 or 13 or younger child 1.5m (approx 5ft) or more in height	Adult seat belt must be worn if available	Adult seat belt must be worn if available	Driver
Adult passengers	Seat belt must be worn if available	Seat belt must be worn if available	Passenger

that provide proper instruction in their correct use.¹⁴

Health care professionals need appropriate guidelines^{39 40} so that they can provide up-to-date information for parents regarding their car safety seat choices and use.⁴¹ Including discussion of car safety as a routine part of child health promotion programmes is an important new initiative.⁴² In Fife we have also held awareness raising seminars outside the health sector for social work department staff who deal with young children and their families, nursery staff, childminders and nannies, as well as vehicle registration and inspection service staff.

Community initiatives such as the establishment of infant car seat loan schemes have been shown to be effective and should be explored further.⁴³ Since it has been shown that lack of parental knowledge about child restraint device use contributes to improper use of these devices,⁴⁴ efforts should be made to raise public awareness and knowledge of this issue.^{44 45}

In the UK, the 'In-Car Safety' initiative has organised public displays and open access In-Car Safety clinics at which the public can receive a free car restraint safety check. It is important that priority is given to these initiatives and that this is coupled with on-going evaluation so that the most effective initiatives in any setting are identified. Without such activity the potential for reducing road traffic accident injuries and fatalities will not be fully achieved.

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