TRANSPORT RESEARCH LABORATORY

National hospital study of road accident casualties

Prepared for Road Safety Division, Department of the Environment, Transport and the Regions*

***DETR customer: D O'Reilly**

H F Simpson

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Executive Summary

The Department of the Environment, Transport and the Regions aims to reduce the number of road accidents by a third of the 1981-85 average by the year 2000. To achieve this aim more detailed information on the numbers and types of accidents occurring is required so that resources can be directed most effectively. Some safety measures are expected to reduce severity rather than avoid injury altogether. Currently, the only national information on road accidents and casualties is that collected by the police and recorded in the Stats19 database, but it is recognised that many injury accidents are not reported to the police and are therefore excluded from national statistics. Also, the injury severity of casualties is categorised into three levels within Stats19; fatal, serious and slight and so changes in injury severity may be difficult to detect. Hospital studies can provide more detailed information on both reported and non-reported accidents, and can provide more detailed information on injury severity, to enhance our knowledge of the types and numbers of accidents occurring.

Previous hospital based studies have been regionally based or concerned with sub-groups of patients, such as in-patients, so a research project was set up to collect information on all road accident casualties attending the Accident and Emergency Departments of a sample of hospitals across Britain over a three year period from 1993 to 1995. From this information, estimates of the characteristics and severity of road accident casualties have been made.

This report presents the results of information collected during the study. The results are in line with those expected from a hospital based study and show that in some respects the characteristics of casualties attending hospital are similar to those of casualties in police reported accidents, for example the large proportion of casualties injured on urban roads. In other respects their characteristics are dissimilar, for example, a relatively large proportion of pedal cyclists and single vehicle accidents.

Casualties recorded in the hospital survey were more severely injured than those recorded in police data, with around a quarter of casualties classed as seriously injured compared with 15 per cent of casualties in Stats19. Within both the hospital and police data, casualties who were seriously injured were more likely to be in the younger or older age groups and to be pedestrians, pedal cyclists or motorcyclists (the vulnerable road users). Slight casualties tended to be middle-aged and to be vehicle occupants.

One of the aims of the study was to assess the injury severity of casualties in more detail. Severity was estimated in terms of the Abbreviated Injury Scale (AIS) and in terms of length of stay in hospital for seriously injured casualties and in terms of injury type in the case of slight casualties. Severity was more widely spread among serious casualties than among slight. Among serious casualties, pedestrians and motorcyclists were shown to have more severe distributions of severity than pedal cyclists and vehicle occupants. Among slight casualties, the incidence of whiplash injury (one of the more severe injuries classified as slight) was greater for vehicle occupants, especially car and goods vehicle occupants and the middle-aged.

Information on the part of the body injured, and type of injury was also collected. This allowed the nature of injuries sustained by different road user groups to be investigated. Significant differences between the road user groups emerged, particularly the high incidence of head injuries amongst pedestrians and pedal cyclists, injuries to the lower limbs amongst motorcyclists and bus occupants, and the prevalence of neck injuries to other vehicle occupants. Pedestrians, pedal cyclists, motorcyclists and bus occupants were also more likely to sustain serious injuries which were fractures but these were less common amongst other road users. Vehicle occupants were more likely to suffer slight injuries which were whiplash and sprains/strains, whereas cuts and bruises were more likely for other types of road user.

Details of the involvement of the ambulance, police and fire services following road accidents were also collected. Use of such services was greater following accidents in the following circumstances: where casualties were more seriously injured; where injured vehicle occupants or more than one vehicle were involved; following accidents on rural roads and motorways.

Comparison of the results for 1993, 1994 and 1995 showed that there had been some small but statistically significant changes. The proportion of pedal cyclist casualties and casualties on rural roads had increased from year to year. There was also an increase in the proportion of road users injured as the result of a fall from a vehicle which was likely to be associated with the increase in pedal cyclist casualties. In contrast the proportion of pedestrians, casualties injured on urban roads and those injured in collisions had decreased. There was also evidence of an increase in the proportions of casualties with no injury and serious injury, with a consequent decrease in the proportion of slightly injured casualties. The distribution of severity in terms of AIS became more severe for serious casualties and the proportion of slight casualties with whiplash increased.

The study showed that there are some clear differences between the characteristics of casualties recorded in the hospital survey compared with those recorded in police casualty data. The hospital data also enabled the injury types and severity of casualties to be investigated in more detail than is possible using currently available national data. This type of study therefore provides an important additional source of information on the nature of road accident casualties which can be used to identify and clarify possible areas where investment in safety measures might bring the greatest returns.

1 Introduction

The Department of the Environment,Transport and the Regions (DETR) aims to reduce the annual number of casualties by a third of the 1981-1985 average by the year 2000. Accurate information is required on the numbers and types of accidents that occur to aid decisions on road safety investment and to ensure that resources are directed most cost effectively. Currently, the only nationally available road accident figures are based on data collected by the police who attend road traffic accidents or have details reported to them. However, some accidents and casualties are not reported to the police, particularly accidents involving 'vulnerable road users' such as pedestrians, pedal cyclists and motorcyclists, and casualties who have less severe injuries. In addition, police officers are not medically trained and so within the police-reported data, injury severity is classified into one of only three broad categories: fatal, serious or slight by the officer who records details of the accident. Definitions of the categories are given in Appendix A.

Hospital-based surveys can provide more comprehensive information on the numbers of road accident casualties as both reported and unreported casualties are included. In addition, more accurate and detailed information on injury type and location, as diagnosed by medical staff, is recorded for each casualty. It should be noted, however, that there are limitations to hospital data in so far as not all road accident casualties necessarily attend an Accident and Emergency Department. Previous hospital based surveys have been carried out but these have generally been based on a single hospital or area, or have been concerned with in-patients only and there is currently no national collection of information from hospitals on road accident casualties. The DETR therefore funded a research project to collect information on all road accident casualties who attended the Accident and Emergency (A & E) Department of a sample of hospitals in Great Britain for treatment following a road accident. Collection of such information provides a more comprehensive picture of the nature of road accidents and casualties.

1.1 Data collection

Casualty data were collected via the Department of Trade and Industry's Accident Surveillance System. This is an ongoing survey of casualties who attend the A & E Departments of a sample of 18 hospitals in the UK following accidents at home or during leisure activities outside the home. The hospitals in the sample were selected from those which have a 24-hour A&E Department receiving at least 10,000 casualties per year. The selection of hospitals took into account their size and geographical area of the country. From November 1992 until December 1995, the survey was extended to collect data on road accident casualties from the 17 hospitals located in Great Britain (ie the hospital in Northern Ireland was excluded). A list of the hospitals participating in the survey during the period when road accident data were collected is given in Appendix B.

Data were collected by teams of part-time survey clerks based at each hospital who identified patients who attended the A & E Department whose injuries resulted from a road accident. A road accident was defined as 'any accident occurring on the highway (including the footway) in which one or more vehicles is involved'. The information collected included accident circumstances such as when, where and how the accident happened, casualty details such as age, sex and road user type, involvement of the police, fire and ambulance emergency services and clinical details of each casualty's injuries together with their outcome or referral for further treatment.

For all patients, clinical information, age and sex and time of arrival at hospital were collected directly from medical records. Confidentiality was ensured as details of names and addresses were not recorded. In addition, where possible, information about the accident circumstances was collected by the survey clerk during a short interview with the patient whilst they were waiting for treatment in the A & E Department. In some cases, for example, where the casualty was a child, an accompanying adult or relative was interviewed. The clerks also asked police, ambulance staff and nurses for additional details where possible. Overall, an interview took place in 33 per cent of cases, either with the patient or an accompanying adult. As might be expected, interviews were more likely in the case of slightly injured casualties and were also more likely for females and for pedal cyclists, car, bus and light goods vehicle occupants even after severity was taken into account. An interview was also more likely following accidents involving road users aged under 16 because although these casualties could only be interviewed in the presence of an adult, they were also more likely to be accompanied to hospital. If an interview was not possible, for example if the patient was too badly injured or was treated immediately, as much information as possible was taken from the medical records and recorded by the clerks onto the survey form in addition to the clinical information normally extracted.

Details of the casualties and accidents were entered onto computer at the hospitals and then transferred to a central database held by the DTI. Road accident information was extracted and forwarded to the Transport Research Laboratory (TRL) to form a separate database.

Details of fatalities were collected, but they are under-represented in the survey as casualties who die at the scene of an accident will not necessarily be taken to hospital. In addition, the hospitals differ in their procedures for casualties who are dead on arrival which means that some fatalities may not be registered in the A & E Departments. Casualties who die after being registered in the A & E Department are recorded but are not considered to be representative of all fatalities. Also, road accident fatalities are generally considered to be well recorded in police figures. For these reasons fatalities were excluded from the analysis in this report. Details of a total of 68,357 non-fatal casualties were collected; around 20,000-25,000 casualties each year.

This report summarises the information obtained during the three year period from January 1993 to December

1995. Section 2 of the report outlines the characteristics of the casualties and their accidents, Section 3 presents information on the differences between casualties of different levels of severity and details of the injuries sustained, and Section 4 identifies the level of involvement of the emergency services.

1.2 Comparison with police casualty data

The results from the hospital survey are compared, where possible, with national police casualty data to identify any differences in the nature of the casualties recorded in each. When an injury accident is reported to the police the details of the accident circumstances, the vehicles involved and the resulting casualties are recorded in a standard format onto a Stats19 report form. Details of all casualties and accidents reported nationally are collated and held centrally by the DETR on the Stats19 database, and summary tables of the information collected each year are published in the annual publication 'Road Accidents Great Britain'. As mentioned earlier, at present, the Stats19 reporting system provides the only national road accident statistics. Hospital data can supplement this information, since not all casualties who attend hospital are known to the police. The Stats19 data used for comparison with the hospital data were for the same period, January 1993 to December 1995: in this period there were approximately 920,000 casualties.

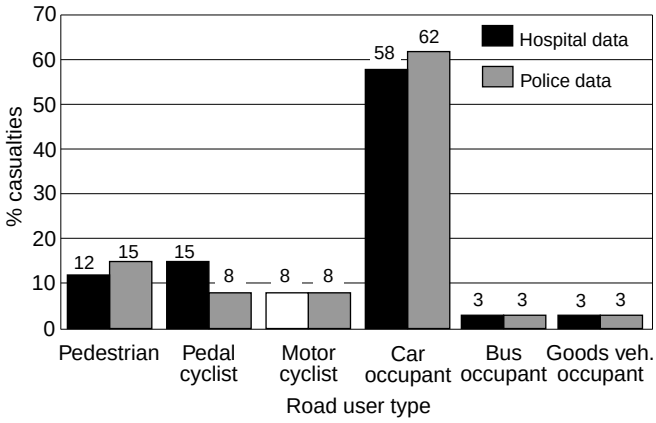
2 Casualties and accidents

This section presents details of the casualties who attended hospital and the accidents in which they were involved.

2.1 Road user type

Casualties were assigned to a road user group based on whether they were a pedestrian or a vehicle occupant and the type of vehicle they were travelling in at the time of the accident. To allow comparison with police data, the road user groups were consistent with those used in the Stats19 database. Six groups were used; pedestrians, pedal cyclists, motor cyclists (including moped and motor scooter riders), car occupants (including occupants of taxis, motor caravans and minibuses), bus/coach occupants and goods vehicle occupants. Figure 1 shows the proportions of casualties of different types who attended hospital, and for comparison, the proportions recorded in national police data. The hospital data contained a much larger proportion of pedal cyclists than the police data, and slightly lower proportions of pedestrians and car occupants. The proportions of motorcyclists, bus occupants and goods vehicle occupants were the same in both data sources. Hence, use of police data alone may result in an under-estimate of the relative numerical importance of pedal cyclist casualties, and an over-estimate of the relative importance of pedestrians and car occupant casualties.

A Chi-squared test was used to establish whether there were any significant variations in the proportions of road user types in the hospital data over the three years of the



Sample size (hospital data): 62234

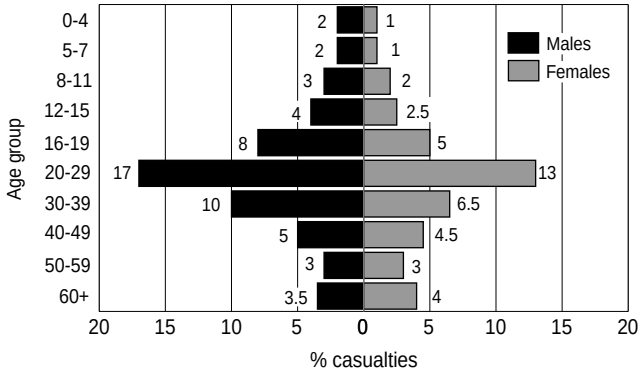
Figure 1 Distribution of road user type within hospital and police casualty data

study. Because of the large sample size, quite small differences in the proportions of casualties in each road user group were found to be significant. The proportions of pedestrians had decreased from 13 to 11 per cent, and the proportion of pedal cyclists had increased from 13 to 16.5 per cent.

2.2 Age and gender

Details of each casualty's age and gender were collected from medical records. Overall, more males than females attended hospital for treatment; 57 per cent of patients were male and 43 per cent were female. The same proportions as are found in the Stats19 data.

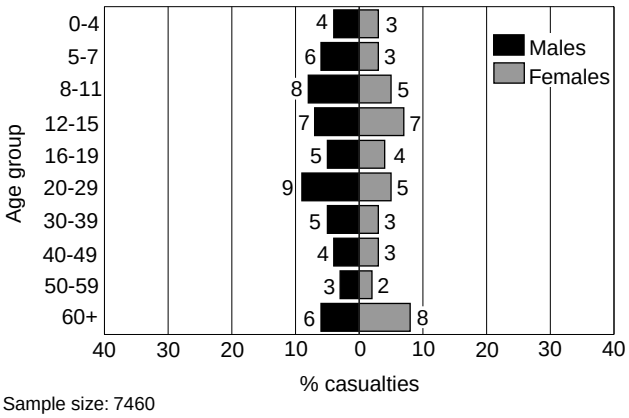
A detailed breakdown of the patients by type of road user and age is given in Table 17 in Appendix C. The age distribution for casualties who attended hospital is shown in Figure 2. The percentages of casualties in each age and gender group are shown at the end of each bar. The distribution shows that casualties who attended hospital were predominantly young; nearly a third were aged under 20 years and three-quarters were aged under 40.



Sample size: 67920

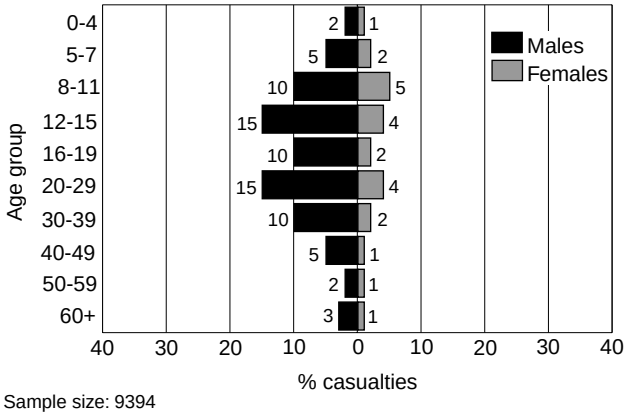
Figure 2 Distribution of casualties by age and gender

Figures 3a to 3f show the age distributions within each of the road user groups. Considerable differences in the proportions of casualties in each age band and the relative



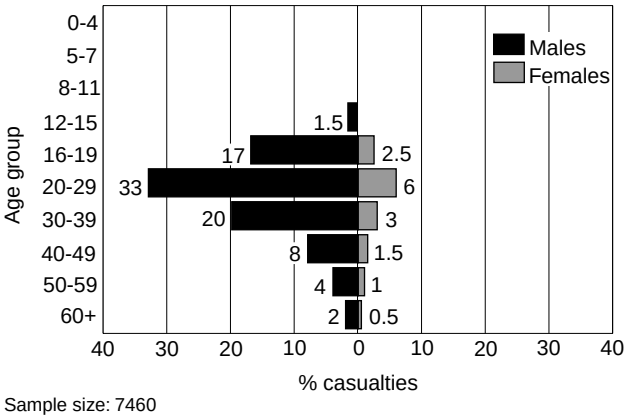
Sample size: 7460

Figure 3a Age/gender distribution: pedestrians



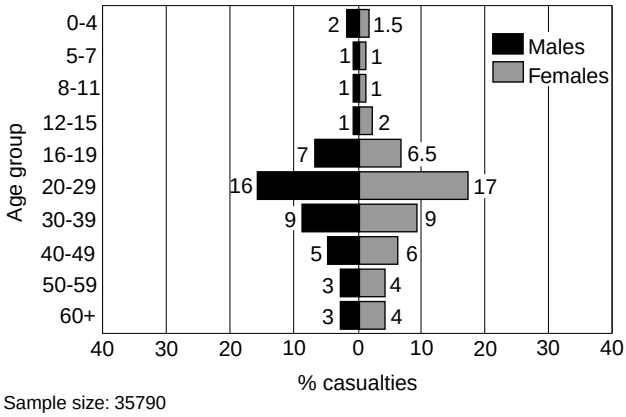
Sample size: 9394

Figure 3b Age/gender distribution: pedal cyclists



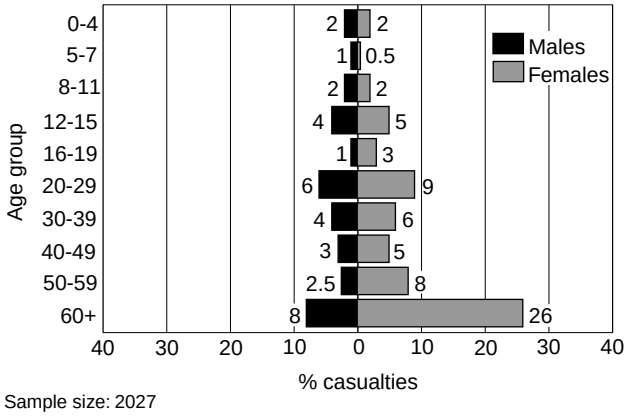
Sample size: 7460

Figure 3c Age/gender distribution: motorcyclists



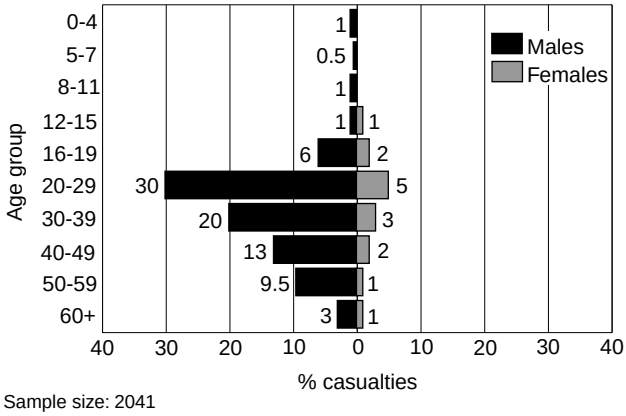
Sample size: 35790

Figure 3d Age/gender distribution: car occupants



Sample size: 2027

Figure 3e Age/gender distribution: bus occupants

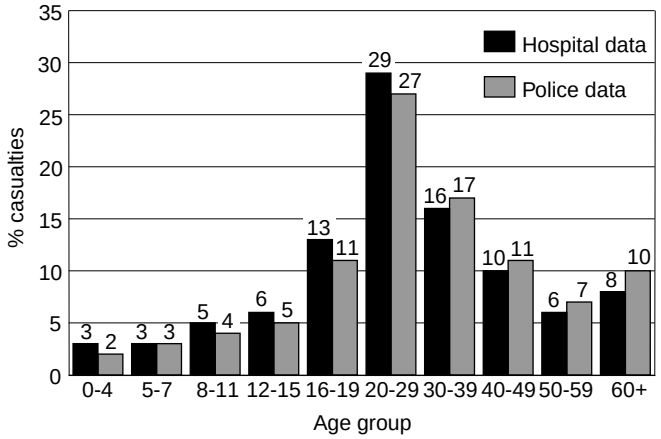


Sample size: 2041

Figure 3f Age/gender distribution: goods vehicle occupants

mix of males and female casualties may be seen within the different road user groups. In particular, there is a predominance of young males among pedal cyclists and motorcyclists, and older females among bus occupants.

The age distributions of casualties in the hospital sample were compared with those of casualties recorded in police data. Figure 4 shows the percentages of casualties in each age group. In comparison with police data, the hospital data contained greater proportions of casualties aged up to 30 years old and lower proportions in the older age groups. This implies that police records may under-estimate the numerical importance of younger casualties.



Sample size (hospital data): 67920

Figure 4 Distribution of age within hospital and police casualty data

Separate comparisons of the age distributions for casualties within the hospital survey and police data for each road user group are shown in Figures 5a to 5f. In general, the distributions are very similar but the hospital data tend to contain relatively high proportions of casualties in younger age groups and low proportions in other age groups for all road user groups.

2.3 Time of accident and arrival at hospital

Casualties who were interviewed were asked about the time of the accident. The exact time was recorded if it was obtained from the interview or recorded in the medical records. The accident time was also estimated within the following broad time bands by the patient or by the survey staff if the exact time was unknown: early morning (midnight -0659), morning (0700-1159), afternoon (1200-1559), early evening (1600-1959) and late evening (2000-2359). Around a quarter of casualties were involved in accidents in the morning, afternoon and early evening (25, 26 and 28 per cent respectively), 14 per cent were in accidents which occurred in the late evening and 7 per cent were in accidents in the early morning. An identical distribution of casualties across these accident times was found for casualties recorded in police data.

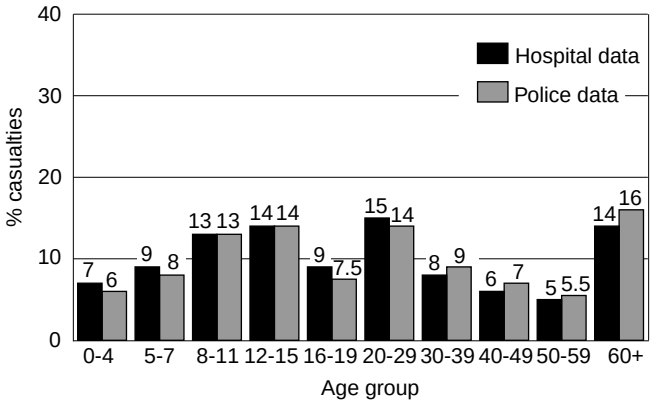
The exact hour of the accident was recorded for around half of casualties. Figure 6 compares the distribution of accident times for casualties who attended hospital with those recorded nationally in police data. Both distributions show an increase in casualties during the morning and through the day, peaking at 0800 and 1700. After 1700 the numbers of casualties decreased steadily through the evening and into the early hours of the morning. The hospital and police distributions are very similar, but higher proportions of casualties in accidents which occurred in the evening, the early hours of the morning and the morning peak were recorded in the police data, whereas the hospital data contained a larger proportion of casualties in accidents which occurred in the afternoon and early evening. These differences were statistically significant.

In addition to the time of the accident, the time when the casualty registered in the A & E Department (i.e their arrival time) was recorded for all casualties. Figure 7 shows that, as might be expected, the distribution of arrival times reflects that of the accident times, with the peaks falling around an hour later. Overall, around 1-2 per cent of all patients arrived each hour between midnight and 0800, 3-4 per cent per hour between 0800 and 0900, 5-6 per cent per hour between 0900 and 1600 and 7-8 per cent per hour between 1600 and 2000. After this the proportion decreased to 5-6 per cent each hour between 2000 and 2100 and 3-4 per cent per hour from 2100 until midnight.

2.4 Accident location

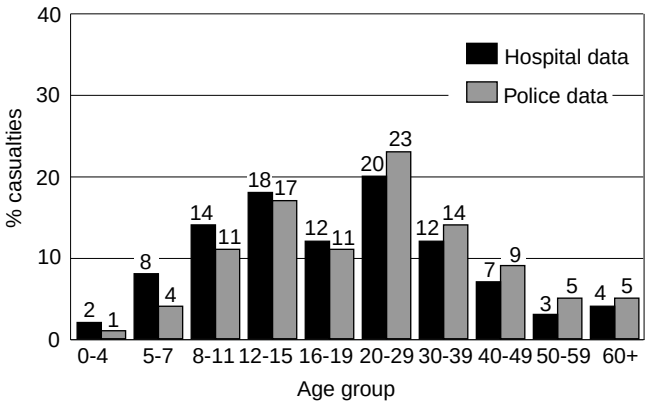
All casualties included in the study were involved in accidents which happened on the highway, but where possible the accident location was coded in more detail in terms of the type of road on which the accident happened. Casualties who were interviewed were asked to describe the type of road on which their accident occurred and to estimate the speed limit. The accident location was coded into one of three categories: motorway (including A(M) roads), urban road (non-motorway road with speed limit of at most 40 mph) and rural road (non-motorway road with speed limit over 40 mph). Where speed limit was not known, casualties were asked whether the road had street lighting and whether it was in a built up area or in the country. Roads in built up areas with street lighting were classed as urban and roads in country areas were classed as rural. Locations in urban areas with no street lighting or those in country areas with street lighting could not be assigned a road type as the likely speed limit was less certain.

Three-quarters of the casualties who attended hospital were injured on urban roads, 20 per cent on rural roads and 5 per cent on motorways. Table 1 shows that, within the hospital data, the proportion of casualties on each type of road varied with type of road user. The proportions of motorcyclists, car and goods vehicle occupants injured on rural roads were above average, as were the proportions of goods vehicle and car occupants injured on motorways. National police casualty data showed a lower proportion of casualties on urban roads, a higher proportion on rural roads and about the same proportion on motorways. In comparison with the hospital data, the police data showed a similar pattern of distribution by road user type but higher proportions of car occupants, bus and goods vehicle



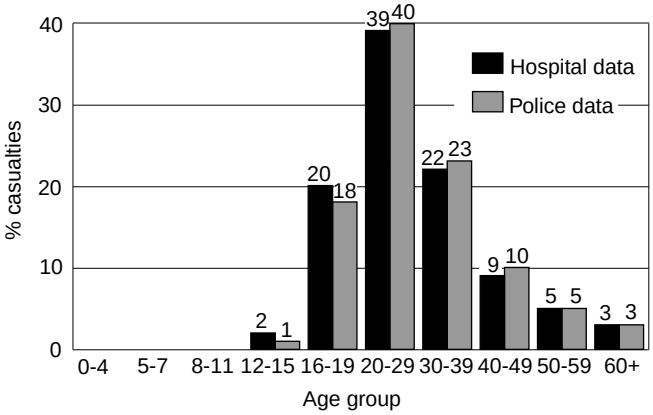
Sample size (hospital data): 7470

Figure 5a Age distributions: pedestrians



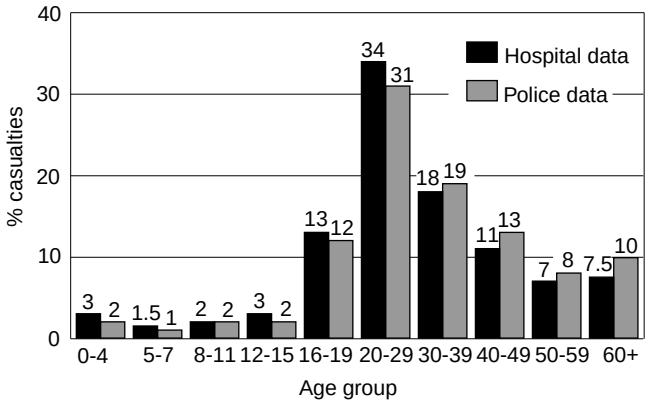
Sample size (hospital data): 9399

Figure 5b Age distributions: pedal cyclists



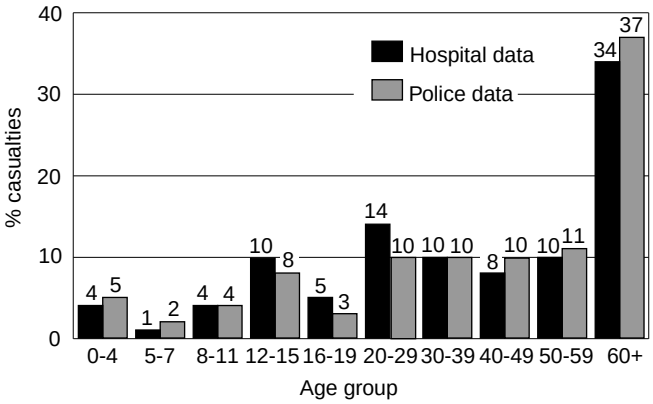
Sample size (hospital data): 5151

Figure 5c Age distributions: motorcyclists



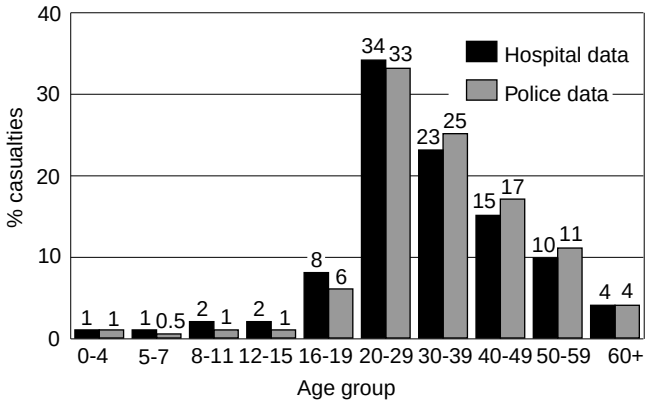
Sample size (hospital data): 35831

Figure 5d Age distributions: car occupants



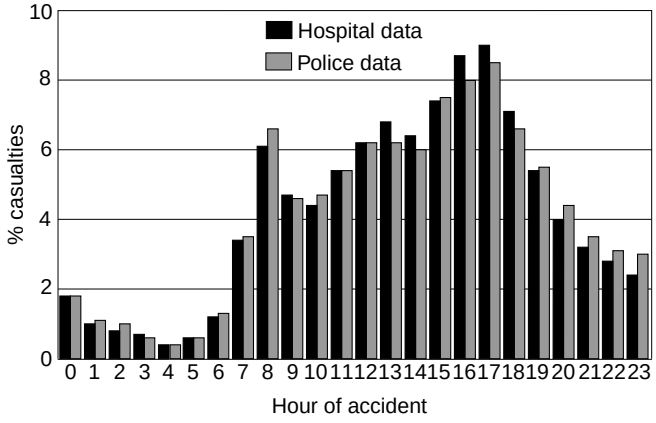
Sample size (hospital data): 2030

Figure 5e Age distributions: bus occupants



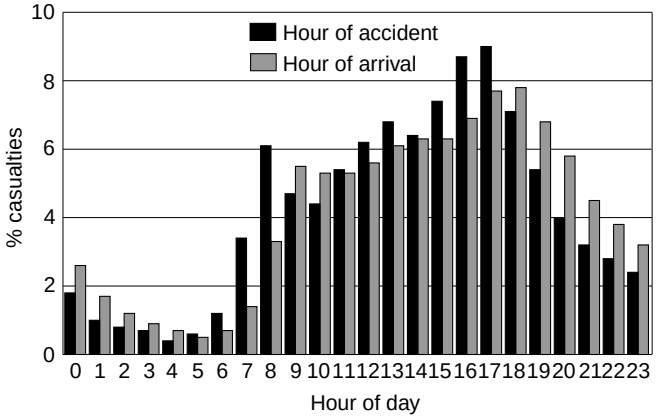
Sample size (hospital data): 2043

Figure 5f Age distributions: goods vehicle occupants



Sample size (hospital data): 35152

Figure 6 Distribution of accident times



Sample sizes: 35152 (accident hour); 68321 (arrival hour)

Figure 7 Distribution of accident and arrival times

Table 1 Percentage of casualties injured on each type of road

		Accident location		
Road user type		*Urban road*	*Rural road*	*Motorway*
Pedestrian	Hospital data %	96	4	<0.5
	Police data %	96	4	<0.5
Pedal cyclist	Hospital data %	91	9	<0.5
	Police data %	91	9	<0.5
Motorcyclist	Hospital data %	73	25	2
	Police data %	74	24.5	1.5
Car occupant	Hospital data %	67	26	7
	Police data %	60	35	5
Bus occupant	Hospital data %	90.5	7.5	2
	Police data %	87	11	2
Goods vehicle	Hospital data %	55	31	14
occupant	Police data %	45	44	11
All casualties[1]	Hospital data %	75	20	5
	Police data %	69	27	4

[1]*including other/unknown road user types*
Sample size (hospital data): 41159

occupants were recorded on rural roads. This could be because the hospital sample is biassed towards urban locations as smaller, more rural towns are less likely to have sufficient numbers of casualties attending the A & E Department. The distributions of accident locations for pedestrian and pedal cyclist casualties were the same in both the police and the hospital data.

The proportion of casualties injured on rural roads increased from 18 to 21 per cent and on urban roads decreased from 77 to 73 per cent over the course of the survey. There was no similar trend within Stats19.

In addition to comparing the percentages of each road user type injured on each type of road, the relative mix of casualties recorded on urban roads, rural roads and motorways within the hospital and police data were compared, shown in Figure 8.

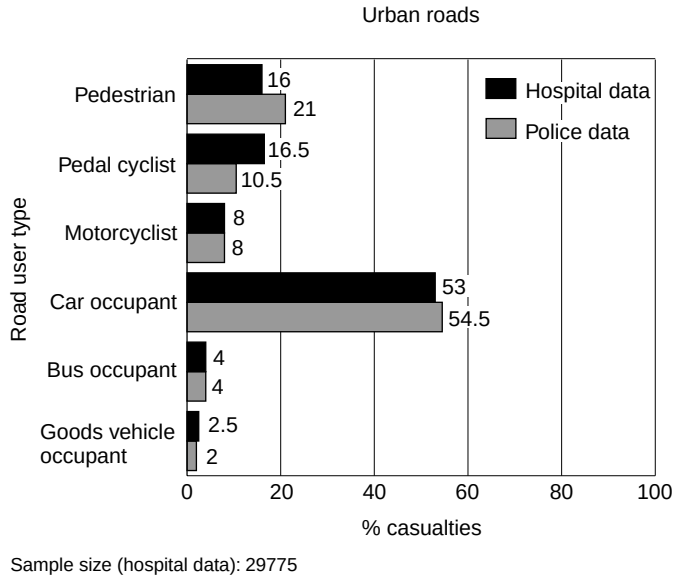
On urban roads the vulnerable road users (pedestrians, pedal cyclists and motorcyclists) as a group accounted for about two fifths of casualties and this was the case in both the hospital and police data. However, the hospital data contained a relatively higher proportion of pedal cyclists and the police data a relatively higher proportion of pedestrians. On rural roads the hospital data contained higher proportions of both pedal cyclists and motorcyclists and a higher proportion of vulnerable road users overall (18 per cent compared with 12 per cent in police figures). Consequently the proportion of vehicle occupant casualties on rural roads in the hospital survey was lower than that recorded in police figures. The mixture of casualty types recorded on motorways was similar in both data sources, and heavily dominated by car occupants.

2.5 Accident type

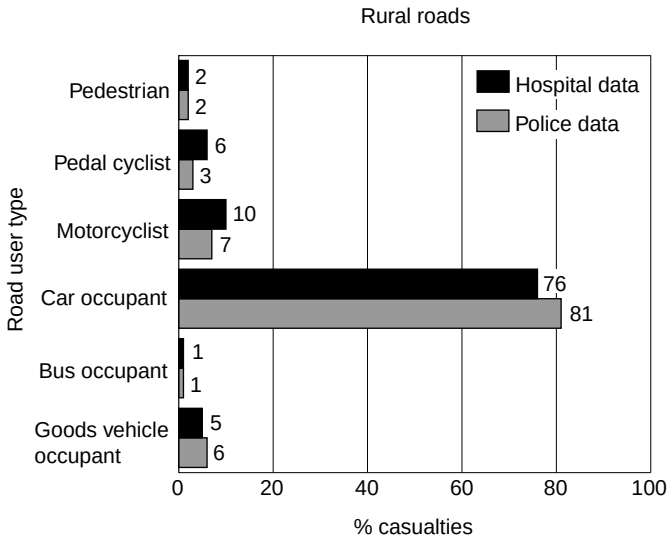
Information on how the accident happened was obtained from interviews with the casualties or from medical records. Using the information, the survey staff assigned an accident type code to each casualty. Six broad accident types were identified. These were: a collision between road users; a skid, swerve or jackknife; a sudden vehicle manoeuvre; a fall from a vehicle; an accident boarding or alighting a vehicle; an accident inside a vehicle. The proportion of casualties injured in each type of accident varied with road user type, as Table 2 shows.

There was a significant increase in the proportion of casualties who were involved in falls from vehicles during the period of the study, and a decrease in the proportion who were involved in collisions. This is probably associated with the increase in pedal cyclist and decrease in pedestrian casualties noted earlier.

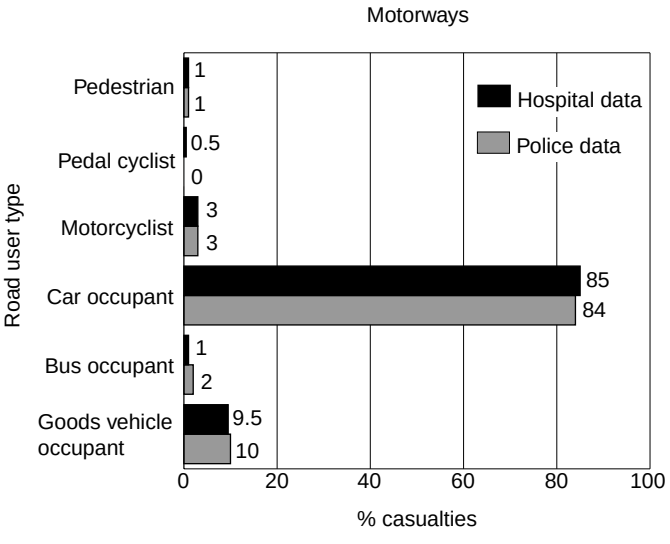
The number of vehicles involved in the accident was also recorded. Overall, 37 per cent of casualties were injured in single vehicle accidents and 63 per cent in multi-vehicle accidents. This compares with 29 per cent of casualties in single vehicle accidents and 71 per cent in multi-vehicle accidents recorded in police figures. The proportion of casualties in single vehicle accidents varied significantly with road user type. Ninety-five per cent of pedestrians were injured in single vehicle accidents, compared with 65 per cent of bus occupants, 62 per cent of pedal cyclists, 45 per cent of motorcyclists, 28 per cent of



Sample size (hospital data): 29775



Sample size (hospital data): 8026



Sample size (hospital data): 2036

Figure 8 Distribution of road users in accidents on urban roads, rural roads and motorways

Table 2 Percentage of casualties injured in each type of accident

Accident type	*Pedes -trian %*	*Pedal cyclist %*	*Motor cyclist %*	*Car occu -pant -%*	*Bus occu -pant -%*	*Goods vehicle occu -pant %*	*All casual -ties*[1]
Collision	100	38	53	88	21	75	77
Skid, swerve, jackknife	-	3	12	7	3	13	6
Vehicle manoeuvre	-	3	4	3	27	6	4
Fall from vehicle	-	55	31	-	6	3	10
Boarding/ alighting	-	-	-	-	22	1	1
Accident in vehicle	-	-	-	1	22	3	2

[1]*including other/unknown road users*
- less than 0.5%
Sample size: 59518

goods vehicle occupants and only 17 per cent of car occupants. The proportion of pedal cyclists in single vehicle accidents increased significantly over the three years of the study from 59 per cent to 62 per cent but there was no significant change for the other road users.

3 Injury and outcome

Information about each casualty's injuries was collected from medical records. The survey form allowed information on up to four body parts per casualty and up to three injuries per body part to be recorded. It was mentioned earlier that injury information collected by the police and recorded in national casualty data is confined to an overall assessment of the injury severity by the police officer. Guidelines for assigning a severity rating are contained in the Stats20 instruction manual for coding road accidents (Department of Transport, 1990). Non-fatal casualties are classified as either serious or slight based on the severity of their worst injury. The definitions used to assign severity are given in Appendix A although in practice such definitions will be subject to interpretation by individual police officers. To compare the severity of casualties attending hospital with those included in national police accident figures, it was necessary to categorise the casualties in the hospital sample in the same way.

3.1 Characteristics of serious and slight casualties

Using information about the type of injury and the definitions in Appendix A, a DETR severity rating was assigned to each casualty who attended hospital. Around a tenth of casualties could not be assigned a rating as their injuries were not specified in sufficient detail within the

medical records. Of those casualties who could be categorised, 24 per cent were classed as serious and 72 per cent as slight. Four per cent of casualties were found to have no diagnosed injury following medical examination at the hospital. The proportion of seriously injured casualties was lower in national police data, where 15 per cent of casualties were classed as seriously injured and 85 per cent were classed as slight. This is to be expected since there would be some casualties recorded in police data who did not attend hospital and who would be likely to be less severely injured than the those who did attend hospital. People who were found to be uninjured at hospital would probably be recorded as casualties by the police if they were known to have attended hospital.

There were some small but statistically significant changes in the proportion of casualties in each of the DETR severity groups over the period of the study; the proportion of casualties with no injury or serious injury both increased by 1 per cent, from 4 to 5 and 23 to 24 per cent respectively, and the proportion of slight casualties decreased from 73 to 71 per cent of the sample.

3.1.1 Road user type

Figures 9 and 10 show the distribution of road user type within the serious and slight groups. The more vulnerable road users (pedestrians, pedal cyclists and motorcyclists), who comprised around a third of all road users who attended hospital, accounted for over half of the seriously injured casualties. This group made up a larger proportion of casualties in the hospital data than was the case in the police data. In contrast, car occupants formed around three-fifths of those who were slightly injured but only two-fifths of those who were seriously injured. The tendency for the hospital data to show a greater proportion of pedal cyclist casualties and a lower proportion of pedestrian casualties than police data can be seen within each severity group.

Casualties who were found to have no injury following medical examination at the hospital were largely car occupants, as Figure 11 shows. One reason for this may be that passengers in cars may accompany injured passengers to hospital and consequently be registered and undergo a check-up whilst they are there.

The proportion of casualties of each level of severity within each road user group is shown in Table 3. Nearly four-fifths of pedestrians and motorcyclists were seriously injured, and almost a third of pedal cyclists. This compares with a fifth of bus and goods vehicle occupants and a sixth of car occupants. These latter groups were also more likely to include casualties who were not injured.

In comparison, police statistics generally show lower proportions of seriously injured casualties, although the tendency for pedestrians and motorcyclists to be seriously injured can still be seen.

Investigation of the severity grouping for 1993, 1994 and 1995 showed that the severity distributions of pedestrians, car and bus occupants had changed significantly over the period. There was an increase in the proportion of seriously injured pedestrians from 37 per cent in 1993 to 41 per cent in 1995, and a decrease in the proportion who were slightly injured, although the proportion who had no injury increased slightly from 3 to 4 per cent between 1994 and 1995. Car occupants also showed an increase in the proportion of seriously injured casualties although this was less than for pedestrians, from 16 to 17 per cent, and a decrease in slightly injured casualties from 79 to 77 per cent. Again, the proportion of casualties with no injury increased by 1 per cent. In contrast, the distribution for bus occupants became less severe with the proportion of slight casualties and uninjured casualties increasing from 72 to 78 per cent and from 3 to 4 per cent respectively, and the proportion of seriously injured bus occupants decreasing from 24 to 17 per cent.

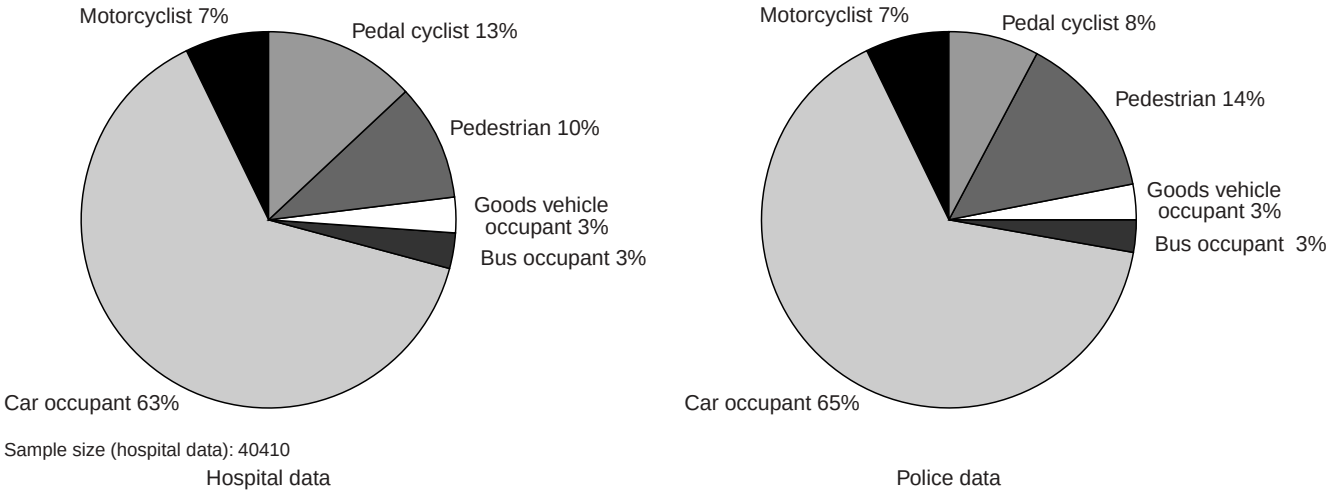


Figure 9 Distribution of road user type within slight casualties

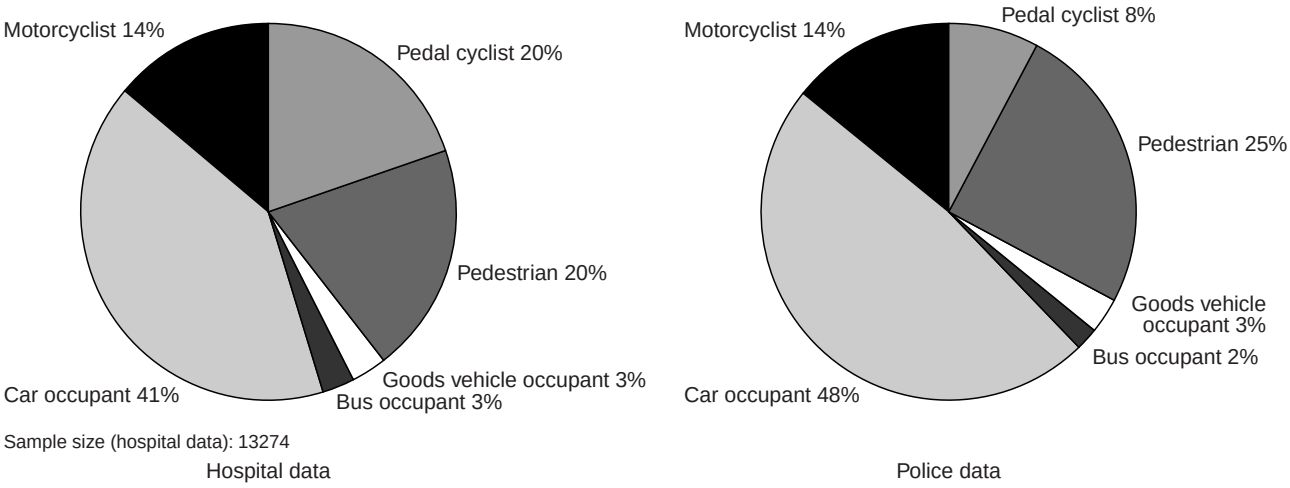


Figure 10 Distribution of road user type within serious casualties

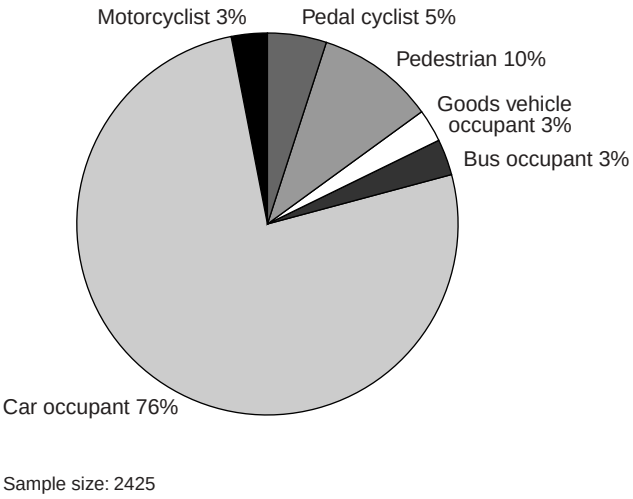


Figure 11 Distribution of road user type within casualties with no injury

Table 3 Distribution of severity within each road user group

		DETR severity		
Road user type		*No injury*	*Slight*	*Serious*
Pedestrian	Hospital data %	3	58	39
	Police data %	n/a	75	25
Pedal cyclist	Hospital data %	2	66	32
	Police data %	n/a	85	15
Motorcyclist	Hospital data %	2	60	38
	Police data %	n/a	74	26
Car occupant	Hospital data %	5.5	78	16.5
	Police data %	n/a	89	11
Bus occupant	Hospital data %	4	76	20
	Police data %	n/a	92	8
Goods vehicle	Hospital data %	4.5	74.5	21
occupant	Police data %	n/a	85	15
All casualties[1]	Hospital data %	4	72	24
	Police data %	n/a	85	15

[1]*including other/unknown road user types*
Sample size (hospital data): 60797

3.1.2 Age and gender

Males were more likely than females to be seriously injured; 65 per cent of seriously injured casualties were male compared with 54 per cent of slightly injured casualties. Police casualty data show the same proportion of male serious casualties, but the proportion of slight casualties who were male was slightly higher at 56 per cent.

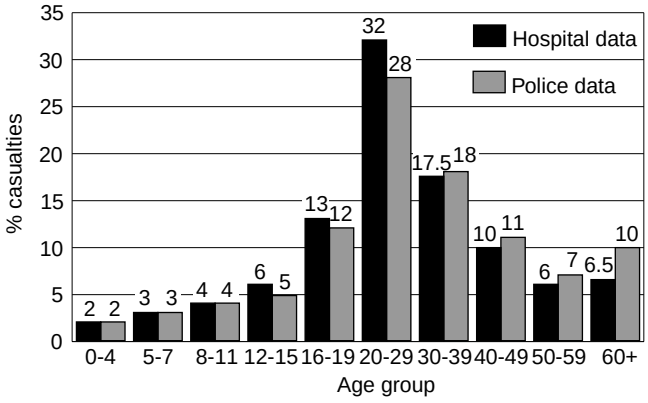
Figures 12a and 12b compare the age distributions of casualties in the serious and slight groups who attended hospital with those in police data.

Slightly injured casualties tended to be more concentrated in the 20-30 year age groups whereas in the seriously injured group higher proportions of casualties were in the younger and older age groups. The tendency for the hospital data to contain slightly higher proportions of younger casualties compared with the police data, and lower proportions of older casualties can be seen at each severity level.

As mentioned earlier, some patients who attended hospital were found to have no injury. This group comprised only about 4 per cent of casualties but their age distribution differed somewhat from those who were injured as Figure 13 shows. Around a fifth were aged between 0 and 4 years and were likely to have been taken to hospital for a check up following the accident.

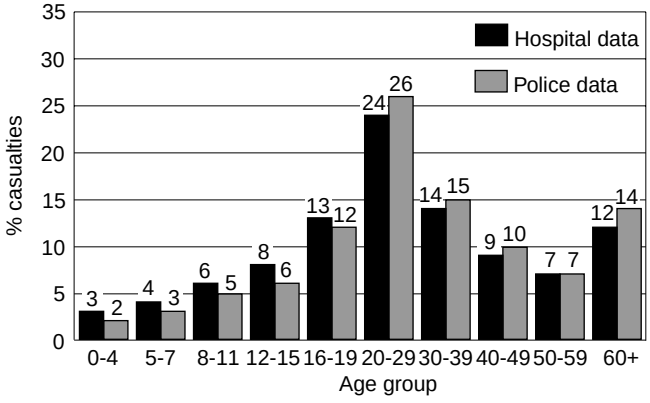
3.1.3 Accident location

Figures 14a to 14f show, for each type of road user, the proportion of casualties injured on urban roads, rural roads and motorways. Those who were seriously injured were generally more likely to be involved in accidents on rural roads than those who were slightly injured. This pattern was reflected within each type of road user.



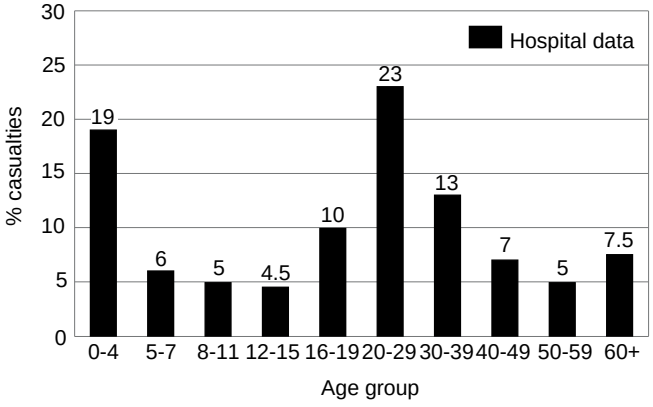
Sample size (hospital data): 43688

Figure 12a Distribution of age within the slight group



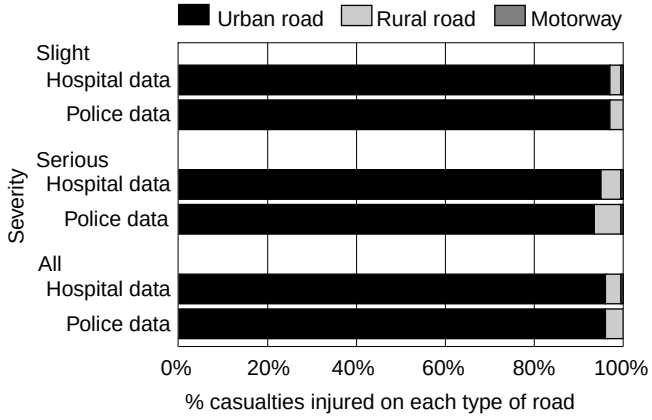
Sample size (hospital data): 14176

Figure 12b Distribution of age within the serious group



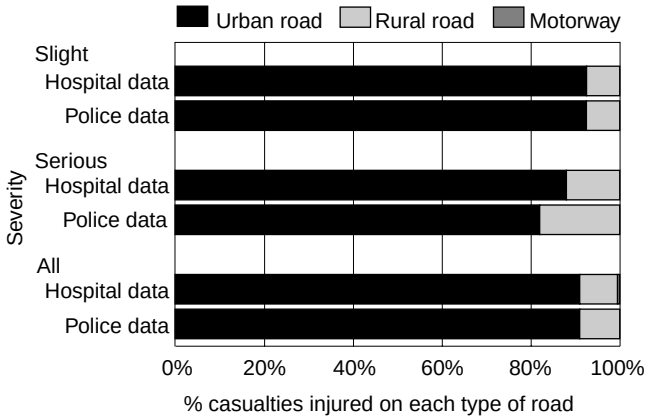
Sample size: 2647

Figure 13 Distribution of age within casualties with no injury



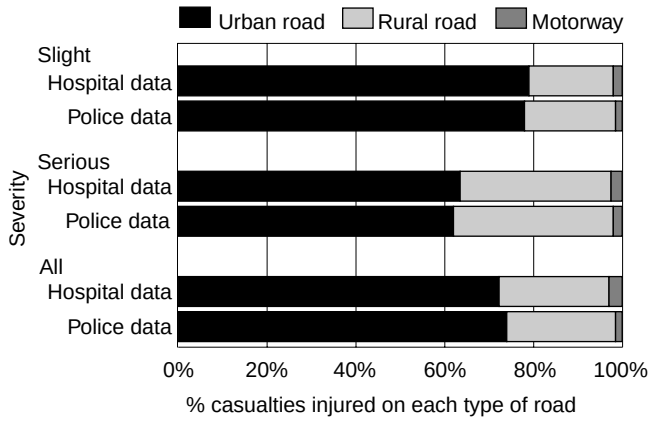
Sample size (hospital data): 5005

Figure 14a Proportion of pedestrians injured on each type of road



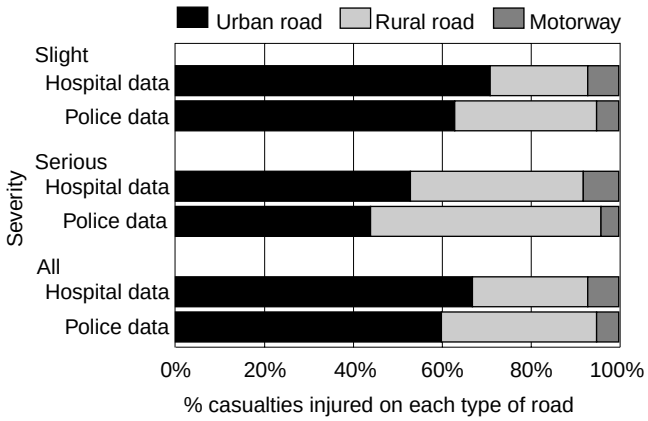
Sample size (hospital data): 5367

Figure 14b Proportion of pedal cyclists injured in each type of road



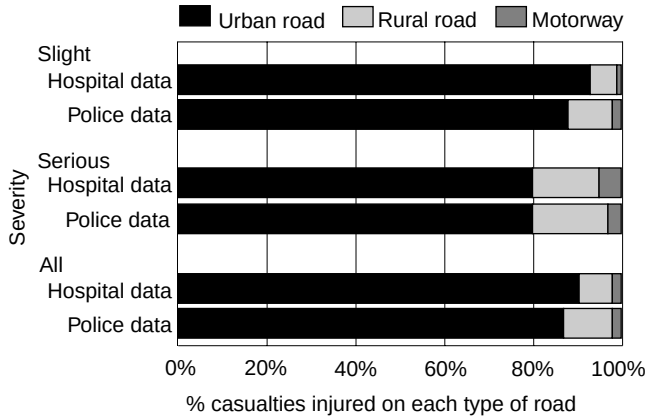
Sample size (hospital data): 3236

Figure 14c Proportion of motorcyclists injured on each type of road



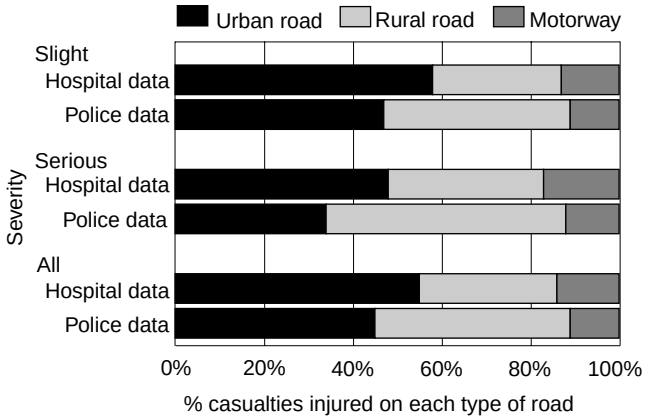
Sample size (hospital data): 23559

Figure 14d Proportion of car occupants injured on each type of road



Sample size (hospital data): 1306

Figure 14e Proportion of bus occupants injured on each type of road



Sample size (hospital data): 1364

Figure 14f Proportion of goods vehicle occupants injured on each type of road

3.2 Injury type and location

3.2.1 Injury location

The type and location of injury were recorded for each casualty. Injury locations were grouped into six body regions; head/face, neck, upper back/thorax, lower back/ pelvis, upper limbs and lower limbs. Figure 15 shows the percentage of casualties who suffered injury to each body region. The percentage for each type of road user may total more than 100 per cent because some casualties had injuries to more than one body region. Injury location varied with type of road user. Around half of pedestrians and pedal cyclists received head injuries. Injuries to the lower limbs were commonly received by pedestrians and were the most common site of injury for motorcyclists. Vulnerable road users also commonly received injury to the upper limbs; over half of motorcyclists and pedal cyclists, and a third of pedestrians received injuries to this region.

The incidence of neck injuries was greatest amongst car and goods vehicle occupants. Head injuries were also common for these groups, together with bus occupants. Bus and goods vehicle occupants also tended to receive injuries to the upper and lower limbs.

Figure 16 shows the proportion of casualties in each age group who received injury to each body region. As for road user type, there were some significant variations. The head/face was the most commonly injured part of the body in casualties up to 11 years old, and injuries to the upper and lower extremities were also important for these groups. As age increased an increase in the occurrence of neck injuries can be seen. This is likely to be associated with the increasing proportion of vehicle occupants. The incidence of injury to the upper back and neck increased from around a tenth of casualties aged 16-39 to a fifth of those aged 50-59 and a quarter of those aged 60 or over.

Over the period of the study, the proportion of casualties who sustained neck injuries increased from 20 to 23 per cent, and the proportion with injuries to the lower limbs fell from 20 to 18 per cent. Car occupants showed a significant increase in neck injuries and a decrease in injuries to the lower limbs. Goods vehicle occupants were the only other road user group to show significant changes in the distribution of injury site, they also experienced an increase in neck injuries and a decrease in injuries to the head and upper limbs.

3.2.2 Injury type

Details of injury type were collected from the medical records and injuries were classified as either serious or slight using the definitions in Appendix A. Within the serious group the following broad injury types were identified: fracture, concussion, major cut or wound (including amputation), general shock, internal injury and unspecified multiple injuries.

Figure 17 shows the types of serious injuries sustained by each type of road user. There are some marked differences. In particular, fractures comprised a much lower proportion of serious injuries to car and goods vehicle occupants compared with other types of road user. Previous research (Murray et al, 1993) has showed that fractures also result in relatively long periods of disability. Concussion was more likely for car and goods vehicle occupants and pedestrians, but least likely for motorcyclists which may reflect the protection afforded by helmets.

Slight injuries were classified in the following way: minor cut or wound, bruise, general tenderness or swelling, whiplash (as diagnosed by medical staff), sprain or strain and dislocation. Figure 18 shows the occurrence of each type of slight injury within each road user group. Again, differences can be seen, especially the incidence of whiplash and strains amongst car and goods vehicle occupants, and the dominance of cuts and bruises amongst other types of road user.

The overall distributions of injury types by road user type and within the different age groups are shown in Tables 4 and 5. The vulnerable road users were more likely to receive serious injuries; one in five injuries to motorcyclists, one in six injuries to pedestrians and one in seven injuries to pedal cyclists were serious. This compares with around one in ten injuries to car, bus and goods vehicle occupants. The number of injuries sustained by each road user type varied significantly from that which might be expected given the numbers of casualties in each road user group and the average number of injuries per casualty was higher for vulnerable road users compared with others.

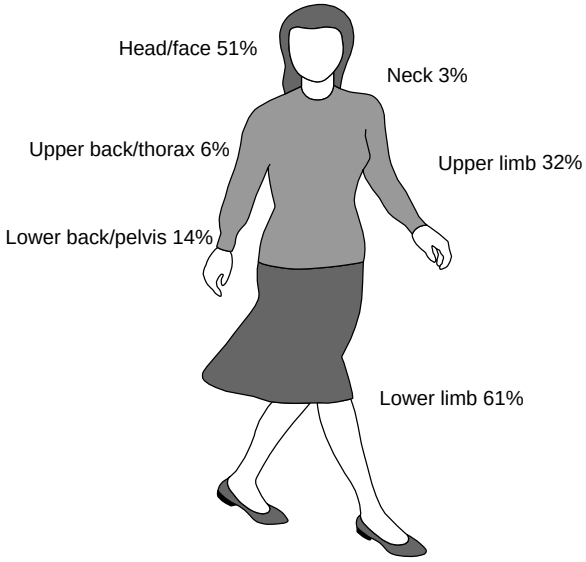
Table 5 shows that casualties aged under 16 and over 60 were generally more likely to sustain serious injury. Around one in 7 or 8 injuries to casualties in the younger group were serious, and nearly one in five injuries to casualties in the older age group. Again, the likelihood of injury varied significantly with age and the average number of injuries per casualty tended to be higher in the 5-19 and 60+ age groups, and much lower for casualties under 5 years old.

3.3 Severity scales

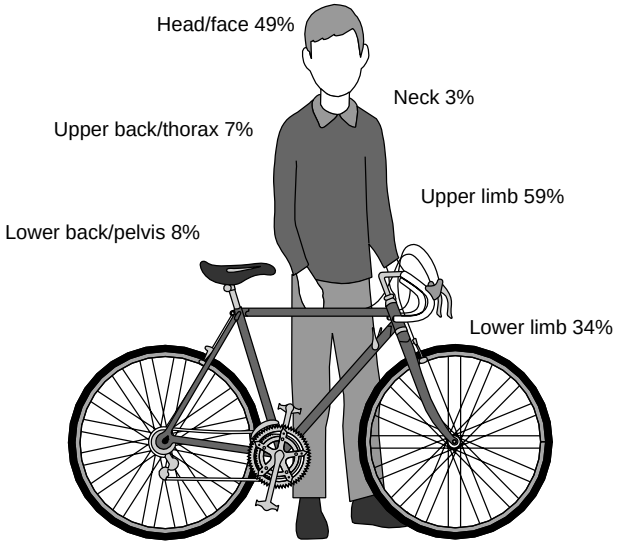
The two DETR severity categories of serious and slight cover a range of injuries. This is especially the case within the serious category where injuries can have a wide range of consequences, both in terms of the costs of treating patients and their resulting disabilities. For example a fractured finger, a fractured pelvis and crushing or amputation of limbs are all categorised as serious injuries. One of the aims of the survey was to estimate the distribution of severity within the serious and slight casualty groups. The hospital survey provided information on the types of injury which meant that injury severity could be assessed in more detail. This was achieved by mapping injury descriptions onto standard scales of injury severity so that variations within the serious and slight groups could be identified.

The injuries were coded onto standard injury severity scales at TRL using a computer software package called TRI-CODE. This coded the injury descriptions onto Abbreviated Injury Scale (AIS) codes (Association for the Advancement of Automative Medicine, 1990). The AIS scale was developed for use in road accident injury research and indicates the severity of each injury primarily

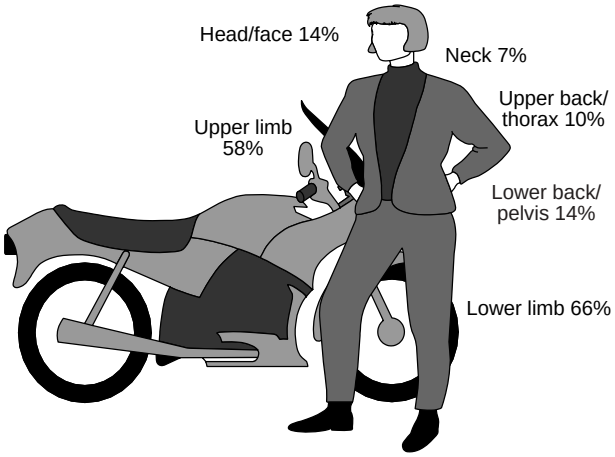
The percentages for each type of road user may total more than 100 per cent because some casualties had injuries to more than one body region.



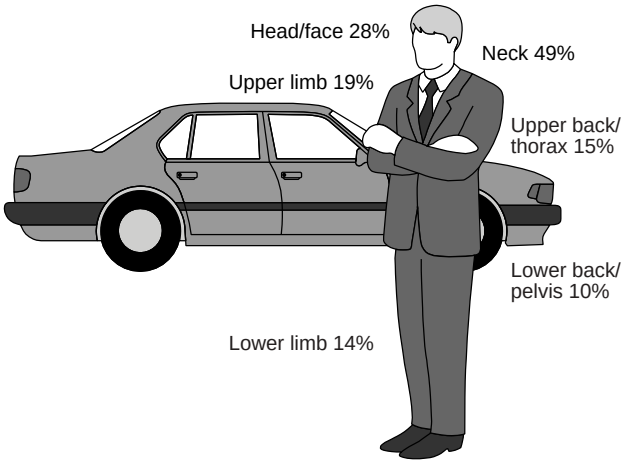
Pedestrian



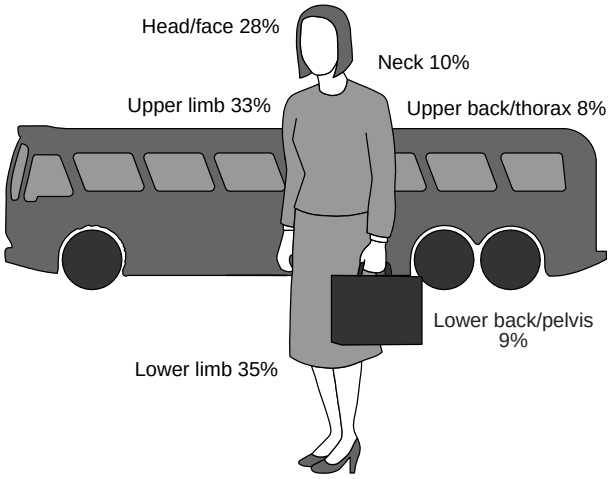
Pedal cyclist



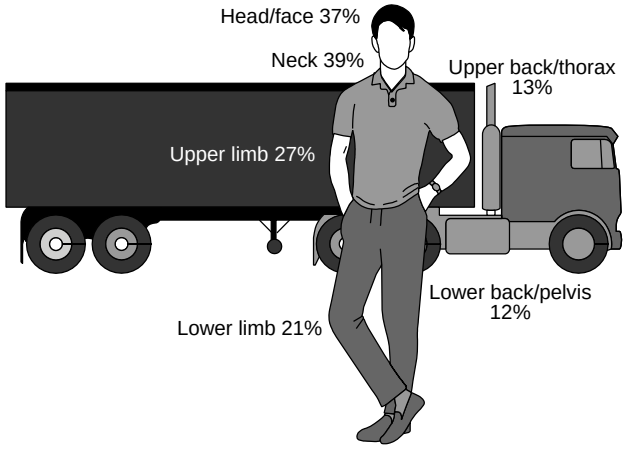
Motorcyclist



Car occupant



Bus occupant



Goods vehicle occupant

Figure 15 Percentage of casualties with injuries to each body region

The percentages for each age group may total more than 100 per cent because some casualties had injuries to more than one body region.

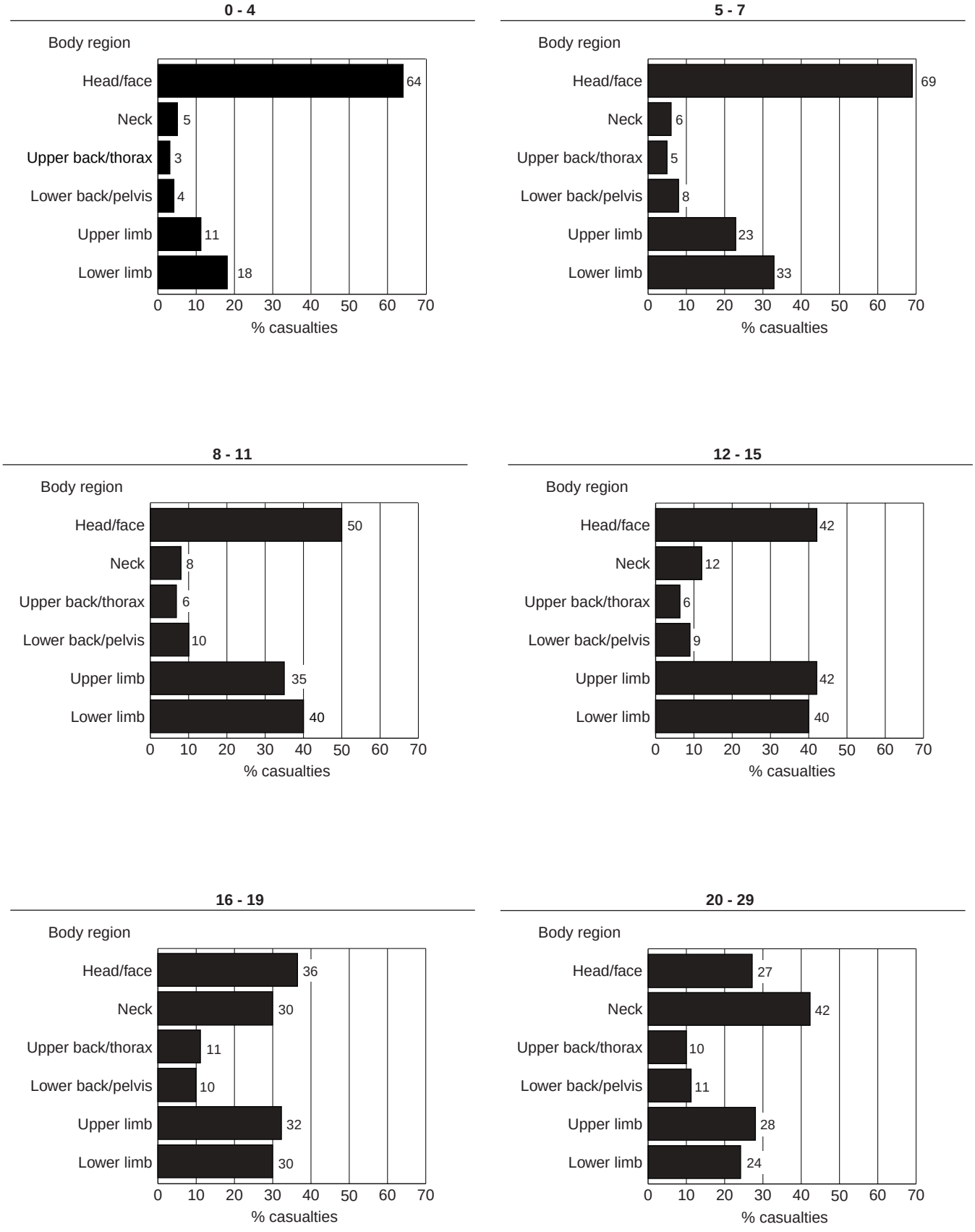


Figure 16 Percentage of casualties in each age group, by body region injured

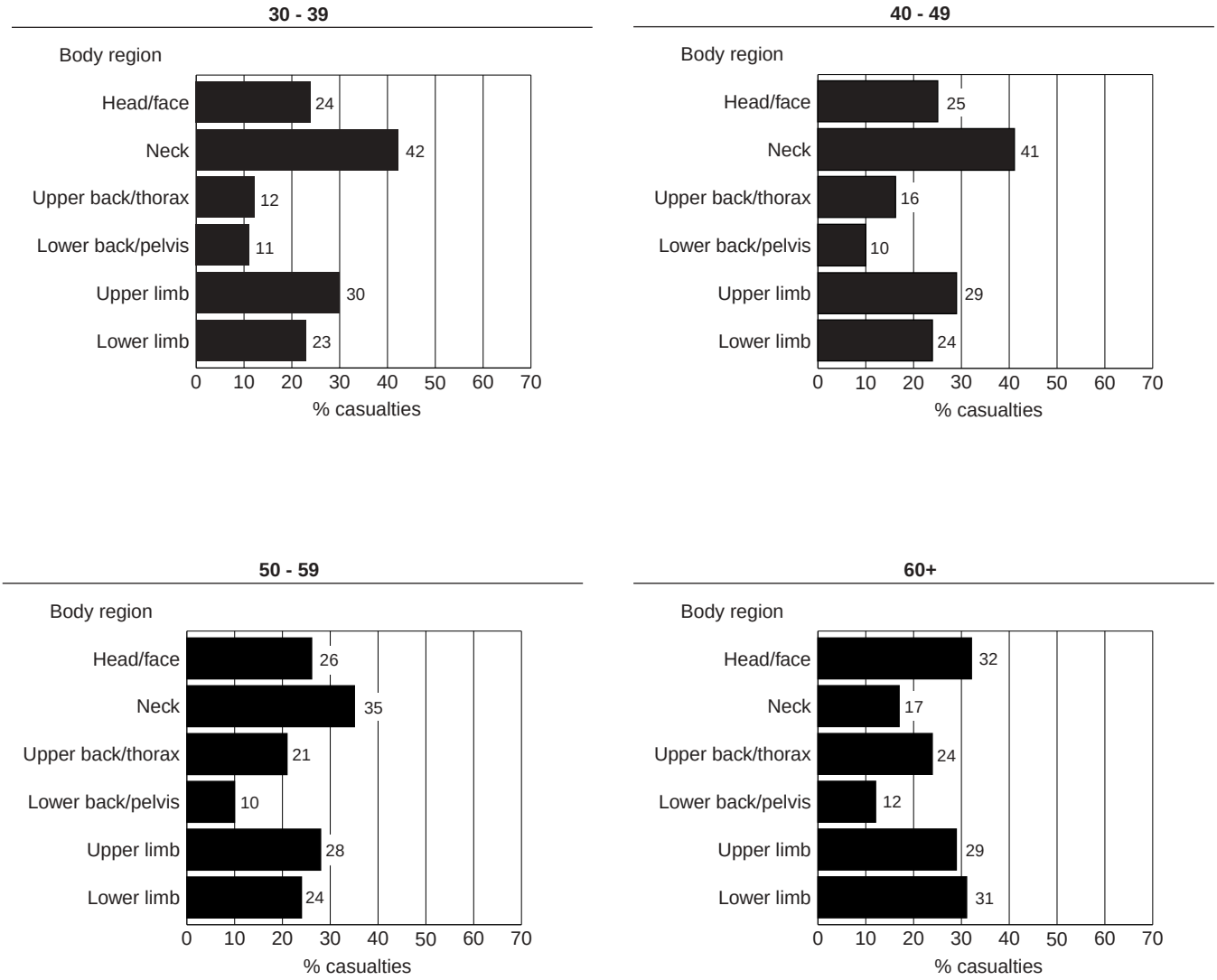


Figure 16 Continued

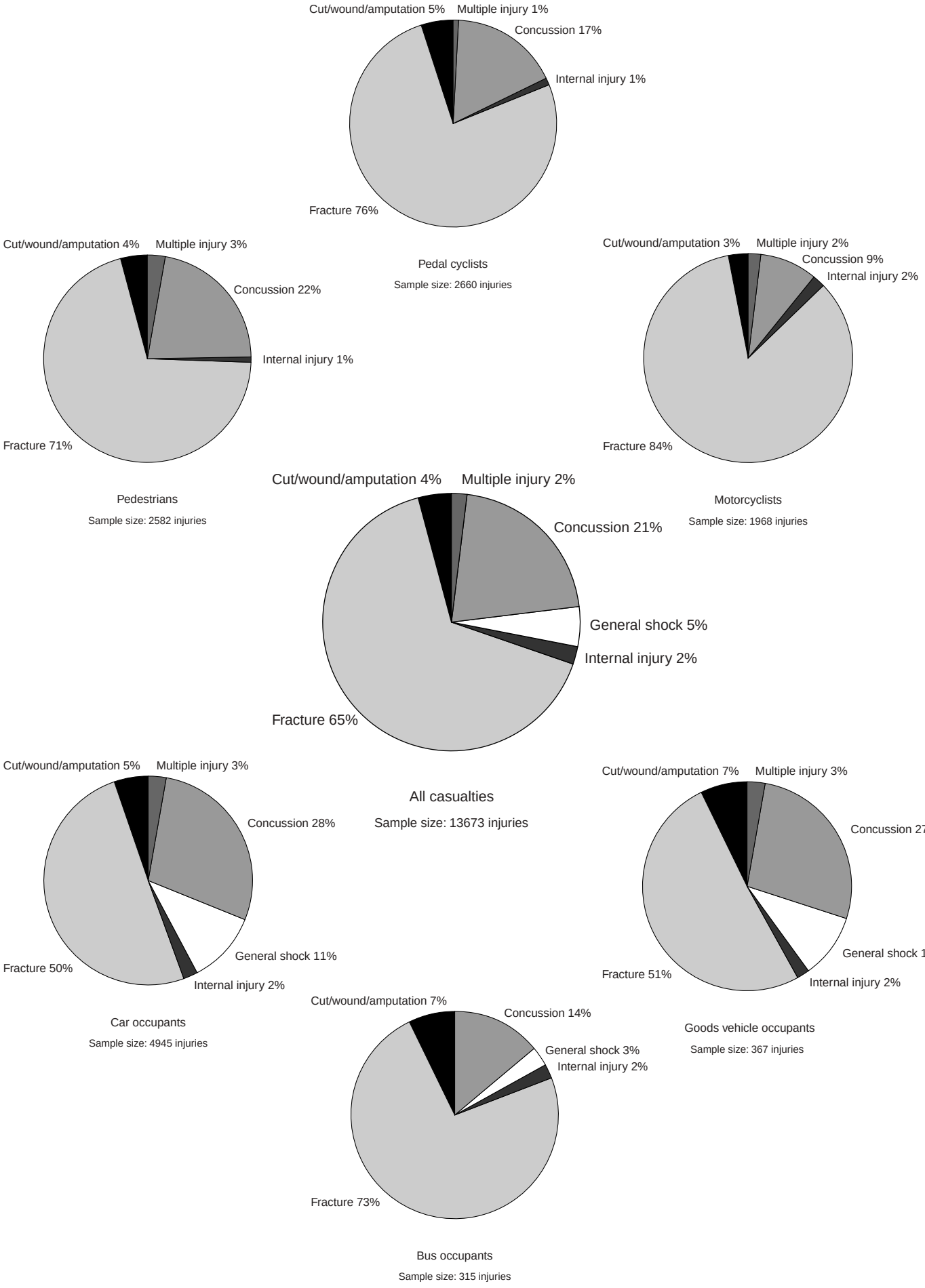


Figure 17 Types of serious injury

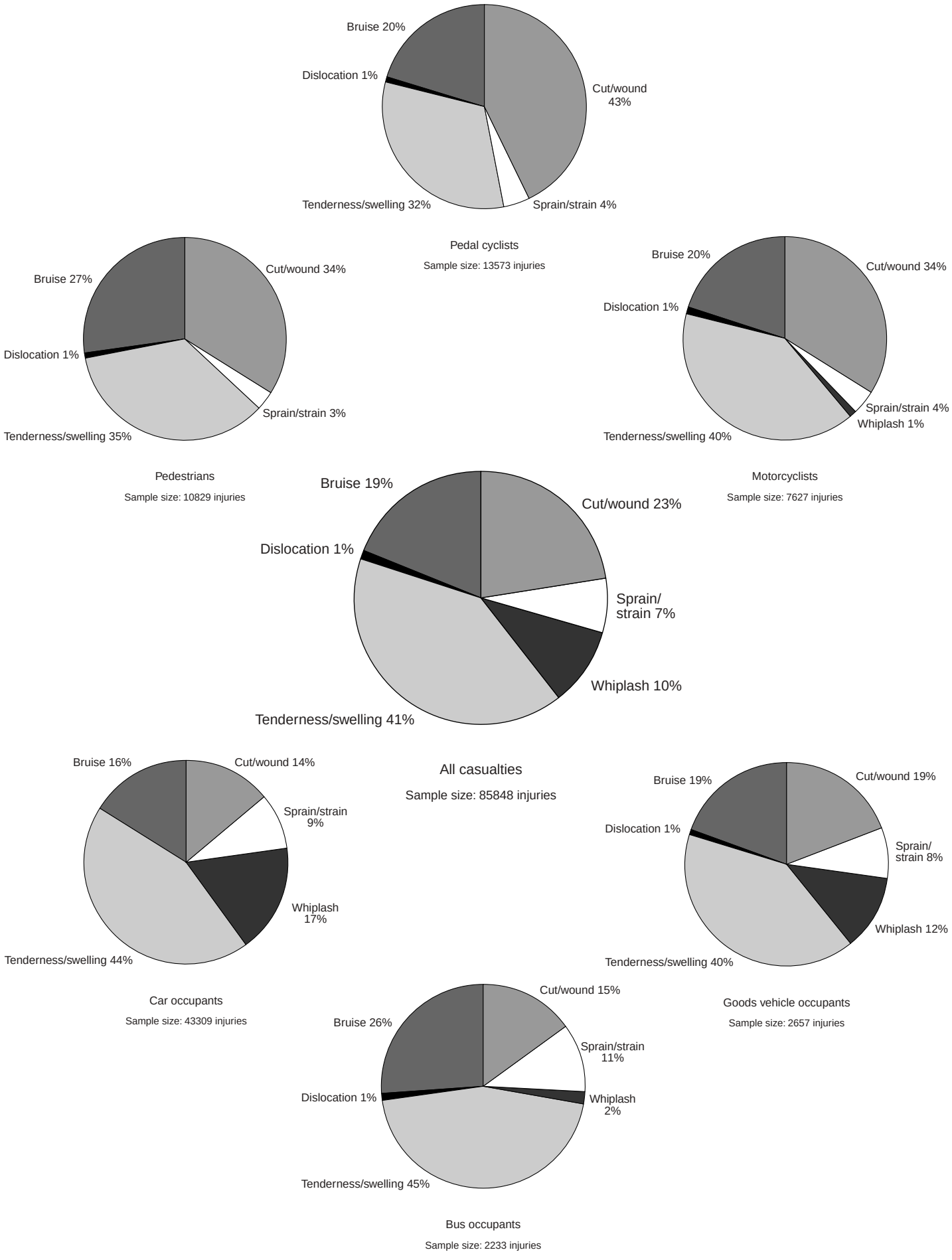


Figure 18 Types of slight injury

Table 4 Distribution of injury types within each road user group

Severity level/injury type	Road user type: Pedestrian %	Pedal cyclist %	Motor cyclist %	Car occupant %	Bus occupant %	Goods vehicle occupant %	All casualties[1]
Slight							
Tenderness	26	24	29	35	35	32	32
Cut/wound	25	33	25	11	12	15	18
Bruise	20	15	14	13	20	15	14
Whiplash	<0.5	<0.5	1	14	2	10	8
Sprain	2	3	3	7	8	7	5
Dislocation	<0.5	1	1	<0.5	1	<0.5	<0.5
All slight	73	76	73	80	78	79	77
Serious							
Fracture	12	11	16	5	8	5	8
Concussion	4	3	2	3	2	3	3
Other	1	1	1	1	1	3	1
All serious	17	15	19	9	11	11	12
Unknown severity							
Cut/wound	5	6	4	4	5	6	5
Other/unknown	5	4	4	6	7	5	6
All unknown	10	10	8	10	12	11	11
Ave no of injuries per casualty	2.0	1.9	2.0	1.5	1.4	1.7	1.6

[1]*including other/unknown road users*
Sample size: 111918 injuries

Table 5 Distribution of injury types within each age group

Severity level/ Injury type	Age group: 0-4 %	5-7 %	8-11 %	12-15 %	16-19 %	20-29 %	30-39 %	40-49 %	50-59 %	60+ %	All casualties[1]
Slight											
Tenderness	18	20	26	29	31	34	33	34	34	30	32
Cut/wound	30	34	28	24	20	15	14	13	13	15	18
Bruise	22	20	18	16	14	12	13	13	14	17	14
Whiplash	1	1	1	2	6	10	11	10	9	4	8
Sprain	1	1	2	4	5	7	7	7	5	3	5
Dislocation	<0.5	<0.5	<0.5	1	<0.5	<0.5	1	1	<0.5	<0.5	<0.5
All slight injuries	73	76	76	76	76	78	79	78	75	69	77
Serious											
Fracture	6	7	9	10	7	6	8	8	9	13	8
Concussion	5	4	4	3	3	2	2	2	2	2	3
Other	3	1	1	1	2	2	2	1	2	3	1
All serious injuries	14	12	14	14	12	10	12	11	13	18	12
Unknown severity											
Cut/wound	6	7	5	5	5	4	3	4	5	7	5
Other/Unknown	7	6	5	5	7	7	7	7	6	6	6
All unknown injuries	13	13	10	10	12	11	10	11	11	13	11
Ave no of injuries per casualty	1.2	1.7	1.7	1.8	1.7	1.6	1.6	1.6	1.6	1.7	1.6

[1]*including other/unknown road users*
Sample size: 111918 injuries

in terms of threat to life. The AIS ranges from AIS 0 (no injury) to AIS 6 (currently untreatable), see Appendix A. Some injuries could not be coded onto the scales and these were mainly unspecific injuries, such as general tenderness/swelling, cases where the injury was not recorded or cases where the information given was insufficient to code the injury onto a specific score. For casualties who had one or more uncodeable injuries, only the codeable injuries were included. Patients who had no diagnosed injury were assigned an AIS of 0. Injuries for 74 per cent of casualties were coded.

The score of the worst injury is the maximum AIS score (or MAIS) and is used as a measure of overall severity. Figure 19 shows the distribution of MAIS within each of the DETR severity categories, and for all casualties attending the A & E Department for whom a MAIS score was calculated. All the casualties who were classed as slightly injured had MAIS values of 1 or 2, and most were MAIS 1. In the serious group, the MAIS scores were more wide ranging. A small number of casualties who were classed as seriously injured were MAIS 0 and these were most probably patients who were not found to be injured but were admitted to hospital for observation. As in-patients they are classified as seriously injured.

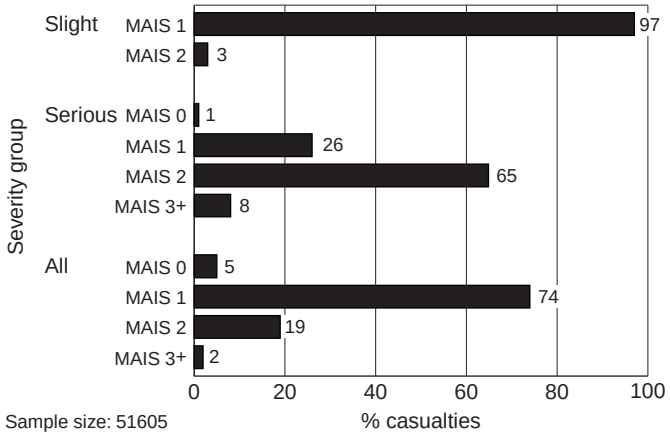


Figure 19 Distribution of MAIS within each DETR severity group

The distribution of MAIS scores showed a small but significant change over the three-year study. The proportion of casualties of MAIS 1 decreased from 76 per cent in 1993 to 72 per cent in 1995, and the proportion of casualties of MAIS 2 and MAIS 3 increased from 18 to 19 per cent, and from 1 to 2 per cent respectively over the same period. This suggests that casualties attending the hospitals in the survey tended to become more severe over the period studied.

Within the slight and serious categories the MAIS distributions also changed significantly. The slight distribution became less severe with the proportions of casualties of MAIS 1 increasing from 96 to 97 per cent. The distribution of MAIS within the serious category became more severe with an increase in the proportion of casualties with MAIS 3+ from 6 to 10 per cent over the three year period, and a decrease in the proportion who were MAIS 1 from 28 to 24 per cent.

The distribution of MAIS scores also varied with road user type, as shown in Figure 20. Pedestrians, pedal cyclists and motorcyclists had the highest proportions of the more severe injuries (MAIS 2 or above), followed by occupants of buses and goods vehicles, and car occupants. Vulnerable road users were also less likely than others to be diagnosed as having no injury (MAIS 0).

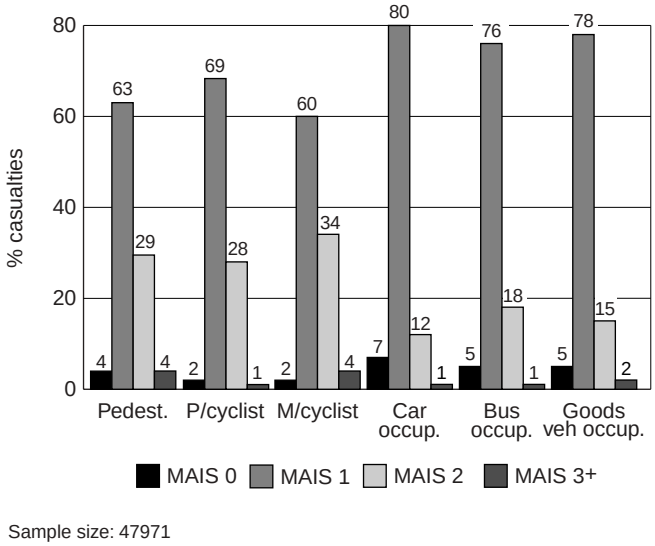


Figure 20 Distribution of MAIS within each road user group

Pedestrians, pedal cyclists and motorcyclists all showed significantly increased injury severity in terms of MAIS over the period of the study. Bus occupants showed a significant decrease in severity. Car occupants showed a slight increase in the proportion of casualties with injuries of MAIS 3+ but an increasing proportion were also uninjured.

MAIS varied with age of casualty, as shown in Table 6. This clearly shows the high incidence of very young casualties who were uninjured, and that larger proportions of younger and older casualties were more severely injured whereas casualties in the middle age ranges were more likely to have only minor injuries.

Table 6 Distribution of MAIS within each age group for all casualties who attended hospital

	MAIS			
Age group	*0*	*1*	*2*	*3+*
0-4 %	29	55	14	2
5-7 %	9	70	18	3
8-11 %	5	68	25	2
12-15 %	4	67	28	1
16-19 %	4	74	20	2
20-29 %	4	78	16	2
30-39 %	4	77	17	2
40-49 %	4	77	17	2
50-59 %	5	75	19	2
60+ %	5	69	22	4

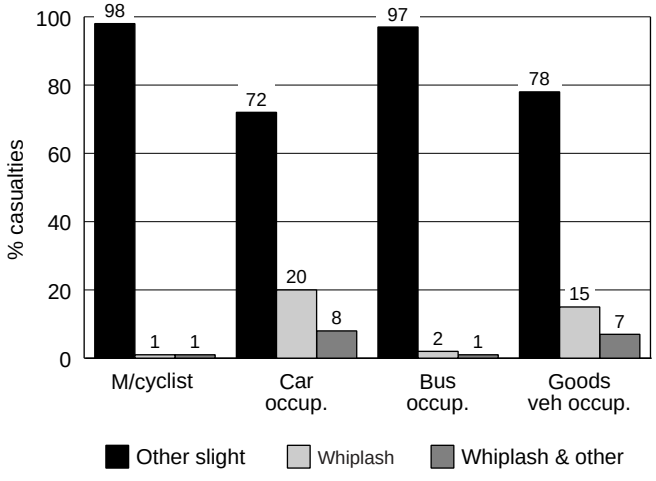
Sample size: 51340

3.3.1 Severity of slightly injured casualties

It was shown in Figure 19 that most casualties within the slight group were classed as MAIS 1 so the MAIS is not a good basis on which to derive a severity distribution for slight casualties. One of the more common slight injuries coded as MAIS 1 but which can lead to quite severe disability is whiplash (Tunbridge et al, 1990; Murray et al, 1993). Previous work on the injury severity of slight casualties (Hopkin et al, 1993; Simpson, 1996) classed slight casualties into three categories; those with whiplash only, those with whiplash and other slight injuries, and those with other slight injuries only. These categories were used to group casualties in the survey.

Overall 13.5 per cent of casualties were diagnosed as having whiplash only, 5 per cent had whiplash in combination with other slight injuries and 81.5 per cent had other slight injuries only. Thus 18.5 per cent of casualties suffered whiplash, but whiplash accounted for only 10 per cent of all slight injuries (shown in Figure 18) as some casualties had other slight injuries as well as whiplash. The proportion of casualties with whiplash compares with an estimate of 20 per cent for slight casualties recorded in police data (Hopkin et al, 1993). There was evidence from the survey that the proportion of casualties with whiplash only increased slightly from 12 to 14 per cent, and the proportion with other slight injuries decreased from 83 to 81 per cent over the three-year period.

Figure 21 shows the distribution of motorcyclists, car, bus and goods vehicle occupants between the slight injury severity groups. Negligible numbers of pedestrians and pedal cyclists suffered whiplash so they are excluded from the graph. Around 28 per cent of car occupants and 22 per cent of goods vehicle occupants were diagnosed with whiplash. The increase in the incidence of whiplash was found to be significant in the case of car and goods vehicle occupants, increasing from 19 to 21 per cent and from 13 to 18 per cent for each group respectively. The incidence of whiplash in combination with other slight injuries also showed a small increase, but this might be due to increased reporting by medical staff.



Sample size: 30972

Figure 21 Distribution of injury severity within slightly injured road users

The distribution of severity by age is shown in Table 7. The incidence of whiplash is higher amongst casualties aged 20-59 compared with casualties aged under 20 or over 59 who were more likely to have other slight injuries.

Table 7 Distribution of injury severity by age within slightly injured casualties

	Injury type		
Age group	*Other slight*	*Whiplash*	*Whiplash & other slight*
0-4 %	98	2	<0.5
5-7 %	99	1	<0.5
8-11 %	96	3	1
12-15 %	95	4	1
16-19 %	84	11	4
20-29 %	77	17	6
30-39 %	76	18	6
40-49 %	77	17	6
50-59 %	79	15	6
60+ %	90	8	3

Sample size: 43686

Most of the casualties with whiplash were car occupants. Their severity distribution is shown separately in Table 8. This shows similar variations with age with around a quarter of casualties aged between 20 and 50 suffering whiplash injury.

Table 8 Distribution of severity within slightly injured car occupants

	Injury type		
Age group	*Other slight*	*Whiplash*	*Whiplash & other slight*
0-4 %	96	3	1
5-7 %	94	5	1
8-11 %	86	10	3
12-15 %	83	13	4
16-19 %	77	17	6
20-29 %	68	23	9
30-39 %	68	24	8
40-49 %	69	23	8
50-59 %	71	21	8
60+ %	83	12	4

Sample size: 25277

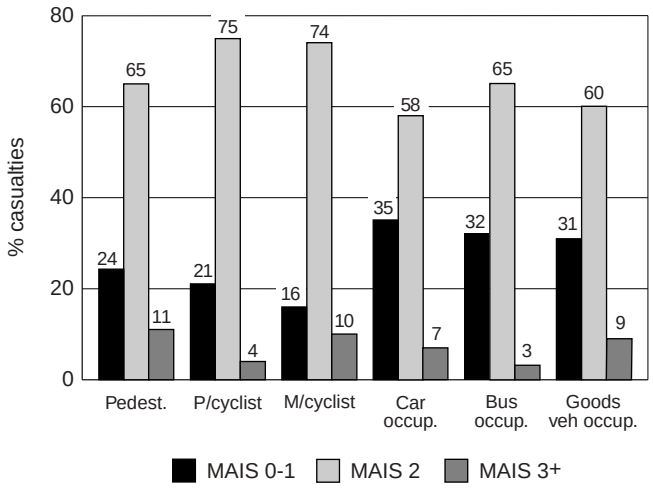
3.3.2 Severity of seriously injured casualties

The following sections present the distribution of severity for casualties who were seriously injured. Two measures of severity are used; MAIS and length of stay in hospital as an in-patient.

3.3.2.1 MAIS

Figure 19 showed that within the serious group, MAIS is relatively widely spread and is therefore a more discriminating indicator of injury severity. Overall, 27 per cent of seriously injured casualties were MAIS 1, 65 per cent were MAIS 2 and 8 per cent were MAIS 3 or more. Figure 22 shows the distribution of MAIS within seriously injured casualties and significant differences were found.

Pedestrians and motorcyclists were more likely to be MAIS 3 or more whereas car, bus and goods vehicle occupant casualties were more likely to be MAIS 1.



Sample size: 11708

Figure 22 Distribution of MAIS within seriously injured road users

It was noted in Section 3.3 that injury severity within seriously injured casualties generally became more severe over the course of the study. The distribution of MAIS varied significantly for pedestrians and car occupants; both groups showed an increase in the proportions of casualties who were MAIS 3+ and a decrease in the proportion who were MAIS 0.

The distribution of MAIS within each age group is shown in Table 9. The results indicate that as age increases the proportion of casualties of MAIS 0-1 increases and those with MAIS 2 decreases. The proportion of casualties of MAIS 3 or more is higher in the 0-7 and 60+ age groups. Again these differences were statistically significant.

Table 9 Distribution of injury severity by age within seriously injured casualties

Age group	*MAIS*		
	0-1	*2*	*3+*
0-4 %	23	67	9
5-7 %	26	63	11
8-11 %	21.5	73	5.5
12-15 %	19.5	76	4.5
16-19 %	25	68	7
20-29 %	25	67	8
30-39 %	28	65	7
40-49 %	30	62	8
50-59 %	33	60	7
60+ %	36	53	11

Sample size: 12351

The distribution of MAIS by age within the main road user groups is shown in Table 10. The differences in the distribution by age for pedestrians, pedal cyclists and car occupants were statistically significant. Although variations in severity by age are apparent for motorcyclists, bus and goods vehicle occupants, these were not found to be significant.

3.3.2.2 Length of stay in hospital

Another measure of severity is length of stay in hospital. By definition, it is only appropriate for serious casualties since all casualties who are admitted to hospital are included in the serious category. Length of stay has been shown to be a good indicator of hospital medical costs and disability (Galasko et al, 1986; Guria 1990), thereby reflecting the costs and consequences of injuries.

The length of stay of in-patients was recorded in terms of the number of nights stay by comparing the date the casualty was admitted with the date of discharge. The numbers of nights stay in hospital were grouped into the following categories: 1-3 nights, 4-10 nights, 11-30 nights and 31 or more nights. Serious casualties who were not admitted were assigned a length of stay of 0 nights, and this group also included a few casualties who were admitted and discharged the same day.

Overall 53 per cent of serious casualties stayed 0 nights, 26 per cent stayed 1-3 nights, 12 per cent 4-10 nights, 6.5 per cent 11-30 nights and 2.5 per cent 31+ nights. The resulting distributions for each type of road user are shown in Figure 23.

Pedestrians were the most likely to be admitted as in-patients, followed by goods vehicle occupants, car occupants and motorcyclists. Pedestrians and motorcyclists tended to stay longer, whereas vehicle occupants and pedal cyclists tended to stay only a few nights.

Length of stay also varied with age as shown in Table 11. This shows that smaller percentages of casualties aged 0-11 and between 40 and 60 years were treated as out-patients, so patients in these groups were more likely to be admitted to hospital. However, once admitted, casualties in the younger age groups were most likely to stay only a few days, whereas greater proportions of those in the older age groups were distributed within the longer length of stay categories. This may be because young casualties tended to be admitted for observation for a day or so following their accident, but older casualties who were admitted needed longer term treatment.

Tables 12a and 12b show the distribution of severity in terms of length of stay in hospital, within each road user type and age group. The mean number of nights stay (for in-patients only) is shown in the last column of the tables.

3.4 Casualty outcome

The clinical information collected from the medical records included details of each casualty's outcome and referral following their treatment in the A & E Department. If the casualty was admitted, details of their outcome and referral following discharge from the hospital was also recorded. Table 13 shows that around a tenth of all casualties attending hospital were admitted, with pedestrians and motorcyclists being most likely to become in-patients. Vehicle occupants were more likely than others to require no further treatment following their visit to the A & E Department, or to be referred to their GP, but

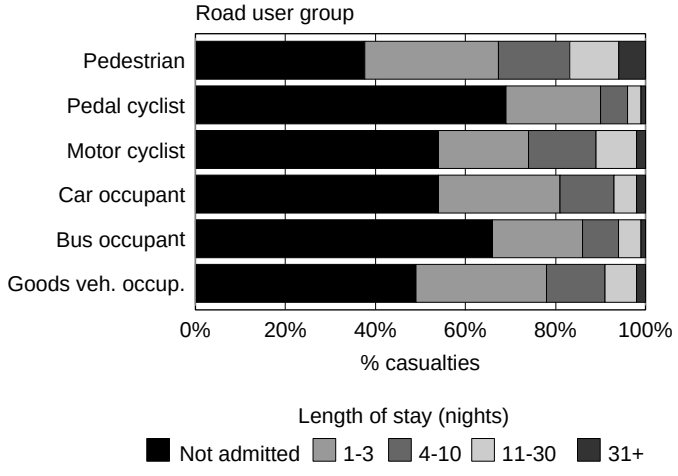
Table 10 Distribution of injury severity by age and road user type within seriously injured casualties

Pedestrian	*MAIS*			*Pedal cyclist*	*MAIS*		
(N=2426)	*0-1*	*2*	*3+*	*(N=2559)*	*0-1*	*2*	*3+*
0-4 %	24	65	12	0-4 %	21	68	11
5-7 %	26	57	17	5-7 %	24	70	7
8-11 %	23	68	9	8-11 %	21	76	3
12-15 %	21	71	8	12-15 %	16	83	2
16-19 %	19	71	11	16-19 %	24	75	1
20-29 %	23	70	7	20-29 %	20.5	76	3.5
30-39 %	25	66	8	30-39 %	23	73	4
40-49 %	29	57	14	40-49 %	23	73	4
50-59 %	25	66	9	50-59 %	21	73	6
60+ %	26	59	15	60+ %	23	59	18
All ages %	24	65	11	All ages %	21	75	4

Motorcyclist	*MAIS*			*Car occupant*	*MAIS*		
(N=1695)	*0-1*	*2*	*3+*	*(N=4312)*	*0-1*	*2*	*3+*
				0-4 %	23	72	5
				5-7 %	30	64	6
				8-11 %	16	82	2
0-15 %	19	77	3	12-15 %	28	66	5
16-19 %	16	75	9	16-19 %	29	64	7
20-29 %	16	73	11	20-29 %	31.5	61	8
30-39 %	15	75	10	30-39 %	36	57	7
40-49 %	17	75	8	40-49 %	37	56	7
50-59 %	17	74	9	50-59 %	44	49	7
60+ %	26	66	8	60+ %	48	43	9
All ages %	17	74	10	All ages %	35	58	7

Bus occupant	*MAIS*			*Goods vehicle occupant*	*MAIS*		
(N=308)	*0-1*	*2*	*3+*	*(N=327)*	*0-1*	*2*	*3+*
0-15 %	27	73	-	0-15 %	39	61	-
16-19 %	25	75	-	16-19 %	31	59	10
20-29 %	33	67	-	20-29 %	25	68	6
30-39 %	42	53	5	30-39 %	33	55	12
40-49 %	42	58	-	40-49 %	26	65	9
50-59 %	36	64	-	50-59 %	37	56	7
60+ %	30	64	6	60+ %	53	35	12
All ages %	32	65	3	All ages %	31	60	9

- no data



Sample size: 12432

Figure 23 Percentage of serious casualties within each length of stay group

Table 11 Distribution of length of stay by age within serious casualties

	Length of stay (nights)				
Age group	*0*	*1-3*	*4-10*	*11-30*	*31+*
0-4 %	52	37	7	3	1
5-7 %	48	36	9	3	4
8-11 %	55	31	9	3	3
12-15 %	59	27	9	4	1
16-19 %	57	25	12	5	1
20-29 %	58	25	10	5	2
30-39 %	58	23	12	6	2
40-49 %	52	26	14	6	2
50-59 %	50	25	15	9	2
60+ %	40	23	15	15	6

Sample size: 13286

Table 12a Distribution of injury severity by age and road user type

Road user/ Age group	Length of stay (nights) 0	1-3	4-10	11-30	31+	Mean nights (in-patients)
Pedestrian (N=2425)						
0-4 %	28	53	12	4	2	4.4
5-7 %	31	44	15	5	5	6.5
8-11 %	38	36	16	4	5	9.4
12-15 %	39	38	15	6	2	5.4
16-19 %	46	28	20	5	2	5.7
20-29 %	52	25	11	9	3	8.9
30-39 %	42	27	16	11	4	9.4
40-49 %	33	28	21	12	6	10.7
50-59 %	39	24	17	19	2	9.4
60+ %	30	16	16	24	14	20.6
All ages %	37	30	16	11	6	10.6
Pedal cyclist (N=2542)						
0-4 %	57	29	9	3	3	*6.2
5-7 %	59	31	5	1	4	6.5
8-11 %	68	26	3	2	1	4.2
12-15 %	71	22	4	2	1	4.2
16-19 %	76	17	5	2	-	3.6
20-29 %	73	21	4	2	<0.5	4.1
30-39 %	73	15	9	3	-	4.6
40-49 %	67	24	6	2	1	4.5
50-59 %	62	20	9	7	2	7.5
60+ %	42	19	18	18	3	10.2
All ages %	69	21	6	3	1	5.2
Motorcyclist (N=1719)						
0-15 %	58	26	13	3	-	*4.1
16-19 %	55	20	16	9	1	7.6
20-29 %	53	23	13	8	3	9.1
30-39 %	56	17	16	8	3	9.4
40-49 %	57	21	16	6	-	5.5
50-59 %	53	14	17	13	3	11.2
60+ %	52	18	14	14	2	*8.4
All ages %	54	20	15	8	2	8.6

** results based on <30 cases*
- no data

Table 12b Distribution of injury severity by age and road user type

Road user/ Age group	Length of stay (nights) 0	1-3	4-10	11-30	31+	Mean nights (in-patients)
Car occupant (N=4979)						
0-4 %	70	26	2	2	-	2.8
5-7 %	73	20	4	1	1	*4.9
8-11 %	64	25	5	3	3	9.5
12-15 %	62	25	7	3	3	6.0
16-19 %	54	28	11	5	2	5.8
20-29 %	56	27	12	4	2	5.7
30-39 %	56	27	12	5	1	6.5
40-49 %	53	27	13	5	1	5.5
50-59 %	47	31	14	7	1	5.9
60+ %	45	27	16	9	3	9.3
All ages %	54	27	12	5	2	6.5
Bus occupant (N=336)						
0-15 %	81	16	3	-	-	*1.8
16-19 %	88	12	-	-	-	*1.0
20-29 %	74	23	3	-	-	*1.9
*30-39 %	83	9	9	-	-	*4.3
*40-49 %	70	11	15	4	-	*5.6
*50-59 %	85	8	8	-	-	*3.3
60+ %	54	26	8	9	3	8.5
All ages %	66	20	8	5	1	6.5
Goods vehicle occupant (N=361)						
*0-15 %	53	35	6	6	-	*3.1
*16-19 %	61	18	14	4	4	*10.3
20-29 %	57	29	7	4	2	5.5
30-39 %	48	32	12	7	1	5.1
40-49 %	43	31	17	9	-	5.4
50-59 %	51	19	23	4	2	*8.0
*60+ %	12	41	24	18	6	*14.1
All ages %	49	29	13	7	2	6.6

** results based on <30 cases*
- no data

Table 13 Percentage of casualties with each outcome

Outcome	Road user type: Pedestrian %	Pedal cyclist %	Motor cyclist %	Car occupant %	Bus occupant %	Goods vehicle occupant %	All road users %
Patient did not wait	2	2	1	1	1	1	2
Examination only	6	5	3	10	6	8	8
Treated; no further required	39	40	43	50	49	48	46
Treated; referred to GP	14	18	11	19	19	20	18
Treated; referred to out-patient clinic	14	25	24	12	18	11	15
All out-patients[1]	75	90	82	92	93	88	89
Transferred to specialist/other hospital	3	1	1	1	<0.5	1	1
Discharged in-patient; no further treatment	5	2	3	2	3	3	3
Discharged in-patient; referred to GP	2	1	1	1	<0.5	1	1
Discharged in-patient; referred to out-patient clinic	12	5	10	3	2	4	5
All in-patients[1]	24	9	17	7	6	11	10
Other/unspecified outcome	1	1	1	1	1	1	1

[1]*including patients with other/unknown outcomes*
Sample size: 68357

pedal cyclists, motorcyclists and bus occupants were more likely to be referred to out-patient clinics. Pedestrians and pedal cyclists were also more likely to be referred to out-patient clinics following discharge from treatment in hospital as an in-patient.

Analysis of the outcome for patients over the period of study showed that there were significant changes. The proportion of patients who did not wait for treatment or were only examined increased slightly, from 1 to 2 per cent and from 8 to 9 per cent respectively. This reflects the increase in the proportion of casualties with no injury reported earlier. There also appeared to be an increase in the proportion of patients who were referred to GPs and a decrease in the proportion who were referred to out-patient clinics.

4 Involvement of emergency services

Information collected during the survey included details of which emergency services were present at or called to the accident. This information may have been available from medical records, especially regarding use of the ambulance service. In addition, casualties who were interviewed were asked which of the services were called to or present at the scene of the accident. Information on the use of the ambulance service was collected in 79 per cent of cases since the information was likely to be available from medical records (where details of whether the patient was brought to hospital by ambulance were noted), in addition to patient interviews. Information about the involvement of the police and fire services was recorded in 42 and 40 per cent of cases respectively as this information was usually only available from those casualties who were interviewed. The proportion of casualties in accidents where each emergency service was involved was calculated from cases where the information was known.

4.1 Ambulance service

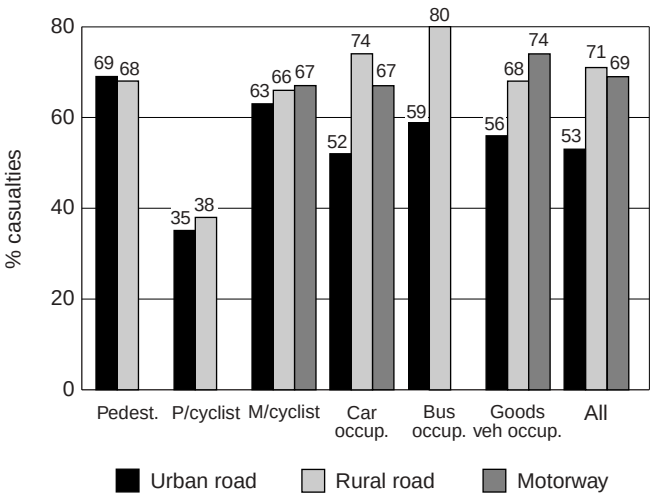
Table 14 shows the percentage of casualties in accidents where the ambulance service was used. Figures for each level of severity and for both single and multi-vehicle accidents are given. On average, just over half of casualties were in accidents where the ambulance service was required. As would be expected, the proportion was higher in cases where the casualty was seriously injured than for those who were slightly injured. Overall, about half of casualties who were slightly injured and three quarters who were seriously injured were in accidents where the ambulance service was used. Pedal cyclists were consistently less likely to report an ambulance being used than other road users.

Use of the ambulance service was higher following accidents on motorways and rural roads compared with urban roads, as Figure 24 shows. There was less difference in the use of the ambulance service by road type for the vulnerable road user groups than there was in the case of vehicle occupants.

Table 14 Proportion of casualties in accidents where ambulance service was present at or called to the accident

Road user type/no. of vehicles involved		*DETR severity*		
		Slight	*Serious*	*All severities*[1]
Pedestrian	- single vehicle[2]	55	85	68
	- multi vehicle	50	84	61
	- all accidents	56	85	68
Pedal cyclist	- single vehicle	16	28	20
	- multi vehicle	45	66	52
	- all accidents	28	44	33
Motorcyclist	- single vehicle	38	65	47
	- multi vehicle	62	86	72
	- all accidents	52	78	62
Car occupant	- single vehicle	57	83	66
	- multi vehicle	48	85	56
	- all accidents	50	85	58
Bus occupant	- single vehicle	39	48	42
	- multi vehicle	57	92	67
	- all accidents	52	74	59
Goods vehicle occupant	- single vehicle	56	79	64
	- multi vehicle	53	83	61
	- all accidents	55	83	63
All[3]	- single vehicle	43	67	51
	- multi vehicle	49	82	57
	- all accidents	48	76	56

[1] *including unknown severity*
[2] *it would be misleading to compare single vehicle pedestrian accidents with other single vehicle accidents since those involving pedestrians actually involve two road users ie a pedestrian and a vehicle occupant*
[3] *including other and unknown road user types*
Sample size: 53707



Sample size: 36443

Figure 24 Percentage of casualties in accidents where the ambulance service was used

4.2 Fire and rescue service

Information on the involvement of the fire and rescue service following road accidents was much less likely to be known, since it was not routinely recorded on the casualty cards. Table 15 shows, from the available information, that just 5 per cent of casualties reported the involvement of the fire service. Seriously injured car, bus and goods vehicle

Table 15 Proportion of casualties in accidents where fire service were present at or called to the accident

Road user type/no. of vehicles involved		DETR severity		
		Slight	*Serious*	*All severities*[1]
Pedestrian	- single vehicle[2]	<0.5	1	1
	- multi vehicle	1	2	1
	- all accidents	<0.5	1	1
Pedal cyclist	- single vehicle	<0.5	-	<0.5
	- multi vehicle	<0.5	1	<0.5
	- all accidents	<0.5	<0.5	<0.5
Motorcyclist	- single vehicle	1	2	1
	- multi vehicle	2	4	2
	- all accidents	1	3	2
Car occupant	- single vehicle	6	21	9
	- multi vehicle	5	24	7
	- all accidents	5	23	7
Bus occupant	- single vehicle	-	2	<0.5
	- multi vehicle	15	58	26
	- all accidents	8	27	14
Goods vehicle occupant	- single vehicle	7	23	16
	- multi vehicle	7	20	10
	- all accidents	7	24	12
All[3]	- single vehicle	2	4	3
	- multi vehicle	4	17	6
	- all accidents	4	11	5

- no data

[1]*including unknown severity*
[2]*it would be misleading to compare single vehicle pedestrian accidents with other single vehicle accidents since those involving pedestrians actually involve two road users ie a pedestrian and a vehicle occupant*
[3]*including other and unknown road user types*
Sample size: 27167

Table 16 Proportion of casualties in accidents where police were present at or called to the accident

Road user type/no. of vehicles involved		DETR severity		
		Slight	*Serious*	*All severities*[1]
Pedestrian	- single vehicle[2]	47	71	55
	- multi vehicle	37	79	49
	- all accidents	45	72	55
Pedal cyclist	- single vehicle	3	6	4
	- multi vehicle	29	46	33
	- all accidents	14	21	16
Motorcyclist	- single vehicle	18	39	25
	- multi vehicle	55	72	62
	- all accidents	39	60	46
Car occupant	- single vehicle	56	77	62
	- multi vehicle	60	86	64
	- all accidents	60	84	64
Bus occupant	- single vehicle	15	13	15
	- multi vehicle	60	89	68
	- all accidents	34	54	40
Goods vehicle occupant	- single vehicle	53	70	59
	- multi vehicle	59	84	65
	- all accidents	59	79	65
All[3]	- single vehicle	32	49	38
	- multi vehicle	57	78	62
	- all accidents	50	65	54

[1]*including unknown severity*
[2]*it would be misleading to compare single vehicle pedestrian accidents with other single vehicle accidents since those involving pedestrians actually involve two road users ie a pedestrian and a vehicle occupant*
[3]*including other and unknown road user types*
Sample size: 28955

occupants were much more likely to report that the fire service was used than other types of road user.

4.3 Police

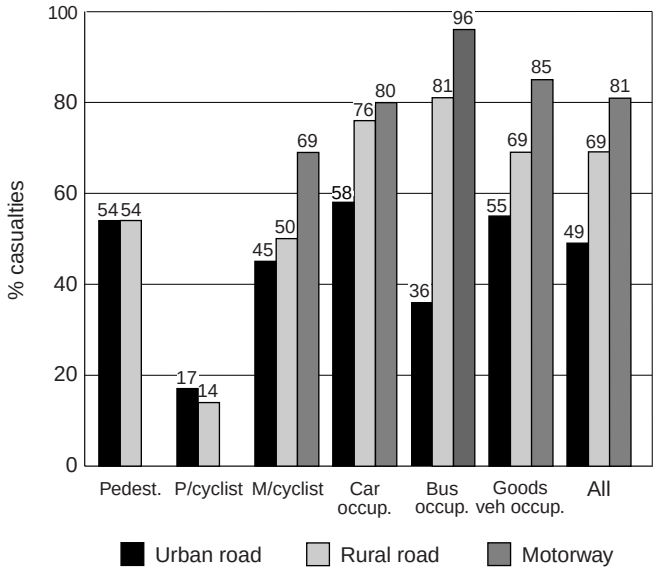
It was stated earlier that the only nationally available information on road accidents is that reported by the police. A separate research project was commissioned to look at the incidence of under-reporting in detail by matching information about casualties who were recorded in the hospital survey with those recorded in national police road accident data as having been involved in road accidents within the hospital catchment areas. A computerised matching process was developed which compared information present in both data sets, including casualty age, sex, road user type and date of accident to determine which casualties were recorded within police data. The results (reported in Simpson, 1996) showed that there was wide variation in the level of recording amongst different types of road accident casualties.

The information recorded from the hospital survey on whether the police were involved following the accident can give some indication of the likelihood of casualties being reported to the police, however it should be noted that some casualties will be reported to the police some time after the casualty has attended hospital and some casualties will not know of the involvement of the police.

Table 16 shows that overall, 54 per cent of casualties were in accidents where the police were reported to have been present at, or called to, the scene. As found in other hospital based studies, the level of police involvement was higher for serious casualties, where two-thirds of casualties reported the police being involved, compared with slight casualties, of whom only half reported that the police were informed.

The level of police involvement varied with road user type and between single and multi-vehicle accidents. The police were generally considered more likely to be involved following accidents involving car and goods vehicle occupants, and pedestrians than those involving pedal cyclists, motorcyclists and bus occupants. Two-thirds of car and goods vehicle occupants considered the police were involved compared with around half of pedestrians and motorcyclists, two-fifths of bus occupants and less than a fifth of pedal cyclists. Levels of police involvement were higher following multi-vehicle accidents, particularly in the case of accidents involving pedal cyclists, motorcyclists and bus occupants.

The level of police involvement also varied with road type with the police being most likely to be involved following accidents on motorways, followed by rural roads and urban roads, shown in Figure 25. For pedestrians and pedal cyclists there was insufficient data to give meaningful results on motorways, but the proportions of casualties reporting that the police were involved following accidents on urban and rural roads were very similar.



Sample size: 23991

Figure 25 Percentage of casualties in accidents where the police were reported to be involved following the accident

5 Summary and conclusions

This hospital-based study has investigated the nature of casualties who attended the Accident and Emergency Departments of a sample of hospitals across Britain following a road accident over a three year period. Their characteristics were compared with those of casualties reported in national casualty data based on accidents and casualties recorded by the police. The results show that, whilst the characteristics of casualties attending hospital are similar to those of casualties in Stats19 in some respects, in other respects the results differed and reflected those that would be expected from a hospital-based study. This means that police-recorded data alone may not provide a complete picture of the road accident casualties that are occurring. In addition, the hospital records provide more detailed information about the type and severity of injuries. The involvement of the emergency services was also examined. The main results are summarised as follows:

a The hospital data contained a larger proportion of pedal cyclists than police data suggest, and a lower proportion of car occupants and pedestrians. Casualties tended to be young and nearly three-fifths were male, the same proportion as is recorded in police data. The distribution of age was younger than that of casualties in police data, nearly a third of casualties were aged under 20 compared with a quarter of casualties in Stats19. The distribution of accident times reflected that of accidents recorded in Stats19 well, as did the large proportion of casualties injured on urban roads. However, the hospital data contained higher proportions of casualties involved in single vehicle accidents.

b Around a quarter of casualties were classed as seriously injured using DETR guidelines, this compares with 15 per cent of casualties in Stats19. Casualties who were seriously injured were more likely to be in the younger or older age groups, to be pedestrians, pedal cyclists or motorcyclists (the vulnerable road users) whereas those in the slight group tended to be middle-aged and to be vehicle occupants. The injury severity assessed in terms of the AIS scale of injury severity was more widely spread within the serious group than within the slight group. Within the serious group, pedestrians and motorcyclists were shown to have more severe distributions of injury severity and length of stay in hospital, than pedal cyclists and vehicle occupants. Within the slight group, casualties were assessed in terms of incidence of whiplash injury which was more likely in the case of vehicle occupants, especially car and goods vehicle occupants and those aged in the mid-age ranges.

c Location and type of injury varied with road user type and age. Pedestrians and pedal cyclists were more likely to suffer head injuries, and motorcyclists and bus occupants more commonly received injuries to the lower limbs. Other vehicle occupants tended to sustain injuries to the neck. Serious injuries to pedestrians, pedal cyclists, motorcyclists and bus occupants were more likely to be fractures whereas these were less common amongst vehicle occupants. Slight injuries to vehicle occupants were more likely to be whiplash and sprains/ strains, whereas cuts and bruises were more dominant for other types of road user.

d Investigation into the involvement of the emergency services following road accidents showed that half of slightly injured casualties, three quarters of seriously injured casualties and just over half of all casualties were in accidents where the ambulance service was used. Use of the fire service was very much lower but around 5 per cent of casualties were involved in accidents where it was required. As might be expected its use was higher where seriously injured car, bus and goods vehicle occupants resulted. Information from the hospital survey also estimated level of police involvement following road accidents. It was more likely that the police were involved following accidents which resulted in car occupant, goods vehicle occupant and pedestrian casualties, casualties in multi-vehicle accidents, and those who suffered more severe injury.

e Comparison of the results for each year of the three year study showed that there had been some small but statistically significant changes in the types of casualties in the hospital sample. The proportion of pedal cyclists, casualties injured on rural roads, and those injured as the results of falls had increased. In contrast the proportion of pedestrians, casualties injured on urban roads and those injured in collisions had decreased. There was also evidence to show that the proportions of casualties with no injury, and serious injury had increased with a consequent decrease in the proportion of slightly injured casualties. The distribution of MAIS overall, and for serious casualties also became more severe and the proportion of slight casualties with whiplash increased.

The study has shown that there are some clear differences between the casualty groups which highlight

possible areas where investment in safety measures might bring the most beneficial returns. There are also marked differences between the characteristics of casualties recorded in the hospital survey compared with those recorded in police casualty data and the hospital survey provides an important additional source of information. The hospital data has also enabled the injury types and severity of casualties to be investigated in more detail than is possible using currently available national data.

6 Acknowledgements

The work described in this report forms part of a Road Safety Division, DETR funded research programme conducted by the Transport Research Laboratory. The data were collected using the Department of Trade and Industry's Accident Surveillance System, managed by the Consumer Safety Unit of the DTI.

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Appendix A: Severity definitions

A.1 DETR injury severity definitions

Serious: An injury for which a person is detained in hospital as an in-patient, of any of the following regardless of whether or not they are detained in hospital: fractures, concussion, internal injuries, crushings, severe cuts and lacerations, severe general shock requiring medical treatment, injuries resulting in death 30 or more days after the accident.

Slight: An injury of a minor character such as a sprain, bruise or cut not judged to be severe, or slight shock requiring roadside attention.

A.2 The Abbreviated Injury Scale

The Abbreviated Injury Scale (AIS) is an internationally recognised method of measuring injury severity. It was developed by a committee of specialists for use in crash investigation for work on vehicle design. The scale is as follows:

Abbreviated Injury Scale (AIS)

AIS 0	No injury
AIS 1	Minor injury
AIS 2	Moderate injury
AIS 3	Serious injury
AIS 4	Severe injury
AIS 5	Critical injury
AIS 6	Maximum injury

The AIS is primarily based on threat to life but also takes account of permanent impairment resulting from the injury and the energy dissipation required to cause the injury. The scale has been revised several times to cover a wider range of injuries. In this study text descriptions of the injuries of each patient were coded in terms of AIS-90 (1990 revision) using TRI-CODE computer software.

The MAIS is the single highest AIS score assigned to a casualty and is used to describe overall injury severity.

Appendix B: Survey hospitals

Airedale, Keighley, West Yorkshire; Blackburn Royal Infirmary, Blackburn, Lancashire; Hereford General, Hereford, Herefordshire; King's College, Denmark Hill, London; Luton and Dunstable, Luton, Bedfordshire; Macclesfield District General, Macclesfield, Cheshire; Manor, Nuneaton, Warwickshire; Monklands District General, Airdrie, Scotland; Mount Vernon, Northwood, Middlesex; Norfolk and Norwich, Norwich, Norfolk; North Devon District, Barnstaple, Devon; North Tees General, Stockton-on-Tees; Prince Charles, Merthyr Tydfil, Mid-Glamorgan; Queen Mary's University, Roehampton, London; Royal Berkshire, Reading, Berkshire; Selly Oak, Birmingham; Skegness and District, Skegness, Lincolnshire.

Appendix C: Sample size

Table 17 Sample sizes

Sex/age group	*Pedestrian*	*Pedal cyclist*	*Motor cyclist*	*Car occupant*	*Bus/coach occupant*	*Goods vehicle occupant*	*Total*[1]
Males							
0-15	1939	2917	93	1556	179	73	7000
16-19	380	900	872	2483	29	116	5285
20-29	709	1433	1676	5800	112	604	11540
30-39	400	916	1023	3253	79	417	6740
40-49	273	486	401	1807	61	265	3667
50-59	212	230	206	1124	50	194	2240
60+	446	241	115	1218	164	70	2439
Unknown	26	20	28	87	9	6	202
All males	4385	7143	4414	17328	683	1745	39113
Female							
0-15	1302	1099	18	1804	199	34	4665
16-19	270	201	133	2318	69	43	3416
20-29	392	412	330	6235	178	100	8555
30-39	214	211	135	3241	125	56	4443
40-49	201	134	75	2183	110	34	3039
50-59	148	107	43	1296	152	21	1966
60+	574	107	28	1472	520	14	2925
Unknown	16	-	2	92	17	3	150
All Females	3117	2271	764	18641	1370	305	29159
Total [2]	7512	9419	5181	36012	2058	2052	68357

[1]*including other/unknown road user type*
[2]*including unknown gender*

Abstract

The Department of the Environment,Transport and the Regions has funded a research project to collect information on the casualties who attended a national sample of hospitals for treatment following a road accident during a three year period. The information collected included details of casualty and accident types, and clinical information on injury type, location and casualty outcome. This report summarises the information collected from the survey and compares the results with data from national police accident reports.

Related publications

TRL173 *Comparison of hospital and police casualty data: a national study* by H F Simpson. 1996 (price code H, £30)

PR45 *The cost of long term disabilty from road traffic accidents. Four year study - final report* by P A Murray, M Pitcher and C S B Galasko. 1993 (price code J, £35)

RR379 *Police and hospital recording of non-fatal road accident casualties: a study in Greater Manchester* by J M Hopkin, P A Murray, M Pitcher and C S B Galasko. 1992 (price code H, £30)

CR212 *The cost of long term disability resulting from road traffic accidents: interim report* by R J Tunbridge, P A Murray, A M Kinsella and C S B Galasko. 1990 (price code B, £15)

RR59 *Long-term disability following road traffic accidents* by C S B Galasko, P Murray, M Hodson, R J Tunbridge and J T Everest. 1986 (price code B, £15)

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