TRANSPORT RESEARCH LABORATORY

Linkage of STATS19 and Scottish hospital in-patient data — analyses for 1980–1995

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Executive Summary

The British national road accident reporting system (STATS19) uses three rather general categories of injury severity - Fatal, Serious and Slight. The value to researchers of enhancing STATS19 casualty records with clinical information has long been recognised. Since 1980, TRL has maintained a file of road accident casualty data for Scotland which has been enhanced with information such as length of stay in hospital and the overall Maximum Abbreviated Injury Scale code (MAIS) for each of the six body regions. The clinical information comes from the Scottish Hospital In-patient System (SHIPS), which covers all hospitals in Scotland.

The report provides an overview of trends in the clinical aspects of road accident casualties over the period 1980-95, using information from the linked STATS19/SHIPS data set. The casualties in the linked data set form a sample of the full set of casualties in accidents which are reported to the police in Scotland; the relation between the sample and the full set is shown to be largely stable over time, so it is reasonable to generalise the results found with the linked data to the full set of casualties in Scotland.

Various clear trends have been identified in the linked data, and some of these can readily be explained. For example, reductions in the time spent by in-patients in hospital undoubtedly result from changes in clinical and managerial practice in hospitals over this period. Explanations for other changes will require more detailed research. For example, it is shown that the proportion of head injuries has fallen steadily; improved secondary safety in cars may well have contributed to the fall, but the proportion has fallen among pedestrians and pedal cyclists as well as vehicle occupants - although less rapidly.

The clinical data are analysed in cross-section as well as through time. It is seen that the clinical outcome depends upon the speed limit on the road where the accident occurred and the number of vehicles involved. A more detailed analysis for car occupants finds that the outcome also depends upon the casualty's age, sex and seating position.

Thus, in addition to examining trends in the clinical data from Scottish road accident casualties over the period 1980-95, this report also gives some indications of the scope for more detailed analyses.

1 Introduction

It has long been recognised that it would be valuable to enhance police records of road accident casualties to include more details of the injuries sustained. The British national reporting system (STATS19) uses three categories of injury - Fatal, Serious and Slight; the two non-fatal categories are rather general and do not give any indication of the anatomical sites of injury or of length of stay in hospital. These aspects can be useful to researchers when, for example, assessing the effectiveness of safety measures introduced to reduce injury severity or when costing road accidents.

Since 1980 the Transport Research Laboratory has maintained a database of road accident casualties for Scotland, based on the STATS19 casualty records. These have been enhanced by the addition of clinical data based on the International Classification of Diseases (ICD9) codes (see World Health Organisation, 1975). The clinical information comes from the Scottish Hospital In-patient System (SHIPS), which covers all hospitals in Scotland. The information added to the STATS19 casualty records includes the length of stay and an overall Maximum Abbreviated Injury Scale code (MAIS) for each of the six body regions (see Appendix A). SHIPS and STATS19 casualty records are matched using variables common to both data sources, since personal details such as names are not released to TRL for ethical reasons.

This report analyses the enhanced casualty information for the years 1980-95. Reference is made to two earlier reports dealing with the linked SHIPS/STATS19 information:

Stone (1984) described the procedure for matching the two sources of data and established its validity.

Tunbridge (1987) presented comprehensive analyses of the data (for 1980-83) in terms of patterns and severity of injury for all types of road users involved in various accident circumstances.

The aim of this report is to provide an overview of trends in the clinical data over the full period for which the data have been assembled, and to give some insight into the scope for more detailed analyses. Only brief details of the operation of the linked database are given, the reader who is interested in fuller information is referred to Stone (1984).

2 Creating the SHIPS file

2.1 Data sources

Following every road traffic accident which becomes known to the local police and involves personal injury, a police reporting officer completes a STATS19 form. This form includes details of every person who was injured in that accident. The severity of each casualty is classified according to the three categories used by the STATS19 system:

Fatal - where death occurs within 30 days as a result of the accident.

Serious - injuries including any fracture, internal injury, severe cuts and lacerations, concussion, any injury requiring detention in hospital.

Slight - examples in this category are sprains, bruises, cuts judged not to be severe, and slight shock requiring roadside attention.

The hospital in-patient data is supplied by the Information Services Division of the Scottish Health Service Common Services Agency. It is released to TRL under conditions agreed with the Privacy Committee of the Scottish Health Service Planning Council and the British Medical Association (Scottish Joint Consultants Committee), as described by Stone (1984). Some variables need to be generated from the hospital in-patient data to obtain the STATS19-type variables needed to link with the casualty data; for example, the geographical location is derived from the hospital code, the casualty's age is derived from the date of birth and the road user class is derived from the ICD9 'external cause of injury code'. The variables common to both data sources used for linking records are: geographical location, date and time of accident, sex, age, class of road user.

An important aspect of the clinical information is the body region that was injured. The procedure for translating the ICD9 codes into AIS by body region was developed at the Transport Research Laboratory.

2.2 Matching the data

A summary of the matching procedure is given here, a more detailed account is given by Stone (1984).

The files of in-patient records and police casualty records are compared, and matched in-patient records are marked so that the clinical information can subsequently be added to the STATS19 file. A system of tolerances is used to allow for limited variation in selected variables in the two files, to maximise the number of successful matches in the particular year. Examples of tolerated variations are:

a police forces are allowed to vary with neighbouring ones;

b the severity of injury in the police data may be allowed to be slight or fatal;

c when an accident occurs shortly before midnight, the SHIPS record is allowed to be on the next day;

d ages may vary slightly - the STATS19 data may be estimated by the reporting officer and the SHIPS data is derived from the date of birth.

Only unique matches are accepted, i.e. ambiguous cases where an in-patient record appears to be linked with two or more STATS19 records or *vice versa* are excluded. The same matching algorithm with the same system of tolerances has been applied to each year's data, and Table 1 shows the proportion of unique matches for each year. The table shows that the proportion of these matches has tended to fall very slightly over the years.

2.3 STATS19 enhanced file

Once the unique matches have been established, each matched STATS19 casualty record is enhanced by adding variables from the corresponding in-patient record. The

Table 1 The percentage of unique matches, by year

Year	*Number of SHIPS records*	*Percentage matched*
1980	8744	69.7
1981	9080	69.0
1982	8664	69.3
1983	7512	68.5
1984	7650	70.1
1985	7521	68.2
1986	7065	70.0
1987	6349	70.0
1988	6546	70.8
1989	6665	70.8
1990	6461	71.8
1991	6148	69.8
1992	5890	69.5
1993	5399	67.0
1994	5411	68.6
1995	5321	67.8

variables are: tolerance level of the match, length of stay in hospital, up to five ICD9 injury codes, the overall casualty MAIS and the MAIS code for the most severe injury to each body region.

3 Results

A series of tables is presented to summarise the analyses of the linked data that have been carried out. Some of the more notable findings are also illustrated by figures. A considerable volume of statistical material is presented, the following notes mention some of the salient features.

Table 2 presents an overview of the distribution of the matched SHIPS casualties for the period 1980-95.

Table 3 studies variations over the 1980-95 period using four periods. 1980-82 is taken as the first period in view of the important effects of the introduction of compulsory seat belt wearing in January 1983. The remainder of the period is divided into one 3-year and two 5-year periods. Trends in three aspects of the clinical data are studied: MAIS, (most severely injured) Body Region and Length of Stay (days in hospital).

For each road user group and for each period, the great majority of casualties have MAIS=2 and the mean MAIS is close to 2.0 in each case. Each of the distributions has, however, 'spread' through time: the proportion with MAIS=2 has declined while the proportion with MAIS=1 or 3/4 has risen (pedestrians present a minor exception). Figure 1a illustrates this phenomenon using the data for drivers of motor vehicles.

The proportion of casualties suffering head injuries has decreased sharply through time among car occupants and motorcyclists, it has decreased rather less for pedal cyclists and pedestrians. There are corresponding increases for other body regions, e.g. the proportion of car occupants with chest injuries almost doubled between 1980-82 and 1991-95. Figure 1a also illustrates this phenomenon using the data for drivers of motor vehicles.

The mean length of stay in hospital has fallen steadily over the period studied. The mean summarises the distribution, to give a fuller account Figure 1b compares the cumulative distributions of the five road user groups in 1980-82 and 1991-95. The general reduction in length of stay is clearly visible.

The final lines in the table show the relative size of the casualty groups. The falling number of motorcyclist casualties is particularly noticeable, although this is already familiar from the annual publications of STATS19 data.

The great majority of in-patients in the SHIPS file who can be linked with casualties in the STATS19 file tend to be recorded by the police as seriously injured. The table shows, however, that a small minority of in-patients die within 30 days of the accident and so are recorded as fatally injured by the police. Almost one-fifth of linked in-patients were recorded as being slightly injured, and these cases do appear to be have been misclassified by the police. The percentages of STATS19 casualties who can be linked in the SHIPS files are fairly consistent over the years; however, slight casualties have risen nationally as a proportion of all casualties so the proportion of slight casualties among the linked casualties has also risen (see Table 4).

Table 5 compares the distribution of road users in the SHIPS file with the distribution among STATS19 serious casualties. The comparisons for the four periods are fairly consistent, with pedestrians over-represented in the SHIPS file and the other groups under-represented; however, car occupants were under-represented in the earlier years but were over-represented in 1991-95. These differences appear unlikely to affect comparisons *within* a road user group, but could affect comparisons for grouped data, e.g. for all road users.

Table 6 makes the same set of comparisons as Table 4, except that different types of accident are compared rather than different periods. The four accident types are:

Single vehicle accidents on BU roads, i.e. all accidents which occurred on a Built-Up road (the speed limit was $\leq$ 40 mph) and involved only a single vehicle,

Multi-vehicle accidents on BU roads, i.e. all accidents which occurred on a Built-Up road and involved two or more vehicles,

Single vehicle accidents on NBU roads, i.e. all accidents which occurred on a Non Built-Up road (the speed limit was > 40 mph) and involved only a single vehicle,

Multi-vehicle accidents on NBU roads, i.e. all accidents which occurred on a Non Built-Up road and involved two or more vehicles.

The casualty numbers are low for certain groups, especially pedal cyclists injured in sva's on NBU roads and pedestrians injured in mva's on NBU roads, but most of the comparisons should be robust. The mean MAIS is generally highest in mva's on NBU roads, but the clearest difference relates to Length of Stay in hospital; the mean is clearly highest for this group of accidents. This may be influenced by the high proportion of casualties in these accidents with injuries to their lower limbs. Figure 2 illustrates these results for car occupants - the greater length of stay for casualties in mva's on NBU roads is shown clearly.

Table 2 Overall number of SHIPS casualties and their distribution by road user class — Scotland, 1980–95

Class of road user	*Total*	*Pedal cycles*		*Motorcycles*		*Cars*		*PSV*		*Goods <1.5T*		*Goods >1.5T*		*Others*	
Drivers/riders	34763	3677	4.8%	8267	10.8%	20443	26.7%	88	0.1%	1329	1.7%	809	1.1%	150	0.2%
Passengers	17254	38	0.1%	1023	1.3%	14161	18.5%	855	1.1%	843	1.1%	220	0.3%	114	0.2%
Pedestrians(struck by)	24680	155	0.2%	1145	1.5%	20366	26.6%	878	1.1%	1407	1.8%	580	0.8%	149	0.2%
All casualties	76697	3870	5.1%	10435	13.6%	54970	71.7%	1821	2.4%	3579	4.7%	1609	2.1%	413	0.5%

	Pedestrians					*Pedal cyclists*					*Motorcyclists*				
Other vehicle involved	*0-15*	*16-25*	*26-50*	*51-99*	*Total*	*0-15*	*16-25*	*26-50*	*51-99*	*Total*	*0-15*	*16-25*	*26-50*	*51-99*	*Total*
PC	52	13	18	72	155	17	15	4	4	40	1	28	6	1	36
M/C	319	164	202	460	1145	39	16	10	4	69	7	138	28	2	175
Car	9384	2920	3026	5036	20366	1280	398	303	164	2145	54	3210	833	138	4235
PSV	233	146	215	284	878	40	12	10	2	64	0	62	16	3	81
Goods <1.5T	652	174	182	399	1407	74	35	23	14	146	3	261	81	17	362
Goods >1.5T	174	84	116	206	580	33	24	22	16	95	1	144	54	14	213
Rest	56	19	36	38	149	440	295	291	130	1156	66	2959	967	196	4188
Total	10870	3520	3795	6495	24680	1923	795	663	334	3715	132	6802	1985	371	9290

Car occupants by age and sex

	Drivers					*Front seat passengers*					*Rear seat passengers*				
Sex\age groups	*0-15*	*16-25*	*26-50*	*51-99*	*Total*	*0-15*	*16-25*	*26-50*	*51-99*	*Total*	*0-15*	*16-25*	*26-50*	*51-99*	*Total*
Male	27	5652	6599	2997	15275	264	1780	1045	479	3568	782	1197	472	175	2626
Female	0	1581	2451	1136	5168	154	1387	1529	1691	4761	776	928	501	651	2856
Total	27	7233	9050	4133	20443	418	3167	2574	2170	8329	1558	2125	973	826	5482

PSV and goods vehicle occupants by age and sex

		0-15	*16-25*	*26-50*	*51-99*	*Total*
PSV and goods vehicle drivers		2	603	1375	378	2358
PSV passengers	Male	78	34	63	114	289
	Female	41	47	75	403	566
Total		119	81	138	517	855

Table 3 Distribution of MAIS, body region and length of stay for different classes of road user — Scotland, 1980-95

	Driver of motor vehicle				*Passenger of motor vehicle*				*Motorcyclist*				*Pedal cyclist*				*Pedestrian*			
	1980-82	*1983-85*	*1986-90*	*1991-95*	*1980-82*	*1983-85*	*1986-90*	*1991-95*	*1980-82*	*1983-85*	*1986-90*	*1991-95*	*1980-82*	*1983-85*	*1986-90*	*1991-95*	*1980-82*	*1983-85*	*1986-90*	*1991-95*
MAIS severity																				
0	1.3%	1.1%	1.3%	1.3%	1.4%	1.1%	1.5%	1.4%	0.8%	0.5%	1.6%	0.5%	0.1%	0.1%	0.9%	0.6%	0.4%	0.3%	1.2%	0.6%
1	14.5%	15.9%	18.5%	20.2%	17.6%	17.9%	18.8%	21.8%	11.2%	11.9%	14.0%	12.5%	8.0%	11.9%	14.8%	17.2%	7.6%	9.1%	10.9%	14.1%
2	66.7%	64.6%	59.3%	56.9%	65.5%	61.6%	58.0%	54.6%	60.4%	59.6%	53.4%	53.6%	75.7%	69.3%	65.2%	62.0%	68.8%	67.5%	65.8%	63.9%
3	14.8%	15.3%	17.4%	17.8%	13.3%	16.5%	17.8%	17.6%	24.5%	24.6%	27.9%	29.3%	14.7%	16.6%	16.0%	17.1%	20.2%	20.7%	19.2%	18.3%
4	2.2%	2.4%	2.7%	2.7%	1.4%	2.1%	3.0%	3.5%	2.3%	2.7%	2.4%	3.4%	1.3%	2.0%	2.8%	3.0%	2.6%	2.2%	2.6%	2.7%
5	0.3%	0.4%	0.4%	0.8%	0.6%	0.6%	0.7%	1.0%	0.7%	0.7%	0.6%	0.6%	0.1%	0.0%	0.3%	0.1%	0.3%	0.2%	0.2%	0.4%
6	0.3%	0.2%	0.2%	0.3%	0.2%	0.2%	0.2%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%
mean MAIS	2.04	2.04	2.04	2.04	1.98	2.03	2.05	2.03	2.18	2.19	2.18	2.25	2.09	2.08	2.06	2.05	2.18	2.16	2.12	2.10
Body region																				
Head	60.2%	52.7%	46.6%	40.2%	63.9%	51.1%	45.3%	40.2%	31.2%	29.4%	23.3%	18.6%	64.8%	59.8%	60.3%	53.9%	51.7%	49.3%	46.9%	43.5%
Spine	4.5%	6.4%	7.1%	9.0%	5.6%	8.1%	9.0%	9.6%	3.2%	3.8%	5.1%	5.6%	1.9%	2.2%	1.8%	3.1%	1.1%	1.0%	1.3%	1.6%
Chest	9.1%	9.5%	12.4%	17.1%	5.9%	9.6%	11.7%	15.1%	2.4%	2.8%	3.6%	4.3%	1.6%	1.8%	2.3%	3.6%	2.1%	2.1%	2.0%	2.5%
Abdomen	2.3%	2.5%	2.6%	2.9%	1.7%	2.7%	3.4%	4.9%	3.2%	2.8%	2.6%	2.8%	0.7%	1.5%	1.1%	1.8%	2.2%	1.6%	1.6%	1.6%
Upper limbs	6.6%	10.2%	10.3%	10.4%	8.4%	10.9%	12.8%	13.2%	16.0%	19.0%	20.4%	26.0%	10.2%	8.4%	10.9%	14.4%	6.7%	7.3%	8.2%	10.3%
Lower limbs	17.3%	18.6%	20.9%	20.4%	14.4%	17.6%	17.9%	17.0%	44.0%	42.2%	44.9%	42.7%	20.7%	26.3%	23.7%	23.1%	36.2%	38.7%	40.1%	40.5%
Length of stay																				
0	7.9%	8.7%	8.1%	10.3%	8.4%	9.2%	8.7%	11.1%	5.6%	5.6%	5.5%	5.5%	3.2%	3.1%	3.8%	5.1%	4.3%	4.3%	5.1%	6.2%
1	31.9%	31.4%	29.0%	33.7%	30.7%	29.6%	29.3%	33.0%	23.9%	23.8%	22.5%	23.6%	32.9%	34.8%	37.1%	40.2%	26.5%	27.6%	25.3%	29.4%
2	13.4%	14.7%	14.9%	13.8%	15.0%	15.3%	14.1%	13.7%	11.4%	12.5%	11.8%	12.9%	17.9%	18.7%	17.4%	17.9%	13.6%	14.1%	14.2%	13.9%
3	7.7%	7.8%	8.0%	8.2%	8.5%	7.9%	9.0%	7.0%	8.1%	8.9%	8.5%	8.5%	9.7%	7.8%	8.6%	8.4%	7.3%	7.3%	8.0%	7.6%
4-10	21.4%	21.0%	22.4%	18.9%	21.7%	20.5%	22.0%	21.1%	21.9%	22.6%	26.7%	26.9%	19.7%	21.5%	18.6%	19.1%	20.7%	20.3%	21.6%	20.7%
11-30	11.2%	10.7%	12.2%	11.0%	10.1%	10.9%	11.7%	10.3%	16.5%	16.6%	16.7%	16.3%	10.4%	7.9%	8.4%	6.6%	15.1%	14.1%	15.4%	14.1%
31-100	6.1%	5.3%	5.3%	3.9%	4.9%	6.0%	4.9%	3.6%	11.6%	9.1%	8.1%	6.0%	5.9%	6.1%	6.1%	2.6%	12.0%	11.5%	9.8%	7.6%
101-365	0.4%	0.5%	0.2%	0.3%	0.7%	0.5%	0.2%	0.3%	0.9%	0.9%	0.3%	0.2%	0.2%	0.1%	0.0%	0.1%	0.6%	0.7%	0.6%	0.4%
Mean LoS	7.58	7.15	7.07	6.09	7.25	7.59	6.83	5.94	11.83	10.65	9.46	8.30	7.15	6.72	6.50	4.71	11.29	11.09	10.37	8.77
Total number	5055	4068	7015	6663	3902	3009	5052	4226	3078	2319	2438	1455	843	873	1093	906	5478	5357	7779	6066
Annual average	1685	1356	1403	1333	1301	1003	1010	845	1026	773	488	291	281	291	219	181	1826	1786	1556	1213

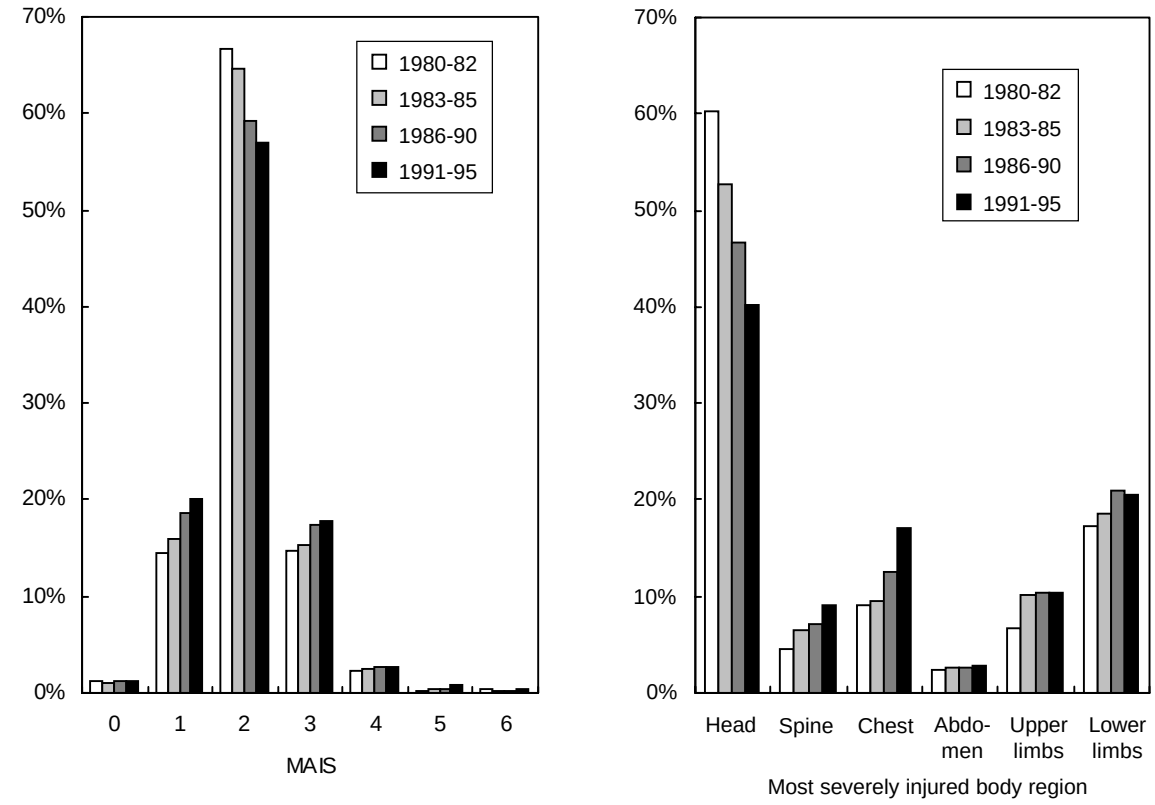


Figure 1a MAIS and body region in four periods, drivers of motor vehicles (data from Table 3)

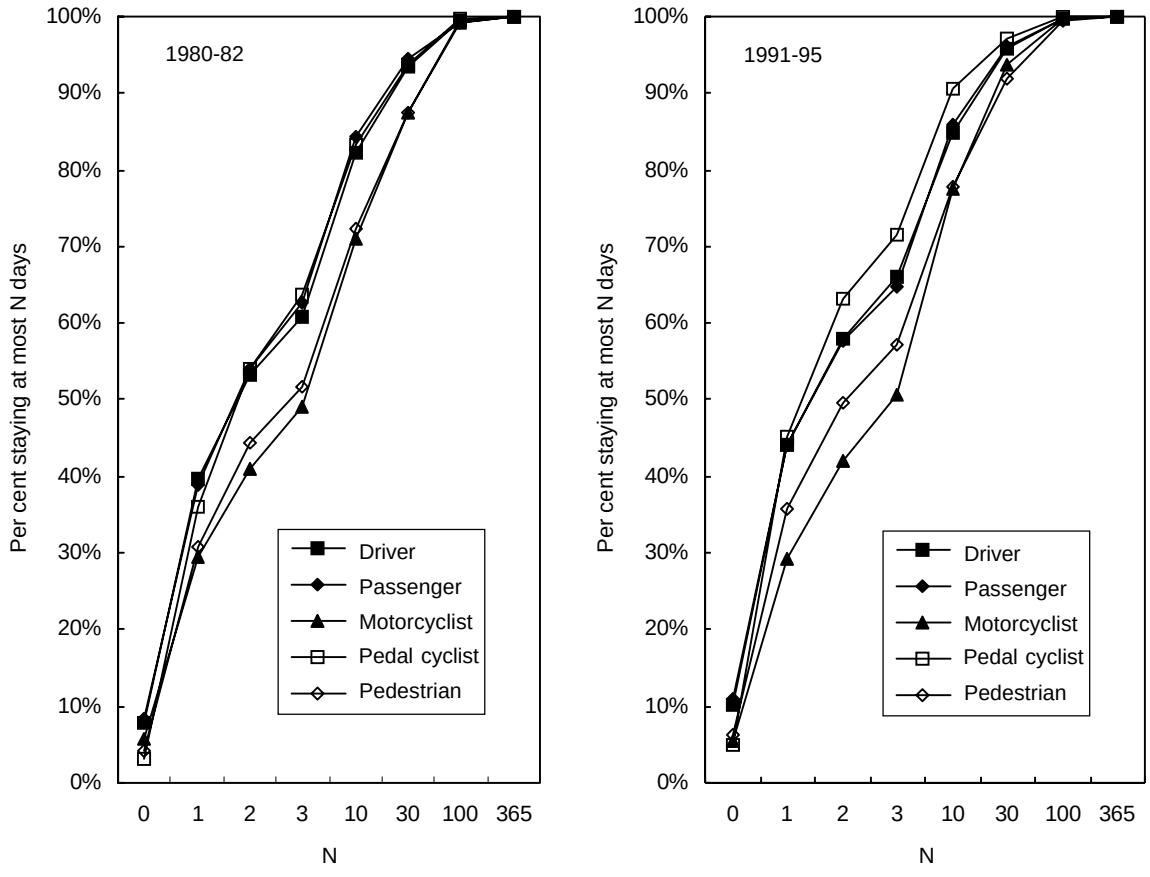


Figure 1b Cumulative distribution of length of stay (data from Table 3)

Table 4 Relationship between linked data and STATS19 records

	Fatal casualties			*Serious casualties*			*Slight casualties*			*Distribution of linked casualties by police severity classification*		
	Linked	*STATS19*	*Percentage linked*	*Linked*	*STATS19*	*Percentage linked*	*Linked*	*STATS19*	*Percentage linked*	*Fatal*	*Serious*	*Slight*
1980	108	700	15.4%	4940	8837	55.9%	1045	19741	5.3%	1.8%	81.1%	17.2%
1981	120	677	17.7%	4994	8840	56.5%	1148	19249	6.0%	1.9%	79.8%	18.3%
1982	114	701	16.3%	4935	9260	53.3%	956	18312	5.2%	1.9%	82.2%	15.9%
1983	100	625	16.0%	4141	7633	54.3%	905	16968	5.3%	1.9%	80.5%	17.6%
1984	88	599	14.7%	4220	7727	54.6%	819	17832	4.6%	1.7%	82.3%	16.0%
1985	93	601	15.5%	4358	7773	56.1%	908	18874	4.8%	1.7%	81.3%	16.9%
1986	97	601	16.1%	4044	7421	54.5%	801	18088	4.4%	2.0%	81.8%	16.2%
1987	77	556	13.8%	3671	6705	54.8%	697	17485	4.0%	1.7%	82.6%	15.7%
1988	80	543	14.7%	3814	6655	57.3%	743	17949	4.1%	1.7%	82.3%	16.0%
1989	90	553	16.3%	3827	6974	54.9%	799	19948	4.0%	1.9%	81.1%	16.9%
1990	76	545	13.9%	3632	6255	58.1%	934	20433	4.6%	1.6%	78.2%	20.1%
1991	72	487	14.8%	3294	5644	58.4%	927	19222	4.8%	1.7%	76.7%	21.6%
1992	60	460	13.0%	3048	5180	58.8%	987	18542	5.3%	1.5%	74.4%	24.1%
1993	58	399	14.5%	2514	4445	56.6%	1043	17558	5.9%	1.6%	69.5%	28.9%
1994	51	363	14.0%	2947	5207	56.6%	712	17013	4.2%	1.4%	79.4%	19.2%
1995	58	408	14.2%	2758	4927	56.0%	794	16848	4.7%	1.6%	76.4%	22.0%

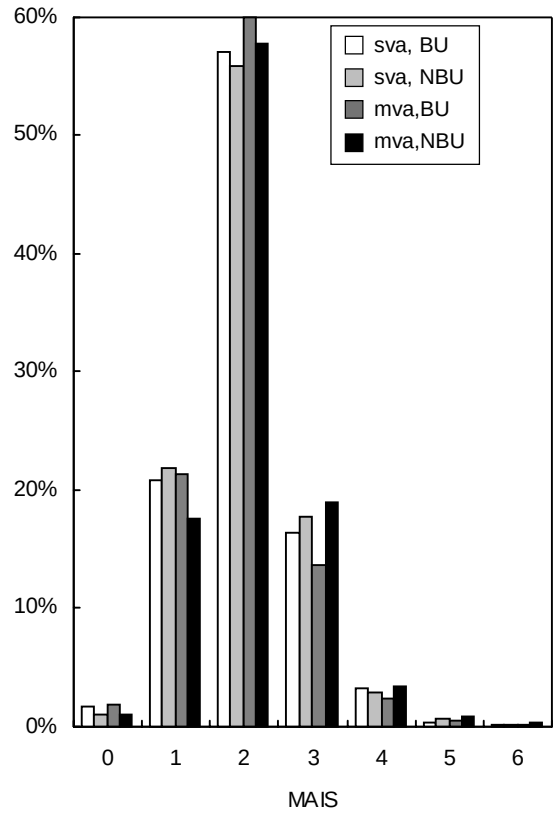
Table 5 Distribution of road user class for linked and STATS19 serious casualties

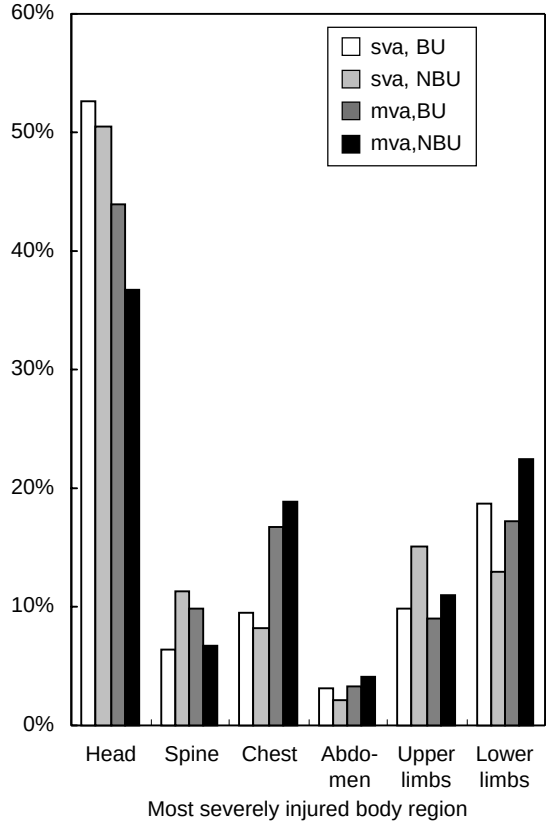
	1980-82			*1983-85*			*1986-90*			*1991-95*		
	Linked	*STATS19*	*Difference*	*Linked*	*STATS19*	*Difference*	*Linked*	*STATS19*	*Difference*	*Linked*	*STATS19*	*Difference*
Pedestrian	30%	27%	2.6%	34%	31%	3.0%	33%	31%	2.2%	31%	30%	1.2%
Pedal-cyclist	5%	5%	0.0%	6%	6%	-0.4%	5%	5%	-0.6%	5%	5%	-0.5%
Motor-cyclist	17%	17%	-0.5%	15%	15%	-0.3%	10%	11%	-0.3%	8%	8%	-0.2%
Car occupant	43%	44%	-1.1%	40%	41%	-1.1%	46%	46%	-0.1%	51%	50%	1.0%
Light goods occ	3%	3%	-0.2%	3%	3%	0.0%	3%	3%	-0.1%	2%	3%	-0.2%
Others	3%	3%	-0.7%	3%	4%	-1.1%	3%	4%	-1.2%	3%	4%	-1.4%
Total	18360	26937		15632	23133		23382	34010		19323	25403	

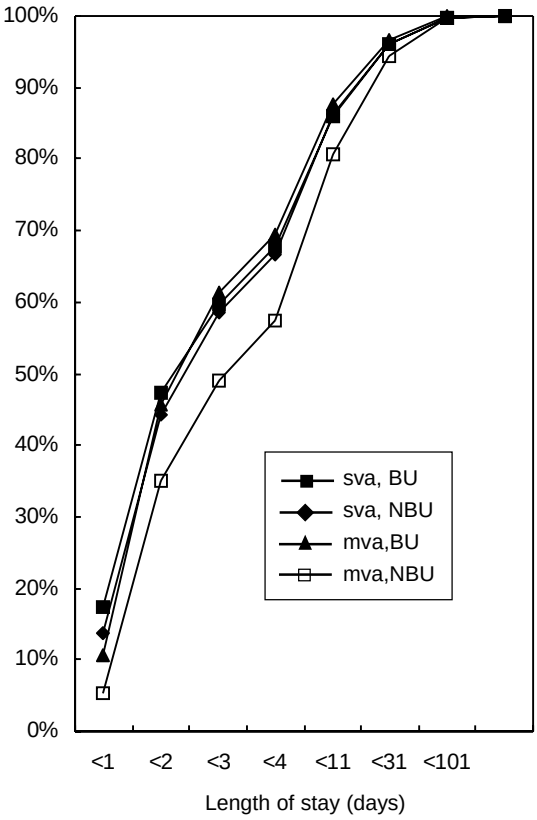
Table 6 Distribution of MAIS, body region and length of stay for different classes of road user and types of accident — Scotland, 1986–95

	Car occupants				*LGV occupants*				*Motor-cyclists*			
No. vehs involved	*1*		*2+*		*1*		*2+*		*1*		*2+*	
speed limit	*BU*	*NBU*	*BU*	*NBU*	*BU*	*NBU*	*BU*	*NBU*	*BU*	*NBU*	*BU*	*NBU*
MAIS severity												
0	1.8%	1.0%	1.9%	1.1%	1.5%	2.3%	3.3%	1.8%	1.6%	0.8%	1.5%	0.7%
1	20.9%	21.8%	21.3%	17.6%	16.4%	22.1%	14.7%	17.8%	18.2%	15.5%	12.3%	11.4%
2	57.1%	55.8%	59.9%	57.7%	59.0%	56.1%	64.5%	54.2%	57.3%	54.1%	54.2%	50.2%
3	16.4%	17.7%	13.8%	19.0%	14.9%	16.8%	16.6%	22.8%	20.0%	24.8%	29.3%	33.8%
4	3.2%	2.8%	2.4%	3.4%	6.7%	2.0%	0.5%	3.0%	3.0%	3.8%	2.0%	3.1%
5	0.4%	0.7%	0.6%	0.9%	1.5%	0.3%	0.5%	0.5%	0.0%	0.9%	0.6%	0.8%
6	0.2%	0.1%	0.1%	0.3%	0.0%	0.3%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%
mean MAIS	2.00	2.02	1.96	2.10	2.13	1.96	1.98	2.09	2.05	2.18	2.20	2.30
Body region												
Head	52.6%	50.4%	44.0%	36.7%	56.3%	53.5%	52.3%	40.4%	32.7%	25.2%	19.9%	16.2%
Spine	6.3%	11.3%	9.9%	6.8%	4.4%	13.0%	8.3%	6.9%	5.2%	8.9%	4.1%	4.5%
Chest	9.5%	8.1%	16.7%	18.8%	7.4%	5.3%	7.9%	10.2%	4.5%	4.6%	3.7%	3.3%
Abdomen	3.1%	2.1%	3.3%	4.1%	7.4%	2.7%	1.4%	3.2%	1.4%	2.7%	2.2%	3.9%
Upper limbs	9.8%	15.1%	9.0%	11.1%	5.2%	15.0%	6.5%	9.7%	23.5%	28.3%	19.4%	22.5%
Lower limbs	18.7%	13.0%	17.2%	22.5%	19.3%	10.6%	23.6%	29.6%	32.7%	30.3%	50.7%	49.6%
Length of stay												
0	17.2%	13.9%	10.6%	5.4%	11.3%	10.4%	8.2%	6.7%	8.8%	6.6%	4.6%	4.4%
1	30.0%	30.3%	35.2%	29.6%	31.2%	33.1%	37.9%	32.2%	29.3%	25.6%	22.4%	18.7%
2	12.4%	14.4%	15.5%	14.1%	12.1%	13.1%	17.2%	12.0%	11.3%	13.7%	12.2%	11.4%
3	8.2%	8.0%	8.1%	8.3%	7.1%	9.6%	11.2%	4.6%	10.5%	7.4%	8.5%	8.5%
4-10	18.1%	19.7%	18.3%	23.4%	28.4%	20.9%	17.2%	22.9%	19.7%	26.9%	29.6%	25.3%
11-30	10.2%	9.7%	8.9%	13.5%	5.7%	8.4%	5.6%	14.5%	15.6%	13.8%	16.1%	19.9%
31-100	3.6%	3.8%	3.3%	5.4%	3.5%	4.5%	2.6%	6.9%	4.7%	5.8%	6.3%	11.4%
101-365	0.3%	0.3%	0.1%	0.3%	0.7%	0.0%	0.0%	0.0%	0.2%	0.2%	0.2%	0.4%
Mean LoS	5.73	5.85	5.23	7.59	6.21	5.71	4.28	7.88	7.18	7.83	8.51	11.65
Total number	1809	5078	4517	9110	141	335	232	475	468	813	1592	1020

	Pedal cyclists				*Pedestrians*				*Others*			
No. vehs involved	*1*		*2+*		*1*		*2+*		*1*		*2+*	
speed limit	*BU*	*NBU*	*BU*	*NBU*	*BU*	*NBU*	*BU*	*NBU*	*BU*	*NBU*	*BU*	*NBU*
MAIS severity												
0	0%	0%	0.9%	1%	0.9%	0.7%	1.5%	0%	2%	2%	2%	1%
1	23%	24%	15.0%	15%	12.4%	10.4%	11.7%	10%	18%	25%	17%	19%
2	56%	59%	65.3%	62%	65.5%	62.6%	59.7%	56%	56%	53%	55%	54%
3	17%	9%	16.3%	18%	18.4%	19.9%	24.8%	27%	24%	18%	22%	23%
4	3%	8%	2.3%	4%	2.5%	5.0%	2.1%	6%	1%	2%	3%	2%
5	0%	0%	0.2%	0%	0.2%	1.1%	0.2%	0%	0%	0%	0%	1%
6	0%	0%	0.0%	0%	0.0%	0.3%	0.2%	0%	0%	0%	0%	0%
mean MAIS	2.00	2.01	2.05	2.11	2.10	2.22	2.16	2.29	2.06	1.94	2.09	2.11
Body region												
Head	77%	81%	55.3%	53%	46.0%	40.7%	43.4%	31%	43%	47%	42%	36%
Spine	1%	0%	2.3%	4%	1.3%	1.6%	2.3%	2%	7%	10%	11%	8%
Chest	1%	1%	3.1%	3%	2.1%	3.9%	2.0%	3%	7%	7%	8%	8%
Abdomen	0%	1%	1.9%	0%	1.5%	3.7%	0.8%	4%	0%	2%	4%	3%
Upper limbs	8%	12%	12.6%	14%	9.1%	10.8%	8.6%	7%	11%	15%	10%	10%
Lower limbs	12%	4%	25.0%	26%	40.0%	39.4%	42.9%	53%	33%	20%	26%	35%
Length of stay												
0	9%	3%	3.8%	5%	5.5%	7.1%	4.8%	6%	5%	9%	6%	4%
1	38%	35%	41.1%	29%	27.7%	20.3%	25.7%	20%	25%	39%	31%	32%
2	15%	19%	18.0%	17%	14.2%	14.0%	12.6%	9%	12%	12%	13%	12%
3	11%	9%	7.9%	10%	7.8%	9.0%	7.3%	6%	7%	7%	9%	6%
4-10	18%	27%	17.4%	23%	21.1%	21.8%	22.0%	21%	27%	20%	20%	24%
11-30	6%	4%	6.7%	13%	14.6%	16.3%	16.5%	26%	15%	8%	15%	18%
31-100	3%	3%	5.1%	3%	8.6%	10.9%	10.6%	11%	8%	5%	5%	4%
101-365	0%	0%	0.1%	0%	0.6%	0.6%	0.3%	1%	0%	0%	0%	0%
Mean LoS	4.49	4.57	5.77	6.08	9.51	11.05	10.47	12.71	9.11	5.71	7.56	7.20
Total number	137	77	1435	350	12287	792	641	125	347	307	230	387







Notes:
sva = single vehicle accidents
mva = multi-vehicle accidents
BU = accidents on Built-Up roads (speed limit ≤40mph)
NBU = accidents on Non Built-Up roads (speed limit >40mph)

Figure 2 Illustrative results from Table 6 for car occupants

Table 7 focuses on car occupants, to examine whether a casualty's age, sex or seating position affect the injuries sustained. The casualty numbers are low for certain groups, especially child front seat passengers and older male passengers, so results will be less precise for these groups. There are subtle differences between the MAIS distributions, but there are some clearer differences between the Body Region distributions: Figure 3 illustrates the variations in the incidence of head injuries. The clearest differences between males and females arise with chest injuries to front seat passengers, but curiously the differences are much less among drivers and rear seat passengers. The Length of Stay distribution also varies, with older casualties spending much longer in hospital on average than younger casualties. This is most pronounced among rear seat passengers: the mean figures are also illustrated in Figure 3.

Table 7 has examined variations with age of the mean MAIS and Length of Stay, variations with age of the Body Region distribution cannot be handled in the same way. Instead, Table 8 compares the distributions directly. Once again, the clearest differences are found with head and chest injuries, as illustrated in Figure 4.

4 Conclusions

This report has provided an overview of trends in the clinical aspects of road accident casualties over the period 1980-95, using information from the linked STATS19/ SHIPS data set which is maintained at TRL. The casualties in the linked data set form a sample of the full set of casualties in accidents which are reported to the police in Scotland; it appears that the relation between the sample and the full set is largely stable over time, so it is reasonable to generalise the results found with the linked data to the full set of casualties in Scotland.

Various clear trends in the linked data have been identified, and some of these can readily be explained. For example, reductions in the time spent by in-patients in hospital undoubtedly result from changes in clinical and managerial practice in hospitals over this period. Explanations for other changes will require more detailed research: for example, improved secondary safety in cars will presumably have contributed to the steady reduction in the proportion of head injuries, but the proportion has fallen among pedestrians and pedal cyclists as well as vehicle occupants - although less rapidly.

The data have been analysed in cross-section as well as through time. It has been seen that the clinical consequences depend upon the speed limit on the road where the accident occurred and the number of vehicles involved. A more detailed analysis for car occupants found that the consequences also depend upon the casualty's age, sex and seating position.

Thus, in addition to examining trends in the clinical data from Scottish road accident casualties over the period 1980-95, this report has given some indications of the scope for more detailed analyses.

5 Acknowledgements

The work described in this report was carried out in the Safety and Environment Resource Centre of TRL. The assistance provided by Fred James in extracting information from the linked database is gratefully acknowledged.

6 References

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Appendix A: 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)

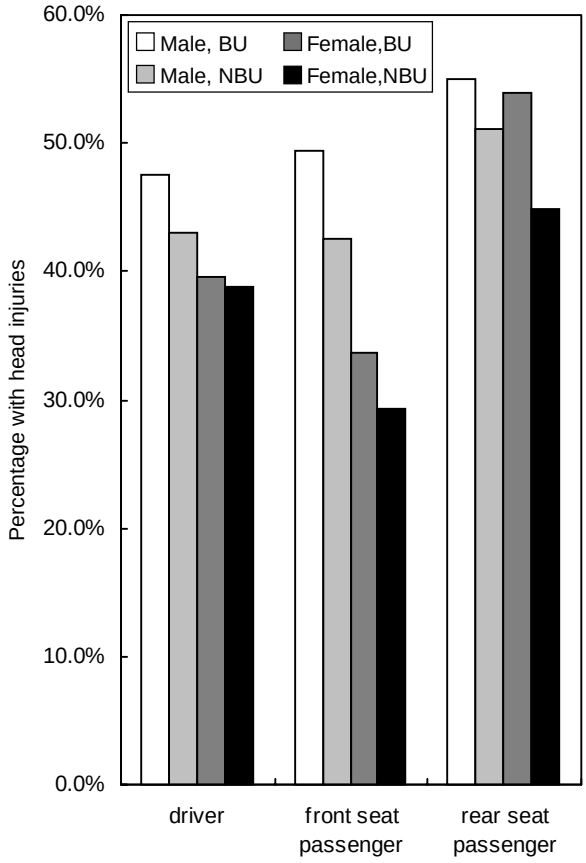
AIS 0	No injury
AIS 1	Minor injury
AIS 2	Moderate injury
AIS 3	Serious injury
AIS 4	Severe injury
AIS 5	Critical injury
AIS 6	Maximum injury

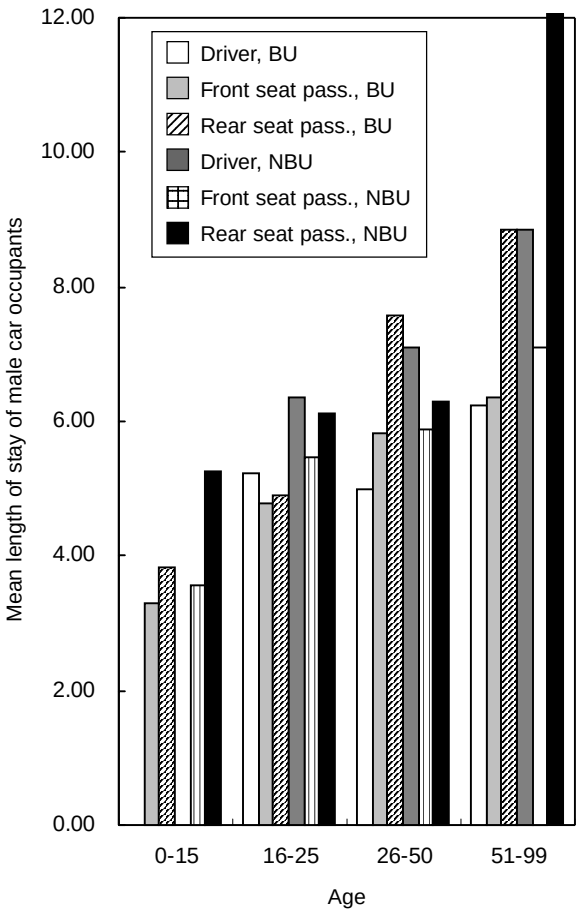
The AIS is based on threat to life but also takes account of permanent impairment resulting from the injury and the energy dissipation required to cause the injury. The scale has been revised several times to cover a wider range of injuries.

The MAIS is the single highest AIS score assigned to a casualty and is used to describe overall injury severity. In this report MAIS is also used to classify each body region.

Table 7 Distribution of MAIS, body region and length of stay for car occupants by age, sex and type of road — Scotland, 1986–95

	Car driver				*Car passenger, front seat*				*Car passenger, rear seat*			
	BU roads		*NBU roads*		*BU roads*		*NBU roads*		*BU roads*		*NBU roads*	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
MAIS severity												
0	2.2%	1.5%	1.0%	0.8%	1.5%	2.3%	0.7%	1.5%	1.1%	1.2%	1.6%	1.3%
1	20.1%	24.7%	18.1%	19.9%	19.9%	22.2%	20.0%	18.0%	18.7%	21.8%	19.7%	23.1%
2	59.4%	59.8%	57.0%	60.3%	58.7%	58.4%	55.4%	59.9%	57.9%	59.1%	53.8%	51.4%
3	15.1%	11.9%	19.5%	16.4%	15.5%	14.1%	18.6%	16.8%	16.7%	14.7%	19.1%	19.3%
4	2.5%	1.3%	3.4%	1.9%	3.4%	2.7%	3.8%	2.7%	4.8%	2.8%	4.2%	4.1%
5	0.5%	0.7%	0.7%	0.6%	0.8%	0.4%	1.1%	0.9%	0.4%	0.4%	1.3%	0.7%
6	0.3%	0.1%	0.3%	0.1%	0.2%	0.0%	0.3%	0.2%	0.2%	0.0%	0.2%	0.1%
Mean MAIS												
0-15					1.94	1.82	1.94	2.03	1.85	1.98	1.99	1.88
16-25	2.01	1.87	2.09	2.01	2.09	1.97	2.09	2.02	2.17	2.00	2.16	2.03
26-50	1.99	1.87	2.10	2.00	1.96	1.83	2.10	2.03	2.11	1.94	2.07	2.14
51-99	1.91	1.95	2.11	2.04	1.95	2.02	2.15	2.09	2.28	1.96	2.23	2.18
All	1.98	1.89	2.10	2.01	2.03	1.94	2.09	2.05	2.08	1.97	2.09	2.04
Body region												
None	2.1%	1.5%	1.0%	0.8%	1.5%	2.3%	0.7%	1.5%	1.1%	1.2%	1.6%	1.3%
Head	47.6%	39.6%	43.0%	38.8%	49.3%	33.7%	42.5%	29.4%	55.0%	54.0%	51.1%	44.9%
Spine	7.6%	12.0%	6.9%	8.8%	6.8%	11.3%	9.8%	10.9%	6.3%	7.1%	7.7%	8.3%
Chest	14.4%	17.6%	14.5%	16.9%	10.5%	24.5%	12.4%	23.7%	5.0%	5.7%	7.2%	8.7%
Abdomen	2.8%	2.1%	2.9%	2.1%	5.6%	3.9%	3.5%	4.6%	3.9%	2.4%	5.0%	5.0%
Upper limbs	8.4%	7.5%	11.6%	10.8%	11.1%	8.8%	15.0%	13.8%	12.0%	10.1%	13.8%	12.8%
Lower limbs	17.0%	19.7%	20.1%	21.8%	15.1%	15.6%	16.0%	16.2%	16.7%	19.6%	13.6%	19.1%
Length of stay												
0	14.2%	7.9%	8.7%	6.6%	16.0%	10.0%	11.9%	6.1%	14.9%	12.2%	11.3%	7.9%
1	32.8%	36.4%	29.2%	31.7%	31.8%	32.9%	31.0%	26.6%	34.0%	34.3%	33.2%	30.5%
2	14.9%	13.8%	14.2%	15.3%	14.5%	17.3%	12.7%	15.1%	11.4%	13.7%	14.1%	12.0%
3	8.6%	9.3%	8.0%	7.5%	6.5%	7.7%	7.6%	8.6%	8.3%	6.7%	8.8%	9.4%
4-10	17.0%	20.1%	21.9%	21.0%	18.2%	18.8%	22.1%	25.3%	18.6%	19.7%	18.5%	22.3%
11-30	8.9%	9.6%	12.4%	12.9%	10.4%	9.8%	11.3%	12.9%	8.5%	8.6%	9.3%	12.4%
31-100	3.5%	2.8%	5.3%	4.5%	2.2%	3.4%	3.3%	5.0%	4.3%	4.7%	4.6%	5.3%
101-365	0.2%	0.1%	0.3%	0.4%	0.3%	0.1%	0.1%	0.4%	0.0%	0.2%	0.4%	0.3%
Mean LoS												
0-15					3.30	6.73	3.56	4.82	3.82	5.13	5.27	4.90
16-25	5.23	4.36	6.34	5.67	4.79	4.29	5.47	6.59	4.89	4.95	6.11	6.16
26-50	5.00	4.44	7.10	6.73	5.82	5.60	5.88	6.40	7.57	4.93	6.31	7.37
51-99	6.24	7.92	8.84	9.65	6.35	6.22	7.09	9.17	8.86	9.59	12.24	11.01
All	5.34	5.20	7.18	7.03	5.12	5.47	5.70	7.42	5.47	6.00	6.28	7.18
Number of casualties												
0-15					50	22	88	65	123	147	335	295
16-25	928	311	2086	649	319	221	587	476	205	150	483	344
26-50	979	499	2492	1033	169	233	352	587	94	93	158	177
51-99	491	241	1156	459	55	264	187	677	32	106	70	266
All	2398	1051	5734	2141	593	740	1214	1805	454	496	1046	1082





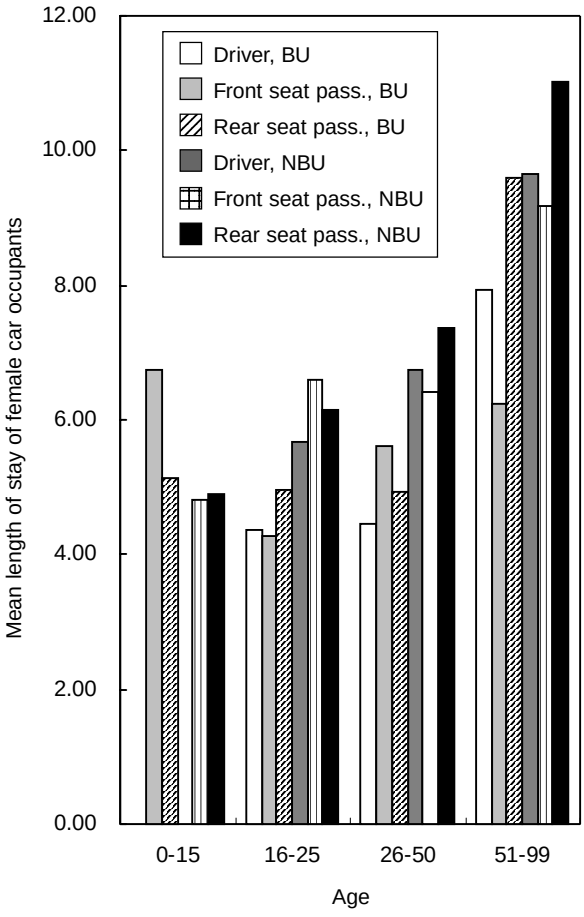


Figure 3 Illustrative results from Table 7

Table 8 Distribution of most severely injured body region for car occupants by age, sex and type of road — Scotland, 1986–95

	BU roads								*NBU roads*							
	Male				*Female*				*Male*				*Female*			
	0-15	*16-25*	*26-50*	*51-99*	*0-15*	*16-25*	*26-50*	*51-99*	*0-15*	*16-25*	*26-50*	*51-99*	*0-15*	*16-25*	*26-50*	*51-99*
Driver																
None		2%	2%	3%		2%	1%	1%		1%	1%	1%		1%	1%	1%
Head		55%	47%	34%		49%	39%	29%		53%	40%	31%		47%	41%	24%
Spine		7%	8%	8%		11%	14%	10%		6%	8%	6%		11%	8%	7%
Chest		6%	15%	29%		8%	18%	29%		6%	15%	29%		9%	16%	30%
Abdomen		3%	3%	2%		2%	3%	1%		3%	3%	3%		3%	2%	2%
Upper limbs		8%	9%	7%		8%	7%	7%		12%	13%	10%		10%	11%	12%
Lower limbs		19%	16%	16%		19%	18%	23%		20%	20%	20%		21%	21%	24%
Front seat passenger																
None	2%	1%	2%	2%	4%	2%	3%	2%	1%	1%	0%	2%	1%	2%	2%	1%
Head	65%	51%	46%	34%	52%	48%	34%	20%	52%	48%	40%	26%	55%	42%	31%	17%
Spine	0%	7%	9%	7%	9%	13%	13%	9%	2%	11%	9%	10%	9%	11%	11%	11%
Chest	6%	5%	13%	38%	4%	10%	24%	40%	3%	5%	15%	33%	4%	8%	23%	37%
Abdomen	6%	5%	7%	3%	4%	4%	4%	3%	10%	3%	4%	3%	7%	3%	4%	5%
Upper limbs	8%	12%	12%	3%	9%	9%	7%	10%	16%	16%	14%	14%	10%	13%	14%	15%
Lower limbs	13%	18%	11%	12%	17%	15%	15%	16%	15%	16%	18%	13%	12%	21%	15%	14%
Rear seat passenger																
None	2%	0%	1%	0%	1%	2%	0%	2%	3%	1%	2%	0%	3%	1%	1%	1%
Head	69%	52%	51%	34%	66%	58%	54%	32%	61%	51%	39%	37%	59%	50%	38%	27%
Spine	2%	6%	13%	9%	3%	10%	11%	5%	3%	11%	8%	7%	4%	12%	10%	6%
Chest	1%	4%	9%	11%	1%	4%	5%	15%	3%	6%	14%	23%	1%	4%	13%	21%
Abdomen	2%	5%	2%	9%	4%	1%	2%	2%	8%	4%	3%	3%	5%	2%	7%	7%
Upper limbs	11%	13%	12%	11%	7%	9%	10%	16%	10%	15%	20%	7%	11%	13%	12%	15%
Lower limbs	13%	19%	13%	26%	18%	17%	17%	28%	13%	13%	14%	23%	17%	18%	19%	23%

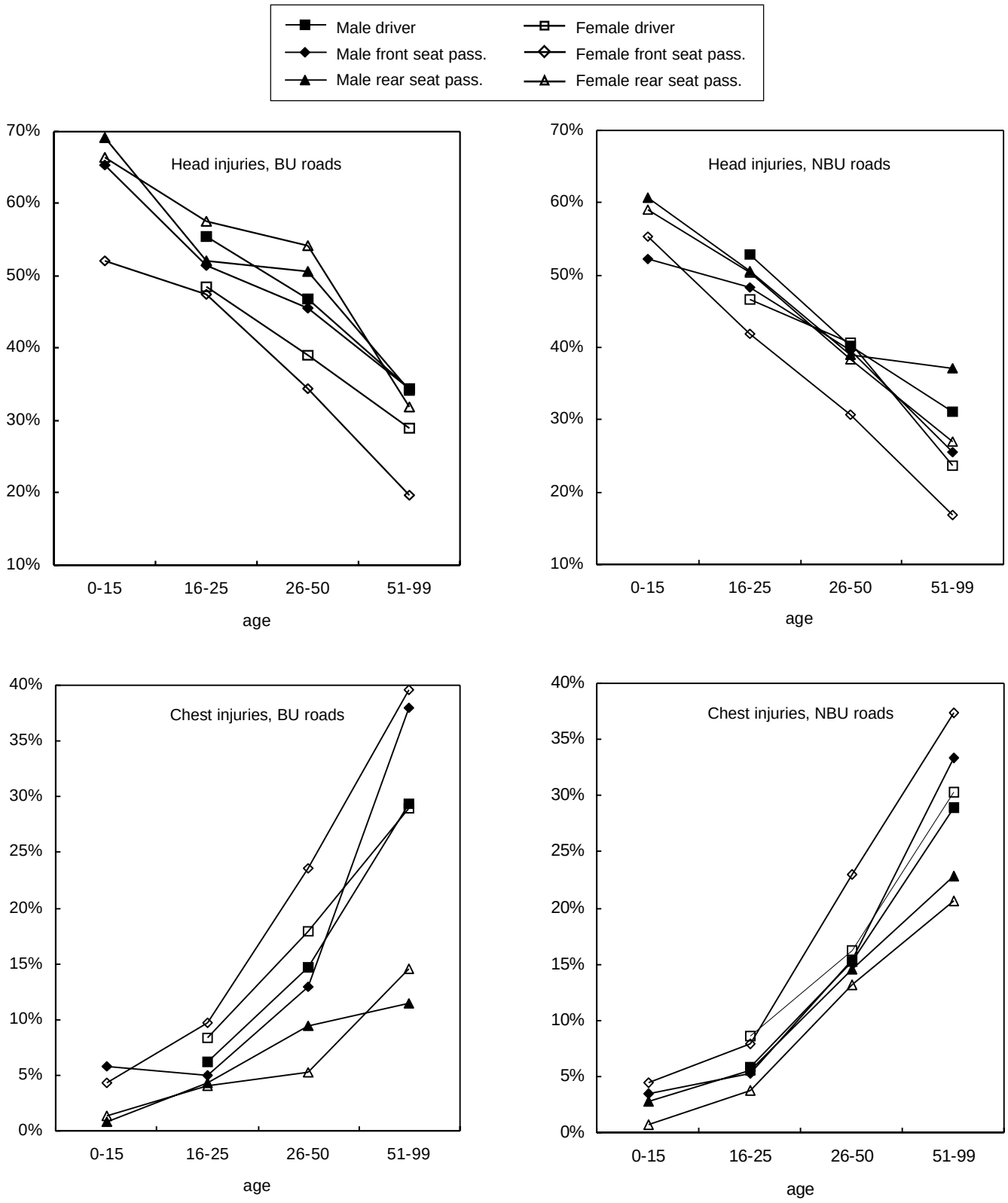


Figure 4 Illustrative results from Table 8

Abstract

The British national road accident reporting system (STATS19) uses three rather general categories of injury severity - Fatal, Serious and Slight. The value to researchers of enhancing STATS19 casualty records with clinical information has long been recognised. Since 1980, TRL has maintained a file of road accident casualty data for Scotland which has been enhanced with information such as length of stay in hospital and the overall Maximum Abbreviated Injury Scale code (MAIS) for each of the six body regions.

This report analyses the enhanced casualty information for the years 1980-95. Its aim is to provide an overview of trends in the clinical data over these sixteen years, and to give some insight into the scope for more detailed analyses. Various clear trends are identified, and some clear differences in the distribution of the clinical details are reported.

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