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Fatal Injuries to Car Occupants: Analysis of Health and Population Data

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EXECUTIVE SUMMARY

Introduction

In 2000 the Government set the following casualty reduction targets (from baseline 1994–98 average) to be achieved by 2010:

- a 40% reduction in the number of people killed or seriously injured in road accidents;
- a 50% reduction in the number of children killed or seriously injured in road accidents; and
- a 10% reduction in the slight casualty rate, expressed as the number of people slightly injured per 100 million vehicle kilometres.

In 2002, an additional target was set to reduce casualties in deprived areas of England more rapidly than in England as a whole by 2005, compared with the baseline average for 1999–2001.

The first and second three-year reviews of the Government's road safety strategy and targets for 2010 indicate that progress towards meeting the targets is good. However, the previous picture of fatality trends following those of serious casualties no longer applies, and since the mid-1990s the two trends have diverged, with the annual number of deaths falling more slowly. The number of deaths began to rise again in 2001 and 2003, before falling in 2004 and 2005. If the current trend continues, fatalities will only reduce to about 19% below the 1994–98 baseline by 2010.

It is against this background that the Department for Transport has commissioned a research programme to investigate trends in fatal car-occupant accidents by examining a wide range of factors that may explain the trends, including accident characteristics, survivability of crashes, changes in exposure, and changes in risk affected by characteristics such as licence holding and the types of vehicles currently driven.

Aims of the study

The road safety casualty reduction targets are based on police data, however, in addition to this data, health data can provide insights into the role medical care plays in the survivability of road accidents and, because the line between death and very serious injury is a fine one, it is instructive to look at health data trends in severe casualties to see if they mirror some of the patterns of fatal casualties. Population data can provide information on mortality and social class in order to explore whether a social gradient class exists for car-occupant fatalities.

The aims of the study are to investigate the extent to which trends can be explained in terms of changes in the injuries that lead to fatalities and the health services' response to them, and the current distribution of fatalities among socio-economic classes. The summary of this report and the wider research programme on fatal trends is published in Ward *et al.* (2007).

Method

An analysis of secondary data sources was applied to the following datasets:

- the Trauma Audit and Research Network (TARN) – health service delivery data;
- Hospital Episode Statistics (HES) – hospital admission data;
- the Patient Episode Database for Wales (PEDW) – hospital admission data;
- the Scottish Mortality Record (SMR01) – hospital admission data;
- the Office for National Statistics (ONS) – mortality data; and
- the Nottingham University fatal road traffic crash research database of police fatal accident files.

Summary

The main points to emerge from this study are as follows.

Care of the injured

- The probability of surviving with serious head injury is lower than for other injuries.
- Most fatally-injured people have a head and/or chest injury.
- Ambulance travel times have not changed in the period 1996–2003.
- The effectiveness of the health care of the injured has not changed in the period 1996–2003.
- Eighty per cent of deaths occur at the scene or before admission to hospital.
- There is some evidence that the number of the most severe casualties is not reducing as rapidly as the number of the least severe.

Deprivation

The disadvantaged in society have a higher fatality rate as vehicle occupants than the more affluent.

Conclusions and recommendations

The number of car-occupant casualties with serious injuries within STATS19 is falling. However, when health data are analysed there is some evidence that the number of more seriously-injured car occupants is not declining and appears to be tracking the fatal injury trend. This means that the fall is coming from the less severely injured in the serious category. Whilst this helps to explain the divergence between the fatal and serious trends, it cannot, in itself, account for the flattening of the fatal tend. This study has investigated whether this flattening can be explained in terms of a change in the types of injuries leading to death, or the health services' response to them. In neither case have any significant trends been identified.

However, to effect a decrease in the fatality rate, policies and interventions are needed to start to bring down the types of accidents where common factors but no trend can be detected. The health service has its part to play in improving the care of the critically injured, especially those with head injuries whose survival up to the time of discharge from hospital is the lowest. An increase in the provision of specialist neurosurgical care could reduce fatality rates in those surviving up to the time of hospital admission.

The socio-economic status of fatally injured car occupants was investigated to try to establish whether there were gradients in fatality rates across the socio-economic classification. Whilst the data did not allow trends to be identified, there was evidence that those in NS-Sec Groups 1 and 2 (higher and lower managerial and professional occupations) were substantially less at risk of death as car occupants than other occupations. Analysis of the Nottingham fatals database supports the premise that the less affluent are more at risk. Whilst more work needs to be undertaken to gain a better understanding of the link between deprivation and risk of death as car occupants, potential risk factors for the less affluent car occupants, such as lower levels of full licence holding, unlicensed driving, driving older cars, and low seat-belt use, need to be addressed.

1 INTRODUCTION

1.1 Government targets: concern over fatality rates

The first and second three-year reviews of the Government's road safety strategy and targets for 2010 (see Box 1.1) indicate that progress towards meeting the targets is good (DfT, 2004; 2007). This progress is being monitored regularly and recent analysis suggests that both the overall killed or seriously injured (KSI) target and the target for children are likely to be exceeded by 2010. The target for slight casualties has already been met.

However, the trends for fatal[1] and serious casualties used to parallel each other, but since the mid-1990s they have begun to diverge, with deaths rising between 2001–03. If the current trend continues, the number of fatalities in 2010 is likely to be only 19% below the 1994–98 baseline. This means that the previous picture of fatality trends following those of serious casualties no longer applies because serious casualties are falling faster (Figure 1.1). Changes in the level of reporting of accidents to the police are unlikely to account for this reduction in casualties nor for the divergence in trends (Ward *et al.*, 2006).

Box 1.1: 2010 Government casualty reduction targets (from baseline 1994–98 average)

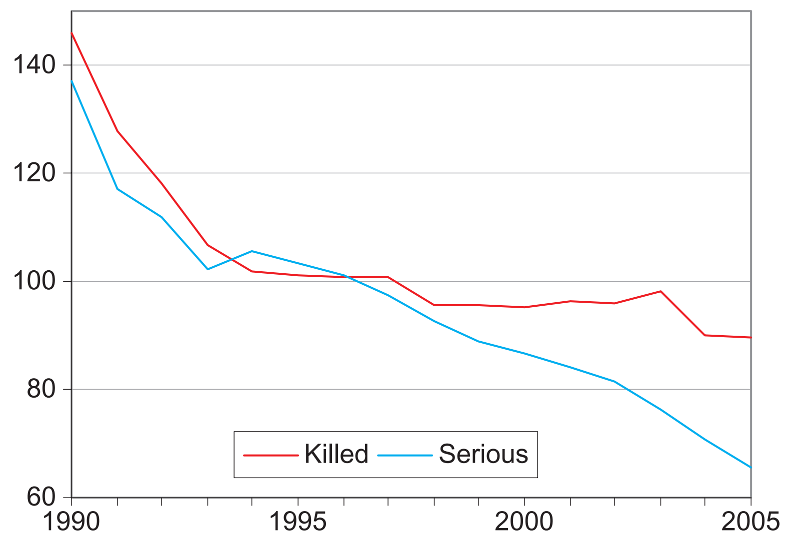
- A 40% reduction in the number of people killed or seriously injured in road accidents.
- A 50% reduction in the number of children killed or seriously injured in road accidents.
- A 10% reduction in the slight casualty rate, expressed as the number of people slightly injured per 100 million vehicle kilometres (DETR, 2000).
- In 2002, an additional target was set to reduce casualties in deprived areas of England by more than for England as a whole by 2005, compared with the baseline average for 1999–2001.

Trends in pedestrian and cyclist fatalities are broadly in line with their serious casualty trends, although the trend in pedal cycle fatalities has started to rise out of step with the trend in serious casualties. The excess deaths are coming from car occupants and motorcyclists. However, indications from work by Broughton and Buckle (2006) are that motorcycle fatalities are following exposure while car-occupant fatalities are ahead of exposure, especially for older cars, meaning the

1 'Fatal accident' – an accident in which at least one person is killed or who sustained injuries which caused death less than 30 days after the accident. Confirmed suicides are excluded.

fatality rate is rising. There were fewer fatalities among motorcyclist and car occupants in 2004 than in 2003, but the fall only continued in 2005 among motorcyclists (Broughton and Buckle, 2007).

Figure 1.1: Trends in KSI casualties (100 = 1994–98 baseline) (source: Broughton and Buckle, 2006)



Broughton (2005), in his analysis of STATS19[2] police reported contributory factors, suggests that behavioural factors are playing an ever-increasing role and argues that fatalities may not be falling as fast as serious casualties because driving standards may have fallen. An example of this is that loss of control accidents have significantly increased between 1999–2004. His work also indicates a rise in drink-drive deaths, especially among younger car drivers, and this accounts for a sizeable proportion of the increase in car driver fatalities.

Research suggests that socio-economic status is an important factor in understanding those most at risk of road traffic injury (Christie, 1995; Lyons *et al*., 2003; Towner *et al*., 2004). There is a steep social class gradient in child pedestrian fatalities, with the rate of children killed in the lowest class, where parents are classified as never having worked or as long-term unemployed, being nearly 21 times[3] higher than in the top social class, where parents were classified as being employed in the higher managerial/professional occupations (Edwards *et al*., 2006). Less is known as to whether this gradient exists for all types of road user and for adults and children alike.

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2 STATS19 is the national database of police completed accident report forms on all injury road traffic accidents reported to them. The Department for Transport owns the full dataset for Great Britain.

3 Based on the new classification of social class, see www.statistics.gov.uk/methods_quality/ns_sec/nssec.

1.2 Aims of the study

The aims of the study are to investigate the extent to which trends can be explained in terms of changes in the injuries that lead to fatalities and the health services' response to them, and the current distribution of fatalities among socio-economic classes. The study is part of a research programme looking at other factors that can explain the trends, including accident characteristics, survivability of crashes, changes in exposure, and changes in risk affected by characteristics such as licence holding and the types of vehicles currently driven. The summary of this report and the research programme on fatal trends is published in Ward *et al*. (2007).

2 METHOD OF ANALYSIS

2.1 Datasets and analysis

2.1.1 Health data used in the analysis

The **Trauma Audit and Research Network (TARN)** is a database that collects information on injury process and outcomes to develop effective care, and represents 50% (33 core hospitals) of all trauma-receiving NHS departments across England. The database is managed by staff based at the Hope Hospital in Salford, near Manchester, supported by the University of Manchester and the Healthcare Commission (see www.tarn.ac.uk/Login.aspx).

TARN data were analysed for 1996–2003 by road user type. The analysis covered the following:

- trends in the median time from the scene to the hospital for drivers injured in road accidents in order to examine if the changes in the time to the hospital could explain fatality rates;
- observed and expected deaths for drivers and car passengers combined, and standardised mortality ratios (SMRs[4]) and 95% confidence intervals for 33 core hospitals in TARN from 1996 to 2003; and
- survival up to the time of hospital discharge following injury for those seriously injured with or without a head injury for different road user groups to examine the importance of the management of brain injury to survivability for different road user groups.

Hospital admission data were analysed for:

- England using Hospital Episode Statistics (HES). HES is a database of admitted patient care in NHS hospitals in England and is a record-level database of hospital admissions for analysis of health care within the NHS. Currently, the database contains over 13 million records. The database is owned by the Department of Health (see www.dh.gov.uk/PublicationsAndStatistics/Statistics/HospitalEpisodeStatistics/fs/en);
- Wales using the Patient Episode Database for Wales (PEDW). This is a centralised database of all hospital admissions of Welsh residents and contains details such as address of residence, admission, and discharge dates, ICD-10[5] and procedure codes (see); and

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[4] SMR is the rate of deaths relative to national average rates after adjustments have been made for the age structure and relative social class of the study population.

[5] ICD-10 codes – International Classification of Diseases, 10th revision (see www.who.int/classifications/icd/en/). Fatality codes: pedestrian (V01–V09), pedal cyclists (V10–V19), motorcyclists (V20–V29), car occupants (V40–V49), pick-up trucks or vans (V50–V59) and heavy goods vehicles (V60–V69).

- Scotland using the Scottish Mortality Record (SMR01)). This is a nationally linked database of SMR01 (hospital discharge) records and Registrar General death records. This database holds all SMR01 and death records for each patient linked by a common patient ID number. The database holds patient records from 1975 and covers 18 million records for almost 4 million people.

These databases were used to examine trends in admissions by road user group. Trends in hospital admissions were compared with STATS19 casualty trends for serious casualties (1999–2003) in order to assess whether serious casualties in hospital records showed similar trends to fatal records compared with police reported data.

2.1.2 *Population data used in the analysis*

Office for National Statistics (ONS) Mortality data were obtained for all deaths for 2001–04 in England and Wales by cause of death, by age, and by social class and/or area deprivation score. ICD codes were used to identify car occupants. Standard mortality rates with 95% confidence intervals were constructed for male car occupants aged 20–64 years killed in each of seven of the eight social classes. Social class was assigned by National Statistics Socio-economic Classification (NS-SeC) codes. The denominator data were derived from the census. The NS-SeC Analytic Classes used in this study were:

1. Higher managerial and professional occupations.
    1.1. Large employers and higher managerial occupations.
    1.2. Higher professional occupations.
2. Lower managerial and professional occupations.
3. Intermediate occupations.
4. Small employers and own account workers.
5. Lower supervisory and technical occupations.
6. Semi-routine occupations.
7. Routine occupations.
8. Never worked and long-term unemployed.

The **Index of Multiple Deprivation (IMD)**[6] was used as an ecological measure of socio-economic status for coding fatal casualties recorded in the Nottingham database of police fatal accident files. A total of 1,185 records from police fatal accident reports collected between 1994 and 2005 were analysed by Clarke *et al*.

[6] The IMD was produced by the Office of the Deputy Prime Minister (ODPM) in 2004 as a composite indicator of the socio-economic environment in England. IMD 2004 is a super output area level index, derived by a combination of seven deprivation indices.

(2007) in order to produce a database of information about the accident leading to the fatality. Information on the post codes of the residences of the casualties was extracted along with age, sex, and body location of injury. The post code data were converted by the University College London (UCL) team to Ordnance Survey grid references which were mapped onto census super output areas. Each of the super output areas in which a fatally-injured casualty lived has been assigned an IMD, which categorises area-based levels of deprivation. The ranks assigned to the IMDs were categorised into quintiles and these were used as a measure of deprivation onto which certain features of injuries were mapped.

3 SUMMARY OF KEY FINDINGS

3.1 Analysis of in-patient data

As the line between death and very serious injury is a fine one, it is instructive to look at severely injured casualties as they may mirror some of the patterns of fatalities.

Table 3.1 shows the number of deaths occurring in hospital as a result of a road traffic accident. Table 3.2 shows the number of deaths recorded in STATS19. These two tables indicate that the percentage of deaths that occur after admission to hospital has reduced slightly from 19.1% in 1999 to 16.8% in 2003. This shows that the overwhelming proportion of deaths occur either at the scene or in hospital but before admission (e.g. in the emergency department or in the operating theatre).

Table 3.1: Number of in-hospital deaths arising from a road traffic accident

	1999	2000	2001	2002	2003
Wales	43	33	37	31	32
Scotland	57	47	36	44	39
England	553	516	498	488	517
Great Britain	653	596	571	563	588

Table 3.2: Number of deaths as recorded in STATS19

	1999	2000	2001	2002	2003
Great Britain	3,423	3,409	3,450	3,431	3,508

The trends in hospital admissions for vehicle occupants in the datasets for the three Home Countries were investigated and were found to differ slightly from each other. Those for England and Scotland show a relatively flat trend, while Wales shows a decline (10% difference between 1999 and 2003). However, the magnitude of the changes between countries is not large in comparison with the potential for an apparent change due to subtle differences in health policies, practices and coding, and greater year-to-year variability in the number injured in the less populous countries. In contrast to the health data, the trend for the seriously-injured casualties in the national STATS19 data diverges by country, with a greater decline in England than in Wales and Scotland (Ward *et al*., 2006).

Ward *et al.* (2006) in their study of the under-reporting of road casualties looked at STATS19 records in conjunction with emergency department records for individual hospitals. By studying the records of casualties that can be found in both the STATS19 and emergency department datasets, it is possible to estimate the proportion of police-defined serious casualties that are treated as more serious or less serious by the hospital. In general, about 10% of those reporting at emergency departments with road traffic injuries are admitted and about half of those in the STATS19 record reported as serious are admitted. In addition to those correctly classed as serious, about the same number again that are recorded by the police as slight are admitted by the hospital.

3.2 Analysis of the TARN database

Health care provision and clinical practice do not stay constant and there will have been changes over the period in question (1996–2003). There are many complex issues surrounding the use of hospital in-patient data systems, but as these do not contain a measure of severity and this makes it very difficult to distinguish between several concomitant changes in health care provision and practice and changes in the incidence of severe injury, as measured by hospital admission rates. Comparison with a dataset that includes injury severity measures is helpful.

The TARN database is based at the Hope Hospital in Salford (www.ihs.man.ac.uk/research networks/TARN). The TARN data were analysed for the period 1996–2003. This database includes those patients with a length of stay in hospital greater than 72 hours, those admitted to a high dependency area, or those transferred to another specialist hospital. While a proportion of the cases in this database will be deaths in hospital, including deaths in the emergency department, i.e. prior to admission, the majority of cases represent the more severely-injured casualties. Data from a core of 33 hospitals were used in the analysis. These had been providing reliable information over this period.

Table 3.3 shows that there has been no decline in the number of the most serious road traffic related casualties admitted to the 33 core hospitals used in this analysis. There is quite a bit of year-to-year variability in the data and there has been an increase in the number of non-road casualties admitted over this period, but it is not possible to determine why this increase has occurred. The pattern from the TARN data is consistent with the pattern of hospital admissions across Britain and as the line between death and very serious injury is a fine one, it is not surprising that the

Table 3.3: Number of road traffic and non-road casualties admitted to 33 core hospitals – TARN, 1996–2003

Year	Road	Non-road	Total
1996	3,089	6,273	9,362
1997	3,072	6,482	9,554
1998	2,766	6,332	9,098
1999	2,919	7,025	9,944
2000	2,788	7,037	9,825
2001	2,876	7,571	10,447
2002	3,042	7,706	10,748
2003	3,147	7,636	10,783

trend for these severe injuries is similar to that for the fatal injuries. This supports the tentative conclusion that any observed reduction in the number of serious casualties in the STATS19 record has not come from a reduction in the number of more severely injured casualties (i.e. those requiring hospital admission or specialist trauma care).

Both the health service data and the STATS19 data show the distribution of injured road users has changed over the 1997–2003 period. Table 3.4 shows the distribution in the TARN data. There is quite a bit of year-to-year variability, but there are clear trends for several categories of road users. There has been a marked reduction in the number of pedestrians injured and this trend is slightly steeper than that found in the STATS19 data. The marked increase in the number of motorcyclists injured is greater in the TARN data than that in the STATS19 data. The number of car drivers injured in both datasets has increased since 1998. These trends are illustrated in Figure 3.1.

Table 3.4: Number of road traffic casualties by category of road users from 33 core hospitals – TARN, 1996–2003

Year	Drivers	Car passengers	Pedestrians	Motorcyclists	Other categories
1996	803	486	926	570	304
1997	786	491	903	593	299
1998	648	394	883	594	247
1999	679	430	842	676	292
2000	672	403	781	683	249
2001	742	395	758	737	244
2002	749	466	712	866	249
2003	833	429	708	900	277

Figure 3.1: Trends in serious road traffic injuries by road user type from 33 core hospitals – TARN, 1996–2003

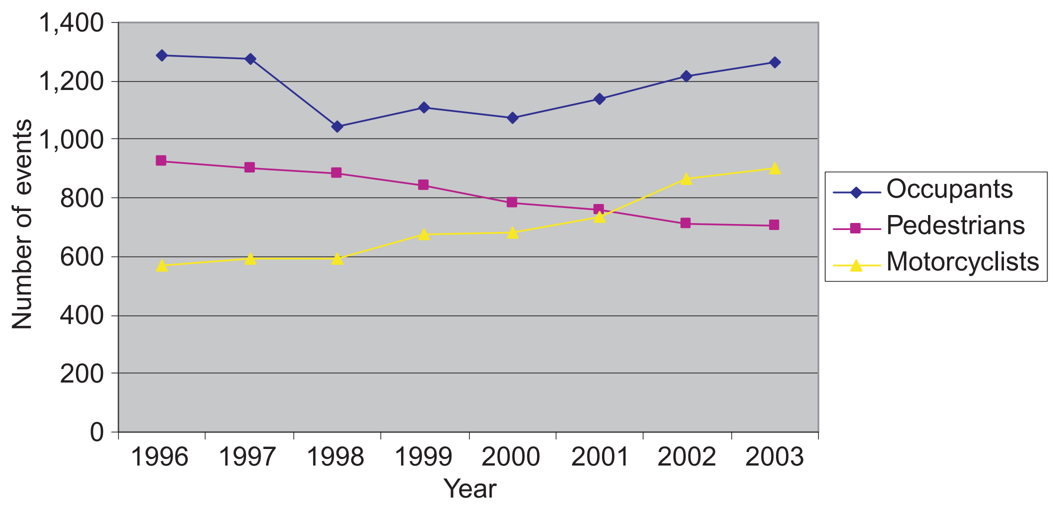

Table 3.5 shows the median Injury Severity Score (ISS) by category of road user over the period 1996–2003. The ISS is a scoring method which provides a general severity score for casualties. An ISS score is calculated through AIS[7] scores. A casualty's three most severe AIS scores are squared and combined to produce the ISS score. The ISS score ranges from 0 to 75. If any injury is given an AIS of 6, then the ISS score is automatically assigned to 75. The ISS score correlates with mortality, morbidity and hospital stay. There has been hardly any change, indicating that there has been no trend in the severity of serious road traffic related casualties in the catchment areas of the 33 hospitals over this time period.

Table 3.5: Trend in median ISS by selected road user categories from 33 core hospitals participating in TARN, 1996–2003

Category	1996	1997	1998	1999	2000	2001	2002	2003
Drivers	10	10	10	10	10	10	10	10
Car passengers	10	10	10	10	10	10	10	11
Pedestrians	10	10	10	10	10	10	10	10
Motorcyclists	9	9	9	9	9	9	9	9
Non-road users	9	9	9	9	9	9	9	9

3.3 Analysis of health care response to injury

It has been suggested that improvements in health care have helped to keep people alive who otherwise might have died from their injuries. There are three sources of information which may help to go some way to answer this question:

- ambulance response times to the scene;
- travel times from the scene to the hospital; and
- survival up to the time of hospital discharge following a serious road traffic injury.

The Department of Health publishes annual bulletins summarising information about the 31 ambulance services in England. The prioritisation of emergency calls to ensure that the immediately life threatening calls get the quickest response was introduced in 2001. These are categorised into Category A emergencies, which are immediately life threatening, or Category B/C calls, which are not life threatening. Ambulance services are expected to reach 75% of Category A calls within 8 minutes. For Category B/C calls, rural services should respond to 95% of incidents

[7] The AIS score for each body region is recorded for each occupant. The AIS is an internationally-recognised method of measuring injury severity developed by a committee of specialists for use in crash investigation. The scale ranges as follows: AIS 0 = no injury to 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.

within 19 minutes and urban services within 14 minutes. For all emergency calls, a rapid response vehicle other than an ambulance, crewed by a paramedic, may be dispatched first and this counts towards the response times.

Over the period 1996–97 to 2004–05, the number of emergency calls that were responded to have increased from 2.99 million to 4.53 million, with patient journeys increasing from 2.57 million to 3.47 million. The data do not allow disaggregation by type of emergency, but road traffic accidents will make up a minority of these calls. Since the 2001 categorisation into A, B and C, the ambulance service has improved its Category A response times from 70.7% to 96% within 8 minutes, while its category B times have declined slightly from 90.2% to 87.8% arriving within 14 or 19 minutes, depending whether the location is urban or rural (DH, 2005).

In summary, these response times are unlikely to have affected the number of deaths arising from road traffic accidents.

Travel to the incident is one part of the journey, the journey back to the hospital with the casualty is also important and is likely to be slower than the outward journey for reasons of patient comfort and safety, and the work of the paramedics in stabilising the casualty en route to the hospital.

Table 3.6 shows, from an analysis of the TARN data, the median length of time taken to convey an injured road user to hospital by ambulance over the study period. There has been no marked change in the time taken. Thus, it is possible to say that any change in road traffic related deaths over this period has not been influenced by any global changes in the average time taken to convey a seriously-injured casualty to hospital.

Table 3.6: Trend in median time from the scene to the hospital for drivers injured in road accidents in 33 core hospitals – TARN, 1996–2003

Year	Median time (minutes)
1996	20.0
1997	20.0
1998	19.0
1999	19.0
2000	20.0
2001	18.0
2002	18.0
2003	19.0

Table 3.7 shows that the probability of surviving a serious road traffic related injury is largely dependant on the presence of a serious head injury. Survival up to the time of discharge from hospital of people without head injuries is very high (about 96%) and there is limited room for improvement. However, for head injuries the position is not so good, with around a quarter of patients dying. The proportion of

motorcyclists with head injuries is low, reflecting the protective effect of hard helmets. The proportion and number of pedestrians with head injuries is very high, reflecting the absence of available countermeasures to protect the head in collisions involving pedestrians.

Table 3.7: Survival up to the time of hospital discharge following injury in the TARN database for cases between 1996 and 2003 for 33 core hospitals by road user type and head injury status

	Non-head injury		Head injury	
	Number	% surviving	Number	% surviving
Drivers	6,153	96.0	2,166	77.5
Car passengers	3,497	96.2	1,369	76.7
Pedestrians	5,757	96.4	3,950	75.7
Motorcyclists	7,204	97.6	957	68.4
Non-road users	97,546	97.3	19,725	78.6

The analysis of injury patterns of fatally-injured drivers using the Nottingham police fatals files database indicates that three-quarters of the sample of 1,184 car occupants included details of their injuries. The age range was from 14 to 91 years, with an average age of 40 years. Males made up 77% of the fatally-injured car occupants in this sample. Of the fatal casualty records with injury descriptions, about 64% had multiple injures and 26% had a single injury noted. While there is no indication of the severity of any one injury, 72% of those with single or multiple injures had suffered a head injury thus underlining the importance of their prevention and treatment.

A recent study undertaken by the TARN revealed that one-third of severe head injuries were treated outside specialist neurosurgical centres in England and Wales, and this group had a 2.15-fold increase in the odds ratio of death (Patel *et al.*, 2005).

It is possible to predict the likelihood of death for patients in hospital and how many patients might be expected to die within a group. Expected deaths are calculated from a complex algorithm that takes into account:

- the distribution and severity of injuries;
- the mechanism of injury; and
- the age and the physiological condition of the patient on arrival.

The probability of death is estimated from these variables and the outcomes from a very large database of treated trauma patients. Thus, it is possible to predict the likelihood of death for every patient and how many patients would be expected to die within a group. By comparing the number who actually die (observed deaths) with the number expected to die, it is possible to calculate a standardized mortality ratio (SMR). SMRs are a point estimate and like all summary statistics have a range of uncertainty which is best shown as a 95% confidence interval (CI). An SMR of 1 indicates that the observed number of deaths is equal to the expected number. For an SMR to be statistically significantly different to 1, the 95% CI around the point estimate should not include 1.

Table 3.8: Observed and expected deaths for drivers and car passengers combined, and SMRs and 95% CI for 33 core hospitals – TARN, 1996–2003

Year	Observed deaths	Expected deaths	SMR	95% CI
1996	122	121	1.01	0.84–1.20
1997	95	92	1.03	0.84–1.26
1998	67	81	0.83	0.64–1.05
1999	65	74	0.88	0.68–1.12
2000	71	72	0.99	0.77–1.24
2001	76	83	0.92	0.72–1.15
2002	75	85	0.88	0.70–1.10
2003	91	86	1.06	0.85–1.30

Table 3.8 shows that none of the SMRs is significantly different from 1. Therefore, while there is some random year-to-year variability in survival, it is possible to say that there has been no significant change in risk-adjusted survival or mortality rates over the period of study. Any change in road traffic deaths between 1996 and 2003 does not appear to be influenced by changes in the effectiveness of treatments provided by the health service.

3.4 Analysis of population data

While there is routinely-collected data describing the basic demographics of road traffic fatalities in terms of age and gender, rarely has their socio-economic status been taken into account, though this information is available from the Office for National Statistics (ONS). Research suggests that socio-economic status is an important factor in understanding those most at risk of road traffic injury (Christie, 1995; Lyons *et al*., 2003; Towner *et al*., 2004). There is a steep social class gradient in child pedestrian fatalities, where children in the lowest class (parents who are long-term unemployed or never worked) are 20 times more likely to be killed than those in the highest social class (parents who are in higher managerial and professional occupations) (Edwards *et al*., 2006). Less is known about whether this gradient exists for all types of road user and for adults and children alike.

For vehicle occupants, factors that may enhance the survivability of road traffic accidents, such as newer cars and the use of appropriate restraints, may be less evident among the lowest socio-economic groups (Towner *et al*., 2004). There is also evidence that a group that could be identified amongst unlicensed drivers included those who were low-income earners, shift workers, socially-excluded young individuals, joy riders, and those disqualified ahead of getting a licence.

Unlicensed drivers were also found to have a crash risk between 2.7 and 9 times greater than for all drivers (Knox *et al.* 2003). The evidence supports both an increase in unlicensed driving (Noble, 2005) and a higher, and probably more severe accident rate (Knox *et al.* 2003). While the data are not sufficient to estimate the link between this and fatalities, an understanding the socio-economic situation of an injury can be beneficial in terms of targeting interventions.

The individual-level classification of socio-economic status currently uses the National Statistics Socio-economic Classification (NS-SeC). It is based upon occupation and is designed for those who are currently, or potentially, in the labour market, i.e. those aged from 16 years to retirement age. It does not include full-time students or those who cannot be allocated to a group, such as retired people (although many people in the 60–74 age group are not retired so do have an NS-SeC code). Dependant children under the age of 16 are coded according to the household reference person (HRP).[8] These occupations are collapsed into eight major analytic classes, as follows:

1. Higher managerial and professional occupations.
    1.1 Large employers and higher managerial occupations.
    1.2 Higher professional occupations.
2. Lower managerial and professional occupations.
3. Intermediate occupations.
4. Small employers and own account workers.
5. Lower supervisory and technical occupations.
6. Semi-routine occupations.
7. Routine occupations.
8. Never worked or long-term unemployed.

For this analysis the NS-SeC codes for people who had died in road traffic accidents in England and Wales were supplied by ONS. NS-SeC codes were present for all those aged 0–74 years. The denominator data were derived from the census. However, there are discrepancies between the occupation recorded at death registration (and hence the mortality data) and the census data. This arises because there is nearly always sufficient information on the death certificates to classify people but not always on the census, which is essentially a self-report of current occupation. This is most acute for women of all ages and men over the age of 65.

8 The person responsible for owning or renting, or who is otherwise responsible for the accommodation. Where there are joint householders, the person with the highest income takes precedence. Where incomes are equal, the oldest person is taken as the HRP (see www.statistics.gov.uk/methods_quality/ns_sec/downloads/NS-SEC_User.pdf).

The mismatch in proportion with an NS-SeC code in census and mortality files is lower for men in occupations. NS-SeC Group 8 (never worked or long-term unemployed) and those under 20 years who are students are known to have particular problems. Thus, for the purposes of this study, mortality and census data are used for men aged 20–64 who can be categorised into Groups 1–7. Further research is currently being conducted by the ONS to investigate the numerator-denominator discrepancies in the other age ranges and groups.

Given the caveats of a higher proportion of occupations being registered at death and being assigned to an NS-SeC group than in the general population, analysis of the ONS data shows that:

- about 40% of the population that can be categorised are in the top two social groups (1 and 2 – higher and lower managerial and professional occupations) but account for 22% of the classifiable road traffic fatalities;
- 13% of the population that can be categorised fall into NS-SeC Group 7 (routine occupations) but they account for 20% of the fatalities; and
- those with more intermediate, technical or semi-routine occupations have about the number of fatalities expected given the population size.

For male car occupants aged 20–64 years, there appears to be a socio-economic gradient in deaths between NS-SeC Groups 1–2 and Groups 3–7, and this is shown in Figure 3.2 and Table 3.9. Groups 1 and 2 have an age-standardised mortality rate of about 11 and, on average, Groups 3–7 have a rate which is about double this.

Table 3.9: Number of fatal car occupants (2001–04) in each NS-SeC group for men aged 20–64 years with age-standardised rate and 95% CI

NS-SeC	Fatal casualties	Standard rate	Upper CI	Lower CI
1	231	11.35	12.81	9.88
2	350	11.22	12.39	10.04
3	228	23.32	26.35	20.30
4	282	23.55	26.30	20.80
5	303	16.33	18.17	14.49
6	400	25.33	27.81	22.84
7	551	29.17	31.61	26.74

The implication of this analysis of the mortality data indicates that those who are in Groups 1 and 2, who may be assumed to be in the top decile for income and to have higher car ownership and use, are less likely to be fatally injured than those in other occupations.

There was sufficient information in the Nottingham police fatals files database, described earlier, to place about 55% of the fatally-injured car occupants in a census super output area and, hence, assign an IMD rank to them. By dividing the IMD ranks into quintiles, it was possible to investigate, in a preliminary manner, whether there may be a link between fatal injury, deprivation and age.

Figure 3.2: Standard mortality rates and 95% CI per 100,000 population by NS-SeC group for male car occupants aged 20–64, England and Wales 2001–04

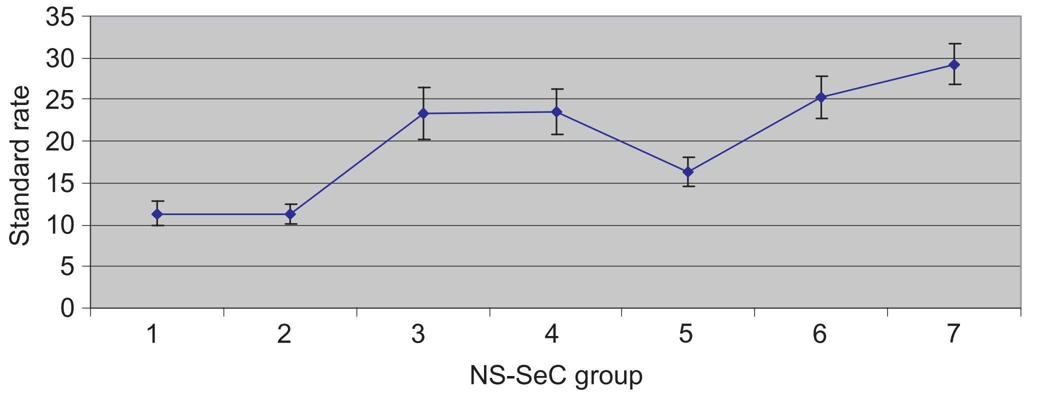

Figure 3.3: Distribution of fatally-injured car occupants by age and IMD quintile

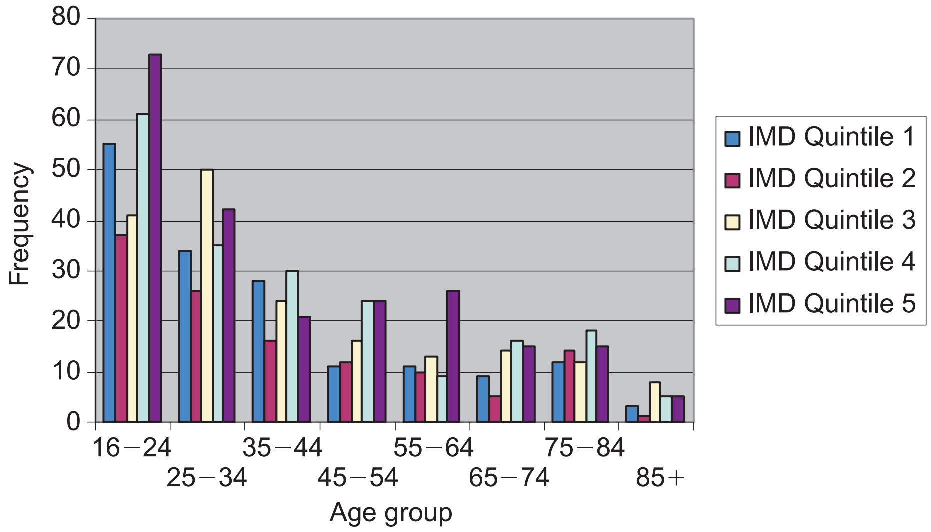

Figure 3.3 shows the distribution of fatally-injured car occupants by age and IMD quintile, with 1 indicating that the casualty came from the 20% most affluent areas in the Nottingham sample area and 5 indicating the least affluent 20%. While it is a small sample, it is indicates that there is potential for a further study relating fatal injury suffered by car occupants to indices of deprivation, and is an area which warrants more attention.

4 SUMMARY

The aims of the study were to investigate the extent that trends can be explained in terms of changes in the types of injuries that lead to fatalities and the health services response to them, and to investigate the current distribution of fatalities among socio-economic classes.

The main points to emerge from this study are as follows.

4.1 Care of the injured

- The probability of surviving with a serious head injury is lower than for other injuries.
- Most fatally-injured people have a head and/or chest injury.
- Ambulance travel times have not changed in the period 1996–2003.
- The effectiveness of the health care of the injured has not changed in the period 1996–2003.
- Eighty per cent of deaths occur at the scene or before admission to hospital.
- There is some evidence that the number of the most severe casualties is not reducing as rapidly as the number of the least severe.

4.2 Deprivation

The disadvantaged in society have a higher fatality rate as vehicle occupants than the more affluent.

5 CONCLUSIONS AND RECOMMENDATIONS

The number of car-occupant casualties with serious injuries within STATS19 is falling. However, when health data are analysed, there is some evidence that the number of more seriously-injured car occupants is not declining and appears to be tracking the fatal injury trend. This means that the fall is coming from the less severely injured in the serious category. Whilst this helps to explain the divergence between the fatal and serious trends, it cannot, in itself, account for the flattening of the fatal tend. This study has investigated whether this flattening can be explained in terms of a change in the types of injuries leading to death, or the health services' response to them. In neither case have any significant trends been identified.

However, to effect a decrease in the fatality rate, policies and interventions are needed to start to bring down the types of accidents where common factors but no trend can be detected. The health service has its part to play in improving the care of the critically injured, especially those with head injuries whose survival up to the time of discharge from hospital is the lowest. An increase in the provision of specialist neurosurgical care could reduce fatality rates in those surviving up to the time of hospital admission.

The socio-economic status of fatally-injured car occupants was investigated to try to establish whether there were gradients in fatality rates across the socio-economic classification. Whilst the data did not allow trends to be identified, there was evidence that those in NS-Sec Groups 1 and 2 (higher and lower managerial and professional occupations) were substantially less at risk of death as car occupants than other occupations. Analysis of the Nottingham fatals database supports the premise that the less affluent are more at risk. Whilst more work needs to be undertaken to gain a better understanding of the link between deprivation and risk of death as car occupants, potential risk factors for the less-affluent car occupants, such as lower levels of full licence holding, unlicensed driving, driving older cars, and low seat-belt use, need to be addressed.

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