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Trends in Fatal Car-occupant Accidents

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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.

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. There were fewer fatalities among motorcyclist and car occupants in 2004 than in 2003, but the fall only continued in 2005 among motorcyclists.

Among car drivers, fatalities occur predominantly among the young, with 41% of all fatally-injured drivers being in the 16–29 age group. The predominant road type for driver fatalities is A-class non-built-up roads, but the fastest increase occurred on the A-class built-up roads. Here the rise in fatalities was way ahead of the rise in traffic.

Analyses of police data, including contributory factors to accidents, suggests that behavioural factors are playing a more important role and that fatalities may not be falling as fast as serious casualties because driving standards may have fallen, with loss of control accidents having significantly increased between 1999–2004. There is also a rise in drink-drive deaths, especially among younger car drivers, and over the period 1999–2004 this has accounted for a sizeable proportion of the increase in car driver fatalities. By contrast, rather fewer motorcyclists die in drink-drive accidents. Their problems tend to be more of excessive speed and a lack of judgement of their own path.

Research suggests that socio-economic status is an important factor in understanding those most at risk of road traffic injury. There is a steep social class gradient in child pedestrian fatalities, with children in the lowest class being nearly 21 times more likely to be killed than those in the highest social class. Less is known as to whether this gradient exists for all types of road user and for adults and children alike.

Aims and objectives of study

The aim of this study was to gain a better understanding of the trends and circumstances of fatal accidents by reviewing existing data on road traffic fatalities and by identifying potential countermeasures. The objectives were as follows:

1. To what extent can trends be explained in terms of:
   - accident circumstances;
   - survivability of crashes;
   - health care after injury; and
   - deprivation.
2. To identify main contributors to fatal trends in terms of:
   - the people involved;
   - their behaviour;
   - the vehicles they drive;
   - the environments in which they have their accidents; and
   - the injuries that lead to fatalities and the health services response to them.
3. To take into account factors which may influence fatal trends in terms of exposure and risk, such as:
   - licence holding and vehicle ownership;
   - changes in exposure in terms of average distance driven by car drivers;
   - trends in the manufacture of larger, heavier cars and polarisation of the fleet in terms of size and mass.

A collaborative multidisciplinary approach was adopted involving three research teams:

1. University College London (UCL) and the universities of Surrey and Swansea;
2. the University of Nottingham; and
3. the Transport Research Laboratory (TRL).

This report is a synthesis of the research undertaken by each group. Separate reports are to be published on the detailed analysis undertaken by each research team.

Method

Statistical analysis of secondary data sources were applied to the following datasets:

- STATS 19 – police accident reports;
- on-the-spot (OTS) data – detailed accident data collected at the collision scene;
- police fatal files – police reports on fatal collisions;
- the Co-operative Crash Injury Study (CCIS) – biomechanical data;
- 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; and
- the Office for National Statistics (ONS) – mortality data.

Summary of key findings

Drivers and passengers

Of the drivers fatally injured, young male drivers are most at risk of death. Compared with older drivers (30 years and over) they:

- choose higher speeds;
- deliberately drive more recklessly;
- are involved in more loss of control accidents;
- are more likely to cause a fatal accident than be innocently involved in one;
- are more likely to consume alcohol and drugs and then drive;
- have a lower seat-belt wearing rate;
- have a tendency to drive older cars; and
- are more likely to drive while unlicensed.

Of the passengers fatally injured:

- women, even licence holders, are often passengers in a male-driven car and therefore are more at risk of death than when they are driving;
- young passengers tend to be with young drivers and exhibit similar behavioural traits to the drivers they are with;

- the younger the passenger, the less likely they are to be wearing a seat belt;
- seat-belt wearing rates are lower at night than during the day and lower in rear seats (as low as 11% for young men) than in front (75%); and
- rear-seat passengers not wearing a seat belt are more likely to be ejected from the vehicle than other seating positions.

The fatally-injured older drivers (65 and over) have:

- fewer accidents than younger drivers but age-related changes mean that they are physically more frail; and
- a tendency to be involved in the more injurious right of way accidents, especially turning right.

Age, size and type of cars

The mean risk of death in car-car collisions:

- for drivers of newer cars (registered between 2000–03) is half that for drivers of older cars (registered between 1988–91);
- for a driver in collision with a newer car is 46% higher than the risk when in collision with an older car (partly because newer cars weigh more than older cars), and this difference is greater on non-built-up roads;
- for a driver of the smallest type of car is four times that of the largest type;
- for a driver in collision with the largest type of car is over twice the risk than when in collision with the smallest type;
- all types of cars are involved in loss of control accidents – many of which lead to overturning – 4x4s and people carriers are the most prone to overturn; and
- newer cars are more likely to overturn than older cars.

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.
- Effectiveness of 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 more severe casualties is not reducing as rapidly as the number of the less severe.

Deprivation

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

Conclusions and recommendations

The aim of this study was to identify factors which may be contributing to the slowing and flattening of the previously downward trend in accidents leading to fatalities among car occupants.

From the evidence presented in this report, the four areas in which trends can be detected in driver behaviour, or in vehicle design, are an increase in:

- drink-drive deaths;
- loss of control accidents, many of which involve vehicles overturning;
- an aggressiveness of newer vehicles, both in terms of mass within broad vehicle types and the increased proportion in the fleet of the largest (4x4s and people carriers) types of car; and
- the diversity of mass with greater proportions of the smallest (minis and superminis) and the largest vehicles (4x4s and people carriers).

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 trend in fatal casualties. This means that the fall is coming from the less-severely injured in the serious category.

These four upwards trends are, in their various different ways, likely to be reversing the previously downward trend in fatalities. Among all serious casualties, the likelihood that the more severe are falling at a slower rate than the less severe helps to explain the divergence between the fatal and serious casualty trends but cannot, in itself, account for the flattening of the fatal trend.

There are areas in which no trends can be detected. Hence, while these have an important influence on the number of fatalities, they cannot themselves explain the change in trend:

- seat-belt use has remained low, especially at night among fatally-injured young people; and
- there is no observable change in the care of the injured.

Finally, there are four further areas which have been identified as being important during the study:

- high-speed choice and reckless driving, especially by the young who were fatally injured on non-built-up roads at night;
- older cars pose more risk of death to their drivers when involved in an accident;
- severe head and chest injuries are the prime causes of death; and
- the fatality rate is considerably higher among the disadvantaged.

To effect a decrease in the fatality rate, policies and interventions are needed to reverse the upward trends where identified and to start to bring down the types of accidents where common factors, but no trend, can be detected.

The two major areas of driver behaviour which appear to be deteriorating are drink-driving and loss of control of the vehicle, which implicates excess or inappropriate speed. The low rate of seat-belt wearing among the fatally injured is an area of concern and this would be contributing to the high incidence of head and chest injures among car occupants.

In 2005 there were 1,106 car drivers and 557 passengers killed on the roads of Great Britain, with a ratio of 3.7 male drivers to every female and 1.3 male passengers to every female. Men aged under 30 years make up 44% of male driver deaths and women under 30 make up 38% of female driver deaths. This is a large burden of injury and is out of proportion with the number of men and women of this age in the driving population. The non-wearing of seat belts, especially car passengers at night, alcohol consumption, drug use, and excess and inappropriate speed leading to loss of control while overtaking and on bends are all higher among the fatally injured in this age group.

It is estimated that 565 fatally-injured drivers and passengers of all ages were not wearing a seat belt in 2005. If they had all been wearing one, about 370 of these people would be alive today. Wearing a seat belt can help prevent head injuries which are related to lower survival rates than injuries to other body parts. They also help prevent ejection from the vehicle with the concomitant serious head and chest injuries.

About 140 fatally-injured drivers under the age of 30 years were over the legal blood alcohol limit. If none of them had been drinking, about 100 might be alive today. However, if a driver has been drinking, they are likely not to be wearing a seat belt so the two figures are not additive but it remains that the large majority of these deaths were preventable.

Drivers of small cars, especially the superminis, are four times more at risk of death in a collision with a larger car than drivers of the largest type of car. The increasing divergence in mass is estimated to have increased the number of car occupants killed by about 1%, or 30 extra deaths.

There is a tendency for younger people to drive older cars and/or smaller cars. The older cars have fewer secondary safety features than newer cars, albeit they are less likely to overturn. Over the period 1997–2005, about 21% (118) of 17–22-year-old men were fatally injured driving cars over 13 years of age, compared with the all-age male average fatally injured in these cars of about 17%.

The under 30s are more likely than older drivers to have excessive speed recorded as a contributory factor when involved in an accident, and over 60% of fatally-injured drivers in this age group, and over 75% of drivers under the age of 20 years, were judged to have been driving too fast. Speed is a factor in loss of control accidents leading to overturning. Newer cars are more likely to overturn when the driver loses control in an accident and the number of cars that overturn has risen. 4x4s and people carriers are most at risk of overturning, but all cars can and do overturn. There is the potential for speed management, including enforcement, and other measures to moderate speed at bends, approaches to junctions and when overtaking to reduce this type of accident which leads to very serious injury and death.

There is some evidence, among men aged 20–64 at least, that the risk of death increases with disadvantage. There is also evidence that young men from more disadvantaged backgrounds are less likely than their more affluent peers to have a full driving licence and are more likely to be driving unlicensed and/or uninsured. While the link to fatalities is not proven, there is evidence which suggests that accidents of unlicensed drivers are more frequent and more severe.

Young drivers drive less often and fewer miles per licence holder than older adults, and the unlicensed drive even fewer miles than the licensed. Given the rising trend in deaths among this young age-group, coupled with their lower than average exposure, means that their risk of death is also increasing and this is a cause for concern. The trend to lower levels of full licence holding, especially among the less affluent young, needs to be reversed by imaginative, cost-effective and inclusive solutions.

It needs urgent action from central and local government, and the police, in order to improve driver behaviour, especially of the under 30s, through better and more consistent speed management, and better education about speed, seat-belt wearing and drink-driving. More and better trained traffic police are needed to enforce traffic laws where necessary and to reverse the decline in driver behaviour. The perceived risk of being detected and stopped must rise sufficiently in order to become an effective deterrent.

More needs to be done to give drivers timely and relevant warning of excess speed on the approach to bends and curves so there is time for them to make corrections.

Older drivers need more support for them to recognise the dangers to themselves and others of turning out of, or into, side roads. More targeted information about developing new coping strategies is needed.

The health service has its part to play in improving the care of the critically injured, especially those with head injuries whose survival to discharge is the lowest. An increase in the provision of specialist neurosurgical care could reduce fatality rates among those who survive up to the time of hospital admission.

The recognition by drivers of the higher fuel consumption and carbon emissions of larger, heavier vehicles may, in time, act as a natural selector in their popularity and therefore act as a balancer in the diversity of mass in the fleet.

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 2004a, 2007). This progress is being regularly monitored and recent analysis suggests that both the overall killed or seriously injured (KSI) target and target for children are likely to be exceeded by 2010. The target for slight casualties has already been met.

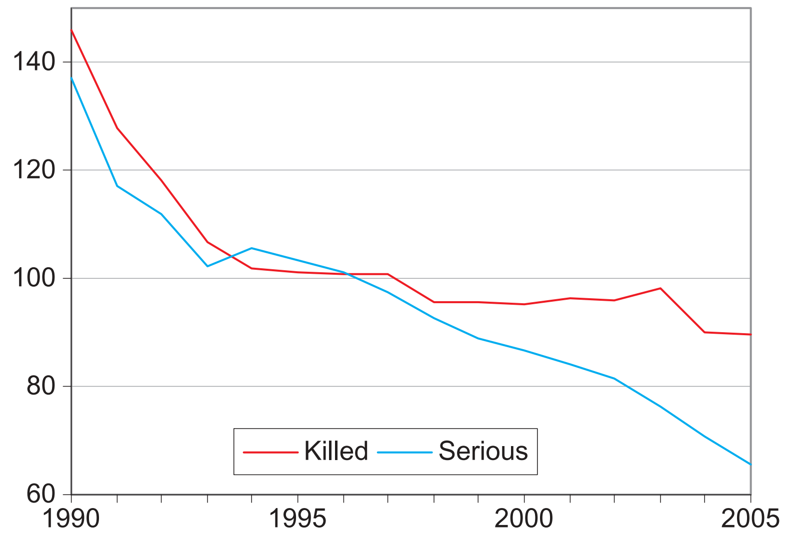
However, the trends for fatal and serious casualties used to parallel each other but since the mid-1990s they have began to diverge, with deaths rising between 2001–03. If the current trend continues, the number of fatalities in 2010 is likely to be only 19% below the 1994–98 baseline. This means that 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).

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 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).

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.

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



Among car drivers, fatalities occur predominantly among the young, with 41% of all fatally-injured drivers being in the 16–29 age group. The predominant road type for driver fatalities is A-class non-built-up roads, but the fastest increase occurred on the A-class built-up roads. Here the rise in fatalities was way ahead of the rise in traffic.

Broughton (2005) in his analysis of STATS 19 police-reported contributory factors suggests 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. By contrast, rather fewer motorcyclists die in drink-drive accidents. Their problems tend to be more of excessive speed and a lack of judgement of their own path.

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[1] higher than in the top social class, where parents were classified as being employed in 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.

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

1.2 Aim and objectives of the study

This study concentrates on fatal car accidents because this is the area where least is understood about the complexity of the driver-vehicle-road interaction, and this is leading to a lack of progress in reducing the national fatality total for car occupants.

The antecedents in fatal accidents are many and complex. A particular combination of events in one circumstance may prove fatal but in another may not. There is no easy formula for determining which predisposing factors need to be present before an accident might result in a fatality, but we do know that fatal accidents are related to the fourth power of the impact speed (Nilsson, 2004), and the more vulnerable in society are most at risk of injury.

This study is primarily about the characteristics of car occupants and the cars themselves in order to focus on areas where the data exist to help identify trends over time in accident occurrence and vehicle design. It aims to increase our knowledge about the characteristics of people, places, vehicles and circumstances, which, when combined in various ways, lead to adverse injury outcomes that can end in death.

The specific aim of the study was to gain a better understanding of the trends and circumstances of fatal accidents by reviewing existing data on road traffic fatalities and by identifying potential countermeasures. The objectives were as follows:

1. To investigate to what extent trends can be explained in terms of:
   - accident circumstances;
   - survivability of crashes;
   - health care after injury; and
   - deprivation.
2. To identify the main contributors to fatal trends in terms of:
   - the people involved;
   - their behaviour;
   - the vehicles they drive;
   - the environments in which they have their accidents; and
   - the injuries that lead to fatalities and the health services response to them.
3. To take into account factors which may influence fatal trends in terms of exposure and risk, such as:
   - licence holding and vehicle ownership;
   - changes in exposure in terms of the average distance driven by car drivers; and
   - trends in the manufacture of larger, heavier cars and polarisation of the fleet in terms of size and mass.

1.3 A collaborative multidisciplinary approach

Three research teams were commissioned to investigate fatal accident databases. These were:

1. University College London (UCL) with the universities of Surrey and Swansea;
2. the University of Nottingham; and
3. the Transport Research Laboratory (TRL).

Each research team took the responsibility to analyse data to address a number of specific research questions:

1. What are the common mechanisms of fatal car collisions?
2. Why have car accidents become relatively more likely to be fatal?
3. Is there a group of accidents which are not survivable and is the number of these accidents not being reduced?
4. How is driver/rider behaviour impacting on vehicle user deaths?
5. What is the role of medical care in the number of fatalities resulting from road traffic accidents?
6. What is the influence of vehicle factors, such as vehicle compatibility and secondary safety, in vehicle user fatalities?
7. Are there different problems on urban roads compared with rural roads?
8. What are the roles of fatigue and impairment?
9. Have the injury types changed to less survivable ones?
10. Are people from lower socio-economic groups more likely to be killed?

This report is a synthesis of the research undertaken by each group. Separate reports are to be published on the detailed analysis undertaken by each research team (Broughton and Walter, 2007; Clarke *et al.*, 2007; Ward *et al.,* 2007).

2 METHOD OF ANALYSIS

2.1 Datasets and analysis

The following datasets were used in the analysis of fatal trends:

- STATS 19 – police accident reports;
- on-the-spot data (OTS) – detailed accident data collected at the collision scene;
- police fatal files – police reports on fatal collisions;
- the Co-operative Crash Injury Study (CCIS) – biomechanical data;
- 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.

Detailed descriptions of the datasets used in this report are given in Appendix 1.

2.2 Accident circumstances

STATS19 and OTS data were analysed to achieve a picture of the contributory factors of fatal accidents by linking as many as possible of the OTS records to STATS19 police accident reports. Each police fatal file was analysed in detail, paying particular attention to the sequential behavioural mechanisms in the accident. Induced exposure measures were calculated from:

(a) the characteristics of the other road users involved in the accidents; and

(b) the relative prevalence of particular sub-groups of drivers/passengers and motorcyclists in particular types of fatal collision.

2.3 Survivability

STATS19 data were linked to the CCIS data to provide a full picture of the relationship between survivability and car type, car occupant characteristics and behaviours such as seat-belt wearing. Cluster analysis was also undertaken to investigate whether there were homogeneous groups according to:

- driver age (average years);
- seating position (driver, front passenger, rear passenger);
- speed limit (built-up, non-built-up); and

- first point of impact (none, front, back, offside or nearside).

Analysis of unlinked CCIS data was also used to examine trends in:

- crash and injury severity;
- the age of the vehicles;
- accidents involving rollovers;
- the age and sex of the driver; and
- seat-belt wearing.

Survivability was examined in relation to the type of impact for a number of groups:

- frontal impact with belted occupants;
- side impact with belted occupants;
- rear impact with belted occupants; and
- rollover at some point in the accident with belted occupants.

As failure to wear a seat belt considerably reduces the probability of survival, unbelted occupants were treated as a separate group.

The data were analysed using ‘AnswerTree’, a statistical program that applies the CHAID (Chi-squared Automatic Interaction Detector) technique which identifies segments, patterns and factors that influence the outcome measure. The analysis contained collision variables, such as vehicle deformation, speed, the number of vehicles involved and the demographics characteristic of those involved in collisions of different types.

2.4 Health care after injury

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 crashes 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) 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 (HES), Wales (PEDW) and Scotland (SMR01) to examine trends in admissions by road user group. Trends in hospital admissions were compared with STATS19 casualty trends for serious casualties (1999–2003) to assess whether serious casualties in hospital records showed similar trends to fatal records compared with police reported data.

2.5 Deprivation

ONS mortality data were obtained for all deaths for 2001–04 in England and Wales by cause of death by age and social class and/or area deprivation score. International Classification of Diseases (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 given by the National Statistics Socio-economic Classification (NS-SeC) codes. The denominator data were derived from the census.

Operational definitions for key terms are shown in Box 2.1.

Box 2.1: Key operational definitions

Injury classifications

Fatal accident – an accident in which at least one person is **killed**.

Killed – human casualties who sustained injuries which caused death less than 30 days after the **accident**. Confirmed suicides are excluded.

ICD-10 codes – International Classification of Diseases, 10th revision (ICD-10) (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).

The Abbreviated Injury Scale (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 is as follows:

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

Box 2.1: (*Continued*)

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 Maximum Abbreviated Injury Score (MAIS) – the single highest AIS score assigned to a casualty and is used to describe overall injury severity. The six body regions are:

- head or neck – including injury to the brain or cervical spine, skull or cervical spine fractures;
- face – including those involving mouth, ears, eyes, nose or facial bones;
- chest – including all lesions to internal organs and also injuries to the diaphragm, rib cage and thoracic spine;
- abdominal or pelvic contents – including all lesions to internal organs and also lumbar spine lesions;
- extremities or pelvic girdle – including sprains, fractures, dislocations and amputations, except for the spinal column, skull and rib cage; and
- external – including lacerations, contusions, abrasions and burns, independent of their location on the body surface.

The Injury Severity Score (ISS) – the sum of the squares of the highest AIS code in each of the three most severely injured body regions. ISS scores range from 1 to 75; any injury coded as AIS 6 is automatically assigned an ISS of 75.

Standardised Mortality Ratio (SMR) – 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.

Box 2.1: (*Continued*)

Demographics

Adults – persons aged 16 years and over (except where otherwise stated).

Children – persons under 16 years of age (except where otherwise stated).

Socio-economic status – the individual level classification of socio-economic status currently used the National Statistics Socio-economic Classification (NS-SeC) (see www.statistics.gov.uk/methods_quality/ns_sec/downloads/NS-SeC_User.pdf**).** 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). 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.

3 KEY FINDINGS

3.1 Factors which may influence fatal trends in terms of exposure and risk

The amount people travel and the manner in which they do so can affect the number of accidents and casualties occurring on the road. There have been sharp trends in car travel by men and women over the last 10 years. The most fundamental change has been the increase in the number of women holding a driving licence and owning and using their own car. Since 1995–97 the vast majority of the growth in car traffic can be attributed to the growth in the average distance driven by women as car drivers, which increased by 21% over that period compared with a fall of 8% for men.[2]

Another trend is in the increasing proportion of women who are ‘main drivers’ of a household car, a rise from 38% to 48% between 1995–1997 and 2005, which is in line with the increase in households with two or more cars. The travel patterns of men have changed much less and one of the underlying influences in the change in women’s travel is their changing employment patterns (DfT, 2005).

One interesting change in licence holding is that fewer young people (17–20 years), both male and female, held a full licence in 2005 compared with 1995–97, where the percentage has fallen for men from 50% to 37%, and for women from 36% to 27%. Various reasons have been suggested, such as it is more difficult to pass the driving test and, as more young people are now students than before, they cannot afford the cost of owing a car, which is high for the under 25s (Noble, 2005). The introduction of the Road Traffic (New Drivers) Act 1995, which came into force on 1 June 1997, meant that if new drivers within the two-year probationary period immediately following passing their test, accumulate six or more penalty points on their licence, the licence is revoked until a further driving test is passed. Partly as a result of this and for the cost reasons noted above, there is some indication that there may be as many as 100,000 young people, predominantly men, who may be driving without a licence. This will be discussed further in Section 3.3.4

Over this same period (1995–97 to 2005), licence holding among men of all ages is about 81% and for women it is about 63%.

While women have increased the number of trips they make as drivers, men are more likely to be drivers than passengers for all trips, but women are more likely to be passengers for leisure trips. Women’s average trip lengths as drivers are interestingly shorter than women’s trip lengths as passengers, which indicates that

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2 Source: National Travel Survey specially extracted data (2007)

holiday and day trips are made as passengers predominantly in a male-driven car (DfT, 2005).

In general, women drive about 40% fewer miles than men (4,800 miles per person as opposed to 7,900 miles per person for males per year). Young men (17–20 years) drive, on average, about 2,210 miles per person compared with young women who drive about 1,530 miles per person per year. Adjusting for the low numbers of licence holders in this group, young drivers with a full licence drive 5,470 miles per year compared with 6,480 miles for drivers of all ages, with young men driving further than young women.[3]

Just because a person does not have access to a household car does not mean they do not drive or cannot be a passenger in one. People in households without a car make about nine trips per person a year as drivers compared with 530 trips per year for people in households with one or more cars. The picture for passengers is less polarised where 111 trips are made by people in households without a car compared with 264 trips as passengers by people in households where there is one or more cars. In general, people with access to a car make nearly half as many trips more and travel further (across all modes) than people living in households without a car (DfT, 2006a).

There is a clear relationship between deprivation and access to a car. In the most deprived areas, about 55% of households do not have access to a car compared with 7% in the least deprived. Linked to this is the amount people travel. Those living in the most deprived areas make the fewest trips, about a quarter fewer per person than those in the least deprived, but they travel, on average, 60% fewer miles, reflecting the lower use of the car (DfT, 2005).

The lower number of trips and distance travelled among people living in more deprived areas is also a cause for concern when fatality rates by deprivation are considered later in this report.

These trends in car use might be expected to result in more fatalities among women and fewer among young people. In fact the opposite is emerging, and the trends in fatalities highlighted in the rest of this report, especially among young people, are even more disturbing when trends in licence holding and travel are considered.

3.2 Characteristics of drivers and passengers killed in cars

Broughton's 2005 study of car occupant and motorcyclist deaths between the years 1994 and 2002 highlighted the high proportion of young drivers and passengers among the fatally injured. Between 2000 and 2002 about 40% of male and 30% of

[3] Source: National Travel Survey specially extracted data (2007).

female driver fatalities were aged between 16 and 29 years. By 2005 this had risen to nearly 44% for men (379/870 deaths)[4] and 38% for women (89/236 deaths) (DfT, 2006b).

Three-quarters of fatally-injured male car passengers (240/316 deaths) were under the age of 30 years compared with 44% of women (106/241 deaths). Interestingly, older women are more at risk as passengers than older men probably because they are, on average, more fragile than their male counterparts, and they make about twice as many trips and travel further per person as passengers than as drivers.

The proportion of all road deaths that were car passengers has remained stable over the years 1994–2004 at about 13% for men and 30% for women (DfT, 2006b).

The following sections will concentrate on the two most vulnerable groups: the young and the old. However, there are aspects of driver behaviour that are found among drivers of all ages that may increase their risk of accident and injury.

First of these is drink-driving. In Clarke *et al.*'s (2007) sample of fatal accidents, nearly 20% of all fatalities across all road user groups involved a driver over the drink-drive limit. The comparable national proportion for 2005 is 17% and represents 560 deaths (DfT, 2006b). The average blood alcohol level, where this could be measured among the dead drivers in Clarke's study, was 176 mg/dl, which is over twice the UK legal limit.

Until 1999 the number of car drivers who died in drink-drive accidents was falling, then it began to rise again. For car occupants, Broughton (2005) estimates that there was an increase of 54 fatalities between 1999 and 2002 and this on its own can account for as much as 80% of the overall fatality increase over this period. About half the driver deaths between 10pm and 4am involve excess alcohol (DfT, 2006b).

Second is seat-belt wearing. About 34% of occupant deaths in Clarke *et al.*'s (2007) and Broughton and Walter's (2007) studies were not wearing a seat belt. Applying this to 2005 figures might represent about 565 people and it is estimated that about 65% of these, or 368 people, might have survived if they had been belted (Broughton and Walter, 2007).

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4 Excludes minibus drivers – see Table 3.1.

Table 3.1: Number and percentage of deaths in 2005 for male and female car drivers and passengers by age group*

	Age group	Number of deaths Driver	Percentage	Number of deaths Passengers	Percentage
Males	0–16	8	1	43	14
	17–19	118	14	70	22
	20–24	151	17	92	29
	25–29	110	13	35	11
	30–59	319	37	47	15
	60–74	82	9	13	4
	75–99	81	9	15	5
	Unknown	1	0	1	0
	All ages	870	100	316	100
Females	0–16	0	0	36	15
	17–19	27	11	39	16
	20–24	40	17	22	9
	25–29	22	9	9	4
	30–59	92	39	50	21
	60–74	26	11	40	17
	75–99	29	12	45	19
	Unknown	0	0	0	0
	All ages	236	100**	241	100**
All		1,106		557	

* Excludes minibus drivers and passengers.
** Figures may not total 100 due to rounding.

The number of people killed when their cars overturn has increased in recent years (Broughton and Buckle, 2007) but STATS19 does not record whether an occupant was wearing a seat belt or was ejected. Analysis of the CCIS data indicates that the proportion ejected is much higher when the occupant was not wearing a seat belt and is highest for unbelted rear-seat passengers. Irrespective of seating position, 83% of fatally-injured ejected occupants in overturning accidents were not wearing a seat belt compared with 25% of fatally-injured occupants who were (Broughton and Walter, 2007). Overturning accidents will be considered in more detail in Section 3.4.3.

The highest proportion of fatally-injured drivers not wearing a seat belt is in the 25–29 age group, with 42% unbelted (although the numbers are higher for those aged 20–24), and for passengers aged 16–19 years (with over half unbelted), but despite seat-belt wearing rates increasing steadily with age (see Figure 3.1), there remains 20% of fatally-injured occupants aged 60 years and older being unbelted. However, while wearing rates are low among fatally-injured car occupants, there is no evidence that their front seat-belt wearing rates have changed over the period 1999–2001 (Clarke *et al.*, 2007). The Department for Transport seat-belt survey also indicates that wearing rates for all car drivers and front-seat passengers have changed little, at about 92% and 94% respectively, over the years 1999–2004 (DfT, 2004b).

Figure 3.1: Percentage of all fatalities not wearing a seat belt by driver age, *n* = 1,185, sample from the years 1994–2005 (source: Clarke *et al.*, 2007)

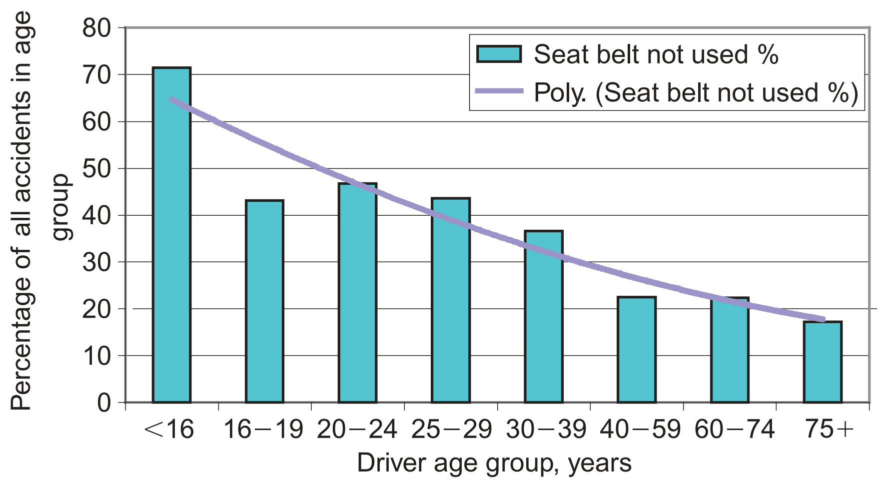
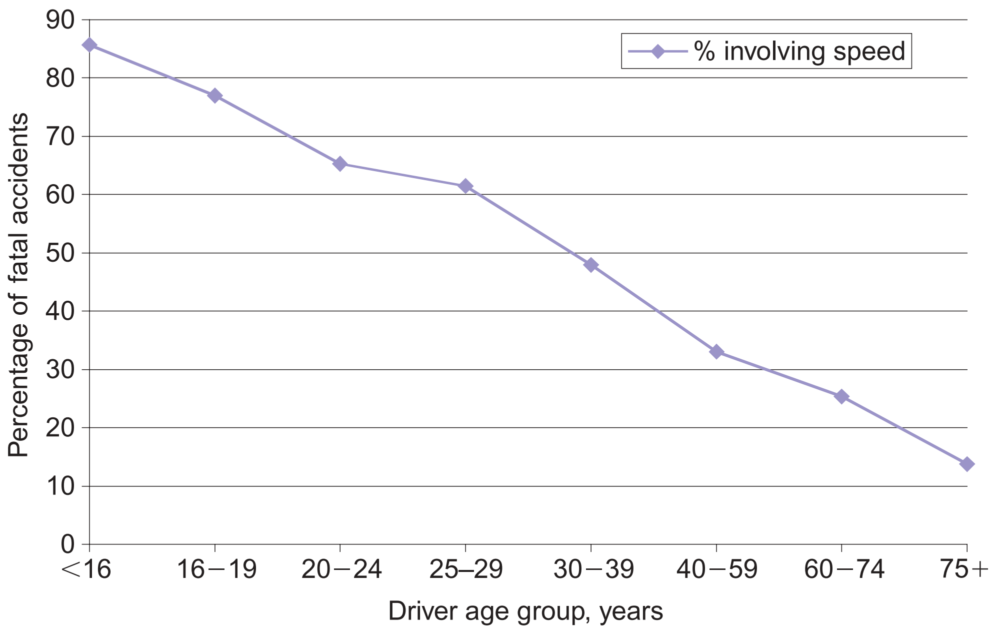


Figure 3.2 Percentage of speed-related fatal accidents by driver age group, *n* = 1,185, sample from years 1994–2005 (source: Clarke *et al.*, 2007)



Third is speed as a contributory factor to a fatal accident. Although the actual number of speed-related fatal accidents declines with age, it is only when drivers are over 30 years of age that the percentage of fatal accidents in each age group with speed as a contributory factor falls below 50% of the total fatal accidents for each age group (see Figure 3.2).

3.3 Young drivers and passengers

3.3.1 Young drivers, speed and risk taking

Previous studies have highlighted the higher than average risk of death and injury to young car drivers and their passengers. Clarke *et al.*'s (2007) in-depth study of fatal accident records points directly to this group who take the most risks and choose the highest speeds. Of the fatal accidents where 'blameworthiness' could be assigned by Clarke's team, young drivers, especially those under 20 years, were nearly 12 times more likely than those aged 35–65 years to have caused a fatal accident than to have been innocently involved in one.

Almost 50% of the accidents were judged to be speed related but among drivers aged under 25 years speed was a factor in between 65% and 75% of their accidents (see Figure 3.2). Men were found to be involved in a far greater number of 'to blame' speed-related accidents than women (57% and 31%, respectively). Men were more likely to commit deliberate risk actions than women and are more likely to exceed the speed limit or deliberately drive too fast for the conditions. By contrast, women were more likely to have been ignorant of the correct speed limit or to be travelling too fast for the conditions rather than deliberately speeding (Clarke *et al.*, 2007).

These young drivers had the majority of their accidents by losing control on bends or curves, typically at night in rural areas and/or while driving for 'leisure' purposes. These accidents show high levels of deliberate speeding, alcohol involvement and recklessness. Broughton (2005) also found a high proportion of fatal accidents involving the following as police listed co-factors:

- loss of control;
- behaviour – careless/thoughtless/reckless; and
- aggressive driving.

Young drivers were more likely to have lost control than older drivers, but there were only minor differences between men and women. Excessive speed was reported more frequently for young car drivers (over 50% as a precipitating factor for those aged 39 and younger) and more for men than women. In cars with dead occupants, the incidence of careless/thoughtless/reckless driving is lower among women than men and falls with age from drivers aged under 24 years.

Broughton (2005) commented that 'at a time when improving car technology had been expected to reduce the number of car occupant fatalities, this trend has been offset by a decline in the driving standards of some drivers'.

3.3.2 Young drivers and seat belts

In 2005, 1,106 car drivers were killed. In Clarke *et al.*'s (2007) study of fatally-injured occupants, only 70% were wearing a seat belt. Wearing rates are particularly low among young drivers (17–29 years), with only 60% of those killed wearing a seat belt. The proportion of fatally-injured drivers wearing a seat belt increases with age from about 30 years (see Figure 3.1).

Seat-belt wearing is lower at night, especially among fatally-injured young men. From the CCIS data, fewer than two-thirds of those killed at night were wearing a seat belt compared with just over three-quarters of those of the same age killed during the day (Broughton and Walter, 2007).

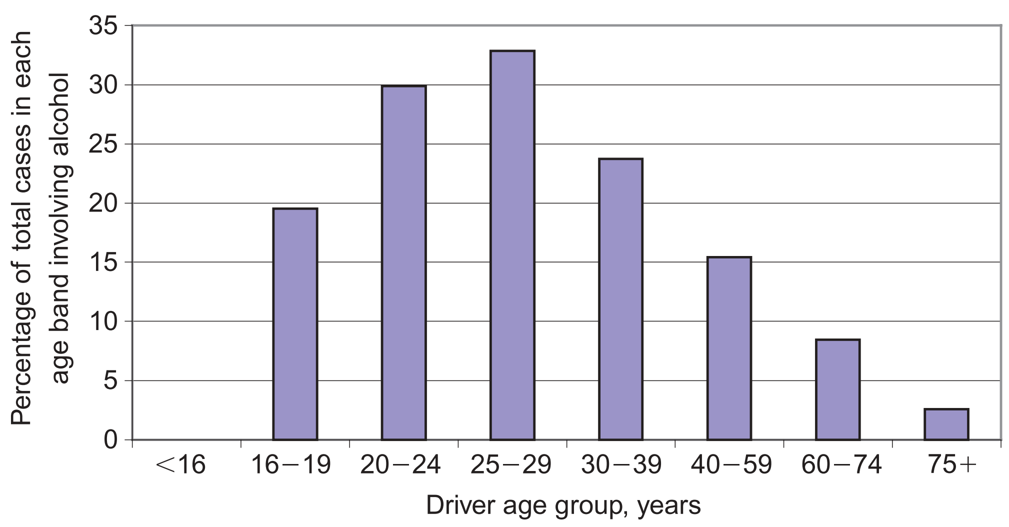
Wearing rates among fatally-injured drivers are generally lower on built-up roads than on non-built-up roads, with the male rate for all ages below 50% at night on built-up roads compared with about 70% on non-built-up roads.

3.3.3 Young drivers and alcohol and drugs

Among male drivers involved in accidents of all severities, those in the 20–24 age group have the highest percentage of breath test failures at 5.6%. For accident-involved women, the 20–24 year age group also has the highest rate of breath test failures, but at 1.7% it is much lower than for men (DfT, 2006b).

Clarke *et al.* (2007) estimate that 27% of fatal accidents where the driver was aged under 30 years (see Figure 3.3) involved the driver being over the legal alcohol limit or impaired by drugs. After about the age of 30, fatal accidents involving alcohol or

Figure 3.3: Percentage of fatal accidents involving alcohol-impaired drivers over the legal limit, $n = 1{,}185$, sample from years 1994–2005 (source: Clarke *et al.*, 2007)



drugs show a downward trend with age. These estimates are based on a sample of 135 young alcohol-impaired drivers in 505 fatal accidents.

The national picture from STATS19 records indicates that the percentage of drivers fatally injured through drink-driving could be up to 40%, especially for men in the 25–29 year age group. This group has the highest proportion of drunk-driver fatalities, 41%, but the number is highest for men in the 20–24 year age group (37% of fatalities) (Broughton, 2005). The national picture for 2004 indicates that 26% of fatally-injured drivers (both men and women) aged 16–19 years and 31% of drivers aged 20–29 years were over the legal blood alcohol limit. This represents about 137 drivers (DfT, 2006b).

Male drivers aged under 30 years who died in drink-drive accidents between 1999–2001 outnumbered female drivers by about 9:1 (Broughton, 2005).

The peak time for fatally injured drink-drug impaired drivers in Clarke *et al.*'s sample is 2am to 4am, with the hours of 8pm to 4am accounting for over 40% of the fatal accidents studied. This has risen to about 50% in 2004. The peak days are the early hours of Saturday, Sunday and Monday.

3.3.4 *Unlicensed driving among the young*

As already noted in Section 1, full licence holding among young drivers is in decline and several reasons were hypothesised, such as:

- the increased expense of learning to drive;
- a driving test that is more difficult to pass; and
- provisions in the New Drivers Act for new drivers to lose their licence after accumulating six penalty points on their licence.

Some of these drivers never go on to take another test. In their study of unlicensed drivers, Knox *et al.* (2003) assessed the characteristics of this group from questionnaires, and from telephone and face-to-face interviews and found that they:

- tended to be young and male (the convictions data for unlicensed driving give a male to female ratio of 10:1 (Noble, 2005));
- have a high belief in their own driving ability;
- are more likely to drive without insurance and to drink and drive;
- tended to agree with statements supporting aggressive driving; and
- were less likely to have passed the theory test.

The group of unlicensed young 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 that for all drivers. This means that young, unlicensed drivers are even more likely to be involved in road accidents than other young males. Also, the accidents were, compared with the average, likely to be of higher severity and involve more passengers.

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, it is an area with important implications for road safety.

3.3.5 Young passengers

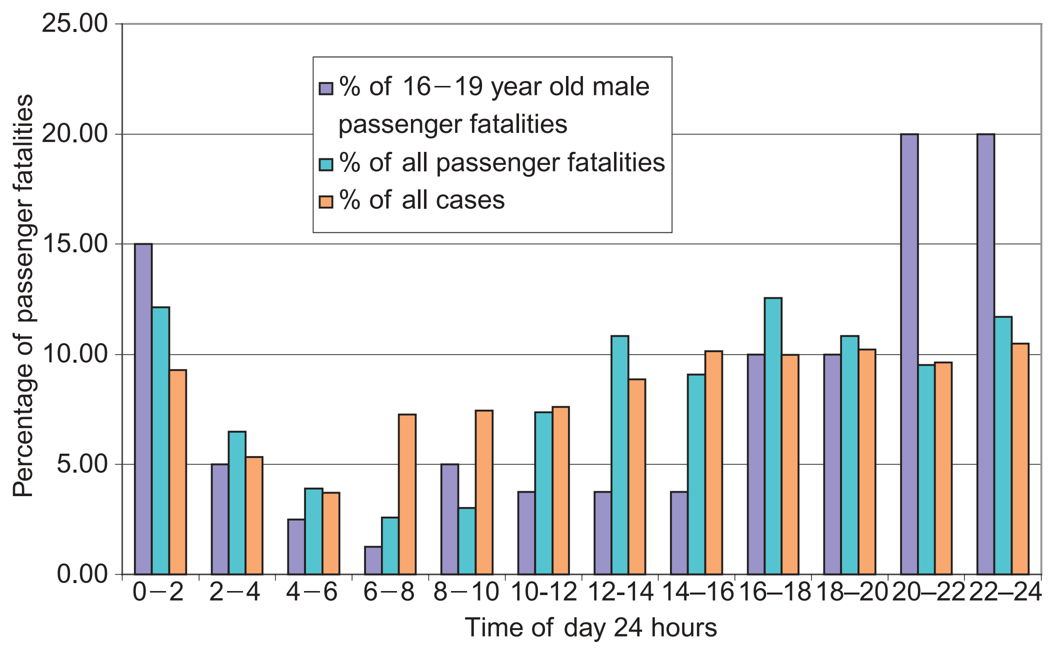
There is some evidence from Clarke *et al.*'s (2007) work that there is a 'commonality of behaviour' between drivers and passengers, i.e. if a driver had been drinking/taking drugs/not wearing a seat belt, it was likely that the passengers had also been drinking/taking drugs/not wearing a seat belt.

In 2005 there were 142 passenger deaths aged between 16 and 19 years. Both Broughton and Walter (2007) and Clarke *et al.*'s (2007) work shows that the younger the passenger, the less likely they were to be wearing a seat belt in fatal accidents. In the rear seat about half the young men and women wore a seat belt during the day, but this dropped to as low as 11% for fatally-injured young men at night and 33% for fatally-injured young women (albeit with small samples of 28 and 15 cases, respectively). In the front seat, the proportions for both were about 80% during the day but this dropped to 75% for men and 65% for women at night (Broughton and Walter, 2007). While wearing rates among fatally-injured passengers are lower in the back than in the front, the seat-belt survey has shown that general wearing rates in the back have improved over this period.

The majority of the 16–20-year-old fatally-injured passengers (68%) were with drivers who were slightly older (mean age 21 years), who were deliberately speeding or who were with a driver who was being deliberately reckless and racing (36%) (Clarke *et al.*, 2007).

The 16–19-year-old male passenger group had a peak in their accident involvement late in the evening (22:00–02:00 hours, see Figure 3.4). This four-hour period accounted for 35% of 16–19-year-old passenger deaths. Clarke *et al.* (2007) suggest that these young passengers display similar behavioural characteristics to the drivers with whom they become involved in accidents.

Figure 3.4: Percentage of passenger fatalities by time of day, 1994–2005 (source: Clarke *et al.*, 2007)



3.3.6 *Older drivers*

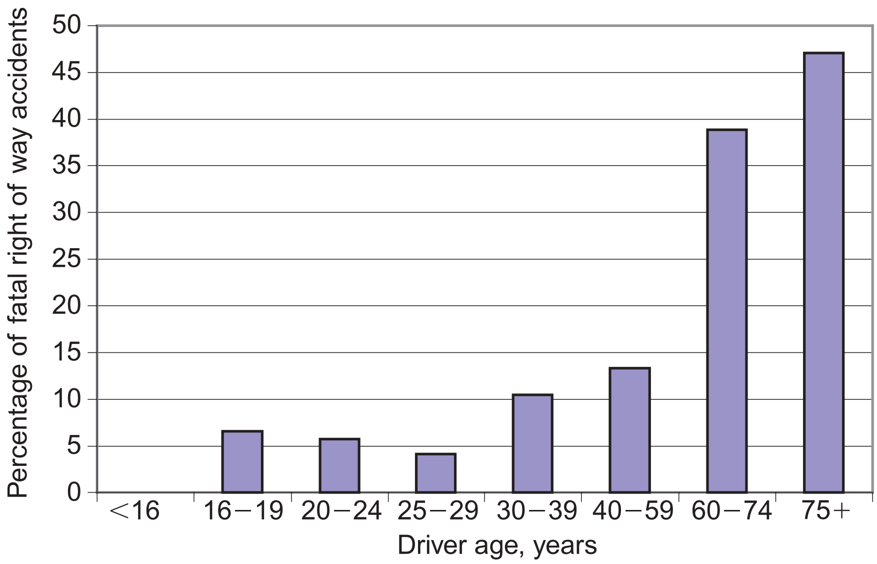
In 2005 there were 218 drivers aged over 60 years who were fatally injured. This represents about 20% of all car driver deaths. In addition, there were 118 passenger deaths in this age group, which represents about 21% of all car passenger deaths.

Older drivers have relatively few accidents but those fatal accidents that they were involved in tended to involve misjudgement and perceptual errors in 'right of way' collisions, typically in the daytime on rural rather than urban roads. Right turns onto, and from, the main road are common failures.

Blameworthy right of way errors were, as a proportion of total fatal accidents in that age group, notably higher for drivers aged over 60 years. This represents about 40% of fatal accidents involving drivers over 60 years compared with just 6% for those under 30 years (see Figure 3.5).

Older people tend to be frailer and be injured more easily. They also take longer to recover from their injuries. The right of way type of collisions, more common among older drivers, predispose them to side impacts which tend to lead to more serious injuries from structures within and outside the car (McLellan *et al.*, 1996; Fildes *et al.*, 1994). In addition to Clarke's observation, it can be established from the CCIS data that older people (60 and over) are proportionately more likely to be involved in side-impact collisions than frontal collisions, and, in turn, occupants are more likely to die in side-impact collisions than frontal collisions.

Figure 3.5: Percentage of fatal right of way accidents by driver age-band for all at-fault drivers, *n* = 974, 1994–2005 (source: Clarke *et al.*, 2007)



3.4 Characteristics of vehicles involved in fatal accidents

3.4.1 Age of car

For many young drivers their first car is often a hand-me-down from the family or a cheaper used-car, usually smaller and/or older. About half the cars on the road in 2005 were less than six years old, and just over another third were between 6 and 12 years old. About 15% of cars were older than 12 years (Society of Motor Manufacturers and Traders, 2006).

From his analysis of the STATS19 data, Broughton (2007) has noted that, when two cars collide, drivers of older cars are more at risk of being killed in an accident than drivers of newer cars:

- the mean risk of death for a driver of a car registered in 2000–03 is less than half the risk for the driver of a car registered in 1988–91;
- the mean risk of death for a car driver in collision with a car registered in 2000–03 is 46% greater than the risk when in collision with a car registered in 1988–91; and
- the increase in casualty rate when in a collision with a more modern car is greater on non-built-up roads where speeds are higher.

Analysis of the STATS19 data for the period 1997–2005[5] indicates that, for fatally-injured male drivers aged 17–22 years, about 21% were driving cars over 13 years

[5] Excludes where the age of a car was unknown.

of age compared with the average for men of all ages of about 17%. About another 48% of young male driver deaths were in cars aged 7–12 years, compared with an average of about 43% for men of all ages. For fatally-injured young women, the corresponding percentages are 14% and 45%, which are both close to the averages for females of all ages for cars aged over 13 years and 7–12 years.

The percentages of young fatally-injured male passengers (17–22 years) in cars older than 13 years and 7–12 years are very similar to those for drivers at 21% and 47% respectively. For female passengers the difference between driver and passenger is more marked, with about 18% of young women (17–22 years) killed as passengers in cars aged over 13 years compared with the average for all ages of about 15%. Another 45% of all young female deaths as passengers are in cars aged 7–12 years (compared with the average of 40% for all ages). This, with other evidence, indicates the higher risk to women as passengers than as drivers.

3.4.2 Size of car

On average, over the last 30 years, the weight of cars has increased by about 30% (see Figure 3.6). This increase in weight reflects the need for more components to be added to increase safety, improve driving characteristics, reduce noise and emissions, and increase comfort. Broughton's (2007) analyses of accident data from 2001–05 show clearly that driver casualty rates fall with increasing size of their own car and that in car-car collisions the driver casualty rate increases with the size of the other car:

- the mean risk of death for the driver of the smallest type of car (mini/supermini)[6] is four times the risk for the largest type (4x4/people carriers); and
- the mean risk of death for the driver in collision with the largest type of car is over twice the risk than when in collision with the smallest type.

Over the period 1997–2003 there has been a marked increase in the number of minis and superminis (from about 7 to 8.2 million) and of 4x4s and people carriers (from about 0.75 to just over 2 million), while the number of cars of intermediate size has been relatively stable. One of the consequences is that the variance in mass of the car fleet has grown, thus increasing, over time, the chances that a collision would involve cars of unbalanced mass. This increased variance is estimated to have increased the number of car occupants killed in 2002 by 1% or about 30 extra deaths (Broughton, 2005).

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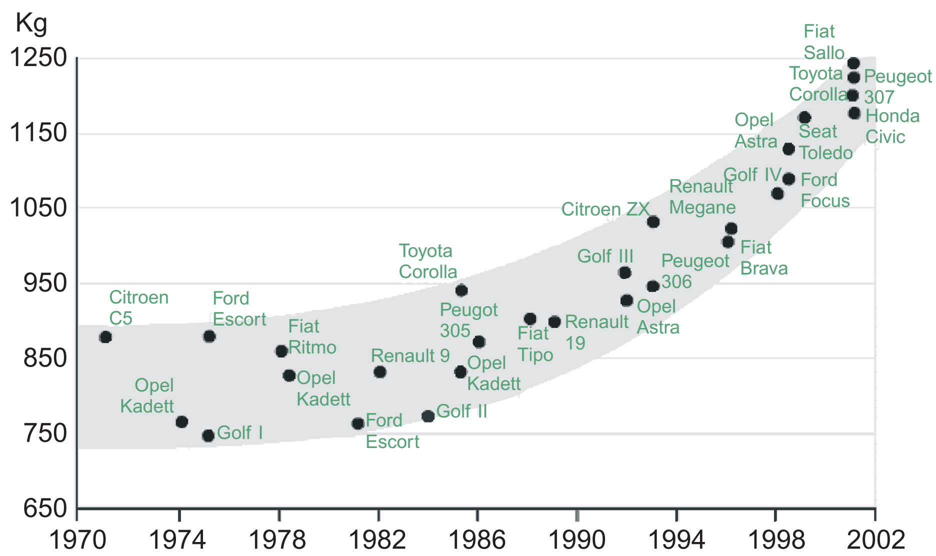
6 Minis and superminis include cars such as the Austin/Rover Metro, Ford Fiesta and VW Polo.

Figure 3.6: Weight of European compact cars at date of model introduction (source: FKA, 2002, Appendix, p. 3)



Broughton suggests that improvements in car design over the last 15 years or so have come at a price. The increased aggressiveness of modern cars in fatal accidents, while not sufficient to cancel out the benefits from secondary safety over this time, might be one of the factors in why the fatality rate has not come down as quickly as expected.

3.4.3 *Cars that overturn*

Broughton and Buckle's (2006) analysis of contributory factors data indicates that 80% of drivers whose cars had overturned had lost control of their cars compared with less than half of those whose cars did not overturn. The incidence of loss of control in accidents has increased markedly between 1999 and 2004, with the consequence that there has been a steady increase in the proportion of casualties whose cars have overturned. Casualties in these types of accidents tend to be more severely injured, especially if they are ejected from the vehicle. Indeed, Broughton and Walter's (2007) analysis of STATS19 data has shown that fatalities in rollover accidents have increased by 40% between 1994 and 2004, and that the number of casualties of all severities has risen by 20%.

4x4s and people carriers are more likely to overturn in the event of a collision than other types of car. Analyses indicate that, in 1997–99, 38% of those killed in a 4x4 or people carrier were in a vehicle that overturned. In 2002–04, this percentage had reduced to 30%. For other types of car, the percentage of fatalities whose cars had overturned had increased between these two periods, indicating that newer cars are more likely to overturn than older cars. However, even when this and the greater proportion of 4x4s and people carriers are taken into account, the increase in the proportion of casualties in overturning cars since 1994 has been significant.

3.4.4 Unsurvivable accidents

Broughton and Walter (2007) have used the CCIS data to investigate 'unsurvivable' accidents, which they describe as those where the impact was so severe that the occupants would not survive. In practice a threshold was used of more than 20% of casualties dying. The probability of survival is considerably increased by wearing a seat belt while it is reduced by being in an accident where the car overturns, the occupant is ejected, or where there is substantial deformation of the passenger compartment. The impact speed of the car is also an important determinant and this was measured by the team collecting the CCIS data using the equivalent test speed (ETS), which is the speed a car would have to hit a solid barrier to suffer the same amount of damage as in the accident. High values of ETS also lead to reduced survivability, especially in side- and rear-impact collisions. The study could not distinguish trends in the incidence of car occupants injured in unsurvivable accidents (1994–2004) and concludes that, while unbelted occupants have the highest chance of dying in these accidents, on their own they cannot explain the divergence in fatal and serious injury trends.

3.5 Care of the injured by the health service

Medical care plays an important part in the survivability of road accidents. It has been suggested that improvements in health care have been able to keep people alive who might otherwise have died from their injuries. There are two sources of information which may help to go some way to answering this question. The first is ambulance travel times from the scene of the accident to the hospital and the other is survival up to the time of hospital discharge following a serious road traffic injury.

The analyses undertaken by Ward *et al.* (2007) show that over the period 1996–2003 there was no change in the median time (about 19 minutes) taken to convey an injured person to hospital. It appears that any change in road traffic fatalities over this period has not been influenced by global changes in the average time taken to convey seriously-injured casualties to hospital.

The probability of surviving a serious road traffic accident is largely dependent on the presence of a serious head injury. Survival up to the time of discharge 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 (Ward *et al.* 2007). A recent study undertaken by the Trauma Audit and Research Network (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, using factors such as the distribution and severity of injuries, the mechanism of injury, and the age and the physiological condition of the patient on arrival. By comparing the number who actually die with the number expected to die, it is possible to calculate a standard mortality ratio, which when equal to 1 indicates that these two are in balance. For the period 1996–2003 none of the standard mortality ratios for car drivers and passengers differs significantly from 1. This indicates that 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 (Ward *et al.*, 2007).

3.5.1 Types of injury leading to death

The CCIS data contain details of the medical condition of car occupants together with the Abbreviated Injury Scale (AIS) score for each body region injured. The M(aximum)AIS is the highest of the AIS scores assigned to a casualty.

The head, neck and chest are the principal body regions injured among the fatalities. In just under half of the deaths in the CCIS database, the head/neck was the most severely injured body region and the chest was the most severely injured body region in a further 50% of the deaths. The remaining few per cent of deaths were where the most severely injured body region was the abdomen or pelvic region. Both head and chest injuries are consistent with those sustained from not wearing a seat belt, being involved in an overturning accident, being ejected or there being deformation of the passenger compartment. However, there are no consistent trends in this database of location of injury across the years 1994–2003.

3.5.2 Trends in available health data

The use of available health data can help to provide insights into the nature and distribution of injuries sustained in road traffic accidents, including those leading to death.

There are several important sources of data:

- hospital inpatient statistics which are collected by hospitals and compiled separately for England, Wales and Scotland;
- emergency department data which, at the moment, are collected individually by each hospital and are not compiled into a national record; and
- specialist datasets, such as TARN.

A comparison of national STATS19 data and hospital inpatient data indicates that only 20% of fatally-injured people were admitted to hospital before death. The vast majority either do not survive the accident or die shortly afterwards in hospital but before they can be admitted to a ward (e.g. in the operating theatre or in the emergency department) (Ward *et al.*, 2006).

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

The trends in hospital admissions for vehicle occupants in the datasets for the three Home Countries 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[7] 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 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.

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 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.

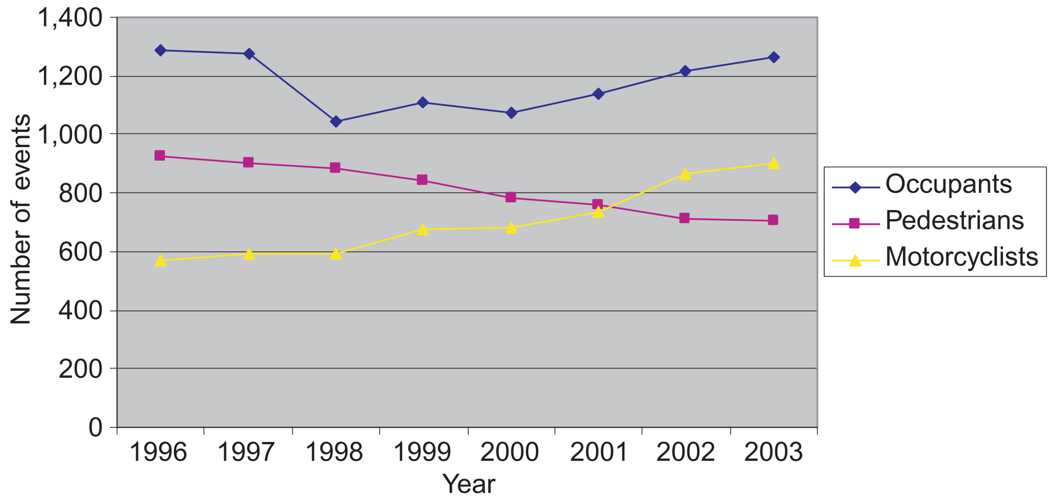
The TARN data were analysed for the period 1996–2003. This database includes those patients with a length of stay in hospital greater than 72 hours, those admitted to a high dependency area, those transferred to another specialist hospital or those who died. Data from a core of 33 hospitals were used in the analysis. These had been providing reliable information over this period and showed that there had not been a decline in the number of the most serious road traffic related casualties. The pattern from the TARN data is consistent with the pattern of hospital admissions across Britain. This supports the tentative conclusion that any observed reduction in the number of serious casualties in the STATS19 record has not come from a

[7] The STATS19 definition of serious is wider than admission to hospital.

reduction in the number of more severely-injured casualties (i.e. those requiring hospital admission or specialist trauma care) (Ward *et al.*, 2006).

Health service data and STATS19 data show that the distribution of injured road users has changed over this period. The pattern in the different datasets is largely similar but with some minor differences. Pedestrian casualties show a slightly steeper downward trend in health data than STATS 19, while motorcycle casualties are rising more rapidly in the TARN data (see Figure 3.7) (Ward *et al.*, 2006). Broughton and Walter (2007) in their analysis of the STATS 19 and the CCIS data found a similar trend. For car drivers they calculated the proportion of fatal or serious casualties who died, and found that this has increased from 15% to 20% between 1994–96 and 2002–04.

Figure 3.7: Trends in serious road traffic casualties by road user type (from 33 core TARN hospitals, 1996–2003 (source: Ward *et al.* 2007)



While none of these datasets covers all casualties, they do imply, however tentatively, that the number of more seriously-injured casualties needing hospitalisation is not coming down as quickly as the number of serious casualties recorded in STATS19. This has implications for policy and practice for reducing the number of fatal casualties.

3.6 Is the risk of fatal injury evenly distributed across society?

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 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 (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), therefore understanding the socio-economic situation of 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 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). Dependent children under the age of 16 are coded according to the household reference person.[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 collisions 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

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 household reference person (HRP) (see www.statistics.gov.uk/methods_quality/ns_sec/downloads/NS-SEC_User.pdf).

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, does not contain sufficient information. This is most acute for women of all ages and men over the age of 65.

The mismatch in proportions with an NS-Sec 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.

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.

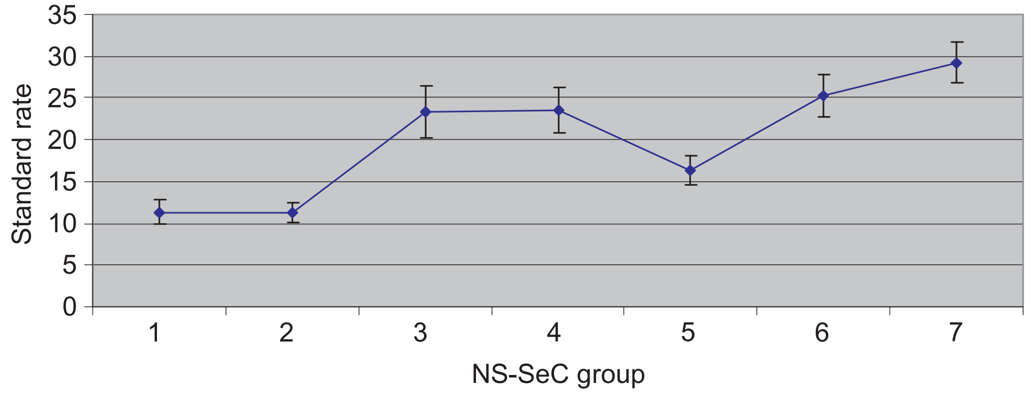
For male car occupants aged 20–64 years, there appears to be a socio-economic gradient in deaths between NS-SeC Groups 1–2 and Groups 3–7, and this is shown in Figure 3.8 and Table 3.2. Groups 1and 2 have an age-standardised mortality rate of about 11 and, on average, Groups 3–7 have a rate which is about double this.

Table 3.2: Number of fatal car occupants (2001–04) in each NS-SeC group for men aged 20–64 years with age standardised rate and 95% confidence intervals

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.

Figure 3.8: Standard mortality rates and 95% confidence intervals per 100,000 population by NS-SeC group for male car occupants aged 20–64, England and Wales 2001–04 (source: Ward *et al.*, 2007)



4 SUMMARY

4.1 Drivers and passengers

Of the drivers fatally injured, young male drivers are most at risk of death. Compared with older drivers (30 years and over) they:

- choose higher speeds;
- deliberately drive more recklessly;
- are involved in more loss of control accidents;
- are more likely to cause a fatal accident than be innocently involved in one;
- are more likely to consume alcohol and drugs and then drive;
- have a lower seat-belt wearing rate;
- have a tendency to drive older cars; and
- are more likely to drive while unlicensed.

Of the passengers fatally injured:

- women, even licence holders, are often passengers in a male-driven car and, therefore, are more at risk of death than when they are driving;
- young passengers tend to be with young drivers and exhibit similar behavioural traits to the drivers they are with;
- the younger the passenger the less likely they are to be wearing a seat belt;
- seat-belt wearing rates are lower at night than during day and lower in rear seats (as low as 11% for young men) than in front seats (75%); and
- rear-seat passengers not wearing a seat belt are more likely to be ejected from the vehicle than other seating positions.

The fatally-injured older drivers (65 and over) have:

- fewer accidents than younger drivers but age-related changes mean they are physically more frail; and
- a tendency to be involved in the more injurious right of way accidents, especially turning right.

4.2 Age, size and type of cars

The mean risk of death in car-car collisions:

- for drivers of newer cars (registered between 2000–03) is half that for older cars (registered between 1998–91);
- for a driver in collisions with a newer car is 46% higher than the risk when in collision with an older car (partly because newer cars weigh more than older cars) and this difference is greater on non-built-up roads;
- for a driver of the smallest type of car is four times that of the largest type; and
- for a driver in collision with the largest type of car is over twice the risk than when in collision with the smallest type.

Also:

- all types of cars are involved in loss of control accidents, many of which lead to overturning – 4x4s and people carriers are the most prone to this; and
- newer cars are more likely to overturn than older cars.

4.3 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 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 more severe casualties is not reducing as rapidly as the number of the less severe.

4.4 Deprivation

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

5 CONCLUSIONS AND RECOMMENDATIONS

The aim of this study was to identify factors which may be contribute to the slowing and flattening of the previously downward trend in accidents leading to fatalities among car occupants.

From the evidence presented in this report, the four areas in which trends can be detected in driver behaviour or in vehicle design are an increase in:

- drink-drive deaths;
- loss of control accidents leading to overturning;
- aggressiveness of newer vehicles, both in terms of mass within broad vehicle types and the increased proportion in the fleet of the largest (4x4s and people carriers) types of car; and
- diversity of mass, with greater proportions of the smallest (minis and superminis) and the largest vehicles (4x4s and people carriers).

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.

These four upward trends are, in their various different ways, likely to be reversing the previously downward trend in fatalities. Among all serious casualties, the likelihood that the more severe are falling at a slower rate than the less severe helps to explain the divergence between the fatal and serious trends, but cannot, in itself, account for the flattening of the fatal tend.

There are areas in which no trends can be detected. Hence, while these have an important influence on the number of fatalities, they cannot be the only reason for the change in trend:

- seat-belt wearing has remained low, especially at night among fatally-injured young people; and
- there is no observable change in the care of the injured.

Finally, there are four further areas which have been identified as being important during the study:

- High-speed choice and reckless driving, especially by the young who were fatally injured on non-built-up roads at night;
- older cars pose more risk of death to their drivers when involved in an accident;

- severe head and chest injuries are the prime causes of death; and
- the fatality rate is considerably higher among the disadvantaged.

To effect a decrease in the fatality rate, policies and interventions are needed to reverse the upward trends where identified and to start to bring down the types of accidents where common factors but no trend can be detected.

The two major areas of driver behaviour which appear to be deteriorating are drink-driving and loss of control of the vehicle, which implicates excess or inappropriate speed. The low rate of seat-belt wearing among the fatally injured is an area of concern and this would be contributing to the high presence of head and chest injures among car occupants.

In 2005 there were 1,106 car drivers and 557 passengers killed on the roads of Great Britain, with a ratio of 3.7 male drivers to every female and 1.3 male passengers to every female. Men aged under 30 years make up 44% of male driver deaths and women of the same age make up 38% of female driver deaths. This is a large burden of injury and is out of proportion with the numbers of men and women of this age in the driving population. The non-wearing of seat belts, especially car passengers at night, alcohol consumption, drug use, and excess and inappropriate speed leading to loss of control while overtaking and on bends are all higher among the fatally injured in this age group.

It is estimated that there were 565 fatally-injured drivers and passengers of all ages not wearing a seat belt in 2005. If they had all been wearing one, about 370 of these people would be alive today. Wearing a seat belt can help prevent head injuries, which are related to lower survival rates than injuries to other body parts. They also help prevent ejection from the vehicle with the concomitant serious head and chest injuries.

About 140 fatally-injured drivers under the age of 30 years were over the legal blood alcohol limit. If none of them had been drinking, about 100 might be alive today. However, if a driver has been drinking, they are likely not to be wearing a seat belt, therefore the two figure are not additive but it remains that the large majority of these deaths were preventable.

Drivers of small cars, especially the superminis, are four times more at risk of death in a collision with a larger car than drivers of the largest type of car. The increasing divergence in mass is estimated to have increased the number of car occupants killed by about 1%, or 30 extra deaths.

There is a tendency for younger people to drive older cars and/or smaller cars. The older cars have fewer secondary safety features than newer cars, albeit they are less inclined to overturn. About 21% (118) of 17–22-year-old men are fatally injured driving cars over 13 years of age, compared with the all-age male average fatally injured in these cars of about 17%.

The under 30s are more likely than older drivers to have speed recorded as a contributory factor in their accidents, and over 60% of fatally-injured drivers in this age group, and over 75% of drivers under the age of 20 years, were judged to have been driving too fast. Speed is a factor in loss of control accidents leading to overturning. Newer cars are more likely to overturn when the driver loses control in an accident, and the number of cars that overturn has risen. 4x4s and people carriers are most at risk of overturning, but all cars can and do overturn. There is potential for speed management, including enforcement, and other measures to moderate speed at bends, approaches to junctions and when overtaking to reduce this type of accident which leads to very serious injury and death.

There is some evidence, among men aged 20–64 at least, that the risk of death increases with disadvantage. There is also evidence that young men from more disadvantaged backgrounds are less likely than their more affluent peers to have a full driving licence and are more likely to be driving unlicensed and/or uninsured. While the link to fatalities is not proven, there is evidence which suggests that accidents of unlicensed drivers are more frequent and more severe.

Young drivers drive less often and fewer miles per licence holder than older adults, and the unlicensed drive even fewer miles then the licensed. Given the rising trend in deaths among this age group, coupled with their lower than average exposure, means that their risk of death is also increasing, and this is a cause or concern. The trend to lower levels of full licence holding, especially amongst the less affluent young, needs to be reversed by imaginative, cost-effective and inclusive solutions.

It needs urgent action from central and local Government, and the police, in order to improve driver behaviour, especially of the under 30s, through better and more consistent speed management, and better education about speed, seat-belt wearing and drink-driving. More and better trained traffic police are needed to enforce traffic laws where necessary and to reverse the decline in these driver behaviours. The perception of the chance of being detected and stopped must rise sufficiently in all three areas in order to become an effective deterrent.

More needs to be done to give drivers timely and relevant warning of excess speed on the approach to bends and curves so there is time for them to make corrections.

Older drivers need more support for them to recognise the dangers to themselves and others of turning out of, or into, side roads. More targeted information about developing new coping strategies is needed.

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 is the lowest. An increase in the provision of specialist neurosurgical care could reduce fatality rates among those who survive up to the time of hospital admission.

The recognition by drivers of the higher fuel consumption and carbon emissions of larger, heavier vehicles may, in time, act as a natural selector in their popularity and therefore act as a balancer in the diversity of mass in the fleet.

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APPENDIX 1
THE DATASETS

Accident circumstances

STATS 19 are 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. Data cover all injury road accidents (i.e. accidents in which one or more people are injured) which are reported to the police in Great Britain. Data are available at council and police force levels. Three types of information are available:

1. Attendant circumstances of the accidents – including the severity, number of vehicles and casualties involved, time and location, road class and number, speed limit, weather and road conditions, and carriageway hazards.
2. Vehicles involved in each accident – includes type, location and manoeuvre at time of accident, and data about the driver (age, sex and breath-test results).
3. Casualties – age, sex, injury severity and whether a driver, passenger or pedestrian.

On-the-spot data are owned by the Department for Transport and managed by TRL. The purpose of the database was to examine the influences on accident causation and injury mechanisms of human involvement, vehicle design and highway design. Data include vehicle rest positions, witness contact details or road surface conditions. The data were supplemented by a road user survey, and injury data are obtained from hospitals and coroners. This information was then used to reconstruct the accident to understand causal factors. The study was conducted in South Nottinghamshire and the Thames Valley Police Authority area. A total of 1,519 accident investigations were carried out over the three years of the project.

The **Nottingham University fatal road traffic crash research database** is owned and managed by the University of Nottingham, School of Psychology. It uses data which were collected between 1994–2005. A sample of 1,185 records was used for the analysis. The database comprises basic information about the accidents, such as time, place, etc., together with a sketch plan, a narrative description of the flow of events, and details of injuries, explanatory factors, possible countermeasures, the vehicle types involved, witness comments, blameworthiness, weather, manoeuvres executed, and other relevant features. The purpose of the data is to provide a detailed record of the circumstances of each fatal accident, and to support some statistical analysis according to key features of the data.

Survivability

The **Co-operative Crash Injury Study (CCIS**) database is owned by the Department for Transport. The CCIS records details of cars involved in tow-away accidents and combines them with data from hospitals and coroners to build a comprehensive database. The purpose of the data is to provide information on the relationship between vehicle damage and occupant injuries to monitor the crash performance of car structures and occupant-protection systems. The data were collected between 1994–2004 and contain 21,797 records. The data are deemed to be a representative sample of road traffic accidents where one of the vehicles is under seven years old (see www.ukccis.org/).

Health care after injury

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).

The **Hospital Episode Statistics (HES)** database is owned by the Department of Health. 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 (see www.dh.gov.uk/PublicationsAndStatistics/Statistics/HospitalEpisodeStatistics/fs/en).

The **Patient Episode Database for Wales (PEDW)** is a centralised database of all hospital admissions of Welsh residents and contains details such as the address of residence, admission and discharge dates, ICD-10 and procedure codes (see).

The **Scottish Mortality Record (SMR01)** 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.

Deprivation

Office of National Statistics (ONS) Mortality Database (see www.statistics.gov.uk/) – the ONS is a government office which holds information on all registered deaths by cause and key demographics, including social class. Data on accidental injury by eternal cause and road user type are not routinely analysed. Therefore a special request was made for data on road traffic fatalities between 2001–04 to examine the relationship between social class and road traffic mortality.