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Killer crashes: Fatal road traffic accidents in the UK

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ABSTRACT

Road traffic accidents are responsible for over 3000 deaths per year in the UK, according to Department for Transport (2004a) figures. Although progress is being made in a number of areas, vehicle occupant fatalities have not been falling in line with casualty reduction targets for the year 2010. A sample of 1185 fatal vehicle occupant cases was considered, from ten UK police forces, from the years 1994–2005 inclusive. The main findings were: (1) over 65% of the accidents examined involved driving at excessive speed, a driver in excess of the legal alcohol limit, or the failure to wear a seat belt by a fatality, or some combination of these. (2) Young drivers have the great 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 speeding, alcohol involvement and recklessness. (3) Older drivers had fewer accidents, but those fatalities 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. Blameworthy right of way errors were notably high for drivers aged over 65 years, as a proportion of total fatal accidents in that age group.

1. Introduction

According to research conducted by the UK Transport Research Laboratory (TRL) (Broughton, 2005), there has been a lack of progress with the reduction of the UK fatality total. One of the main problem areas was revealed to be deaths of car occupants, which have risen since the year 2000.

Car occupant fatalities were found to have occurred predominantly among the young. Contributing significantly to these totals were weekend peaks in fatalities of both car drivers and passengers occurring between 9 pm and midnight. Such accidents show a high level of alcohol involvement. Previous research by Clarke et al., 2002 has shown similar increases in alcohol related accidents at such times. Alcohol-related accidents, however, may not be the exclusive preserve of the young; Abdel-Aty and Abdelwahab (2000), using US state data, found that "the 25–34 age group experience the highest rate of alcohol/drug involvement in accidents." There is also evidence that young male drivers take more risks when driving with passengers, particularly other male passengers. Simons-Morton et al. (2005), using an observational study, found that "the observed rate of high risk driving (defined as speed ≥15 mph or more above the posted speed limit and/or headway of ≤1.0 s) for the teen male driver/male passenger condition was about double that of general traffic."

Speeding as a factor in fatalities has been well-researched; Bédard et al. (2002) found that "travelling at a speed of 112 kph (70 mph) or more was independently associated with a 164% increase in the odds of a fatality compared with speeds of less than 56 kph (35 mph).". Bédard et al. also pointed out that larger decelerations (i.e. larger impact velocities) were associated with more post-injury medical complications, independent of age and injury severity. Quimby (2005) found that UK drivers recognized that driving too fast was "a major contributory factor in accidents compared to drivers in most other [EU] countries" but also that they "do not necessarily associate driving 'faster' (than other drivers) with driving more 'dangerously'—where their own driving is concerned.".

Authors such as Jonah (1997) have linked sensation seeking with other risky driving behaviours such as failure to use a seatbelt. Begg and Langley (2000), in a review of the literature, stated that "failure to use seat belts is most common among young adults, and particularly males. There is also evidence that those who do not use seat belts engage in other risky driving behaviours such as speeding and alcohol-impaired driving.". It has been noted (e.g. by Salzberg et al., 2002) that there can be a discrepancy between observed level of seatbelt use in the driving population and that seen in vehicle occupant fatal cases.

Older drivers and passengers are also more at risk of fatality as car occupants. A review of European research on older drivers by Hakamies-Blomqvist and Peters (2000) quoted Maycock (1997), who estimated that "half of the increased fatality risk of drivers

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aged 75 years or more, compared to drivers aged 30 years, might be due to the enhanced susceptibility of the older drivers to be killed in the accidents in which they are involved, rather than to their higher accident rates.".

Older drivers, according to Hakamies-Blomqvist and Peters (op. cit.), also have specific problems with visual attention. Studies quoted in their review showed that a simulated driving task combined with a secondary task of visual analysis in experimental conditions found significant performance decrements in older drivers. Brouwer et al. (1991) found that older drivers were over-represented in crashes when turning at intersections, usually by failing to yield the correct right of way. Brouwer et al. suggested that divided attention could be a problem for older drivers; they "misperceive or do not adequately react to other traffic ... particularly in complex acts such as turns at intersections." Åberg and Rimmö (1998), in their update of work by Reason et al. (1990), found that inattention errors increased with age; they reported that increased scores on this factor possibly resulted from the "automatization of driver behaviour" that occurs with increased driver age and experience.

Older drivers have been shown to be over-represented in junction accidents in many other studies over the last two decades (e.g. Moore et al., 1982; Viano et al., 1990; Verhaegen, 1995). With an ageing population which has greater susceptibility from side impacts (Viano et al., 1990), and an increased risk of fatality from side impacts as opposed to frontal impacts (Bédard et al., op. cit.), it seems likely that the human and financial cost of this type of accident will increase with time.

2. Aims of the study

The aims of the study were to examine and analyse a sample of police reports of fatal car-occupant crashes in order to gain insight into the causation of these crashes and the factors underlying them.

3. Method

Our method relies on the interpretation of the full sequential nature of the crash story in each individual case, which is where the technique of qualitative judgment methodology proves more useful than more traditional statistical methods applied to aggregated data. A sample of 1185 fatal vehicle occupant cases was considered, from ten UK police forces, from the years 1994–2005 inclusive.

Contained in each file is a report sheet/card, which is a summary of information about the accident such as date, time, location, weather conditions, junction type and many other items. The sheet also includes a brief accident story as interpreted by the attending police officer. It contains the actions, and in some cases the reported intentions and behaviours of drivers and witnesses. In addition to the report sheet/card, the detailed fatal files contain a range of further items, which help to fill out the often complex circumstances of the accident. These include maps, photographs, statements of vehicle examiners and, perhaps most importantly, interview and witness statements which are rich in information. The interpretation consisted of the reconstruction of an entire accident story from the information available in the police file.

The data were entered into a FileMaker Pro database customised to handle the information and search parameters required for this project. Data were entered describing the relatively objective facts of each case: time of day, speed limit, class of road, etc. A 'prose account' was also entered for each case giving a step-by-step description of the accident. The causal story was always written from the viewpoint of the driver of the car containing the primary fatality, though much consideration was also given to other drivers' actions and intentions. An interest was taken in all accidents involving any in-vehicle fatality, and all cases were assessed by coders as to the blameworthiness of any participants in the crash. Drivers could be rated as 'to blame', 'at least partly to blame', or 'not to blame' in any given crash, based on the presence or absence of contributory factors to the crash for each individual driver, although quantified percentages were not used. There were also codings for unforeseen mechanical failure and miscellaneous others. Comparisons using non-blameworthy drivers were used as a quasi-induced exposure measure; such measures have been found to be effective in recent research, e.g. Chandraratna and Stamatiadis (2009). The prose accounts gave a detailed summary of the available facts, including information from witnesses that appeared to be sufficiently reliable. Discrepancies did occur between the interviews of drivers and the statements of independent witnesses, but these were usually resolved by considering all statements together with various other reported facts. These included measurement of skid marks by police, vehicle damage reports, etc.

A minimum set of possible explanations for each accident was recorded from a standard checklist adapted and developed from a previous study (Clarke et al., 1998). The list has subsections for the road environment, vehicle and rider characteristics, and specific driver actions. Phenomena such as fatigue and illness were only recorded as explanatory factors when there was evidence that they directly played a part in the crash (for example, an acute stroke pre-crash would be contributory, while one three months prior would not). The emphasis throughout is on giving the finest grain description possible of each accident, not for use as a formal coding scheme, but rather to provide search and selection aids to identify homogeneous groups of cases for further qualitative analysis.

Finally, entries were made in additional fields for comments and quotes from involved drivers, taken from interview transcripts. The reliability of coders' interpretation of cases using this structured method has been previously found to be good in a similar prior study (Clarke et al., 1998). Three experienced coders were used; all were experienced drivers with additional expertise in forensic crash reconstruction.

4. Results

4.1. Blameworthiness ratios

All cases were assessed by coders as to the blameworthiness of any participants in the incident. Drivers could be rated as either 'to blame', 'at least partly to blame', or 'not to blame' in any given accident, and there were also codings for unforeseen mechanical failure and miscellaneous others. Fig. 1 shows the pattern of blameworthiness ratios across drivers in each age band, i.e. the number of accidents where the driver is rated as at least partly or fully to blame, divided by the number of accidents caused by all other factors, most usually another road user/driver.

It can be seen that drivers aged 20 years or under appeared to be nearly 12 times more likely to have caused a fatal accident than they were to have been innocently involved in such an accident. This effect decreased dramatically with increasing driver age, only rising again beyond the age of 65; results in the last age group should be treated with caution as there are only a small number of drivers in the sample aged 86–90 years.

Younger drivers showed factors such as speeding and deliberate recklessness in causing fatalities to themselves and others. They 'specialised' particularly in loss of control accidents, typically on bends. Older drivers seemed to make more observational and misjudgement errors and had a higher proportion of right of way violation accidents, compared with other accident types this older group became involved in, as shown in Fig. 2 below.

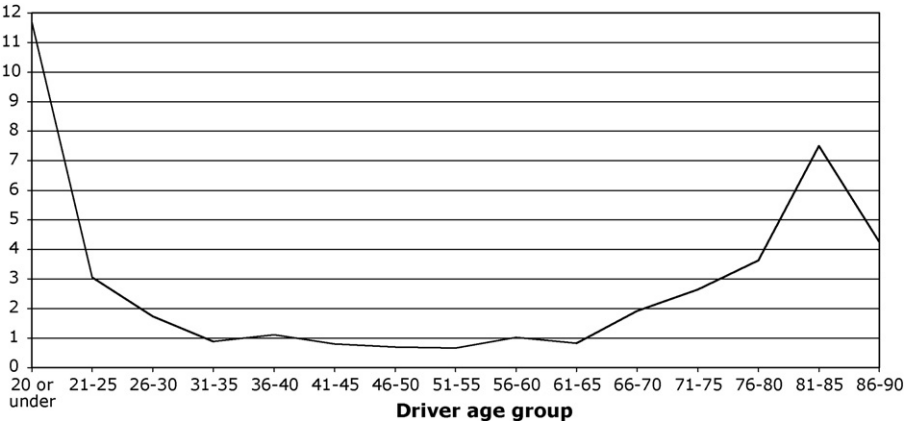

Fig. 1. Pattern of blameworthiness ratios by driver age group.

4.2. Speed: accidents involving loss of control on bends

44% of fatal accidents sampled involved a vehicle going out of control on a bend or curve. The mean age of drivers at fault in these bend accidents was significantly younger than the mean age of drivers in all other accidents in the sample (mean age 33 years, vs. mean age 45 years, unpaired $t = 10.45$, $p < 0.01$). 54% of these accidents were single vehicle accidents (SVAs). There were approximately five times as many male drivers at fault in this fatality class as there were female drivers at fault.

The majority of loss of control on bend accidents (74%) were, unsurprisingly, characterised by excessive speed for the bend in question contributing to the loss of control by the driver. The age distribution of 'at fault' drivers in bend accidents is shown in Fig. 3 below. The figure shows the percentage of bend accidents in the total 'at-fault' accidents for each age band. A second order polynomial curve has been added to Fig. 3 to show the pattern of the drop from the peak of 60+% of fatalities occurring in loss of control bend accidents in the two youngest driver age groups (under 25 years).

Fig. 3 clearly shows that, for drivers under the age of 30, a very large proportion of fatal accidents were caused by loss of control on a bend or curve. As a whole, these fatal accidents occurred over four times as often on rural roads as they did on urban roads. Over half (57%) occurred during the hours of darkness.

There were two general patterns of bend control loss. The first, occurring in approximately 70% of such cases, seemed to occur where a driver approached at excess speed and was unable to make the bend at all; this usually resulted in the car either leaving the road to either side, sometimes hitting oncoming traffic before doing so (in the case of nearside bends).

In the second type (approximately 27% of such cases), the pre-accident sequence was somewhat more complex: The driver appeared to have made attempts to steer out of a skid and regain control, but ended up typically contributing to the loss of control by overcorrecting and inducing a yawing skid, as the path taken in correction exceeded the available grip on the road surface. The vehicle could then spin off either side of the road or into opposing traffic.

The average ages of driver involved in either of these two types of bend loss of control accidents were not significantly different from one another. The ratio of male/female drivers at fault was also the same in either case, and was no different from loss of control bend accidents considered as a whole. There was no evidence that slippery road conditions were playing a major part in either type of loss of control accident.

In both of the two causation patterns identified above, there appeared to have been a high number of side or non-frontal impacts to the car, although this was found to be more common in the second type (67% side/non-frontal impacts vs. 45% in the first type). Side impacts have been found to cause twice as many fatalities as frontal impacts (e.g. by Bédard et al., op. cit.)

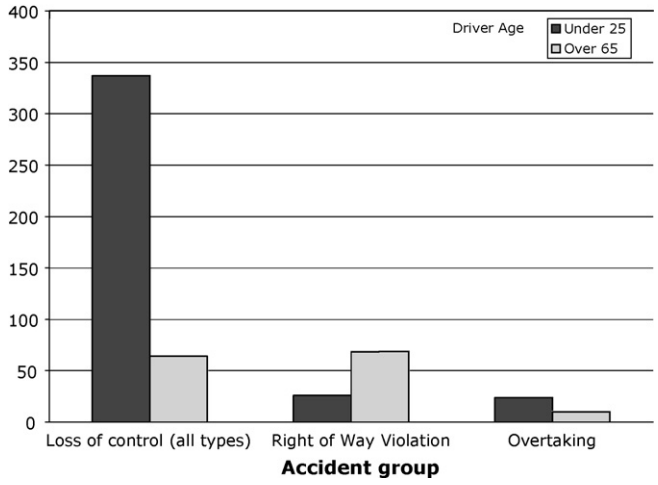

Fig. 2. Three groups of accident; drivers aged 25 and under compared with drivers aged 65 and over.

4.3. Alcohol and drugs

Nearly 20% of all fatalities involved a driver over the drink drive limit. The average blood alcohol level (where this could be measured) was 176 mg/dl (i.e. over twice the UK legal driving limit of 80 mg/dl). The highest blood alcohol level recorded was 384 mg/dl, i.e. nearly five times the legal limit. Drivers found to be above the alcohol limit had an average age lower than that found in the sample of drivers where alcohol was not a factor (mean age 31 years vs. 42 years; unpaired $t = 7.29$, $p < 0.01$).

4% of cases involved drugs. Cannabis was the most widely found drug, but also evident in these cases were amphetamines, MDMA (ecstasy), cocaine and heroin. Level of drug use is unfortunately likely to be an underestimate, as toxicology reports were not always performed, and/or the results were not always made available in the police reports. Drivers found to have used drugs had an average age lower than that found in the sample of non-drug using drivers (mean age 28 years, vs. 40 years; $p < 0.01$). Of the cases where drivers were identified as driving while under the influence of drink and/or drugs only 18 drivers (8%) were found to have been

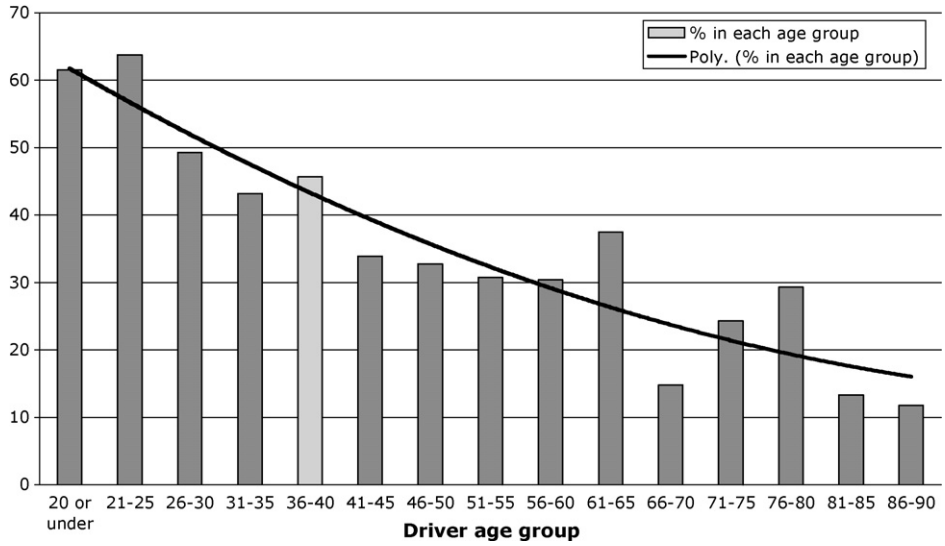

Fig. 3. Percentage of bend accidents by driver age band for all at-fault drivers.

under the influence of drugs and not alcohol, with a further 13 (6%) testing positive for both alcohol and drug intake.

Males were more likely to be driving under the influence of drink and/or drugs when involved in an accident than females. 23% of accidents where male drivers are to blame involved a driver impaired by drink and/or drugs compared with only 13% of females.

There were also very clear types of accidents that impaired drivers were likely to be involved in. A major group was 'loss of control' accidents, especially when attempting to negotiate a bend or curve. Of all the accidents involving an impaired driver 68% were single vehicle accidents (SVAs) and these were nearly all (97%) 'lose control' accidents.

4.4. Driver age and drink/drug impairment

An examination of four age groups covered by the sample showed the general downward trend of the fatal accidents involving drink/drug impairment with driver age (Fig. 4). Age bands have been grouped together in large sets to remove apparent variations caused by small numbers of accidents in individual bands, particularly in the older age groups.

Over a quarter of accidents where drivers were aged under 30 years involved the driver being impaired by drink or drugs. This factor fell in drivers aged over 30 years. In the drivers aged 31–50 years, 16% of accidents involved drink/drug impairment, and nearly the same proportion of accidents involving drivers aged 51–70 years involved drink/drug impairment. This proportion fell very dramatically with more elderly drivers: only 3% of the accidents where the driver was aged over 70 involved impairment by drink or drugs.

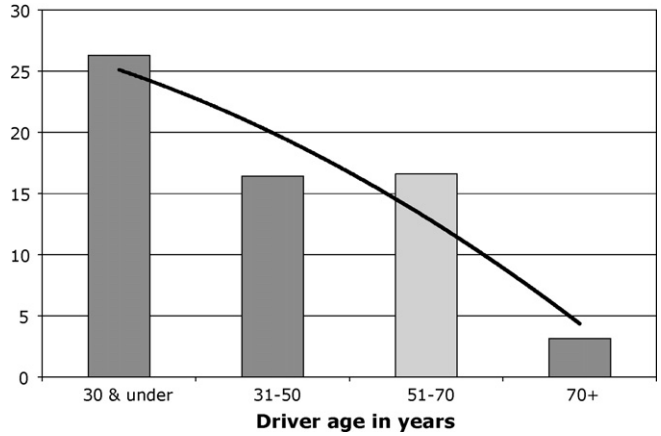

Fig. 4. Age: percentage of accidents involving drink/drug impaired drivers.

Accident involvement by time of day was also examined. Fig. 5 below shows a breakdown by time into two hourly bands starting and ending at midnight, and includes a second order polynomial curve to demonstrate the general trend of the data.

The percentage of drink/drug impaired drivers within each time band increased with time during the hours of darkness, reaching a peak in the 2 am–4 am time band. There were also very noticeable increases after 8 pm: between the hours of 8 pm and 4 am accidents involving drink/drug impaired drivers accounted for over 40% of the total number of fatal accidents. There was a significant drop in the number of accidents involving drink/drug impaired drivers within the remaining time bands between 4am and 8pm. Of these accidents, only 8% involved a driver under the influence of drink or drugs.

4.5. Seatbelts

399 (34%) of cases involved a fatality *not* wearing a seatbelt. 588 (50%) of cases involved a fatality wearing a seatbelt. The remaining 16% of cases occurred where seatbelt use was either 'unknown/unrecorded' or 'not applicable'.

85% of fatalities not wearing a seatbelt were either driving or travelling in the front passenger seat; fatalities were not wearing seatbelts in 58% of accidents involving a rear seat death.

Fig. 6, below, shows the percentage of accidents where the fatality was not wearing a seatbelt falls with the age of the car driver, but still remained quite high throughout all age ranges. A second order polynomial curve has been added to Fig. 6 to show the pattern of the drop from the peak of 45–48% of fatalities in the two youngest driver age groups who were not wearing a seatbelt.

4.6. Accidents involving right of way violations

Fatalities resulting from drivers engaging in right of way violations (ROWVs) formed approximately 16% of the total sample. The mean age of drivers at fault in these ROWV accidents was significantly older than the mean age of drivers in all other accidents in the sample (mean age 57 years, vs. mean age 37 years, $p < 0.01$). 70% of

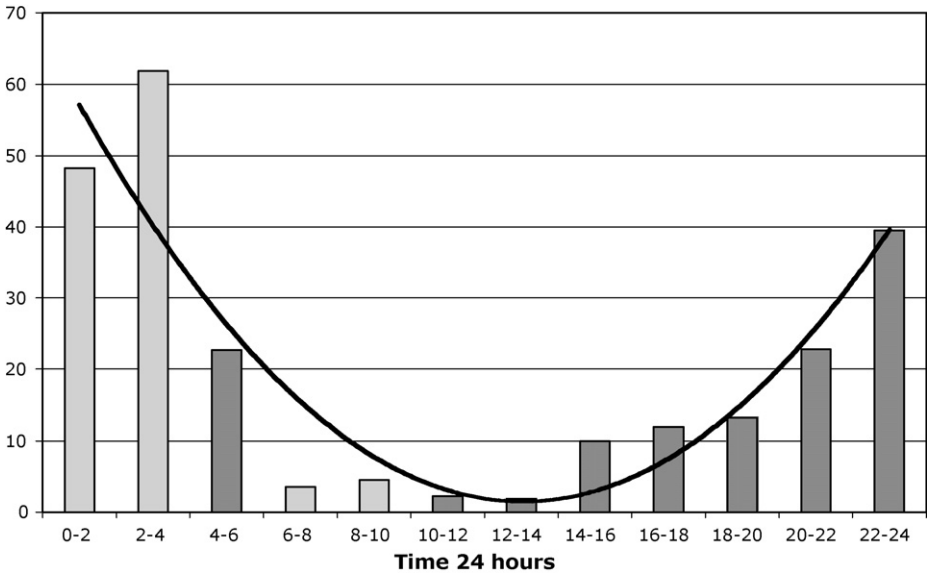

Fig. 5. Time of day: percentage of accidents involving drink/drug impaired drivers.

fatal ROWV accidents occurred in rural areas, which was perhaps a reflection of the higher speeds that can be typically attained/are legally allowed on rural roads when compared with urban roads.

Fig. 7 clearly shows a rise in the proportion of ROWV accidents with driver age; the greater part of this rise occurred after the age of 65 years. When fatal ROWV accidents caused by drivers aged 65 years and over are examined, nearly half (46%) of them involved a driver that 'looked but did not see' (LBDNS); a further 26% involved drivers who seemed not to have looked in the relevant direction at all before the crash.

Fatal ROWV accidents considered as a whole appeared more frequent during daylight (68% in daylight conditions); 'at fault' drivers aged 65 years and over had 83% of their ROWV accidents during the hours of daylight. The most common manoeuvre in the older group was a cross-flow turn onto another road, typically on a rural road; this commonly put the first point of impact at the driver's door, which is a relatively weak part of the car when compared to the crumple zone that typically protects drivers in a frontal collision. As with the bend accidents discussed above, side impacts have been found to cause twice as many fatalities as frontal impacts (e.g. by Bédard et al., op. cit.)

5. Discussion

The use of excessive speed was a clear factor in many of the fatal accidents in this sample. Young male drivers were a particular problem group; they were responsible for a high proportion of fatal collisions that occurred during the hours of darkness, on rural roads, and they 'specialised' in loss of control accidents on bends. The young drivers in the fatal accidents examined here appeared to show the same characteristics as young drivers in previous studies, e.g. Clarke et al. (2002) and Ward et al. (2004). Interview statements by drivers in both these previous studies indicated that they viewed driving as an expressive activity, and found risk-taking to be an exciting challenge to their abilities.

Fatalities involving driving with excess alcohol were also a major problem area. Numbers of fatal accidents involving drink/drug impaired drivers followed fairly predictable patterns, with the most accidents in the late evening and early morning, par-

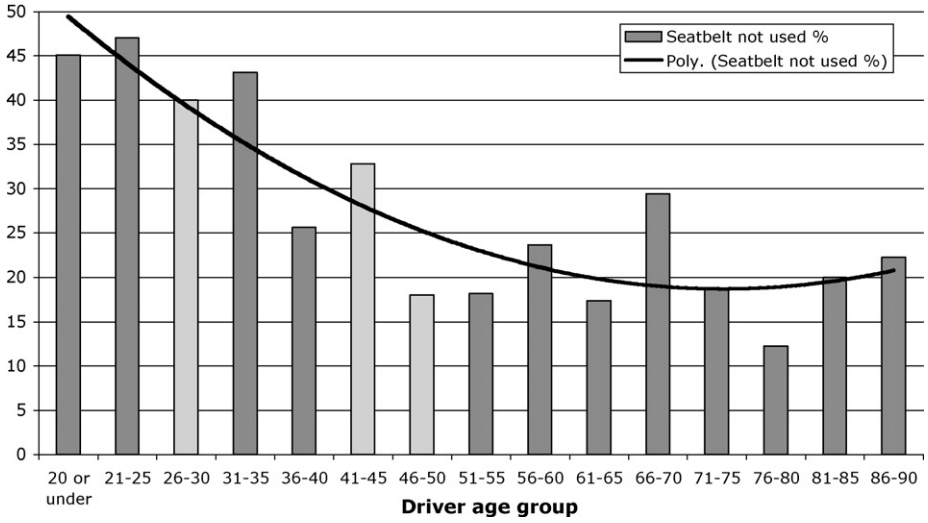

Fig. 6. Percentage of fatalities not wearing seatbelts by driver age.

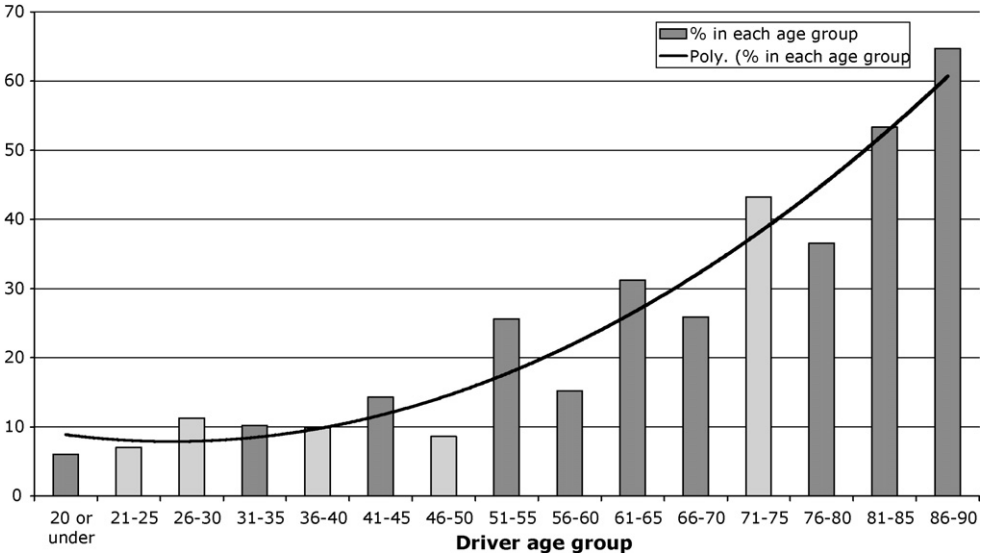

Fig. 7. Percentage of ROWV accidents by driver age band for all at-fault drivers.

ticularly at weekends. The average level of blood alcohol found in impaired drivers causing fatal accidents was over twice the current legal limit. This suggested that these drivers were not simply miscalculating their level of intoxication and ability to drive having erroneously assumed that they were under the limit. It appeared far more likely that they took a deliberate decision to drive while they knew themselves to be intoxicated.

It was clear that many fatalities in the cases examined were not wearing seatbelts. This seemed to be a particular problem with in-car fatalities where the driver was under 35 years of age, but there remained a high level of non belt-wearing by fatalities throughout all age groups of driver. The UK Department for Transport puts a figure of over 90% for drivers and front seat passengers' seatbelt usage, and 66% for rear seat passengers (Department for Transport, 2004b). It seemed that non-belt wearing was much more prevalent in the fatal accidents examined than levels observed in the general driving population. This discrepancy was similar to that noted in research by Salzberg et al. (op. cit.).

'Looked but did not see' (LBDNS) fatal accidents appeared to show a similar pattern of accident causation to that found in previous research into accidents of all severities that involved older drivers pulling out in front of motorcyclists (Clarke et al., 2004): there appeared to be little or no explanation as to why a driver had failed to see another vehicle that should have been in plain view. The increased proportion of ROWV accidents found with age occurred at too great an age (65 years plus) to be related purely to driver skill factors, and suggested an age-related deficit.

This sample of fatal cases examined seemed to show there were two main problem areas. The first, and apparently greater one, concerns the behaviours engaged in by younger drivers, who take most risks and travel at the highest speeds. They show a particular propensity for loss of control accidents of all types, and are also over-represented in night-time accidents, particularly in rural areas. It would seem that younger drivers in fatal accidents are 'violators', as described in the work of Reason et al. (1990), and Åberg and Rimmö (1998). The young driver problem is an area of particular concern not just in the UK, but in all OECD countries: The Fédération Internationale de l'Automobile (FIA, 2005) claimed that, in OECD countries alone, '. . . it is estimated that 9000 people aged between 16-24 [years] were killed on the roads in 2003 [in car crashes]'. Possible solutions to the younger driver problem have included graduated licensing schemes that put additional restrictions on young drivers, such as night-time curfews, restrictions on carrying passengers, and a lowered legal maximum alcohol limit. Begg and Stephenson (2003), for example, in an evaluation of such measures applied since 1987 in New Zealand, found that a graduated licence scheme was the most important factor in the near halving of the killed and seriously injured car occupant rate for under 24 year olds during the period 1987–1998. Mayhew et al. (2001) have also reported that a graduated driver licensing programme in Canada showed that the intervention was associated with a significant reduction in crashes over a three-year period.

A second, and somewhat smaller problem area concerns misjudgements and mistakes made by elderly drivers that can lead to fatalities. Older drivers appear more likely to be involved in fatal 'right of way' collisions, and have the bulk of their accidents in the daytime. It would seem that these drivers are more prone to the errors (as opposed to violations) described by Reason et al. (op. cit.) There have been a number of research studies recommending test procedures that could be adopted by medical professionals when deciding whether an older at-risk driver should continue to drive. Molnar et al. (2007), for example, reviewed some clinical measures that might be used by physicians to identify at-risk older drivers, having pointed out that such physicians often lacked evidence-based tools to do so. They found that sub-normal scores in components of three 'toolkits' were associated with motor vehicle crashes in their subjects. These toolkits were:

(1) Mini-mental State Examination (MMSE), which contained such components as orientation to time, spelling 'WORLD' backwards, etc. (after Folstein et al., 1975). Freund and Colgrove (2008) have also found the MMSE useful in distinguishing between safe and unsafe drivers in a simulated driving experiment.
(2) Driving Habits Questionnaire, including questions on how often drivers committed lapses and misread signs, took the wrong turn off a roundabout, or got into the wrong lane approaching a roundabout or junction. (After Parker et al., 2000).
(3) Ottawa Driving and Dementia Toolkit, which included questions such as 'do you think at present you are a safe driver?', and 'have you had any car crashes in the last year?' (After Byszewski et al., 2003).

In addition, Molnar et al. found that two other responses/tests were associated with past or current crashes. These were the responses that participants were 'bothered a great deal by Diabetes

Mellitus', and the Timed Toe Tap Test (in which, with heel resting on ground, time to tap left toes on ground 15 times is measured). Molnar et al. also reported that 'almost all measures employed were acceptable to enrolled patients'.

The FIA (op.cit.) have argued that campaigns focussing on the three areas of speed, intoxication, and seat-belt use should be carried out on a regular basis, and must be combined with effective education and enforcement measures. It will be recalled that Begg and Langley (op.cit) stated that there was a link between all three areas of risk taking, i.e. that drivers who failed to wear a seat-belt were more likely to drive at speed and/or while intoxicated. This suggests that it is general driver attitudes regarding risks to themselves and others that is the problem, rather than attitudes towards discrete risk-taking behaviours considered in isolation. Similar links regarding networks or patterns of aberrant behaviour have been found in other studies: Broughton (1999) established a link between unlicensed driving and other types of car crime; Chenery et al. (1999) found that drivers who violated the law relating to parking in disabled parking areas were far more likely than others to have criminal records for serious traffic offences; Wellsmith and Guille (2005) showed a link between individuals issued with fixed-penalty notices and 'concurrent criminality'. Such observations have led authors such as Corbett (2003) to argue that emphasis in enforcement should be put on 'intelligence-led offender targeting and intelligence gathering' in police vehicle-stop scenarios.

6. Conclusions

One or more of the 'unholy trinity' of speed, alcohol, and lack of safety restraint were factors in nearly two thirds of the fatal accidents examined here. These are all factors that have been subject to both legal sanctions and extensive campaigns in the past. It would seem that, in the case of fatal accidents at least, certain groups of drivers cannot be told often enough of the dangers to which they can expose themselves and their passengers, or perhaps that additional measures need to be added to the provision of safety information.

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