Physical and psychological effects of injury
Data from the 1958 British birth cohort study

LEAH LI, IAN ROBERTS, CHRIS POWER

Background: There is only scant evidence for the long-term health effects of road traffic injuries. We therefore assessed the extent to which motor vehicle driver injuries influence limiting long-standing illness and psychological distress using data from a nationwide study (the 1958 British birth cohort) in early adulthood. Methods: Information was obtained on driver injuries occurring between ages 23 and 33 years and limiting illnesses and psychological distress at age 33 years. The risks of injury-related adverse consequences were derived using logistic regression and expressed as odds ratios (ORs) and 95% confidence intervals. Results: A single injury was associated with limiting illness (OR=2.01 and 95% CI: 1.38-2.94). The association between a single injury and psychological distress was strong for a recent injury occurring between ages 30 and 33 years (OR=1.86 and 95% CI: 1.24-2.81), but not for injuries occurring earlier on. The population attributable fraction for limiting illness with one injury was 3.8% (range 1.7-5.3%) and with two or more injuries was 1.0% (range 0.5-1.3%). After controlling for potential confounding factors the corresponding figures were 4.2% (range 2.2-5.6%) and 1.1% (range 0.5-1.3%) respectively. Conclusions: Driver injuries are associated with a substantial increase in disability and, also in the short term, with increases in psychological distress. These results highlight the need for identifying effective strategies for the prevention of road traffic injuries as well as more effective approaches for rehabilitation of the injured.

Keywords: disability, driver injury, long-standing illness, psychological distress

Unintentional injury is the leading cause of death among children and young adults in the UK.\(^1\) Road traffic accidents account for the majority of deaths. In 1994, 3,650 people died on the roads in the UK and 46,531 were seriously injured.\(^2\) Over the past decade there has been a steady fall in injury mortality.\(^3\) Reduced case fatality has been responsible for much of the decline in injury death rates. Data from the Major Trauma Outcome Study showed that, between 1989 and 1995, after controlling for injury severity, the probability of death after severe injury declined by 16% per year.\(^4\) However, there is little evidence to show that there has been a fall in injury occurrence. With more people surviving severe injury, establishing the contribution of injuries to long-term morbidity is of increasing public health importance.

In recent years, there has been growing recognition of the importance of the physical and psychological sequelae of road traffic accidents.\(^5,6\) It has been estimated that 5% of road traffic accidents which require hospital treatment result in permanent disability.\(^6\) Regarding the psychological effects of accidents, a follow-up study of 188 consecutive road accident victims with multiple injuries found that nearly one-fifth experienced an acute stress syndrome, characterised by mood disturbance and horrific memories of the accident.\(^7\) Disabling phobic travel anxiety was present in 14% of road accident victims, with post-traumatic stress disorder manifesting in 11%. Moreover, evidence of psychological sequelae was present even among those with relatively minor injury. Despite the evidence from clinical case series for the existence of post-traumatic psychological syndromes in road accident victims, the lack of a comparison group in these studies raises the possibility that at least some of the effects are aetiologically unrelated to the injury. Some of the observed post-injury effects may represent pre-existing psychological characteristics which predispose to road traffic accidents. Furthermore, the demonstration that relatively minor injuries, such as hand injuries and limb fractures, can result in substantial levels of permanent disability raises the possibility that some post-traumatic psychological distress may be a consequence of injury-related physical disability. To assess the extent to which motor vehicle injuries independently result in long-term disability and psychological distress in adulthood, we examined data from the 1958 British birth cohort study. Specifically, we estimated the magnitude of the association between driver injuries between ages 30 and 33 years and the risk of limiting illness and psychological distress at age 33 years after controlling for potential confounding factors.

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METHODS
The 1958 birth cohort is a follow-up of all children born in England, Scotland and Wales during 1 week in March 1958. The study methodology has been described elsewhere. In brief, data were collected at birth and at ages 7, 11, 16, 23 and 33 years. Immigrants to Britain born in the same week were included at ages 7, 11 and 16 years. The current analyses are based on self-reported information obtained at ages 23 and 33 years (in 1991). In the most recent sweep, 11,405 subjects were interviewed (69% of the target population). Information was obtained on motor vehicle crashes resulting in injuries to drivers occurring between ages 23 and 33 years which resulted in hospital admission, accident and emergency attendance or out-patient attendance. Driver injuries were selected for the analysis because information on exposure (number of miles driven) was available for this group but not for passengers and exposure was a potential confounding factor. Two outcome measures were selected: long-standing illness which limited daily activity and psychological distress (indicated by the 24 item Malaise Inventory). Psychological distress was examined as a dichotomous outcome (using a cut-off point of 25 to indicate depression) and as a continuous variable (change in average score at ages 23-33 years). The risks of injury-related adverse consequences were derived using logistic regression, and expressed as odds ratios (ORs) and 95% confidence intervals (CIs) for all injuries (ages 23-33 years) and, separately, for recent injuries (ages 30-33 years). To take into account the potential for continuity of limiting illness and psychological distress from age 23 to 33 years, adjustments were made for prior status at age 23 years. Potential confounding factors were identified from the published literature on disability and psychological distress in this cohort and more generally and from the literature on risk factors for road traffic crashes. Multivariate odds ratios were estimated to take account of potential confounding factors.

RESULTS
Between ages 23 and 33 years, 432 subjects (5%) had at least one motor vehicle occupant injury as a driver. Driver injuries were associated with an increased risk of limiting illness: the occurrence of a single injury was associated with a doubling of the risk, with a fourfold increase in risk for subjects with two or more injuries (table 1). The ORs were similar for all injuries ages 23–33 years and for recent injuries (ages 30–33 years). Driver injuries were also associated with an increased risk of psychological distress at age 33 years, but only for two or more injuries (table 1). However, these data for injuries between ages 23 and 33 years obscured the short-term effects on psychological distress: a recent injury (ages 30–33 years) increased the risk of subsequent psychological distress (OR=1.86 and 95% CI: 1.24–2.81). For subjects who had experienced a driver injury there was an increase in malaise score over the 10 year period, which contrasts with the decrease in malaise score among subjects who had not had a driver injury (table 1).

The population-attributable fraction for limiting illness and one driver injury was 3.8% (95% CI: 1.7–5.3%) and for two or more driver injuries was 1.0% (0.5–1.3%). After controlling for potential confounding factors the corresponding figures were 4.2% (2.2–5.6%) and 1.1% (0.5–1.3%) respectively. The population-attributable fraction for malaise and one driver injury was 0.4% (1.2 to 1.6%) and for two or more driver injuries was 0.4% (0.01 to 0.7%). After controlling for potential confounders the corresponding figures were 0.6% (0.9 to 1.8%) and 0.5% (0.7%) respectively.

DISCUSSION
Although the government strategy for health The Health of the Nation established a reduction in ill health, disability and death from accidents as a national priority, the targets that were set were based entirely on death rates. As a result, the decline in injury death rates over the past 7 years has eclipsed any consideration of injury-related disability. The fact that much of the fall in injury death rates has been shown to be due to reduced case fatality is of considerable importance in this respect, since it raises the possibility that the decline in death rates might not have been accompanied by similar declines in injury occurrence and levels of disability. The strong associations shown here between injury and subsequent disabling illness and the associated population-attributable fraction of 5% suggest that the burden of injury-related disability may be substantial and that the focus on mortality alone may be inappropriate. For both limiting illness and psychological distress, there was a strong association with hospital attendance for an injury, although the association for psychological distress

Table 1 Association between driver injury (ages 23–33 years) and limiting illness and psychological distress

<table>
<thead>
<tr>
<th></th>
<th>Limiting illness</th>
<th>Psychological distress</th>
<th>Change in average malaise score</th>
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<tbody>
<tr>
<td></td>
<td>Age 33 years</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Adjusted OR (95% CI)</td>
<td>Adjusted OR (95% CI)</td>
<td>OR (95% CI)</td>
</tr>
<tr>
<td>No injury accident</td>
<td>1.00</td>
<td>1.00</td>
<td>-0.31 (-0.37 to -0.25)</td>
</tr>
<tr>
<td>One injury accident</td>
<td>2.01 (1.38–2.94)</td>
<td>1.15 (0.84–1.58)</td>
<td>0.14 (-0.13 to 0.40)</td>
</tr>
<tr>
<td>Two or more injury accidents</td>
<td>4.01 (1.57–10.28)</td>
<td>2.32 (1.02–5.26)</td>
<td>0.30 (-0.44 to 1.03)</td>
</tr>
</tbody>
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a: Adjusted for sex, social class (age 33 years), marital status (age 33 years), smoking between ages 23 and 33 years, body mass index (average of ages 23 and 33 years), number of children (average of ages 23 and 33 years), limiting illness (age 23 years), malaise (age 23 years), and number of miles driven between ages 23 and 33 years.

b: Adjusted for sex, social class (age 33 years), marital status (age 33 years), number of children (average of ages 23 and 33 years), limiting illness (age 23 years), malaise (age 23 years), job strain (age 33 years), parental divorce and number of miles driven between ages 23 and 33 years.
was evident only in relation to recent driver injuries. This suggests that psychological effects inferred on the basis of uncontrolled clinical case series might overstate the importance of injuries over the long-term. Nonetheless, the strong effect of injury on subsequent psychological distress over the short term was independent of the effect on limiting illness, supporting the existence of a distinct psychological morbidity from road-related injury.\textsuperscript{5}

Because several relevant confounding factors were measured prior to the assessment of study outcomes in both cases and controls, this study has important advantages over previous uncontrolled case series and cross-sectional studies which have examined the contribution of injury to long-term disability.\textsuperscript{7,10,11} The ability to control for pre-existing illness and psychological distress avoids the possibility of mistaken inferences about the temporal relationship between injury and disability. Nevertheless, there are some methodological issues which may have a bearing on the validity of the results. Perhaps the most important is the potential for bias due to residual confounding. The extent to which pre-existing (age 23 years) illness and psychological distress may account for the observed associations depends critically on the extent to which these have been adequately measured and controlled for. Misclassification of disabling illness and psychological distress at age 23 years would limit the extent to which these were controlled for, with the potential for residual confounding. The possibility of confounding by other unmeasured factors is also open to question. Loss to follow-up between ages 23 and 33 years might also have introduced bias, particularly if loss to follow-up was dependent on exposure status. Furthermore, we cannot discount the possibility that an association with limiting illness might be due to differential recall of injuries, as this is an inherent difficulty of our study design. However, weighed against these limitations are the strengths of the study as mentioned above.

According to recent estimates, injuries account for 1 in every 7 years of healthy life lost and by 2020 they are projected to account for 1 in every 5 years.\textsuperscript{12} Because few studies have documented the full extent of health consequences from traffic crashes, their neglect as a public health problem may be even more significant. The results of this study highlight the need for identifying effective strategies for the prevention of road traffic injuries as well as more effective approaches for rehabilitation of the injured.

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\textbf{REFERENCES}