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Non-fatal occupational injuries in British agriculture
Christine Solomon, Jason Poole, Keith T Palmer, David Coggon

Objective: To investigate the incidence, nature and determinants of non-fatal occupational injuries in British agriculture.

Methods: As part of a postal survey, data on lifetime histories of work in agriculture and occupational accidents were obtained from men born between 1933 and 1977 and residing in three rural areas of England and Wales. Incidence rates for different categories of accident were compared with those derived from statutory reporting. Associations with risk factors were explored by Poisson regression, and summarised by incidence rate ratios (IRRs).

Results: Of the 10,765 responders (response rate = 31%), 3238 (30%) reported at least one occupational accident at the ages of 14–64 years, leading to absence from work for >3 days, including 1492 accidents that could be linked to a specific job listed in the history of agricultural work. The reported incidence of injuries in agriculture was markedly higher than that derived from statutory reporting, particularly for self-employed farmers. During 1996–2003, the highest rates of agricultural accidents were from handling, lifting or carrying (4.9/1000 person-years), falls from a height (4.6/1000 person-years) and injury by animals (3.4/1000 person-years). After adjustment for calendar period and age, the risk of accidents was elevated in men who had only recently entered agricultural work (IRR 3.7, 95% CI 2.7 to 5.1 for men who had worked in agriculture for up to 1 year relative to those who had entered the industry >25 years earlier), and in those who carried out forestry (IRR 1.7, 95% CI 1.5 to 1.9).

Conclusions: Our findings confirm the substantial underascertainment of serious accidental injuries in agriculture through statutory reporting, particularly for the self-employed. The risk of accidents is highest in new recruits to the industry and in those undertaking forestry, and these groups should be a target for further preventive action.

Although much has been done in developed countries to improve safety in the workplace, accidental injury remains an important cause of morbidity and mortality, particularly in certain industries. In Britain, statistics on occupational accidents are available from notifications to the Health and Safety Executive under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR). Among other things, RIDDOR requires employers to report all accidents in the workplace that cause death, specified serious injuries such as fractures and amputations, or absence from work for longer than three working days. The agricultural industry (farming, forestry and horticulture) has one of the highest rates of fatal occupational accidents nationally. Rates of reported non-fatal accidents in agricultural workers are lower than in other non-service industries, but many are self-employed or work in small businesses, and there is thought to be substantial under-reporting in these groups.

Evidence for this theory is provided by the Labour Force Survey (LFS), data from which suggest that, even among agricultural employees, RIDDOR statistics underestimate rates of reportable injury by a factor of 3–5. However, the number of agricultural workers included in the LFS each year is relatively small, limiting the more detailed conclusions that can be drawn.

To find out more about the incidence, nature and determinants of non-fatal occupational injuries in agricultural workers, we analysed data from a survey of health and work in three rural populations of England and Wales.

METHOD
The study population comprised men born during 1933–77, who were residing in three defined rural areas of England and Wales (in north Devon, the Welsh Borders and South Lincolnshire) that were known to have a high prevalence of employment in agriculture. Members of the study population (n = 34,486) were identified from general practice age-sex registers held by local health authorities, and each was sent a postal questionnaire, followed if necessary by a reminder after 10–16 weeks. To protect the confidentiality of the participants, the mailing was carried out by the local health authorities (or their successor organisations) on behalf of the study team and subjects were identified only by a serial number.

The questionnaire addressed many different aspects of work and health, and among other things, collected data on lifetime history of paid work in agriculture (farming, forestry or horticulture) with the ages at which each job started and finished, details of the type(s) of agriculture involved, and a note of whether the subject was an employee or self-employed. It also asked about all occupational accidents (whether in agriculture or other industries) between the ages of 14 and 64 years that had led to absence from work for >3 days. Information was sought on the age at which each accident happened, the job in which it occurred, the circumstances of the accident, and the nature of the injuries produced.

Statistical Analysis
Statistical analysis was carried out using STATA 8.2 SE software. Simple descriptive statistics were used to compare the relative frequency of different types of accidental injury in agricultural workers and other occupations. We then restricted all further analyses to men who had reported working in at least one agricultural job between the ages of 14 and 64 years.

Abbreviations: IRR, incidence rate ratio; LFS, Labour Force Survey; RIDDOR, Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
and to accidents that could be linked to a specific job listed in the lifetime history of agricultural work. Person-years calculations were used to derive incidence rates for different categories of accident during the period from January 1996 to March 2003 (the person-years at risk being calculated from each subject’s history of agricultural work), and the rates were compared with those for non-fatal major and “over three day” injuries in farming, forestry and horticulture nationally during approximately the same period (April 1996–March 2003) derived from RIDDOR reports. Data on the latter were supplied to us by Health and Safety Executive, and population denominators for calculation of the rates were obtained from the Office of National Statistics.

Finally, risk factors for accidents in agricultural workers were examined by applying Poisson regression to data from the whole period covered by the working lives of the participants (1947–2004). In this analysis, data on lifetime histories of work in agriculture were again used to calculate person-years at risk. To account for possible within-subject correlation (292 men contributed data on more than one accident), the cluster option was applied. Risk estimates were summarised as incidence rate ratios (IRRs) with associated 95% confidence intervals (CIs).

RESULTS

Questionnaires were returned by 10,765 subjects (31% of those mailed), including 3,238 (30%) who reported at least one occupational accident at the ages of 14–64 years that had led to >3 days absence from work. The prevalence of such accidents was similar in the 7,810 men who responded to the initial mailing (30%) to that in the 2,955 who answered only after a reminder (31%). In all, 1,025 men indicated that they had suffered 1 accident, including 60 who reported 5 accidents (the maximum number that could be described in the questionnaire).

Of the 4,914 accidents that were reported in total, 1,740 were to men who at the time were working in agriculture (593 entirely as employees and 900 fully self-employed). Table 1 shows the relative frequency of different categories of accidental injury in agricultural and other occupations. Overall, the most commonly reported types of trauma were:

<table>
<thead>
<tr>
<th>Injury</th>
<th>Accidents in all occupations</th>
<th>Accidents in agricultural workers</th>
<th>Accidents in other occupations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fracture</td>
<td>1070</td>
<td>419</td>
<td>648</td>
</tr>
<tr>
<td>Head injury</td>
<td>370</td>
<td>104</td>
<td>263</td>
</tr>
<tr>
<td>Cut needing stitches</td>
<td>1102</td>
<td>446</td>
<td>648</td>
</tr>
<tr>
<td>Burn or scald</td>
<td>127</td>
<td>18</td>
<td>107</td>
</tr>
<tr>
<td>Amputation</td>
<td>106</td>
<td>46</td>
<td>59</td>
</tr>
<tr>
<td>Back injury</td>
<td>1259</td>
<td>381</td>
<td>871</td>
</tr>
<tr>
<td>Other sprain</td>
<td>500</td>
<td>156</td>
<td>90</td>
</tr>
<tr>
<td>Eye injury</td>
<td>296</td>
<td>85</td>
<td>209</td>
</tr>
<tr>
<td>Other</td>
<td>752</td>
<td>261</td>
<td>490</td>
</tr>
<tr>
<td>Unknown</td>
<td>74</td>
<td>35</td>
<td>36</td>
</tr>
<tr>
<td>All accidents</td>
<td>4914</td>
<td>1740</td>
<td>3142</td>
</tr>
</tbody>
</table>

*Information about occupation was missing for 32 accidents.
†Percentage of all accidents in the occupational category. Some accidents resulted in a combination of several injuries, and therefore percentages total to >100.

Table 2

Incidence of accidents among agricultural workers leading to >3 days absence from work during 1996–2003 and comparative data from Reporting of Injuries, Diseases and Dangerous Occurrences Regulations for the same period

<table>
<thead>
<tr>
<th>Type of accident</th>
<th>All agricultural workers</th>
<th>Agricultural employees</th>
<th>Self-employed agricultural workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accidents (n)</td>
<td>Incidence*</td>
<td>Incidence from RIDDOR†</td>
</tr>
<tr>
<td>Contact with moving machinery or material being machined</td>
<td>41</td>
<td>2.9</td>
<td>0.41</td>
</tr>
<tr>
<td>Hit by a moving, falling object or falling object</td>
<td>39</td>
<td>2.8</td>
<td>0.78</td>
</tr>
<tr>
<td>Hit by a moving vehicle</td>
<td>9</td>
<td>0.7</td>
<td>0.14</td>
</tr>
<tr>
<td>Hit something fixed or stationary</td>
<td>15</td>
<td>1.1</td>
<td>0.21</td>
</tr>
<tr>
<td>Injured while handling, lifting or carrying</td>
<td>70</td>
<td>4.9</td>
<td>0.99</td>
</tr>
<tr>
<td>Slipped, tripped or fell on the same level</td>
<td>36</td>
<td>2.6</td>
<td>0.77</td>
</tr>
<tr>
<td>Fall from a height</td>
<td>65</td>
<td>4.6</td>
<td>0.56</td>
</tr>
<tr>
<td>Exposed to, or in contact with, a harmful substance</td>
<td>5</td>
<td>0.4</td>
<td>0.10</td>
</tr>
<tr>
<td>Injured by an animal</td>
<td>47</td>
<td>3.4</td>
<td>0.34</td>
</tr>
<tr>
<td>Other</td>
<td>6</td>
<td>0.5</td>
<td>0.24</td>
</tr>
<tr>
<td>Unknown</td>
<td>30</td>
<td>2.2</td>
<td>0.02</td>
</tr>
<tr>
<td>All accidents</td>
<td>363</td>
<td>19.5</td>
<td>4.58</td>
</tr>
</tbody>
</table>

RIDDOR: Reporting of Injuries, Diseases and Dangerous Occurrences Regulations.
*Incidence per 1000 person-years.
†Incidence of major and “over three day” injuries per 1000 person-years in farming, forestry and horticulture from RIDDOR statistics.

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back injuries (25.6%), cuts needing stitches (22.4%) and fractures (21.8%), the proportion of cuts and fractures being somewhat higher in agricultural workers than in other occupations. There were no major differences in the types of injuries sustained by employees as compared with self-employed agricultural workers (data not shown).

All further analyses were restricted to the 1492 accidents that could be linked to a specific job described in the section of the questionnaire on lifetime history of agricultural work. Table 2 shows the number and incidence of such accidents during 1996–2003 according to the type of accident and whether the subject was an employee or self-employed. For comparison, the table also presents corresponding rates for non-fatal major and “over three day” accidents derived from RIDDOR reports nationally during approximately the same period. The highest rates of accidents reported in our study were from handling, lifting or carrying (4.9/1000 person-years), falls from a height (4.6/1000 person-years), and injury by an animal (3.4/1000 person-years). Rates were broadly similar in employees and self-employed agricultural workers, except that injuries while handling, lifting or carrying tended to be rather more common in the former (6.2 vs 4.2/1000 person-years). The incidence of accidents reported in our study was 4.3 times that from RIDDOR reports. The discrepancy was greatest for the self-employed (a ratio of 31.5), but was also apparent for agricultural employees (ratio = 2.7). For employees, it was largest for injury by animals (ratio = 6.3), whereas the most marked difference in the self-employed was for injury while lifting and handling (ratio = 107).

Table 3 gives IRRs for accidents in agricultural workers in relation to a number of potential risk factors. The frequency of reported accidents increased progressively over the period covered by the study (IRR 0.2, 95% CI 0.1 to 0.4 for 1947–54 as compared with 2000–04), but after allowance for this trend, risk varied little with age, and was only slightly higher in employees compared with the self-employed (IRR 1.1, 95% CI 1.0 to 1.2). There was, however, a markedly higher risk of accidents in individuals who had only recently entered agricultural work (IRR 3.7, 95% CI 2.7 to 5.1 for men who had worked in agriculture for up to 1 year as compared with those who had entered the industry >25 years earlier). In addition, there was a substantial increase in risk among men who were engaged in forestry (IRR 1.7, 95% CI 1.5 to 1.9).

When similar analyses were carried out for specific types of accidents (supplementary table A, available at http://oem.bmj-journals.com/supplemental), the increased risk in foresters was significant for each of: contact with moving machinery or material being machined (IRR 2.5); hit by a moving, flying or falling object (IRR 2.4); hit by a moving vehicle or hit something fixed or stationary (IRR 2.1); injured while handling, lifting or carrying (IRR 1.9); and slipped, tripped or fell on the same level (IRR 2.2). However, there was no marked increase in risk in foresters for falls from a height or injury by animals. As might be expected, the highest risks of injury by animals were in beef (IRR 3.8, 95% CI 1.9 to 7.8) and dairy (IRR 1.8, 95% CI 1.2 to 2.6) farming.

**DISCUSSION**

Our data confirm the substantial under-reporting of serious accidental injuries among agricultural workers under RIDDOR, the shortfall being most marked for those who are self-employed. The most frequent types of accident were from manual handling, falls and injury by animals, and the risk of accidents was highest in men who had only recently entered agricultural work and among those engaged in forestry.

In interpreting these findings, it is important to consider the potential for bias from incomplete response to the questionnaire and from errors of recall. The overall response to the questionnaire was only 31%. The reasons for this are discussed in more detail elsewhere (submitted for publication), but it seems likely that a major factor was the refusal of the ethics
Policy implications

- Statutory reporting schemes can be unreliable as a source of information on occupational accidents in agriculture.
- The higher risks in new recruits to agriculture and in foresters should be a particular focus for preventive action.

consistent with findings from other studies of agricultural workers, and in many other industries that rates of occupational injury are highest in inexperienced workers.

One reason for a higher risk of accidents soon after first entering a job could be that those who are most prone to accidents selectively move on to other work at an earlier stage. In support of this, there is evidence that when followed up long-term, workers employed in two industries (production of man-made mineral fibres and of glass-reinforced plastics) for <1 month had significantly higher mortality from injury and poisoning than longer-term employees of the same companies. However, the main explanation is likely to be that new recruits to an industry are more susceptible to accidents because they lack experience. Either way, our findings suggest that campaigns to reduce accidental injury in agriculture might usefully emphasise the special need for safety training of new workers.

Our estimate of the risk of accidents associated with forestry was for men whose job involved this type of work compared with other agricultural workers. However, some work in forestry was only part-time, the men concerned also carrying out other types of agricultural work, and in these cases, we cannot be sure that the reported accidents all occurred in the course of forestry. Normally, any resultant misclassification would be expected to obscure rather than spuriously exaggerate associations with forestry. Moreover, the excess risk that we observed was restricted to the types of accident that might plausibly be expected to occur in forestry. However, to check for bias, we repeated the analysis specifically for full-time forestry workers, and the risk remained higher (IRR 1.8, 95% CI 1.5 to 2.3).

In conclusion, our results confirm the relatively high rate of occupational accidents among agricultural workers (both employees and self-employed), and point to particularly high risks in those new to the industry, and those engaged in forestry. Further efforts are needed to address this continuing, important source of morbidity.

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Authors’ affiliations

Christine Solomon, Jason Poole, Keith T Palmer, David Coggon, MRC Epidemiology Resource Centre, Community Clinical Sciences, University of Southampton, Southampton, UK

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