Occupational injuries identified by an emergency department based injury surveillance system in Nicaragua

R Noe, J Rocha, C Clavel-Arcas, C Aleman, M E Gonzales, C Mock


Objectives: To identify and describe the work related injuries in both the formal and informal work sectors captured in an emergency department based injury surveillance system in Managua, Nicaragua.

Setting: Urban emergency department in Managua, Nicaragua serving 200–300 patients per day.

Methods: Secondary analysis from the surveillance system data. All cases indicating an injury while working and seen for treatment at the emergency department between 1 August 2001 and 31 July 2002 were included. There was no exclusion based on place of occurrence (home, work, school), age, or gender.

Results: There were 3801 work related injuries identified which accounted for 18.6% of the total 20 425 injuries captured by the surveillance system. Twenty seven work related fatalities were recorded, compared with the 1998 International Labor Organization statistic of 25 occupational fatalities for all of Nicaragua. Injuries occurring outside of a formal work location accounted for more than 60% of the work related injuries. Almost half of these occurred at home, while 19% occurred on the street. The leading mechanisms for work related injuries were falls (30%), blunt objects (28%), and stabs/cuts (23%). Falls were by far the most severe mechanism in the study, causing 37% of the work related deaths and more than half of the fractures.

Conclusions: Occupational injuries are grossly underreported in Nicaragua. This study demonstrated that an emergency department can be a data source for work related injuries in developing countries because it captures both the formal and informal workforce injuries. Fall prevention initiatives could significantly reduce the magnitude and severity of occupational injuries in Managua, Nicaragua.

Annually throughout the world, an estimated 250 million people suffer occupational injuries and 300 000 die from their injuries. The heaviest toll of occupational injuries is in the developing world where the greatest concentration of the world’s workforce is located. In these countries, many people work in hazardous industries such as agriculture, logging, and mining that are not governed by any safety standards or regulations. The estimated economic loss caused by occupational injuries and diseases is equivalent to 4% of the world’s gross national product.

The workforce can be broadly categorized as either formal or informal. The formal sector typically includes workers who are employed on a regular basis for salary; and the majority of them appear in employment and other administrative databases. The International Labor Organization (ILO) defines the informal sector as three broad groups: “owner-employers of microenterprises, which employ few paid workers; own-account workers, who own and operate one-person business and dependant workers; paid and unpaid, including unpaid family workers, contract labor and home-workers”.

These groups “for the most part are unregulated and unrecorded in official statistics, with little access to organized markets, formal credit and training or public services and amenities”. Worldwide, occupational injury statistics are derived from workers covered by governmental bureaus of social security or labor insurance, thus they are more likely to reflect the formal rather than the informal sectors. With less than 10% of the formal sector in the developing world receiving health coverage; generally the available data sources grossly underestimate the burden of occupational injury in these countries.

In Nicaragua (population five million), only 17% of the 1.8 million economically active population receives social security/labor insurance coverage. Forty five percent of the country’s gross domestic product comes from the service industry, 31% from agriculture, and 22.9% from industry.

Surveillance of work related injuries in developing countries is increasingly more difficult due to the rapid expansion of the informal work sector caused by economic globalization. For example, in the urban areas of Nicaragua, 76% of women and 53% of men work in the informal sector. Because this sector is marginalized, there are no mechanisms to measure the magnitude or nature of risk factors, and as a result, the burden of occupational injuries and their mechanisms remains unknown.

The purpose of this study was to identify and describe the work related injuries in both the formal and informal work sectors in Managua, Nicaragua. Because of the limitations of official labor statistics, we used an emergency department based injury surveillance system.

METHODS

Study design and location

This study was a secondary analysis of data collected from an emergency department based injury surveillance system implemented in 2001 collaboratively by the Nicaraguan Ministry of Health, the Pan American Health Organization and the Centers for Disease Control and Prevention (CDC). The study data were from one participating emergency department, at the Hospital Escuela Antonio Lenin Forseca (HEALF), located in capital city of Managua (population 959 000), Nicaragua. HEALF is the national referral center for...
trauma and the emergency department serves 200–300 patients a day.

**Study population and data collection**

All persons sustaining a work related injury and who were seen at HEALF emergency department between 1 August 2001 and 31 July 2002 were included in the analysis. All injured patients entering the emergency department had a two page intake form completed by the doctor which was based on the World Health Organization/CDC injury surveillance guidelines. The form consists of 18 data elements (box 1) in a check off format which includes an injury severity score. The work relatedness of an injury was assumed if the patient was recorded “injured while working” on the injury intake form. Both intentional and unintentional work related injuries (first time visit only) were included in the study, and there was no exclusion based on place of occurrence (home, work, school) age or gender. The general injury event data and specific information on traffic injuries, assaults, and self inflicted injuries were recorded. Every 24 hours the surveys were collected and reviewed in the epidemiology office by a head nurse. Incomplete surveys (20%) were returned to the emergency department medical director, who obtained the missing data. Once completed, the forms were sent to the statistical department where the data were entered into the database using Epi-Info (version 2000, CDC). This study was granted an exemption from review by the University of Washington institutional review board.

**Employment categories**

Job titles of the subjects were identified and grouped into the following employment categories: home based worker, farm worker, construction, transport operator, sales, public/personal services, manufacturing, finance and business, underemployed, and undetermined. Proportions were calculated (table 1). We attempted to categorize by occupation when possible for more specific analysis of potential risk factors. The categories were modeled after established occupational guidelines. The form consists of 18 data elements (box 1) in a check off format which includes an injury severity score. The work relatedness of an injury was assumed if the patient was recorded “injured while working” on the injury intake form. Both intentional and unintentional work related injuries (first time visit only) were included in the study, and there was no exclusion based on place of occurrence (home, work, school) age or gender. The general injury event data and specific information on traffic injuries, assaults, and self inflicted injuries were recorded. Every 24 hours the surveys were collected and reviewed in the epidemiology office by a head nurse. Incomplete surveys (20%) were returned to the emergency department medical director, who obtained the missing data. Once completed, the forms were sent to the statistical department where the data were entered into the database using Epi-Info (version 2000, CDC). This study was granted an exemption from review by the University of Washington institutional review board.

The home based worker category was used to describe the job title “Ama de casa”, which translates literally as “housewife”. In developing countries, the home based workforce is a large part of the informal sector and consists of women whose work is usually linked to home based enterprises which are interwoven into their domestic duties. For the purpose of this study, “Ama de casa” was categorized as home based worker. Underemployed categorized those whose occupations were either “students” or “unemployed”, yet they reported their injury occurred while working. These two categories, home based worker and underemployed, often are in the informal sector in developing countries and therefore are not part of a particular industry.

**RESULTS**

**Demographic data**

Of the 20 425 injuries captured by the surveillance system during the 12 month study period, 3801 (18.6%) were identified as work related. Twenty seven work related fatalities were recorded accounting for 10% of all fatalities recorded in the surveillance system during the study period. The majority of the patients were male (69%). The mean (SD) age at injury was 34 (16.4) years. More than three quarters of the work related injured were 10–44 years old.

**Location of occurrence**

Injuries occurred outside a formal work location for more than 60% of the cases. Almost half of these occurred at home, while 19% occurred on the street (table 2). Both sexes were more likely to be injured outside of a formal work location. This was especially true for females, 76% of whom were injured in the home. Injuries to 15–44 year olds occurred equally at work (40%) and at home (39%), whereas in all other age categories the injuries occurred primarily (50%) in the home.

**Description of work related injuries**

Home based worker and public/personal services workers had the greatest number of work related injury events, accounting for 46% of the overall injuries in the employment categories (table 3). The third largest employment category for work related injuries was underemployed (17%). Eighty percent of the injuries were due to falls, blunt force trauma, and stabs/cuts (table 3). Severity of injuries (see box 1: severity scale) were mostly mild to moderate (91%) with farm worker category having the highest percentage of severe injuries (10%).

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**Box 1: Data elements, Nicaraguan injury survey form, used in the analysis of work related injuries, HEALF emergency department based injury surveillance system, Managua, Nicaragua, 2001–02**

**Sociodemographic data**
- Age.
- Sex.
- Occupation: free text answer.

**General injury data**
- Intention of the injury (unintentional, intentional, or self inflicted).
- Activity or what the person was doing when injured (for example, work, sports).
- Location where the injury occurred (for example, street, home, work).
- Object that caused the injury (for example, person, knife, animal).
- Mechanism of injury (for example, traffic injury, fall, blunt force).

**Specific injury modules**
1. Road traffic injury
   - Type of user (for example, pedestrian, driver, passenger).
   - Type of transport (for example, bicycle, truck, bus).
2. Assaults
   - Relationship of the perpetrator to the victim (for example, current or ex-partner).
   - Context (for example, fight, robbery, drug related).
3. Self inflicted
   - Precipitating factors (for example, conflict with family, financial problems).

**Outcomes**
- Nature of the injury (for example, fracture, burn).
- Severity (mild = superficial, moderate = sutures/fractures, severe = surgery/intensive care unit).
- Disposition (for example, treated/released, admitted, died).
related injuries were recorded in the public/personal services category, 19% (163/805) in underemployed, and 16% (132/805) in construction (table 3). Only 68 and 28 stab or cut injuries were recorded in the farm worker and manufacturing categories, respectively (table 3). Stabs or cuts occurred mainly in two locations: at a workplace (49%) and at home (41%). Almost all (90%) were caused by a knife, blade, or cutting instrument and were treated and released (94%) (data not shown). Males outnumbered females four to one and 25% of the stab/cut injuries were in the 15–44 age group (tables 4 and 5).

**Traffic injury**

Most traffic injuries traffic occurred in the public/personal services category (26%) and transport operators (18%) (table 3). Injuries were evenly distributed between pedestrians (30%), drivers (36%), and passengers (29%) (data not shown). Males and those ages 15–44 had the largest number of work related injury from the traffic injury mechanism (tables 4 and 5).

**Intent of work related injuries**

Of the work related injuries, 89% were unintentional, less than 0.1% were self inflicted, and 11% were intentional. Intentional injuries (n = 400) occurred during a quarrel or fight (n = 138), during a robbery or burglary (n = 116), and 75 injuries were related to gang activity (data not shown). In more than half of the live assaults (60%) the perpetrator was unknown to the victim. Twenty three percent were friends or known persons, 6% were current or ex-partner, and 5% were family members. The major types of mechanism of intentional injury were blunt force (n = 230) and stab or cut (n = 102).

**Work related mortality**

Most fatalities were male (85%) and occurred during the persons’ most productive years (15–44 years old). There were seven deaths in the public/personal services employment category, four in both farm worker and construction, three in each of the transport operator, sales, and underemployed categories, and two home based workers.

Most of the fatalities occurred outside a formal workplace location, which is consistent with the non-fatality injury findings in this study. Seventy percent of the fatalities occurred in the street and in the home, while 30% occurred in the workplace and “other” locale. More than a third of the work related deaths were caused by falls, followed by traffic injury (19%), and another 19% by fire/smoke/heat. Poisoning, blunt force, gunshot wound and other/unknown, collectively were responsible for the remaining seven fatalities.

**DISCUSSION**

The purpose of this study was to describe the burden and mechanisms of work related injuries in a developing country.
and to raise awareness of occupational health and safety needs. Before drawing conclusions, the limitations of the study must be addressed.

The data were from a single emergency department that did not cover a defined geographical population. Therefore, calculating injury rates were not possible. It is unclear what factors influenced people with work related injuries to access care in this hospital. The proximity of the emergency department to the scene of the injury might have affected the numbers or types of injuries described here. HEALF is known as a trauma hospital in Managua, and this distinction most likely increased the rate of referrals, particularly the more severe.

Data were collected through self reporting and proxies for those severely injured. The validity of responses regarding work relatedness and the mechanism of the injury could not be verified. In addition, the surveillance system did not determine whether those with work related injuries were performing paid or unpaid work. Without this information it was impossible to separate injuries that occurred at home and in the street while performing income generating work from those that occurred while performing work such as chores or odd jobs without compensation. Therefore, the sample probably includes some injuries that occurred during non-income generating activities.

The employment categories created for this study have two limitations. First, it was assumed that all work related injuries occurred while the person was performing the tasks of his or her stated occupation. Second, the categorization was difficult due to the lack of standardization and vagueness of many of the occupations recorded. Therefore, a combination of occupational and industry categories were used and makes comparisons with other studies difficult. Further, injury severity comparisons are not possible because the form did not use a standard severity score. Despite these limitations, some conclusions can be made of the importance of work related injuries and which mechanisms appreciably contribute to the burden of injury.

One fifth of the injuries captured in the HEALF emergency department surveillance system were work related. Few studies in the literature describe occupational injuries in developing countries. Other general injury studies have mentioned occupational injuries, but detailed analysis was lacking.

This injury system captured more work related fatalities (27) than was reported by the ILO in 1998 in Nicaragua. This study included both the formal and informal worker sectors, while the ILO statistics did not. However, considering that the study sample was only one hospital and the ILO statistics are for the entire country, it is evident mortality from occupational injuries in Nicaragua is grossly under-reported.

One third of the work related injuries occurred within the informal sector, defined as home based worker or under-employed. This finding was not unanticipated because of the documented large informal workforce in the urban areas of Nicaragua and the country’s high underemployment rate (73%). But until now the work related injuries attributed to this population have not been quantified. This one third finding is likely an undercount because it is possible that the other occupational categories created in this study include workers from the informal sector. This hypothesis is supported by the finding that most of the work related injuries and the fatalities in this study occurred outside a formal workplace (home, street, or other). It is reasonable to conclude that workers hurt outside a formal workplace are often part of the informal workforce.

Lastly, intentional occupational injuries were identified. Injuries caused by violence have been noted in other emergency department based injury surveillance systems both in Nicaragua and in Bangladesh, but neither study reported any intentional injury events as occupational related.

In this study, falls were the leading mechanism of work related injuries and the most severe, responsible for more than a third of the deaths and more than half of the fractures.

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Home based worker</th>
<th>Farm worker</th>
<th>Construction</th>
<th>Transport operator</th>
<th>Sales occupations</th>
<th>Public and personal services</th>
<th>Manufacturing</th>
<th>Business</th>
<th>Underemployed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic injury</td>
<td>23 (3)</td>
<td>20 (10)</td>
<td>15 (4)</td>
<td>51 (20)</td>
<td>26 (9)</td>
<td>71 (9)</td>
<td>8 (7)</td>
<td>16 (15)</td>
<td>48 (8)</td>
<td>278 (8)</td>
</tr>
<tr>
<td>Fall</td>
<td>393 (51)</td>
<td>47 (22)</td>
<td>121 (28)</td>
<td>41 (16)</td>
<td>55 (20)</td>
<td>200 (24)</td>
<td>18 (17)</td>
<td>23 (22)</td>
<td>154 (25)</td>
<td>1052</td>
</tr>
<tr>
<td>Other blunt force</td>
<td>149 (19)</td>
<td>44 (21)</td>
<td>130 (30)</td>
<td>96 (38)</td>
<td>96 (34)</td>
<td>245 (29)</td>
<td>39 (36)</td>
<td>31 (29)</td>
<td>170 (28)</td>
<td>1000</td>
</tr>
<tr>
<td>Stab or cut</td>
<td>84 (11)</td>
<td>68 (32)</td>
<td>132 (31)</td>
<td>37 (15)</td>
<td>63 (23)</td>
<td>208 (25)</td>
<td>28 (26)</td>
<td>22 (21)</td>
<td>163 (27)</td>
<td>805 (23)</td>
</tr>
<tr>
<td>Gunshot</td>
<td>4 (0.5)</td>
<td>3 (1)</td>
<td>2 (0.5)</td>
<td>6 (2)</td>
<td>5 (2)</td>
<td>19 (2)</td>
<td>2 (2)</td>
<td>5 (5)</td>
<td>17 (3)</td>
<td>63 (2)</td>
</tr>
<tr>
<td>Fire/smoke/heat</td>
<td>29 (4)</td>
<td>2 (1)</td>
<td>3 (0.7)</td>
<td>9 (4)</td>
<td>5 (2)</td>
<td>17 (2)</td>
<td>6 (6)</td>
<td>0 (0)</td>
<td>11 (2)</td>
<td>82 (2)</td>
</tr>
<tr>
<td>Contact with a foreign body</td>
<td>41 (5)</td>
<td>10 (5)</td>
<td>14 (3)</td>
<td>5 (2)</td>
<td>16 (6)</td>
<td>25 (3)</td>
<td>3 (3)</td>
<td>7 (7)</td>
<td>28 (5)</td>
<td>149 (4)</td>
</tr>
<tr>
<td>Poisonings</td>
<td>18 (2)</td>
<td>7 (3)</td>
<td>1 (0.2)</td>
<td>0</td>
<td>3 (1)</td>
<td>13 (2)</td>
<td>1 (1)</td>
<td>0 (0)</td>
<td>14 (2)</td>
<td>57 (2)</td>
</tr>
<tr>
<td>Other/unknown</td>
<td>30 (4)</td>
<td>10 (5)</td>
<td>12 (3)</td>
<td>5 (2)</td>
<td>10 (3)</td>
<td>338 (4)</td>
<td>3 (3)</td>
<td>3 (3)</td>
<td>12 (2)</td>
<td>123 (3)</td>
</tr>
<tr>
<td>Total</td>
<td>771</td>
<td>211</td>
<td>430</td>
<td>250</td>
<td>279</td>
<td>836</td>
<td>108</td>
<td>107</td>
<td>617</td>
<td>3609</td>
</tr>
</tbody>
</table>

**Table 3** Mechanism of work related injury, by employment category, captured in HEALF emergency department based injury surveillance system, Managua, Nicaragua, 2001–02.

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>No (%) males</th>
<th>No (%) females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic injury</td>
<td>246 (9)</td>
<td>47 (4)</td>
</tr>
<tr>
<td>Fall</td>
<td>584 (22)</td>
<td>510 (44)</td>
</tr>
<tr>
<td>Other blunt force</td>
<td>798 (30)</td>
<td>252 (22)</td>
</tr>
<tr>
<td>Stab or cut</td>
<td>692 (26)</td>
<td>156 (14)</td>
</tr>
<tr>
<td>Gunshot</td>
<td>58 (2)</td>
<td>81 (70)</td>
</tr>
<tr>
<td>Fire/smoke/heat</td>
<td>42 (2)</td>
<td>45 (4)</td>
</tr>
<tr>
<td>Contact with a foreign body</td>
<td>87 (3)</td>
<td>69 (6)</td>
</tr>
<tr>
<td>Poisonings</td>
<td>33 (1)</td>
<td>24 (2)</td>
</tr>
<tr>
<td>Other/unknown</td>
<td>93 (5)</td>
<td>40 (3)</td>
</tr>
<tr>
<td>Total</td>
<td>2633</td>
<td>1151</td>
</tr>
</tbody>
</table>

**Table 4** Mechanism of work related injury, by sex, captured in HEALF emergency department based injury surveillance system, Managua, Nicaragua, 2001–02.

Missing data = 17, n = 3784. Numbers in parentheses are column percentages.
These findings are consistent with general injury results from a Nicaraguan study, where falls were the leading mechanism of injury and accounted for almost a quarter of the deaths. A community based survey in Ghana found that falls in the urban areas were the leading cause of injury morbidity.

Notably, in our study the morbidity burden of traffic related injuries was considerably lower than the fall mechanism. This is a curious finding, but because the data collection tool had “traveling” for an option of the “activity” data element, it is possible that transport workers selected the “traveling” response versus the “working” response for this element, causing misclassification bias. Even with this uncertainty, the traffic related injuries in this study were similar to past research findings which found a predominance of males between the ages of 15–44 years and traffic mechanism as a major contributor of fatalities. In addition, most injuries were caused by motorized vehicles either as drivers, pedestrians, or passengers. A mortuary data study by London et al in a developing country found similar results except that more than half of the fatalities were pedestrians and another 34% were occupants of cars.

Blunt force mechanism as a large contributor to work related injury for males has not been demonstrated in the literature. A study from emergency department based injury surveillance system, Managua, Nicaragua, 2001–02

<table>
<thead>
<tr>
<th>Mechanism (of injury)</th>
<th>Age (years)</th>
<th>&lt;10</th>
<th>10–14</th>
<th>15–44</th>
<th>45–65</th>
<th>&gt;65</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic injury</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fall</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other blunt force</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stab or cut</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Gunshot</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire/smoke/heat</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Contact with a foreign body</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poisonings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other/unknown</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>29</td>
<td>80</td>
<td>589</td>
<td>362</td>
<td>3779</td>
</tr>
<tr>
<td>Missing data</td>
<td></td>
<td>22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Numbers in parentheses are column percentages.

CONCLUSION
This study found that one in five non-fatal injuries and 10% of all fatal injuries in the emergency department surveillance system in Managua were work related. The burden of occupational injuries in developing countries remains relatively unknown. However, it is likely to be larger than currently considered, given the expanding informal workforce in developing countries where occupational health and safety regulation and standards are virtually non-existent.

Clearly, mechanisms of work related injuries must be studied further to validate the accuracy of these findings related to falls, blunt force, and stabs/cuts. Falls in particular demand further study, as it represents the majority of the fatalities, and therefore should be a priority for further research to identify unique risk factors and hazardous jobs.

Further research is needed to better understand the magnitude and mechanisms of occupational injuries in Nicaragua and in the developing world. Above all this study documents the need to address these injuries in the informal sector. Armed with this information, public health professionals can solicit governments to enforce existing occupational health and safety policies and begin targeting interventions to the informal workforce. The World Health Organization reports that eight out of the 10 of the world’s workers currently live in developing countries, but only 5%–10% of them have access to professional occupational hygiene and safety services.

Key points
- Almost 20% of all non-fatal injuries and 10% of all fatal injuries recorded in the emergency department surveillance system in Managua were occupationally related.
- More work related fatalities (27) were captured in this one emergency department than were reported to the ILO (25) for the entire country of Nicaragua, suggesting severe undercounting of the true burden of work related fatalities in Nicaragua.
- Falls were responsible for the largest single group of occupational fatalities (37%) and should be a priority for further research to identify risk factors and hazardous jobs.
- The data collection tool needs to record whether work related injury occurred during paid or unpaid activities, and whether the injury was related to the stated occupation. A standardization method for categorizing occupations/industries on emergency department injury forms should be used (for example, SIC).
- The burden of occupational injuries in the developing world remains relatively unknown. However, it is likely immense especially given the expanding informal work sector due to globalization and the nearly complete lack of safety standards in this sector.

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Shanthi is particularly interested in supporting research and training activities that enhance the capacity of low and middle income countries to address local injury issues. She is a partner of the Road Traffic Injury Network of the Global Forum for Health Research and the public health representative on the New Zealand Trauma Committee of the Royal Australasian College of Surgeons. She has been an invited contributor to injury research and policy programs in New Zealand and overseas, an external reviewer of national disability surveys, and a member of research review panels and the Injury and Rehabilitation Portfolio Advisory Group of the Health Research Council of New Zealand. She is currently leading a major collaboration between the Fiji School of Medicine and the University of Auckland investigating traffic related injury in the Pacific, funded by the Wellcome Trust (UK) and the Health Research Council (NZ).
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doi: 10.1136/ip.2004.005165