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Population-based estimates of injuries in Sri Lanka

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ABSTRACT

Background: Injuries are the leading cause of public hospital admission in Sri Lanka. Data on injury epidemiology to plan prevention programmes to reduce injury burden are not readily available.

Objectives: To assess the incidence of various types of injuries in the Galle district, Sri Lanka.

Methods: 9568 individuals of all ages were selected from 2000 households in a population-based cross-sectional survey using a stratified cluster sampling technique. Data on non-fatal injuries in the last 30 days irrespective of severity, fatal injuries and those that resulted in disability in the last 12 months were documented. Proxy data were used for half of the injury cases.

Results: 195 (2%) individuals reported non-fatal injuries during the last 30 days, giving an age-sex-urban-rural adjusted annual incidence of 24.6 per 100 population. The leading causes of non-fatal injuries were falls (adjusted annual incidence 6.7 per 100 population, 95% CI 6.0 to 7.3) and mechanical injuries (6.3; 95% CI 5.7 to 6.8), followed by road traffic injuries (4.9; 95% CI 4.4 to 5.5). 114 (58.5%) individuals needed outpatient care and 50 (25.6%) needed inpatient care for their injuries. The annual injury mortality rate and disability rate were 177 (95% CI 72 to 283) and 290 (95% CI 250 to 330) per 100 000 population, respectively.

Conclusions: Nearly one in four people reported non-fatal injury; the majority sought medical attention in this population. It is important to utilise injury epidemiology to develop and implement interventions to reduce the burden of injuries in the population and on the hospitals in Sri Lanka.

Worldwide, injuries account for 9% of all deaths, amounting to over 5 million deaths and 16% of the global burden of disability annually.[1] More than 90% of these injury-related deaths occur in low and middle income countries.[2] The South East Asia region bears a significant proportion of the global burden of injury, accounting for 27% and 31% of the global injury mortality and disability-adjusted life-years lost respectively in the year 2000.[2]

With the introduction of targeted injury prevention programmes, many developed countries have reported significant reductions in mortality and morbidity associated with a variety of injuries, including those from road traffic crashes, falls and drowning.[3–5] If appropriately adapted to the context, some strategies that are effective in developed countries have the potential to benefit developing countries based on the epidemiology of injuries in these settings.[6–9]

The burden of injuries in Sri Lanka is considerable. Injuries accounted for 13.2% of all registered deaths in Sri Lanka in the year 2001.[10] The injury related admission rates in the public hospitals in Sri Lanka increased by nearly twofold from 1980 to 2002, with injuries comprising the leading cause of hospital admission in public hospitals since 1993.[11] With increasing hospital admissions related to injuries, it is imperative that targeted injury prevention programmes are planned and implemented to reduce the burden of injuries in Sri Lanka. However, population-based epidemiological data needed to inform such programme development are not readily available in Sri Lanka. This paper reports the incidence of the various types of injuries from a population-based survey designed to assess the non-fatal injuries in the Galle district in southern Sri Lanka.

METHODS

A cross-sectional survey was conducted in the Galle district situated along the south western coastline of southern Sri Lanka. The most recent census data indicates that the Galle district had a population of nearly 1 million in the year 2001, with 88.7% of the population living in the rural areas.[12] A little less than 30% of the population in the district were 0–14 years of age and 61% were 15–59 years of age; 26% were skilled agriculture and fisheries workers and 19% were elementary unskilled workers among the workers in the district.[13 14]

Sample size and sampling technique

The survey sample was selected using a stratified cluster sampling technique. Using an estimated 2.5% injury incidence rate in the Galle district based on the Sri Lanka hospital injury admission rate,[11] the sample size was calculated as 8237 individuals, considering a design effect of 2, a precision of 0.005 (20% of the estimated incidence of 2.5%) and a non-response rate of 10%.[15] With the average household size of 4.4 members in the Galle district,[14] a sample size of 2000 households was estimated to achieve the sample of 8237 individuals. A household was defined as a group of individuals living together and eating food from the same kitchen.

The primary sampling unit (PSU) was the *Grama Niladhari* area, the smallest administrative unit in a district. There were 896 *Grama Niladhari* areas (846 rural and 50 urban divisions) in the Galle district in 2001.[16] Fifty PSUs were identified, with their probability of selection being proportional to size. The electoral register (which has annually updated information on the addresses and names of the heads of the households) was used as the sampling frame to select 40 households in each of the selected 50 PSUs. To reduce the design effect due to cluster sampling, two starting points were

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Table 1 Annual incidence of non-fatal injuries based on one-month recall period in the Galle district, Sri Lanka

Variable	Total (n = 9568)	Number identified with non-fatal injury (% of total)	Non-fatal injury annual incidence per 100 population (95% CI)
Age group (years)*			
0–4	819	17 (2.1)	26.4 (22.8 to 30.0)
5–9	776	14 (1.8)	25.3 (21.6 to 29.0)
10–14	807	11 (1.4)	18.6 (15.4 to 21.8)
15–19	809	9 (1.1)	14.9 (12.0 to 17.9)
20–29	1721	37 (2.2)	22.3 (19.9 to 24.6)
30–39	1458	39 (2.7)	29.3 (26.5 to 32.1)
40–49	1043	23 (2.2)	29.7 (26.4 to 33.0)
50–59	948	23 (2.4)	27.1 (23.7 to 30.5)
⩾60	1187	12 (1.0)	21.4 (18.6 to 24.1)
Sex†			
Male	4666	126 (2.7)	32.4 (30.3 to 33.7)
Female	4902	69 (1.4)	16.9 (15.7 to 17.7)
Area of residence‡			
Urban	1318	13 (1.0)	11.8 (10.4 to 13.1)
Rural	8250	182 (2.2)	26.5 (25.1 to 27.2)
Overall§	9568	195 (2.0)	24.6 (23.5 to 25.6)

*Incidence rate adjusted for sex and area of residence distribution of the Galle district in 2001.[13]
†Incidence rate adjusted for age and area of residence distribution of the Galle district in 2001.[13]
‡Incidence rate adjusted for age and sex distribution of the Galle district in 2001.[11]
§Incidence rate adjusted for age, sex and area of residence distribution of the Galle district in 2001.[13]

randomly identified in each electoral register using random digit number tables. Identification of the households was supported by the public health midwife of each cluster. Data collection was planned for one day in each cluster. In order to cover 40 households in each cluster, all the adjacent households to the right of each of the two starting points were covered until 20 households were contacted from both starting points. If these selected 40 households included a locked household, it was revisited at least twice on the day of data collection. If the household could not be contacted, it was replaced by the household adjacent to the last selected household. Institutions, hostels, prisons and offices were excluded from the survey.

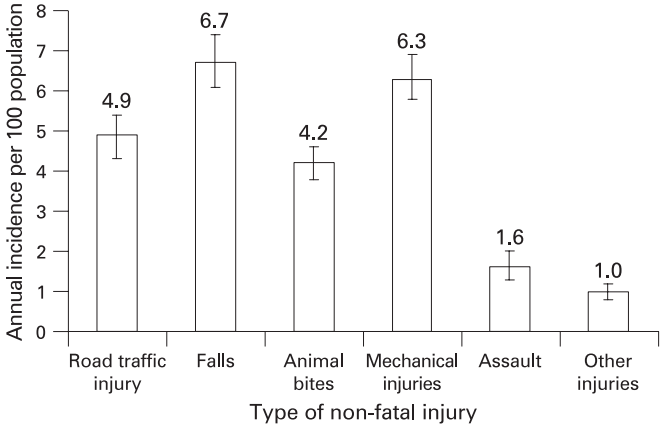


Figure 1 Age-sex-urban-rural adjusted annual incidence per 100 population for the different types of non-fatal injuries in the Galle district, Sri Lanka. Bars denote 95% CI.

Data collection

Data were collected from May to July 2003. Three trained interviewers administered questionnaires in the Sinhalese language. These questionnaires were specifically designed for this survey using the World Health Organization guidelines for community-based injury surveys,[17] and included an injury screening questionnaire, a detailed injury questionnaire and a disability assessment questionnaire. Verbal informed consent was obtained from each respondent before administering the questionnaire.

In each household, the injury screening questionnaire was administered to the female head of the household, or to a responsible adult (>18 years of age) in her absence. It was explained to the respondents what was meant by injuries and the various types of injuries before administering the questionnaire. This questionnaire included household related and demographic information on all members of the household, and was used to identify those members who had had a non-fatal injury irrespective of the severity in the last 30 days, and those with a disability or documented death due to an injury in the 12 months prior to the date of data collection. Detailed data on the fatal injury cases were collected from the respondent who answered the injury screening questionnaire.

The members identified as having suffered a non-fatal injury in the last 30 days or an injury related disability in the last 12 months were contacted for detailed interview on the same day following the screening interview. If a particular member was not available on that day, was <14 years of age or was too ill to be interviewed, the detailed injury data were collected from the respondent who answered the injury screening questionnaire. The type, circumstances surrounding the injury, duration of the illness and the type and place of treatment following the injury were documented. Both unintentional and intentional injuries were documented. Conditions such as chronic back pain and other chronic work related or other discomfort, carpel tunnel syndrome, mental conditions, effects following drug interactions and food poisonings with an infectious origin were not considered as injury.[17]

Data analysis

Data were entered into an MS Office Excel database and were analysed using SPSS V.15 (SPSS, Chicago, Illinois, USA). The overall annual incidence of non-fatal injuries and for the different types of injuries was calculated using the 30 days

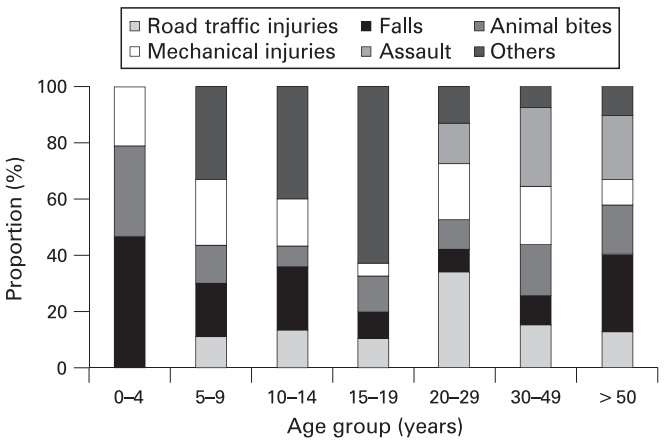


Figure 2 Distribution of non-fatal injuries for the various age groups in the Galle district, Sri Lanka.

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recall period. These injury rates were adjusted for the age, sex and urban–rural distribution of the Galle district,[13] and the 95% CI were adjusted for the design effect due to the cluster sampling strategy.[18] The overall annual incidence rate for non-fatal injuries is reported for age groups, sex and area of residence. The annual injury mortality and disability rates were calculated using data for the last 12 months. Unintentional injuries due to sharp/blunt objects or instruments are described as mechanical injuries. Health services utilisation for a non-fatal injury event is also reported. The outpatient care services included private or public health allopathic or indigenous services; inpatient services included admissions to private or public hospitals. The estimates for the burden of injury in the Galle district based on these data are presented.

RESULTS

Survey population

Data were collected on 9568 individuals living in 2000 households. A total of 104 (5.2%) of the selected households were replaced during data collection as these were locked throughout the day of data collection. No household declined to participate. The survey population included 2402 (25.1%) individuals aged 0–14 years, 5979 (62.5%) aged 15–59 years and 4666 (48.8%) men (table 1).

Incidence of non-fatal injuries

A total of 195 (2%) individuals were identified with a non-fatal injury episode in the last 30 days. More than one episode of injury was not reported for any injured individual during the recall period. Detailed information relating to these episodes was collected from 79 (51.6%) of the injured individuals, with data relating to the remaining episodes provided by a proxy respondent. Seven (53.8%) and 72 (39.5%) of the 13 intentional and 182 unintentional injuries were reported by the injured individuals themselves, respectively.

The annual age-sex-urban-rural adjusted incidence for non-fatal injuries was 24.6 (95% CI 23.5 to 25.6, design effect (DE) 1.43) per 100 population in the Galle district (table 1). The annual non-fatal injury rate per 100 population was the least among those aged 15–19 years; men and people living in rural areas had double the overall incidence of non-fatal injuries compared with women and urban dwellers, respectively (table 1).

Among the 195 individuals with non-fatal injuries, 182 (93.3%) reported unintentional injuries. Figure 1 shows the annual age-sex-urban-rural adjusted incidence for the different types of injuries. A similar proportion of individuals reported injuries due to a fall (52, 26.7%) and mechanical injuries (50, 25.6%), giving an annual age-sex-urban-rural adjusted incidence of 6.7 (95% CI 6.0 to 7.3, DE 1.13) per 100 population and 6.3 (95% CI 5.7 to 6.8, DE 1.42) per 100 population for falls and mechanical injuries, respectively. Sixty-four per cent of mechanical injuries and 53.8% of the falls occurred at home. A total of 40 (20.5%) individuals reported road traffic injuries (RTI), with an annual age-sex-urban-rural adjusted incidence of 4.9 (95% CI 4.4 to 5.5, DE 1.63) per 100 population.

Thirty-three (16.9%) injuries were reported due to an animal bite, of which 12 (36.4%), 7 (21.2%) and 8 (24.2%) were dog, cat and snake bites, respectively. Of the 13 injuries following assaults, 6 (46.2%) were reported by women, 2 (15.4%) were due to domestic violence, and all were reported from the rural areas. Seven (3.6%) individuals reported other injuries (4 burn injuries, and 1 each due to a bomb blast, electricity-related cause and choking).

The incidence of non-fatal road traffic injuries, mechanical injuries and animal bites was significantly higher in men than in women, with a similar incidence reported for falls and assault for the two sexes (table 2). Among women, the incidence of non-fatal falls was the highest (6.4, 95% CI 5.8 to 7.1, DE 0.87). Road traffic and mechanical injuries accounted for the major proportion of non-fatal injuries in the 20–49 years age group (fig 2). The proportion of falls was the highest in the 0–4 years age group, whereas assault was reported more in the 30–49 years age group (fig 2).

Health services utilisation for non-fatal injuries

Among the 195 individuals who reported a non-fatal injury in the past 30 days, 31 (15.6%) individuals received home-based treatment, 114 (58.5%) needed outpatient services and 50 (25.6%) needed inpatient services following their injury.

Among those who sought outpatient care, individuals with non-fatal mechanical injuries (76%), falls (61.5%) and RTI (60%) were significantly more likely to utilise outpatient care compared with those with animal bites (45.5%), assaults (30.8%) or other injuries (14.3%) ($p = 0.002$; fig 3). The overall mean number of inpatient days for these injuries was 3.9 days (median 3 days). RTI required the highest mean number of inpatient days (5.2 days) compared with 2.6, 2.5 and 2.4 days for animal bites, falls and mechanical injuries, respectively.

Annual injury mortality rate

In the past 12 months, 17 deaths following an injury were reported by the households involved in this survey, giving an annual injury mortality rate of 177 per 100 000 population (95% CI 72 to 283, DE 1.56). Six (35.3%) of the injury deaths were due to RTI, 5 (29.4%) were following a fall, 2 (11.8%) were war related injuries, and 1 each (5.8%) were due to dog bite, drowning, assault and a mechanical injury. Of who died, 14 (82.4%) were men.

Table 2 Annual incidence of non-fatal injuries based on one-month recall period for the two sexes in the Galle district, Sri Lanka

Type of injury	Total injured n = 195 (% of total)	Non-fatal injury annual incidence per 100 population (95% CI)†		z-test (p-value)
		Men	Women	
Road traffic	40 (20.5)	9.22 (8.07 to 10.37)	0.76 (0.51 to 1.02)	19.18 (<0.001)
Falls	52 (26.7)	6.60 (5.89 to 7.31)	6.41 (5.77 to 7.05)	0.37 (0.356)
Animal bites	33 (16.9)	5.09 (4.43 to 5.74)	3.21 (2.80 to 3.63)	4.61 (<0.001)
Mechanical	50 (25.6)	8.65 (7.75 to 9.55)	3.91 (3.28 to 4.54)	9.59 (<0.001)
Assault	13 (6.7)	1.63 (1.19 to 2.07)	1.40 (1.02 to 1.77)	0.95 (0.171)
Others*	7 (3.6)	0.83 (0.56 to 1.11)	1.04 (0.77 to 1.30)	−1.05 (0.853)

*Others include 4 burn injuries; and 1 each due to a bomb blast, an electricity-related injury and choking.
†Incidence rate adjusted for age and area of residence distribution of the Galle district in 2001.[13]

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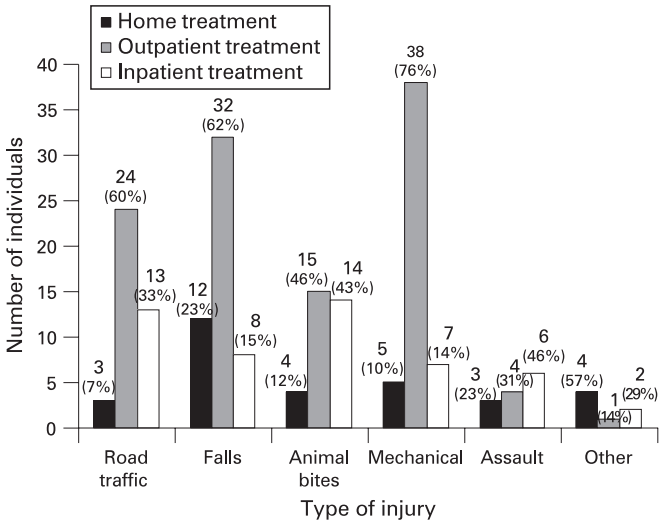


Figure 3 Health service utilisation for non-fatal injuries in the Galle district, Sri Lanka.

Annual injury disability rate

In the past 12 months, an injury event leading to a permanent physical disability was reported for 24 (0.25%) individuals, giving an annual injury related physical disability rate of 290 per 100 000 population (95% CI 250 to 330, DE 1.39). Sixteen (66.7%) of those disabled were male, 7 (29.2%) had disabilities following RTI and 7 (29.2%) had disabilities following a fall. Three (12.5%) individuals reported functional disability and the rest physical disability.

Injury burden in the Galle district

Extrapolating from these data, an estimated 243 660 (95% CI 232 764 to 253 565) individuals suffer non-fatal injuries annually in the Galle district, of whom 62 377 (95% CI 59 588 to 64 913) individuals require inpatient care. In addition, an estimated 1753 (95% CI 713 to 2803) individuals die, and a further 2872 (95% CI 2476 to 3269) individuals suffer permanent disability following an injury in the Galle district each year.

DISCUSSION

To our knowledge, these are the first population-based data on injuries for all ages in Sri Lanka. The annual age-sex-urban-rural adjusted non-fatal injury incidence rate for the Galle district was 24.6 per 100 population, highlighting a considerable burden of injuries in this population.

Our study design included documentation of non-fatal injuries through a proxy respondent (one household member responding for all the others) in case the injured person was not available, and nearly half of these data were given by a proxy respondent. Therefore, it is likely that the non-fatal injuries are underestimated in this study, particularly those that did not require any medical treatment and those that carry social stigma, such as domestic violence and attempted intentional self-harm. While we could not specifically explore this given the limitations of the data available, the gender of the person interviewed may also have biased the reporting of some injuries, for example domestic violence.

To address the issue of recall bias in non-fatal injuries, we used a recall period of one month to estimate the annual incidence of non-fatal injuries.[19 20] We found the non-fatal injury incidence in the rural areas to be more than twice that in urban areas; and men had twice the rate of women. RTI and falls were the most common types of injury among males and females, respectively. Though a direct comparison of our non-fatal injury incidence findings with those reported from other developing countries is not possible given the varying definitions of injuries used in these studies,[21–26] a higher injury incidence in rural areas was found in Pakistan and Ghana,[24 27] and in men in Ghana, Nigeria, Pakistan and Tanzania.[22 24 27 28] While the rate of non-fatal injuries among adolescents aged 15–19 years seems unusually low compared with other ages, this may reflect the instability of estimates within subgroups where the absolute numbers of events are small. It is also possible that school going adolescents in this age group are at lower risk of some injuries due to restricted opportunities or reduced exposure to potentially hazardous activities. However, this needs to be explored further.

Falls and mechanical injuries were the leading causes of non-fatal injuries in this study. Falls have been reported as a leading cause of injury from surveys conducted in Vietnam, Tanzania, Pakistan, India, Ghana, Nicaragua and Nigeria.[21 22 24–29] Interestingly, the majority of those with these falls and mechanical injuries did not seek medical care, suggesting that these injuries are probably less severe in nature. As more than half of these injuries occurred within the home environment, further understanding of the context of these injuries is needed to develop and implement relevant prevention programmes.

RTI and animal bites were the other important non-fatal injuries in this population, with a higher proportion requiring inpatient care and longer duration of stay in hospital compared to falls and mechanical injuries, highlighting the severe consequences of these injuries. It is projected that RTI will be the third leading cause of disability-adjusted life-years lost globally by the year 2020, with the majority of this burden experienced by the South Asia region.[30] Dogs, snakes and cats accounted for most of the animal bite injuries in our study. The annual incidence of dog and snake bite has been reported as 2 and 0.2 per 100 population, respectively, in Sri Lanka.[31 32] An increase in the number of cases admitted to hospitals due to snake bites and decrease in case fatality ratio has also been reported from Sri Lanka.[33] A high population density of dogs and a high proportion of poorly supervised dogs has been previously documented for Sri Lanka.[34]

The incidence of assaults was low in our study; half of these required inpatient care services. It is very likely that assaults are underestimated in our study as these injuries are very sensitive in nature. Likewise, we found a low incidence of poisoning and other self-inflicted injuries, which could be an underestimate, again, due to stigma related with these injuries and because we collected proxy data on the injured individuals. Similar findings have also been reported previously,[35 36] although self-poisoning is a leading cause of death in Sri Lanka.[10 37]

Nearly five in six individuals with non-fatal injuries sought outpatient or inpatient care services in our population. This is a considerably high utilisation of health services for non-fatal injuries compared with that reported for Nicaragua, Nigeria and Vietnam.[21 28 29] It is difficult to differentiate whether this high reported utilisation is due to the actual need or because of good availability and accessibility of health services in Sri Lanka, and in particular free-of-cost services in the public sector.[11] However, these findings highlight that an injury surveillance utilising inpatient and outpatient hospital-based injury data could be sensitive to the changes in injury epidemiology in Sri Lanka.

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What is already known on this topic

- Injuries are the leading cause of public hospital admission in Sri Lanka.
- Population-based injury estimates are not readily available.

What this study adds

- The annual non-fatal injury incidence is 24.6 per 100 population.
- Non-fatal injury incidence is high in rural areas and among men.
- Falls, mechanical injuries, road traffic injuries and animal bites are the leading causes of non-fatal injuries.
- Nearly 5 in 6 individuals with non-fatal injuries in this population-based survey reported that they had sought either outpatient or inpatient care services.

We found an annual injury mortality rate of 177 (95% CI 72 to 283) per 100 000 population. As highlighted from the wide confidence intervals, this study was not designed to assess injury mortality as the sample size required for such an assessment would be large. The injury mortality rate estimated by the Registrar General of Sri Lanka for the year 2001 was 79.1 per 100 000 population for Sri Lanka,[10] which is within the confidence intervals estimated in our study. All *unnatural* deaths are reported to the police in Sri Lanka, and an inquest is carried out for all injury deaths followed by a postmortem examination, if required, to determine the cause and intent of the injury.[38] Therefore, it is likely that the official figures of injury mortality provide a reasonably good injury mortality estimate; however, some concerns have been raised about the classification of cause and intent of the injuries.[38 39] In our study, RTI followed by falls accounted for the majority of injury mortality. The data from the Registrar General of Sri Lanka for year 2001 show that nearly one-third of injury deaths were each due to mechanical injuries and intentional self-harm, and 14% due to RTI.[10] Intentional self-harm is reported to be the leading cause of injury mortality, followed by RTI and animal attacks, based on data from secondary referral hospitals in the North Central Province in Sri Lanka.[37] We did not have any case of intentional self-harm in our study. Other than our study not being designed to assess injury mortality, it is also likely that there could be a variation in the cause of death between the populations in Sri Lanka. For example, the North Central Province is directly affected by the ongoing civil conflict and a human–elephant conflict, which do not directly affect the Galle district.[40]

There was a significant burden of injury related disability in this population. The prevalence of disability in the Galle district was estimated as 1.8% in the 2001 census in Sri Lanka; however, the proportion of injury related disabilities is not known.[41] Our data highlight the need for rehabilitation programmes following injuries to address the specific needs of those disabled due to injuries.

In conclusion, this study highlights the burden of injuries in this population in Sri Lanka, and the need for implementation of injury prevention policies and programmes aimed at reducing injuries in this population. Further qualitative work is needed to inform the context-specific development of prevention programmes for the different types of injuries.

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Competing interests: None.

Ethics approval: The survey was approved by the Ethics Committee of the Faculty of Medicine, University of Ruhuna, Galle, Sri Lanka.

Contributors: KVN conceptualised and designed the study, led data collection and analysis, and wrote the first draft of this manuscript; PF and LR contributed to conceptualisation, design and implementation of the study; LS contributed to conceptualisation of the study; SA contributed to conceptualisation and design of the study and data interpretation; RI provided technical input; and RD contributed to data analysis, interpretation and writing of the draft manuscript. All authors contributed to the manuscript.

REFERENCES

1. **World Health Organization**. *Preventing injuries and violence: a guide for ministries of health*. Geneva: World Health Organization, 2007.
2. **Peden M,** McGee K, Sharma G. *The injury chart book: a graphical overview of the global burden of injuries*. Geneva: World Health Organization, 2002.
3. **Bunn F,** Collier T, Frost C, *et al*. Area wide traffic calming for preventing traffic related injuries (review). *The Cochrane Database Syst Rev* 2003; doi:10.1002/14651858/CD003110.
4. **Thompson DC,** Rivara FP. Pool fencing for preventing drowning in children (review). *The Cochrane Database Syst Rev* 1998; doi:10.1002/14651858/CD001047.
5. **McClure R,** Turner C, Peel N, *et al*. Population based interventions for the prevention of fall related injuries in older people (review). *The Cochrane Database Syst Rev* 2005; doi:10.1002/14651858/CD004441.
6. **Zwi AS,** Forjuoh S, Murugusampillay S, *et al*. Injuries in developing countries: policy response needed now. *Trans R Soc Trop Med Hyg* 1996;**90**:593–5.
7. **Smith GS,** Barss PS. Unintentional injuries in developing countries: the epidemiology of a neglected problem. *Epidemiol Rev* 1991;**13**:228–66.
8. **Forjuoh SN.** Traffic related injury prevention interventions for low income countries. *Inj Control Saf Promot* 2003;**10**:109–18.
9. **Norton R,** Hyder AA, Bishai D, *et al*. Unintentional injuries. In: Jamison DT, Breman JG, Measham AR, *et al*, eds. *Disease control priorities in developing countries*. New York: Oxford University Press, 2006:737–53.
10. **Registrar General Sri Lanka**. Deaths by cause and age groups 1998–2001. http://www.statistics.gov.lk/PopHouSat/VStat/Tables/f5/tbl5.pdf (accessed 8 January 2008).
11. **Ministry of Health, Sri Lanka**. Annual Health Bulletin 2003. http://www.health.gov.lk/AnnualHealthBulletin.htm (accessed 20 January 2008).
12. **Department of Census and Statistics, Sri Lanka**. Brief analysis of population and housing characteristics 2003. http://www.statistics.gov.lk/PopHouSat/PDF/p7%20population%20and%20Housing%20Text-11-12-06.pdf (accessed 4 February 2008).
13. **Department of Census and Statistics, Sri Lanka**. Population by district, 5 year age groups, sex, sector, Population and housing Census 2001. http://www.statistics.gov.lk/PopHouSat/Pop_Chra.asp (accessed 8 January 2008).
14. **Department of Census and Statistics, Sri Lanka**. Employed population and major groups of occupations by district. Population and housing census 2001. http://www.statistics.gov.lk/PopHouSat/PDF/Population/p9p20%20Percentage%20of%20employed%20population%20by%20district%20and%20major%20groups%20of%20occupation.pdf (accessed 15 January 2008).
15. **Lwanga SK,** Lemeshow S. *Sample size determination in health studies: a practical manual*. Geneva: World Health Organization, 1991.
16. **Department of Census and Statistics, Sri Lanka**. Sri Lanka map and Grama Niladhari areas. 2001. http://www.statistics.gov.lk/misc/slmap1.pdf (accessed 13 January 2008).
17. **Holder Y,** Peden M, Krug E, *et al*. *Injury surveillance guidelines*. Geneva: World Health Organization, 2001.
18. **Bennett S,** Woods T, Liyanage WM, *et al*. A simplified general method of cluster-sample surveys of health in developing countries. *World Health Stat Quart* 1991;**44**:98–106.
19. **Mock C,** Acheampong F, Adjei S, *et al*. The effect of recall on estimation of incidence rates for injury in Ghana. *Int J Epidemiol* 1999;**28**:750–5.
20. **Moshiro C,** Heuch I, Astrøm AN, *et al*. Effect of recall on estimation of non-fatal injury rates: a community based study in Tanzania. *Inj Prev* 2005;**11**:48–52.
21. **Hang HM,** Bach TT, Byass P. Unintentional injuries over a 1 year period in a rural Vietnamese community: describing an iceberg. *Public Health* 2005;**119**:466–73.
22. **Moshiro C,** Heuch I, Astrøm AN, *et al*. Injury morbidity in an urban and rural area in Tanzania: an epidemiological survey. *BMC Public Health* 2005;**5**:11.
23. **Kobusingye O,** Gawatudde D, Lett R. Injury patterns in rural and urban Uganda. *Inj Prev* 2001;**7**:46–50

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24. **Fatmi Z,** Hadden WC, Razzak JA, *et al*. Incidence, patterns and severity of reported unintentional injuries in Pakistan for persons five years and older: results of the National Health Survey of Pakistan 1990–94. *BMC Public Health* 2007;**7**:152.
25. **Cardona M,** Joshi R, Ivers RQ, *et al*. The burden of fatal and non-fatal injuries in rural India. *Inj Prev* 2008;**14**:232–7.
26. **Verma PK,** Tewari KN. Injury prevention and control: an epidemiological study of injuries in the area of municipal corporation of Delhi 2003. http://www.searo.who.int/LinkFiles/whd04_documents_injuries-5.pdf (accessed 8 February 2008).
27. **Mock CN,** Abantanga F, Cummings P, *et al*. Incidence and outcome of injury in Ghana: a community-based survey. *Bull World Health Organ* 1999;**77**:955–64.
28. **Olawale OA,** Owoaje ET. Incidence and pattern of injuries among residents of a rural area in south western Nigeria: a community-based study. *BMC Public Health* 2007;**7**:246.
29. **Tercero F,** Andersson R, Pena R, *et al*. The epidemiology of moderate and severe injuries in a Nicaraguan community: a household-based survey. *Public Health* 2006;**120**:106–14.
30. **Kopits E,** Cropper ML. *Traffic fatalities and economic growth*. World Bank Policy Research Working Paper No 3035. 2003.
31. **Gunaratne C.** Letter from Sri Lanka. *Natl Med J India* 2004;**17**:41–2.
32. **Kasturiratne A,** Pathmeswaran A, Fonseka MMD, *et al*. Estimates of disease burden due to land snake bite in Sri Lankan hospitals. *Southeast Asian J Trop Med Public Health* 2005;**36**:733–40.
33. **Fernando R.** The national poison information centre in Sri Lanka: the first 10 years. *Clinical Toxicol* 2002;**40**:551–5.
34. **Matter HC,** Wandeler AI, Neuenschwander BE, *et al*. Study of the dog population and the rabies control activities in the Mirigama area of Sri Lanka. *Acta Trop* 2000;**75**:95–108.
35. **Hoek V,** Konradsen F. Analysis of 8000 hospital admissions for acute poisoning in a rural area of Sri Lanka. *Clinical Toxicol* 2006;**44**:225–31.
36. **Eddleston M,** SudharshanK, Senthilkumaran M, *et al*. Patterns of hospital transfer for self poisoned patients in rural Sri Lanka: implications for estimating the incidence of self poisoning in the developing world. *Bull World Health Organ* 2006;**84**:276–82.
37. **Eddleston M,** Udayakumara N, Adhikari S, *et al*. The importance of poisoning vs. road traffic injuries as a cause of death in rural Sri Lanka. *PloS ONE* 2(7):e599. doi:10.1371/journal.pone.0000599.
38. **World Health Organization**. Status of mortality statistics in Sri Lanka 2007. http://www.searo.who.int/LinkFiles/2007_MortalityStatus-SRL.pdf (accessed 11 March 2008).
39. **Mathers CD,** Ma Fat D, Inoue M, *et al*. Counting the dead and what they died from: an assessment of the global status of cause of death data. *Bull World Health Organ* 2005;**83**:171–7.
40. **Janssen R,** Brouwer R, Heider W, *et al*. Human elephant conflict and poverty in Sri Lanka. Newsletter, No 3, March 2006. http://www.ivm.falw.vu.nl/news/index.cfm (accessed 15 February 2008).
41. **Department of Census and Statistics, Sri Lanka**. Disabled persons by sex and district. Population and housing census 2001. http://www.statistics.gov.lk/PopHouSat/Des_Chra.asp (accessed 10 January 2008).

