

## Epidemiology of intentional self-poisoning in rural Sri Lanka

MICHAEL EDDLESTON, DAVID GUNNELL, AYANTHI KARUNARATNE,  
DHAMMIKA DE SILVA, M. H. REZVI SHERIFF and NICK A. BUCKLEY

**Summary** We investigated the epidemiology of intentional self-poisoning in rural Sri Lanka by prospectively recording 2189 admissions to two secondary hospitals. Many patients were young (median age 25 years), male (57%) and used pesticides (49%). Of the 198 who died, 156 were men (case fatality 12.4%) and 42 were women (4.5%). Over half of female deaths were in those under 25 years old; male deaths were spread more evenly across age groups. Oleander and paraquat caused 74% of deaths in people under 25 years old; thereafter organophosphorous pesticides caused many deaths. Although the age pattern of self-poisoning was similar to that of industrialised countries, case fatality was more than 15 times higher and the pattern of fatal self-poisoning different.

**Declaration of interest** None.  
Funding detailed in Acknowledgements.

Intentional self-poisoning is a major problem worldwide (Hawton & van Heeringen, 2002). In industrialised countries, it predominantly occurs in young people impulsively responding to stressful events who have little desire to die. Deaths are rare, since the medicines ingested are of low toxicity or easily treated. The situation is different in the developing world, where pesticides are the most popular means of self-poisoning (Gunnell & Eddleston, 2003) and cause an estimated 300 000 deaths each year. Relatively little is known about the age and gender patterns of fatal and non-fatal self-poisoning in such regions. This study aimed to identify the poisons used in an agricultural area of Sri Lanka, with the expectation that such knowledge will direct future campaigns to prevent self-harm.

### METHOD

A prospective study was established in the two secondary hospitals (Anuradhapura and Polonnaruwa) of the North Central Province, Sri Lanka, in 2002. This agricultural region has 1.1 million people, 55% of whom are less than 25 years old. Ethics approval was obtained from Oxford and Colombo. Poisoned patients are first admitted to rural hospitals; around half are then transferred to the secondary hospitals according to severity and the facilities available. From 31 March 2002 until 15 March 2003, all patients with self-poisoning were seen on admission by study doctors. The poison was identified from the history, bottles, transfer letter and/or clinical toxidrome. Blood samples were taken from 70% of patients; analysis showed that the poison was correctly identified in over 80% of cases.

We used logistic regression models to investigate the effects of age, gender and poison type on mortality. As no death occurred among those taking acids, hydrocarbons or alkalis, patients taking these poisons ( $n=77$ ) were not analysed.

### RESULTS

A total of 2189 patients with acute self-poisoning were identified over the study period; 68 had occupational or unintentional exposure and their data are not analysed here. Males accounted for more cases ( $n=1257$ , 57%) than females. The overall median age was 25 years (interquartile range (IQR) 19–35); female cases were younger than males: median age 21 (IQR 17–29) *v.* 29 years (IQR 22–40). The 5-year age band with the highest number of cases was 15–19 in women and 20–25 in men. The most common poisons ingested were pesticides (49%), particularly by men (males 59%, females 35%), and oleander seeds (34%; males, 31%, females 38%). Oleander was the poison most

commonly used by females and males under the age of 20. From age 20, pesticide ingestion became more common in both genders. Medicines and hydrocarbons (commonly kerosene) were more often taken by women than men (18% *v.* 3% and 6% *v.* 2%, respectively).

A total of 198 patients died, giving a case fatality ratio of 9.0%, which was higher in males (12.4%) than in females (4.5%). Over half (52%) of female deaths occurred in women under 25; male deaths were spread more evenly, with only 22% of deaths occurring in men under 25 (Fig. 1). Case fatality increased with age. In a logistic regression model controlling for gender and type of poison taken, the risk of death increased by 62% (95% CI 45–81) per 10-year increase in age and was 52% (95% CI 4–124) higher in males than females. Oleander and paraquat were the most important cause of death in both genders under 25 years (Fig. 1), accounting for 74% of deaths. Pesticides in general, and organophosphates in particular, became more important thereafter, responsible for at least 80% (organophosphates 40%) of deaths over the age of 25.

After controlling for age and gender in logistic regression models with medicines as the reference category, the odds ratios for death among patients poisoned by pesticides other than paraquat was 8.7 (95% CI 2.1–36.2), by paraquat 102.0 (95% CI 22.8–456.4) and by oleander 7.2 (95% CI 1.7–30.5).

### DISCUSSION

The age-specific pattern of self-poisoning in rural Sri Lanka is similar to that in industrialised countries: most cases occur in young people, and the incidence peaks around age 15–25 years (5 years earlier in females than in males) and then falls steadily with increasing age (for comparison, see Gunnell & Eddleston, 2003; Fig. 1). There are, however, a number of important differences. Male patients outnumbered women by 1.35:1 – the reverse of most other regions (Hawton & van Heeringen, 2002). The case fatality ratio for self-poisoning patients admitted to Sri Lankan secondary hospitals (9%) is much higher than in industrialised countries (e.g. 0.5% in the UK). A significant number of deaths (52% of female deaths, 11% of all deaths) occur in women under 25 years. A similar pattern of fatal self-poisoning

in young women is seen in rural areas of China and India (Phillips *et al*, 2002; Joseph *et al*, 2003).

Our data were drawn from secondary hospitals and are not directly comparable with population-based statistics. Patterns of transfer from rural hospitals, in particular an increased tendency for transfer of men, would have biased the pattern of admission. A preliminary study has so far found no gender bias for transfers, nor evidence of more women dying before transfer to the secondary hospitals. The case fatality ratio would have been lower if all patients admitted to rural hospitals were transferred, but still several times higher than in the West.

The substances used in fatal poisoning varied with age and with gender. Yellow oleander was most commonly used by people under 20. Paraquat was important

MICHAEL EDDLESTON, South Asian Clinical Toxicology Research Collaboration, Centre for Tropical Medicine, University of Oxford, UK and Department of Clinical Medicine, University of Colombo, Sri Lanka; DAVID GUNNELL, Department of Social Medicine, University of Bristol, UK; AYANTHI KARUNARATNE, Department of Clinical Medicine, University of Colombo; DHAMMIKA DE SILVA, Office of the Provincial Director of Health Services, North Central Province, Anuradhapura; M. H. REZVI SHERIFF, Department of Clinical Medicine, University of Colombo, Sri Lanka; NICK A. BUCKLEY, Department of Clinical Pharmacology and Toxicology, Australian National University Medical School, Australian Capital Territory, Australia

Correspondence: Dr M. Eddleston, Department of Clinical Medicine, Faculty of Medicine, PO Box 271, 25 Kynsey Road, Colombo 8, Sri Lanka. E-mail: eddlestonm@eureka.lk

(First received 16 August 2004, final revision 14 January 2005, accepted 28 January 2005)

in young people; after the age of 30 other pesticides (particularly organophosphates and non-paraquat herbicides) became more important. All are much more difficult to treat than the medicines that are commonly used for self-poisoning in the West.

This study supports the view that organophosphate pesticides are important

causes of fatal self-poisoning in south Asia (Roberts *et al*, 2003). Paraquat and oleander may be more important in women and young people because these substances are highly toxic and even small amounts can kill.

The case fatality ratio rose steeply with age in men and women. This may reflect a greater level of intent in older patients, a greater use of pesticides for self-poisoning, or a problem of comorbidity. Overall, the higher case fatality is predominantly due to the availability of highly toxic poisons and the difficulty of medical management. Restriction of access to highly toxic pesticides, plus improved medical therapy and antidote availability, could rapidly reduce the number of self-poisoning deaths in the rural developing world.

## ACKNOWLEDGEMENTS

We thank the Oxford–Colombo study team and the hospitals' medical and nursing staff for their help, and Nick Bateman and Keith Hawton for critical review. M.E. is a Wellcome Trust Career Development Fellow funded by grant GR063560MA.

## REFERENCES

- Gunnell, D. & Eddleston, M. (2003) Suicide by intentional ingestion of pesticides: a continuing tragedy in developing countries. *International Journal of Epidemiology*, **32**, 902–909.
- Hawton, K. & van Heeringen, K. E. (2002) *International Handbook of Suicide and Attempted Suicide*. Chichester: John Wiley & Sons.
- Joseph, A., Abraham, S., Muliylil, J. P., *et al* (2003) Evaluation of suicide rates in rural India using verbal autopsies, 1994–9. *BMJ*, **326**, 1121–1122.
- Phillips, M. R., Yang, G., Zhang, Y., *et al* (2002) Risk factors for suicide in China: a national case–control psychological autopsy study. *Lancet*, **360**, 1728–1736.
- Roberts, D. M., Karunaratna, A., Buckley, N. A., *et al* (2003) Influence of pesticide regulation on acute poisoning deaths in Sri Lanka. *Bulletin of the World Health Organization*, **81**, 789–798.

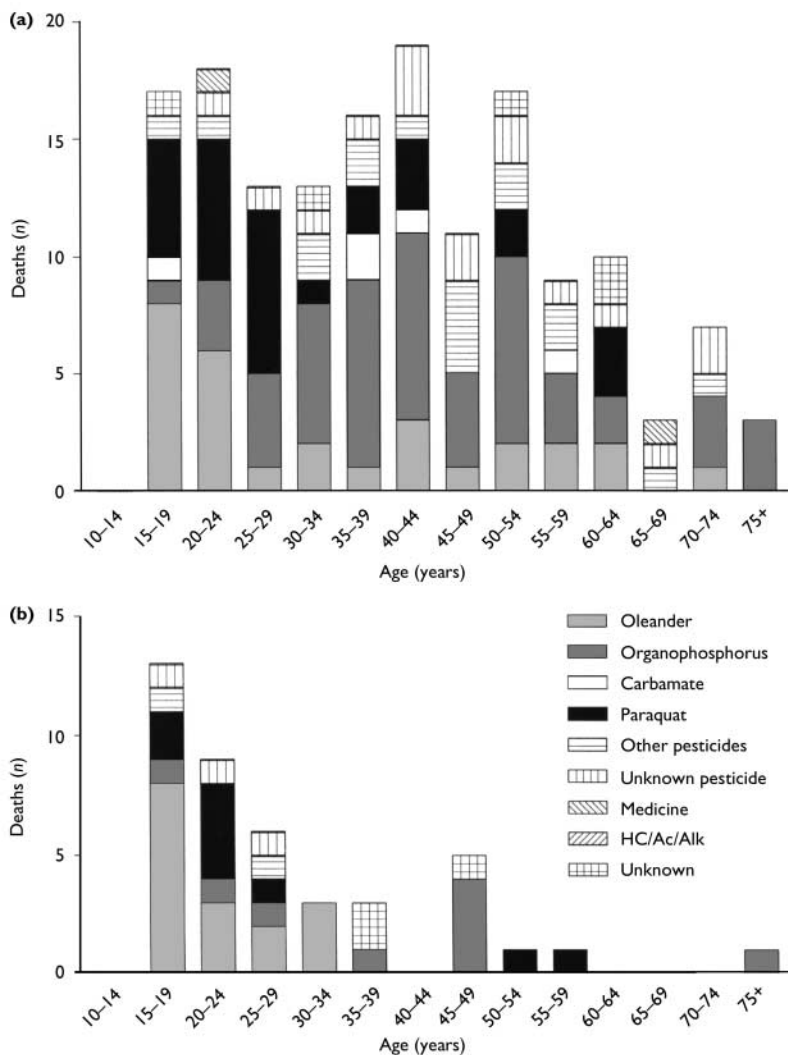


Fig. 1 Poisons used for fatal self-poisoning by (a) males and (b) females, according to age (HC/Ac/Alk, hydrocarbons, acids or alkalis).