



Review article

The global burden of fatal self-poisoning with pesticides 2006-15: Systematic review



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ABSTRACT

Background: Agricultural pesticide poisoning is a major contributor to the global burden of suicide. Over the last decade there has been a marked decrease in the incidence of suicide worldwide. It is unclear whether pesticide poisoning still plays a significant role in the global incidence of suicide.

Methods: WHO method-specific suicide data were supplemented by a systematic review of the literature between 2006 and 2015, including searches of thirteen electronic databases and Google, citation searching and a review of reference lists and personal collections. Our primary outcome was the proportion of total suicides due to pesticide poisoning. Weighted estimates were calculated for seven WHO regional and income strata.

Results: We identified data from 108 countries (102 from WHO data, 6 from the literature). A conservative estimate based on these data indicates that there were approximately 110,000 pesticide self-poisoning deaths each year from 2010 to 2014, comprising 13.7% of all global suicides. A sensitivity analysis accounting for under-reporting of suicides in India resulted in an increased estimate of 168,000 pesticide self-poisoning deaths annually, that is, 19.7% of global suicides. The proportion of suicides due to pesticide self-poisoning varies considerably between regions, from 0.9% in low- and middle-income countries in the European region to 48.3% in low- and middle-income countries in the Western Pacific region.

Limitations: High quality method-specific suicide data were unavailable for a number of the most populous countries, particularly in the African and Eastern Mediterranean regions. It is likely we have underestimated incidence in these regions.

Conclusion: There appears to have been a substantial decline in fatal pesticide self-poisoning in recent years, largely driven by a reduction in overall suicide rates in China. Nonetheless, pesticide self-poisoning remains a major public health challenge, accounting for at least one-in-seven suicides globally.

1. Introduction

Self-poisoning with agricultural pesticides is a major contributor to the global burden of suicide (World Health Organisation, 2014). In a review of the international literature from 1990 to 2007, we estimated that this method was used in approximately one-third of the world's suicides, accounting for an estimated 260,000 deaths per year (Gunnell et al., 2007a).

Pesticide self-poisoning is particularly prevalent in South Asia, South East Asia and China. China is the world's most populous country and previously had relatively high rates of suicide; a previous review (Phillips et al., 2002) indicated that 62% of suicides in China were due to pesticide poisoning. However, since the publication of this review, overall suicide rates have fallen by over one third in China (Liu et al., 2015) and by approximately 10% globally (World Health Organisation, 2014), and a number of countries have implemented strategies to

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reduce the burden of pesticide suicides (Cha et al., 2016; Pearson et al., 2015). For this reason a review of the continued contribution of pesticide poisoning to the global incidence of suicide is timely.

This paper presents an updated systematic review of the contribution made by pesticide self-poisoning to the global burden of suicide. The review is based on method-specific suicide mortality data drawn from World Health Organisation (WHO) mortality statistics (Ajdacic-Gross et al., 2008; World Health Organisation, 2015). We supplemented this data with research published since 2006, drawing on a wider range of bibliographic databases than previously used.

2. Methods

This systematic review is reported according to the PRISMA guidelines for systematic reviews and is registered through PROSPERO (Protocol No. CRD42015023804) (Mew et al., 2015; PRISMA, 2009).

The primary outcome of interest when identifying and extracting data was the proportion of total suicides due to pesticide poisoning. In this review, the term pesticides includes insecticides, rodenticides, herbicides and fungicides.

2.1. Data searches

2.1.1. World Health Organization mortality data

Where available, the number of suicides for all ages (sum of deaths coded using International Classification of Disease (ICD), Tenth Revision (ICD-10) codes X60-X84) and the number of suicides (all ages) by pesticide poisoning (ICD-10 X68) for each country were obtained using the World Health Organization Cause of Death Query Online Database for the most recent year with available data (or the two most recent years if there were less than 500 suicides per year) between 2007 and 2015 (World Health Organisation, 2015). The median year from which data were used was 2012, ranging from 2006 to 2014.

2.1.2. Published literature

We searched thirteen electronic databases to identify papers published between 2006 and 2015, which document the use of pesticides in self-harm (Appendix A): African Journals Online, African Index Medicus, AGRIS, Global Health Library, IMEMR, IMSEAR, INDMED, KOREAM ED, LILACs, PubMed, PsycInfo, Web of Science, WPRIM. All searches were performed in English. The database search was supplemented with: (1) A review of the reference lists of papers from which data were extracted; (2) Citation searches of eight key publications including our original review (Bertolote et al., 2006a, 2006b; Eddleston, 2000; Eddleston et al., 2002; Eddleston and Phillips, 2004; Gunnell et al., 2007a; Gunnell and Eddleston, 2003; Jeyaratnam, 1990) using Google Scholar; (3) A review of papers from personal collections; and (4) An Internet-based search using Google for suicide data of the three most populous countries in each region for which data remained unavailable.

A full description of the search terms for each database can be found in Appendix A. The WHO librarian was consulted regarding the development of the search strategy. The search terms, where possible, combined the concepts: pesticides AND (suicide OR self-harm) AND epidemiologic methods. A second search was performed without using the 'epidemiologic methods' search term as a filter and did not yield any additional articles meeting the inclusion criteria.

2.2. Data selection and extraction

The inclusion and exclusion criteria are listed in Table 1. For regions lacking data that met the inclusion criteria, studies that provide an insight into the burden of pesticide self-poisoning but did not meet the inclusion criteria have been discussed in the results section. These studies did not however inform the regional and global estimates.

We identified relevant papers in three stages (Fig. 1). The first stage involved title and abstract screening (EM). If it was unclear whether a paper fit the inclusion criteria, the paper was included for full-text retrieval. Mid-way through the title/abstract review, the inter-rater agreement between EM and an experienced reviewer (DG) based on 100 citations yielded a kappa score of 0.86, suggesting good agreement. The second stage involved the screening of full-text articles (EM) for eligibility. At the early stages of full-text review, based on 20 full-text articles, the kappa score was 0.57. This suggested moderate levels of inter-rater agreement between EM and an experienced reviewer (DG). The less experienced reviewer tended to be over-inclusive compared to the more experienced reviewer. Following both exercises EM modified the criteria for article inclusion.

The final stage involved thorough evaluation of the remaining full-text articles by PP and DG independently. Data extraction forms were completed for each article. Where there was disagreement regarding inclusion or the quality score, this was resolved through discussion between reviewers. There was no disagreement on any papers that were included in the final estimates.

The data extraction form, which includes a quality assessment tool, was created and finalised by DG after a pilot and discussion with co-authors (Appendix B). Factors included in the quality assessment tool were: representativeness of the study sample, size of study, recency of data, quality of suicide death ascertainment and availability of information on both pesticide and total suicides.

2.3. Data synthesis

Data were categorised according to seven strata described in the 2014 WHO Preventing Suicide Report (World Health Organisation, 2014). High-income countries form a single stratum whilst low- and middle-income countries (LMICs) are divided into six strata: Africa (AFRO), the Americas (AMRO), Europe (EURO), Eastern Mediterranean (EMRO), South-East Asia (SEARO) and Western Pacific (WPRO).

Where there were several sources of data available for a single country, WHO data was prioritised unless more recent national data were available in the published literature. There were eight countries for which both national published literature and WHO data were available; the estimates of pesticide suicides in all eight countries differed by less than 5% between the two sources. The quality rating was used to differentiate between published papers from the same country. If there were two papers with the same quality rating, we considered geographical comprehensiveness, recency of data and whether the data were disaggregated by year.

Where the data sources only present data for a subset of pesticide deaths (e.g. insecticide deaths, rather than combined deaths from insecticides, rodenticides, herbicides and fungicides), we specify this in the text; such figures will lead to under-estimates of the overall number of pesticide suicides.

Pesticide suicides as a proportion of overall suicides were calculated for each data source. This calculation was based on the most recent year for which data were provided. Where there were fewer than 500 total suicides reported in the most recent year, the percentage of pesticide suicides was calculated based on the two most recent years.

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