A review of waste management practices and their impact on human health

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Abstract

This work reviews (i) the most recent information on waste arisings and waste disposal options in the world, in the European Union (EU), in Organisation for Economic Co-operation and Development (OEDC) countries, and in some developing countries (notably China) and (ii) the potential direct and indirect impact of waste management activities on health. Though the main focus is primarily on municipal solid waste (MSW), exposure to bioaerosols from composting facilities and to pathogens from sewage treatment plants are considered. The reported effects of radioactive waste are also briefly reviewed. Hundreds of epidemiological studies reported on the incidence of a wide range of possible illnesses on employees of waste facilities and on the resident population. The main conclusion of the overall assessment of the literature is that the evidence of adverse health outcomes for the general population living near landfill sites, incinerators, composting facilities and nuclear installations is usually insufficient and inconclusive. There is convincing evidence of a high risk of gastrointestinal problems associated with pathogens originating at sewage treatment plants. In order to improve the quality and usefulness of epidemiological studies applied to populations residing in areas where waste management facilities are located or planned, preference should be given to prospective cohort studies of sufficient statistical power, with access to direct human exposure measurements, and supported by data on health effect biomarkers and susceptibility biomarkers.

Introduction

Human activities have always generated waste. This was not a major issue when the human population was relatively small and nomadic, but became a serious problem with urbanisation and the growth of large conurbations. Poor management of waste led to contamination of water, soil and atmosphere and to a major impact on public health. In medieval times, epidemics associated with water contaminated with pathogens decimated the population of Europe and even more recently (19th century), cholera was a common occurrence. Some of the direct health impacts of the mismanagement of waste are well known and can be observed especially in developing countries.

As science and technology developed, the management of an ever increasing volume of waste became a very organised, specialised and complex activity. The characteristics of waste material evolved in line with changes in lifestyle, and the number of new chemical substances present in the various waste streams increased dramatically. The long-term health effects of exposure to substances present in the waste, or produced at waste disposal facilities are more difficult to measure, especially when their concentrations are very small and when there are other exposure pathways (e.g. food, soil). Nonetheless, lack of evidence can cause public concern. Well-publicised industrial accidents, often unrelated to waste management activities, have produced a NIMBY (not in my backyard) syndrome that causes fierce opposition to the construction of landfills, incinerators, or other waste disposal facilities. Government and health authorities are under increasing pressure from the public to provide epidemiological evidence of potential adverse health effects produced by these activities. Thousands of manuscripts have been published on the impact of emissions in proximity of waste disposal sites. A number of authors have written reviews, and reviews of reviews. Epidemiological studies have often shown the existence of an association between human illnesses and proximity to a waste disposal site, or length of residence near such site, but the overwhelming majority have failed to provide significant evidence of a causal link.

The main aims of this review are the following:

- (i)
  summarise the most recent information on waste arisings and waste disposal options in the world, in the European Union (EU), in Organisation for Economic Co-operation and Development (OEDC) countries, and in some developing countries;
- (ii)
  evaluate the epidemiological evidence of direct and indirect impact of waste management activities on health.

The main focus is on municipal solid waste (MSW), but composting facilities and sewage treatment plants are also considered. Also, the results of epidemiological studies on the effects of exposure to radioactive waste are briefly reviewed.

This study builds on the work carried out by Saffron et al. (2003). The literature search was carried out using the same online databases and included primary studies and reviews of epidemiological investigations. The quality of the studies was classified on the basis of the following criteria:

- (i)
  epidemiological study design (experimental studies and prospective cohort studies were listed at the top of the hierarchy);
- (ii)
  sample size and statistical power of the study;
- (iii)
  consideration of confounding factors (such as other sources of pollutants both indoors and outdoors);
- (iv)
  availability of exposure data (as opposed to using surrogates such as distance from waste management facilities, or post code of residence);
- (v)

inclusion of information on waste management procedures at each site (as this can affect the level of a pollutant, its pathways, and exposure route);

- (vi)
  studies carried out on human population (as opposed to studies on animals);

- (vii)
  the strength of the relationship found between possible cause and effect, based on the reported ‘relative risk’.

General information on the different types of epidemiological studies is also provided for readers unfamiliar with the research methodologies used in this field.