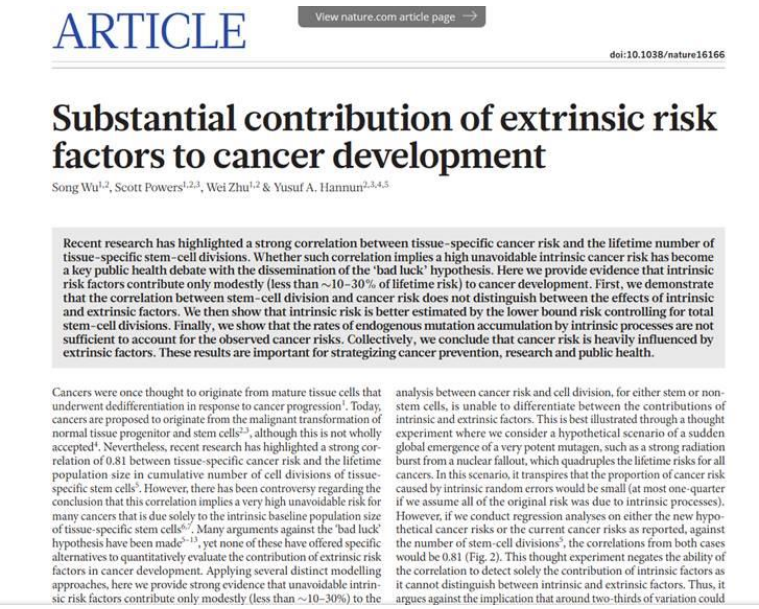

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doi:10.1038/nature16166

Substantial contribution of extrinsic risk factors to cancer development

Song Wu[1,2], Scott Powers[1,2,3], Wei Zhu[1,2] & Yusuf A. Hannun[2,3,4,5]

Recent research has highlighted a strong correlation between tissue-specific cancer risk and the lifetime number of tissue-specific stem-cell divisions. Whether such correlation implies a high unavoidable intrinsic cancer risk has become a key public health debate with the dissemination of the 'bad luck' hypothesis. Here we provide evidence that intrinsic risk factors contribute only modestly (less than ~10–30% of lifetime risk) to cancer development. First, we demonstrate that the correlation between stem-cell division and cancer risk does not distinguish between the effects of intrinsic and extrinsic factors. We then show that intrinsic risk is better estimated by the lower bound risk controlling for total stem-cell divisions. Finally, we show that the rates of endogenous mutation accumulation by intrinsic processes are not sufficient to account for the observed cancer risks. Collectively, we conclude that cancer risk is heavily influenced by extrinsic factors. These results are important for strategizing cancer prevention, research and public health.

Cancers were once thought to originate from mature tissue cells that underwent dedifferentiation in response to cancer progression[1]. Today, cancers are proposed to originate from the malignant transformation of normal tissue progenitor and stem cells[2,3], although this is not wholly accepted[4]. Nevertheless, recent research has highlighted a strong correlation of 0.81 between tissue-specific cancer risk and the lifetime population size in cumulative number of cell divisions of tissue-specific stem cells[5]. However, there has been controversy regarding the conclusion that this correlation implies a very high unavoidable risk for many cancers that is due solely to the intrinsic baseline population size of tissue-specific stem cells[6,7]. Many arguments against the 'bad luck' hypothesis have been made[8–13], yet none of these have offered specific alternatives to quantitatively evaluate the contribution of extrinsic risk factors in cancer development. Applying several distinct modelling approaches, here we provide strong evidence that unavoidable intrinsic risk factors contribute only modestly (less than ~10–30%) to the analysis between cancer risk and cell division, for either stem or non-stem cells, is unable to differentiate between the contributions of intrinsic and extrinsic factors. This is best illustrated through a thought experiment where we consider a hypothetical scenario of a sudden global emergence of a very potent mutagen, such as a strong radiation burst from a nuclear fallout, which quadruples the lifetime risks for all cancers. In this scenario, it transpires that the proportion of cancer risk caused by intrinsic random errors would be small (at most one-quarter if we assume all of the original risk was due to intrinsic processes). However, if we conduct regression analyses on either the new hypothetical cancer risks or the current cancer risks as reported, against the number of stem-cell divisions[5], the correlations from both cases would be 0.81 (Fig. 2). This thought experiment negates the ability of the correlation to detect solely the contribution of intrinsic factors as it cannot distinguish between intrinsic and extrinsic factors. Thus, it argues against the implication that around two-thirds of variation could

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http://tinyurl.com/h5vva7x

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The report on extrinsic factors would tend to suggest more credence to cancers /incinerator proximity reports such as this one in Spain
http://www.navarra.es/NR/rdonlyres/3B6D173E-8FFF-49B8-8C34-9386F4F80168/304361/Mortalidadcancer1.pdf

http://www.ncbi.nlm.nih.gov/pubmed/22954398

Subacute inhalation toxicity assessment of fly ash from industrial waste incinerators.

Shim I, Oh E, Yang S, Ryu T, Soh J, Sul D, Kim P.

Source

Risk Assessment Division, National Institute of Environmental Research, Incheon, Republic of Korea.

Abstract

Fly ash from industrial waste incinerators has been a significant concern because of their constituent toxic heavy metals and organic compounds. The objective of this study was to identify the subacute inhalation toxicity of fly ash from industrial waste incinerators, using whole body inhalation exposure chambers. Male and female groups of Sprague-Dawley rats were exposed to fly ash by inhalation of concentrations of 0, 50, 100, 200 mg/m(3), for 6 h/day, 5 days/week for 4 weeks. There was no significant difference in body weight, and relative organ weight to body weight, between the exposure groups and the control group. Hematological examinations revealed a significant increase of monocyte counts in fly ash exposed rats and brown pigment laden macrophage was found in the lungs of rats exposed to high concentration of fly ash. A decrease of blood glucose levels and an increase in glutamate oxaloacetate transaminase activity were observed in fly ash treated rats. There was also a significant increase of lactate dehydrogenase levels in rat blood exposed fly ash. A significant dose-dependent increase of DNA damage was found in lymphocytes, spleen, bronchoalveolar lavage, liver, lung, and thymus of rats exposed to fly ash. In addition, the level of lipid peroxidation was increased in the plasma of rats exposed to a high concentration of fly ash. These results suggest that inhalation of fly

ash from industrial waste incinerators can induce histopathologic, hematological, and serum biochemical changes and oxidative damage.

Effect of fly ash inhalation on biochemical and histomorphological changes in rat liver.

Mani U, Prasad AK, Suresh Kumar V, Lal K, Kanojia RK, Chaudhari BP, Murthy RC.

Source http://www.ncbi.nlm.nih.gov/pubmed/17166587

Inhalation Toxicology Laboratory, Industrial Toxicology Research Centre, PO Box 80, M. G. Marg, Lucknow 226 001, India. manitoxicology@yahoo.co.in

Abstract

The effect of fly ash inhalation (4h daily, 5 days a week) for 28 days on the deposition of metal ions and histopathological changes in the liver and serum clinical enzymes has been studied. The results showed an increase in the concentration of metals such as cadmium (Cd), chromium (Cr), copper (Cu), manganese (Mn), and lead (Pb) in the tissues of exposed rats. The level of metals varied from metal to metal and from organ to organ. Level of serum enzymes such as serum glutamate oxaloacetate transaminase, serum glutamate pyruvate transaminase, and alkaline phosphatase were increased in fly ash exposed rats using whole body inhalation exposure as compared to sham controls. Histopathological studies of rat liver exposed to fly ash revealed infiltration of mononuclear cells in and around the portal triads, which seems to be laden with fly ash particles. Hepatocytes showed necrotic changes such as pyknotic nuclei, karyorrhexis, and karyolytic. These changes were more towards the centrolobular areas than the midzonal and periportal areas. These findings demonstrate that the toxic metals of inhaled fly ash in rats may get translocated into extrapulmonary organs, become deposited and hence may manifest their toxic effects on different tissues.

PMID:
17166587
[PubMed - indexed for MEDLINE

Epidemiology. 2013 Nov;24(6):863-70. doi: 10.1097/EDE.0b013e3182a712f1.

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http://www.ncbi.nlm.nih.gov/pubmed/24076993

Air pollution from incinerators and reproductive outcomes: a multisite study.

Candela S, Ranzi A, Bonvicini L, Baldacchini F, Marzaroli P, Evangelista A, Luberto F, Carretta E, Angelini P, Sterrantino AF, Broccoli S, Cordioli M, Ancona C, Forastiere F.

From the aEpidemiology Unit, Local Health Authority, Reggio Emilia, Italy; bRegional Reference Centre on Environment and Health, ARPA Emilia-Romagna, Modena, Italy; cPublic Health Service, Emilia-Romagna Region, Italy; and dDepartment of Epidemiology, Lazio Region, Italy.

Abstract

BACKGROUND: The few studies that have investigated the relationship between emissions from municipal solid-waste incinerators and adverse pregnancy outcomes have had conflicting results. We conducted a study to assess the effects of air emissions from the eight incinerators currently in operation in the Emilia-Romagna Region of Italy on reproductive outcomes (sex ratio, multiple births, preterm births, and small for gestational age [SGA] births).

METHODS: We considered all births (n = 21,517) to women residing within a 4-km radius of an incinerator at the time of delivery during the period 2003-2010 who were successfully linked to the Delivery Certificate database. This source also provided information on maternal characteristics and deliveries. Each newborn was georeferenced and characterized by a specific level of exposure to incinerator emissions, categorized in quintiles of PM10, and other sources of pollution (NOx quartiles), evaluated by means of ADMS-Urban system dispersion models. We ran logistic regression models for each outcome, adjusting for exposure to other pollution sources and maternal covariates.

RESULTS: Incinerator pollution was not associated with sex ratio, multiple births, or frequency of SGA. Preterm delivery increased with increasing exposure (test for trend, P < 0.001); for the highest versus the lowest quintile exposure, the odds ratio was 1.30 (95% confidence interval = 1.08-1.57). A similar trend was observed for very preterm babies. Several sensitivity analyses did not alter these results.

CONCLUSIONS: Maternal exposure to incinerator emissions, even at very low levels, was associated with preterm delivery.

www.ncbi.nlm.nih.gov/pubmed/23160082

Cancer mortality in towns in the vicinity of incinerators and installations for the recovery or disposal of hazardous waste

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http://dx.doi.org/10.1016/j.envint.2012.10.003
J. García-Pérez et al. / Environment International 51 (2013) 31–44

In this context, this study sought to:
(1) assess possible excess mortality attributable to 33 tumor sites among the Spanish population residing in the
environs of incinerators and hazardous waste treatment plants governed by the IPPC Directive and E-PRTR Regulation;
(2) analyze this risk according to the different categories of industrial activity, and for each installation individually; and,
(3) perform the analysis for the population, both overall and broken down by sex, using different statistical approaches for the purpose.

Conclusion:

Our results support the hypothesis of a statistically significant higher risk, among men and women alike, of dying from all cancers in towns situated near incinerators and hazardous waste treatment plants, and specifically, a higher excess risk in respect of tumors of the stomach, liver, pleura, kidney, and ovary. Furthermore, this is one of the first studies to analyze the risk of dying of cancer related with specific industrial activities in this sector at a national level, and to highlight the excess risk observed in the vicinity of incinerators and installations
for the recycling of scrap metal and scrapping of ELVs, regeneration of spent baths, and treatment of oil and oily waste.

http://www.ncbi.nlm.nih.gov/pubmed/15242064

J Epidemiol. 2004 May;14(3):83-93.

Risk of adverse reproductive outcomes associated with proximity to municipal solid waste incinerators with high dioxin emission levels in Japan.

Tango T, Fujita T, Tanihata T, Minowa M, Doi Y, Kato N, Kunikane S, Uchiyama I, Tanaka M, Uehata T.

Source

Department of Technology Assessment and Biostatistics, National Institute of Public Health, Wako, Saitama, Japan.

Abstract

BACKGROUND:

Great public concern about health effects of dioxins emitted from municipal solid waste incinerators has increased in Japan. This paper investigates the association of adverse reproductive outcomes with maternal residential proximity to municipal solid waste incinerators.

METHODS:

The association of adverse reproductive outcomes with mothers living within 10 km from 63 municipal solid waste incinerators with high dioxin emission levels (above 80 ng international toxic equivalents TEQ/m3) in Japan was examined. The numbers of observed cases were compared with the expected numbers calculated from national rates adjusted regionally. Observed/expected ratios were tested for decline in risk or peak-decline in risk with distance up to 10 km.

RESULTS:

In the study area within 10 km from the 63 municipal solid waste incinerators in 1997-1998, 225,215 live births, 3,387 fetal deaths, and 835 infant deaths were confirmed. None of the reproductive outcomes studied here showed statistically significant excess within 2 km from the incinerators. However, a statistically significant peak-decline in risk with distance from the incinerators up to 10 km was found for infant deaths (p=0.023) and infant deaths with all congenital malformations combined (p=0.047), where a "peak" is detected around 1-2 km.

CONCLUSION:

Our study shows a peak-decline in risk with distance from the municipal solid waste incinerators for infant deaths and infant deaths with all congenital malformations combined. However, due to the lack of detailed exposure information to dioxins around the incinerators, the observed trend in risk should be interpreted cautiously and there is a need for further investigation to accumulate good evidence regarding the reproductive health effects of waste incinerator exposure.

http://www.ncbi.nlm.nih.gov/pubmed/20581259

- Abstract

Occup Environ Med. 2010 Jul;67(7):493-9. doi: 10.1136/oem.2009.052456.

Maternal residence near municipal waste incinerators and the risk of urinary tract birth defects.

Cordier S, Lehébel A, Amar E, Anzivino-Viricel L, Hours M, Monfort C, Chevrier C, Chiron M, Robert-Gnansia E.

Source

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Abstract

OBJECTIVES:

Waste incineration releases a mixture of chemicals with high embryotoxic potential, including heavy metals and dioxins/furans, into the atmosphere. In a previous ecological study we found an association between the risk of urinary tract birth defects and residence in the vicinity of municipal solid waste incinerators (MSWIs). The objective of the present study was to specifically test this association.

METHODS:

A population-based case-control study compared 304 infants with urinary tract birth defects diagnosed in the Rhône-Alpes region (2001-2003) with a random sample of 226 population controls frequency-matched for infant sex and year and district of birth. Exposure to dioxins in early pregnancy at the place of residence, used as a tracer of the mixture released by 21 active waste incinerators, was predicted with second-generation Gaussian modelling (ADMS3 software). Other industrial emissions of dioxins, population density and neighbourhood deprivation were also assessed. Individual risk factors including consumption of local food were obtained by interviews with 62% of the case and all control families.

RESULTS:

Risk was increased for mothers exposed to dioxins above the median at the beginning of pregnancy (OR 2.95, 95% CI 1.47 to 5.92 for dioxin deposits). When only interviewed cases were considered, risk estimates decreased mainly because the non-interviewed cases were more likely to live in exposed residential environments (OR 2.05, 95% CI 0.92 to 4.57). The results suggest that consumption of local food modifies this risk.

CONCLUSIONS:

This study confirms our previous observation of a link between the risk of urinary tract birth defects and exposure to MSWI emissions in early pregnancy and illustrates the effect of participation bias on risk estimates of environmental health impacts.

Comment in

· Incinerators, birth defects and the legacy of Thomas Bayes. [Occup Environ Med. 2010]

http://myweb.tiscali.co.uk/freeblackpark/sain/children.htm

Predicted health effects of the Colnbrook incinerator

Incinerators: The Effect on Children

By Dr J Thompson

The report on the Sint Niklaas incinerator states “we have dedicated this report to all the deceased children who died from cancer as well as the numerous children who have numerous serious health complaints caused by the waste incinerator in Sint Niklaas. A society that does not take care of its children is less than primitive.

This report, funded by the Belgian government, is the only complete study ever done on incinerators. Although the proposed incinerator at Colnbrook will have a lower dioxin output than that at Sint Niklaas, the fact that it would be nine times larger, will emit higher volumes of particulates and will foolishly be allowed to incinerate radioactive material gives little cause for comfort.

Children are more vulnerable to the pollutants produced by incinerators, breathing in more air than

adults relative to their size, and are likely to be the first to suffer from adverse effects. The foetus and newborn are uniquely vulnerable (see below).

Cancer

The report on the Sint Niklaas incinerator showed that blood and glandular cancers appeared in children about 5 years after the incinerator started operating. This preceded the increase in adult cancers by 7 years. Adults cancers showed a five-fold increase over 20 years. Knox found a doubling of childhood cancers and leukaemias within 5km of municipal incinerators (2) greatly exceeding the risk around non-combustion urban sites.

Congenital Abnormalities

A recent large study by Dummer over a 37 year period showed that the **incidence of spina bifida was 17% higher and heart defects 12% higher near incinerators (3). Congenital defects of many kinds were found at Sint Niklass (1). Orofacial defects were found to be more than doubled near an incinerator at Zeeberg, Amsterdam (4). Dolk found a 33% higher incidence of birth defects, (86% higher neural tube defects, 50% higher incidence of cardiac septal defects) and a higher risk of chromosomal abnormalities within 3 km of municipal waste sites (5). The same pattern of increased congenital defects (12%) with a higher excess of neural tube defects (54%) was found in a study of ethnic minorities near waste sites in the US (6). Chromosomal and other major anomalies (facial clefts, megacolon, renal dysplasias) were found in a study of 70 incinerators in France.**

Asthma and Respiratory Disorders

Incinerators produce vast amounts of fine particulates. Particulate pollution has been shown to increase the incidence of asthma in children (7,8), to reduce immunity (9,10,11), to be associated with higher rates of ear, nose and throat infections (7), increased frequency of respiratory symptoms (12,13), increased duration of infections (14), loss of time from school (16) and significant permanent reduction in peak flow from fibrosis with progressive declines in respiratory function (16,17). The greatest declines have been shown to occur in those who spend more time outdoors. Similarly with asthma the greatest effect is on children who do outdoor sports who have a threefold increase (compared to no increase in unpolluted areas) (18).

Other Illness

The Sint Niklaas study showed an excess of autism, hyperactivity, allergies, asthma, repeated infections and congenital defects. Data from this country shows increased autism rates near incinerators: being 1 in 85 near the Edmonton incinerator and 1 in 30 in parts of Birmingham sandwiched between two incinerators (Tysley and Dudley). Average in UK 1 in 180.

Effects on the Foetus

Chemicals and pollutants that the mother is exposed to during her lifetime will build up in her fatty tissues and in pregnancy these will be actively transported across the placenta into the tiny body of the foetus. Foetuses have virtually no protection against toxic chemicals as they have no fat stores. They store them in the only fatty tissue they have: the brain and nervous system. During the first 12 weeks of life the foetus will be affected by miniscule amounts of chemicals, particularly oestrogenic chemicals and these can be neurotoxic and lead to behavioural disorders (19). Small amounts of PCBs and dioxins can affect neurological development, sexual development of the brain and cause altered expression of genes (20) and alter thyroid status (19,21). These chemicals can affect immunity and be associated with high incidences of middle ear infections and recurrent respiratory infections (22).

Breast Feeding

The situation with breast feeding is already extremely serious as it is known that 90% of samples contain about 350 chemicals. This is higher in industrialised areas showing that inhalation of toxic substances is important (23). The daily dose of toxic substances taken in from breast-feeding can be 50 times greater than that taken in by an adult (24). This has been shown to affect neurological development (25). Sadly breast-feeding is one of the few effective ways of reducing the mother's toxic load. There is no question

that an incinerator would add to this already dangerous chemical load and there is no justification for this as safe technology exists for waste disposal.

The Next Generation

It has been clearly demonstrated in animal studies that chemicals can cause cancer in not only the exposed animals but also its offspring for several generations (26). We now know that both chemicals and heavy metals can form DNA adducts and these can be passed on to the foetus. This is very worrying scenario and demonstrates the importance of the precautionary principle and avoiding further pollution.

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Report on the health impact of the MIWA-waste incinerator in Sint-Niklaas Belgium

http://www.ecomed.org.uk/content/IncineratorReport_v3.pdf
The Health Effects of Waste Incinerators 4th Report of the British Society for Ecological Medicine

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3305392/

Contamination of livestock due to the operation of a small waste incinerator: a case incident in Skutulsfjörður, Iceland, in 2010

Thorhallur I Halldorsson,[1,2] Guðjón Atli Auðunsson,[#3] Rannveig Guicharnaud,[4] Ólafur R Dýrmundsson,[5] Sigurður Örn Hansson,[6] and Kjartan Hreinsson[<image001.jpg>6]
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Supplement

Environmental contaminants and animal health. Proceedings of the 26th Symposium of the Nordic Committee for Veterinary Scientific Cooperation (NKVet)

Conference

Environmental contaminants and animal health. The 26th Symposium of the Nordic Committee for Veterinary Scientific Cooperation (NKVet)
6-7 October 2011
Helsinki, Finland

Go to:

Abstract

Summary

Background

In 2010 contamination by dioxins and dioxin-like PCBs was detected in milk and meat in the valley Engidalur situated at the bottom of a fjord (Skutulsfjörður) in North West Iceland. The valley is narrow and surrounded by high mountains resulting in prevailing calm weather. The contamination was traced to a small municipal waste incinerator operating in the valley. Annual agricultural production in Engidalur was modest (≈6 tons of meat and 45 tons of milk). The Icelandic Food and Veterinary Authority conducted a series of measurements examining the contamination and the results are reported in this paper.

Results

Earlier inspection of the waste incinerator had shown dioxin levels in fly ash of 2.1 ng I-TEQ/m^3, which exceeded the EU maximum limit of 0.1 ng I-TEQ/m^3. Late in 2010 routine inspection found 4.0 pg WHO-TEQ/g for PCDD/Fs and 7.4 pg total WHO-TEQ/g fat in one milk sample from a farm in Engidalur; levels exceeding the EU maximum limits of 3.0 and 6.0 pg WHO-TEQ/fat for dairy fat, respectively. These results were confirmed in an additional milk sample. Elevated levels exceeding the maximum limits were also observed in one out of two beef samples collected from the farm (4.7 pg WHO-TEQ/g for dioxins and 12.3 pg total WHO-TEQ/g fat). Elevated levels in lamb and ewe meat were also observed but concentration varied greatly, reflecting different migration routes of animals during summer grazing and different sources of hay used during winter. A composite sample of hay from Engidalur had levels of PCDD/Fs of 0.85 pg WHO-TEQ/g and 1.36 pg total WHO-TEQ/g; levels that were marginally, but not significantly, above the EU maximum limit of 0.75 pg WHO-TEQ/g and 1.25 pg WHO-TEQ/g, respectively.

Br J Cancer. 1996 March; 73(5): 702–710.
PMCID: PMC2074344 http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2074344/

Cancer incidence near municipal solid waste incinerators in Great Britain.

P. Elliott, G. Shaddick, I. Kleinschmidt, D. Jolley, P. Walls, J. Beresford, and C. Grundy
Small Area Health Statistics Unit, Department of Public Health and Policy, London School of Hygiene and Tropical Medicine, UK.

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This article has been cited by other articles in PMC.

Abstract

By use of the postcoded database held by the Small Area Health Statistic Unit, cancer incidence of over 14 million people living near 72 municipal solid waste incinerators in Great Britain was examined from

1974-86 (England), 1974-84 (Wales) and 1975-87 (Scotland). Numbers of observed cases were compared with expected numbers calculated from national rates (regionally adjusted) after stratification by a deprivation index based on 1981 census small area statistics. Observed-expected ratios were tested for decline in risk with distance up to 7.5 km. The study was conducted in two stages: the first involved a stratified random sample of 20 incinerators; the second the remaining 52 incinerators. **Over the two stages of the study was a statistically significant (P<0.05) decline in risk with distance from incinerators for all cancers combined, stomach, colorectal, liver and lung cancer.** Among these cancers in the second stage, the excess from 0 to 1 km ranged from 37% for liver cancer (0.95) excess cases 10(-5) per year to 5% for colorectal cancer. There was evidence of residual confounding near the incinerators, which seems to be a likely explanation of the finding for all cancers, stomach and lung, and also to explain at least part of the excess of liver cancer. For this reason and because of a substantial level of misdiagnosis (mainly secondary tumours) found among registrations and death certificates for liver cancer, further investigation, including histological review of the cases, is to be done to help determine whether or not there is an increase in primary liver cancer in the vicinity of incinerators.