Impregnation by Dioxins and Incidence of Cancers Near to Household Refuse Incineration Plants.

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Following several health crises triggered by the unease of populations living in the neighbourhood of incinerators, l'In VS and l' Afssa published reports in 2003 recommending the production of two epidemiological studies on a national scale. These studies have been realised and their first results have been made public to the Journals of Enviromental Health in November 2006.

The study 'Cancers' suggested evidence a statistically significant link (in relation to exposure/risk) between residing under the plumes of old incinerators and the occurrence of several cancers (liver, Hodgkins Lymphoma, sarcoma of the soft tissues and breast).
Though a statistically significant increase in risk is shown, the increase is small in comparison to many other cancer risk factors, the increase in risk being in the order of 5 to 10 % for very exposed persons in contrast to less exposed people.

The study "Impregnation" shows that the levels of dioxins measured today in the blood of people living in the neighbourhood of incinerators are not more raised statistically than in people not exposed. One can note, however, that agricultural consumers of local animal products (meat, milk products, eggs) living in the vicinity of older, more polluting, incinerators have a higher level of dioxins statistically than people not exposed. This difference is not found in the vicinity of more recent incinerators.

The statistical link found in the study 'Cancers' does not allow, by itself, one to establish a causality between the polluting emissions of the incinerators and cancer, but it supports other studies which are going in the direction of this hypothesis. Besides, there are other substances besides dioxins that can be implicated: metals, aromatic hydrocarbons, polycyclic aromatic hydrocarbons and dusts. Also this link reflects a situation of old exposure (years 1970- 80) which is very different from the actual situation today, because the incinerators today are better controlled and less polluting. The results of the study 'Impregnation', which reflects a more recent exposure (years 1990-2000), illustrates this improvement.

Abstract

Study of absorption of dioxins of populations living in proximity to household waste incinerators

France possesses the most significant number of household incineration plants (UIOM) in Europe. Their number has been divided around three since 1998 and this reduction has been accompanied by the putting in place conformity of existing installations and the closure of a large number of old installations and the construction of new installations. The discharges of the UIOM in France has therefore reduced since 1998

However, questions have been posed by nearby residents of these installations as regards to their impact on health. These investigations have been linked to, on the one hand, the persistence of certain chemical substances emitted into the environment, notably dioxins, certain metals and on the other hand, the presence, meticulously noted, of these substances in elevated levels in food such as cows milk produced in proximity to incinerators having emitted a great deal of dioxins.

Because of the raised levels of emissions for certain sites, the question was posed to know if the residents near the UIOM were really exposed to dioxins. Some studies carried out abroad have estimated, with the aide of biological indicators, the absorption of dioxins by these residents, absorption which transfers to levels of the organism. The results have concluded that to live around a UIOM had little influence on the concentrations levels of dioxins in the residents (Evans 2000, Schmacher 1999, Demi 1996, Gonzales 1998)

Nevertheless, these works did not take account either the zone of fall out of the plume of the incinerator, nor the principal method of uptake of dioxins, that is the consumption of food. Two studies have taken into account consumption of local food of the residents near to UIOM with strong emissions of dioxins: (a) A Taiwanese study (Chen 2006) which showed an absorption of dioxins a little higher in residents near to incinerators consuming local products and an absorption less by vegetarians and

(b) A Belgian study (Fierens 2003) which showed that the consumption of animal fat sources from local products (meat, eggs, or milk products) obtained under the fallout plume of the incinerator, was associated with an augmentation of concentrations levels of dioxins of the nearby residents.

In 2004 the Institute of Health watchdog (InVS) issued in collaboration with the Agence Francaise de Securite Sanitaire des Aliments (Affssa) a national study, financed by the body Plan Cancer to reply to the following question:

Populations living around the household waste incinerators, are they more impregnated by dioxins than those living further away? And if so Why?

The objectives of the study are to be able:

(i) To estimate the absorption of the dioxins of the populations living near to a household waste incineration plants (UIOM), and compare it to a population not exposed who were not living near to an incinerator.

(ii) To identify the factors influencing this absorption in populations living near to a UIOM.

One important particiularity of this study is to search for a better understanding of the role of behaviour foodstuffs on the absorption by dioxins and notably the influence of the consumption of local products. It is a question of a study of absorption which has not for the objective to study the impact of dioxins on the health, that which would necessitate other methods.

At this time, the only French data available of absorption by dioxins in the general population are those of the content in mothers' milk measured in 1998 (InVS 2000). In complement of the stated objective, this study is going to supply the first given on the levels of dioxins measured in the blood serum in the general French population through the levels observed in the population not exposed to an incinerator. This study distinguished itself from all the other international studies on the subject by its extent and the specific and very detailed approach to foodstuffs.

Study of the incidence of cancers in the proximity of household waste incinerators

Department of Environmental Health

Analysis of the Preliminary Results

Introduction

Since 1970, France has had recourse to incinerators to eliminate household waste.
The conditions of exploitation and the value of limits of emission of pollutants in the atmosphere were less severe then than those imposed today by regulation. Although the number of household waste incineration plants and their discharges have greatly diminished since 1990, disquiet has installed itself in the neighbouring residents about the impact of these installations on their health.

These household waste incinerators are fed by refuse of a very diverse nature which contains organic materials, plastic matter and metals. The atmospheric emissions from these industrial installations include a complex mixture comprised of oxides of nitrogen and sulphur, particles, dangerous substances initially present in the refuse such as heavy metals (cadmium, thallium, lead, arsenic, chrome, copper, manganese, nickel, mercury) and notably, when the incineration process is incomplete, compounds such as dioxins, furans and polycyclic aromatic hydrocarbons at the time of combustion of primary materials.

People living near to incinerators are potentially exposed to pollutants emitted into the atmosphere by the inhalation of polluted air, by the consumption of water or or by contaminated food products, or by cutaneous contact with the soil.(1-3)

The toxicity of an exposure to the majority of these substances or families of substances which has been demonstrated in animals in experimental studies is strongly suspected in man.

Epidemiological studies have shown in particular that an excess of risk of cancer was able to be associated with raised levels of dioxins, in a working environment or in an accidental situation (5,4)

However, the transposition of these results to the general population is difficult because, on the one hand, professional exposures are generally of a higher intensity than environmental exposures and on the other hand the workers differ from the general population in terms of age, sex, lifestyle and are usually in good health (“worker health bias”) (5)

Studies, recently conducted in the general population (6,8) in France have shown an excess of risk of malignant lymphomas, non-Hodgkins lymphomas

and sarcomas of the soft tissue in populations residing near a household waste incinerator. It is one of the first environmental studies conducted in France relating to low concentrations of toxins from the discharge from these industrial installations

In 2003 l'InVS suggested a national study financed by the organisation Plan Cancer to evaluate the risk of cancer linked to the exposure from household waste incinerators. The first results of this work are presented in this document

Objective

The general objective of the study was to analyse the relationship between the risk of cancer in adults and their exposure to the atmospheric discharges from the household waste incinerators.

Methods

Ecological Study

The level of statistical observation is collective and not individual. The data has thus been collected on the level of districts or, for those comprising more than 10,000 inhabitants, of their subdivisions: les IRIS (small islands grouped for statistical information).

Study Area

This epidemiological study concerned four French metropolitan departments in order to compare within the population the number of cancers arising between 1990- 1999 according to the level of exposure to the plumes of incinerators.

The four departments concerned are *l'Isere*, *le Haut-Reine*, *le Bas Rein* and *le Tarn* which have available adequate registers of cancers and which had a total of 16 incineration plants active between 1972 and 1990.

The analyses concerned a collection of adult cancers and cancers described in scientific literature as being the most common in the vicinity of incinerators or associated to exposure to dioxin: cancer of the lung, cancer of the liver, cancer of the breast, malignant lymphomas non-Hodgkins and sarcomas of the soft tissues. Thus 135 567 cases of cancers were evaluated within a population of 2.5 million people over a period of 10 years (1990-1999)

Duration of Study

The duration of the study was defined as stretching from the start of incineration, ie 1972 at the earliest, to 1985 so as to take into account a period of average latency of 10 years between the exposure and the appearance of cancer.
The exposure to a collection of potentially carcinogenic chemical substances was able to be estimated on the scale of IRIS by spatial modeling. The

dispersion of plumes emitted by the incinerators and the quantities of pollutants spread on the ground were calculated by computer.

The modeling took into account the technical characteristics of the incinerator and their evolution during the time and also included factors such as the meteorological parameters and topography of each site.

The accumulation of, and the degradation of, pollutants spread in the environment were equally integrated. Other environmental factors liable to influence the frequency of cancers and included in the statistical analysis were: the urban density, the socio-economic level, the status urban/rural, atmospheric pollution due to road traffic and the density of industrial material.

Quality Assurance
These internal procedures assured and controlled the quality, the confidentiality and the security of the data during the duration of the study.

Scientific Expertise
The protocol and the results were validated by a scientific committee uniting experts in epidemiology, biostatistics and environmental health.

Example of the modelling of the deposits of the surface of incineration??
Incinerator de la Tronche, Isere

Results

The study concerned 135 567 cases of cancer collected from 25 000 000 person -years and split up into 2 272 units of observation (IRIS) (see **Methods**)

The analysis gave evidence of a statistical link between the level of exposure to incinerators in the years 1970-1980 and the growth of frequency of certain cancers in the course of the years 1990-1999.

The relationship between exposure and significant risk are summarized in the following table, illustrating the excess risk of cancer between different thresholds of exposure with (in parentheses) a confidence interval of 95%.

The data indicates, for example, that women who were residing in an IRIS with average exposure had a risk of cancer (all locations added together) raised by 2.8% compared to those living in a less exposed IRIS, and that those who were living in a strongly exposed IRIS had a risk of cancer raised 4% in comparison to inhabitants of less exposed IRIS.

Only statistically significant relationships illustrating the increased risk are shown

The value of $p < 0.05$ signifies that the probability that this relationship was not linked to the hazard is less than 5%.

EXCESS RISK OF CANCER, BY SITE, FOR INHABITANTS OF CENSUS BLOCKS WITH INTERMEDIATE AND HIGH EXPOSURE, COMPARED TO RESIDENTS OF SLIGHTLY EXPOSED CENSUS BLOCKS			
Sites	Excess risk for residents of census blocks with intermediate exposure (50^{th} percentile compared with the 2.5^{th} percentile)	Excess risk for residents of census blocks with intermediate exposure (90^{th} percentile compared with the 2.5^{th} percentile)	P values
Liver Cancer (both sexes)	6.8% (0.1 – 14.1)	9.7% (0.1 – 20.3)	p<0.05
Malignant non-Hodgkins lymphoma (both sexes)	1.9% (0.0 – 3.8%)	8.4% (0.2 – 17.2)	p<0.05
Soft-tissue sarcoma (both sexes)	9.1% (-1.7 – 20.9)	12.9% (-2.3 – 30.6)	p=0.1
All cancers in women	2.8% (0.7 – 5.1)	4.0% (0.9 – 7.2)	p<0.05
Breast cancer in women	4.8% (2.0 – 7.7)	6.9% (2.9 – 11.0)	p<0.05

The analysis provided evidence of a statistical link between the level of exposure to incinerators in the years 1970-1980 and the growth of frequency of certain cancers in the years 1990-1999.

We observed for example, that for all cancers together in women, the residents exposed to a median value of exposure have a risk of cancer increased by 2.8% in relation to people residing in the less exposed IRIS (2.5 ieme percentile)

At the same time, when one considers populations strongly exposed (90 ieme percentile of exposure) the risks of all categories of cancer in women is increased by 4% in comparison with people residing in the less exposed IRIS

Discussion

The strengths this study are the significant size of the population under consideration, the quality of the data furnished by the registers of cancers, the utilisation of all the data available and the use of powerful modeling techniques to analyse the population exposures, taking into account the principal factors cited in scientific literature and potential confounding factors that could be measured at a collective scale, and the quality of statistical analytical methods used.
Its limits are similar to those of all studies where exposure is estimated at a community as opposed to individual level. As the residential history of the people and certain personal characteristics have not been taken into account such as: local or not, food consumed, type of food, smoking habits, alcohol consumption, professional exposure to toxic substances.

The study by itself, does not permit the establishment of a causal link in the report given in evidence.

However, it furnishes arguments in favour of links already observed in other studies and brings a new element in suggesting a growth, in women, of the risk of all types of cancers. The greatest increase in risk is observed for sarcomas of the soft tissues however, the rarity of this pathology leads to the significance of the statistical relationship being weak.

This retrospective ecological study shows that there exists a significant association between the incidence of certain cancers and exposure to the discharge of incinerators. The principal points of this study are the following:

- It is about a multi-centered study important in terms of size of population and the number of incinerators concerned. These important and contrasting samples allow the statistical weight necessary to give evidence of the risks linked with rare cancers amongst the population.

- Estimation of exposure has used all the available data and benefited from high performance techniques for modeling the dispersion of atmospheric pollution. This has allowed the most accurate approach possible of the exposure of populations residing around incinerators

- Use of the latest developments in spatial statistical analysis has permitted as much reduction of statistical uncertainly as possible

- The quality and abundance of the data furnished by the registers – in terms of comprehensiveness and accuracy.

- Taking into account the principal factors of confusion stated in scientific literature.(9)

The limits of this study are those of all ecological study in which exposure is estimated on the scale of the community and not at an individual level. Thus the residential history of people and certain personal characteristics have not been taken into consideration: local origin, whether food consumed is grown

locally, type of foods, nicotine addiction, alcohol consumption, professional exposure to toxic substances.

The impossibility of arranging data of very old exposures (1972-1990) reliable and precise, at the same time on the explanation in cause and on the other potentially confusing factors of exposure (routine pollution, industrial pollution, environment urban /rural) has made preferable the utilisation of recent more robust data to describe the level of exposure in the path. This was able to take off the errors of classifying or adjusting in taking into account factors of confusion.

The choice of periods of latency of occurrence of the pathogens - respectively 5 years for the leukemias and 10 years for the other cancers - was made for operational reasons and in the absence of strong epidemiological data in the literature. The choice of these short periods of latency would be to have the effect of reducing the statistical links shown in this study.

Dioxins have been used as a ‘marker’ of the pollution emitted by the incinerators. However, the relations shown in evidence express a link between the occurrence of cancer and global exposure to discharges from incinerators without it being possible to say which are individual pollutants are actually responsible.

The analysis of the role of the co-variables such as the influence of sociological factors in raised occurrences of cancer of the breast, the absence of a relationship found for cancer of the bladder, cancer control, or the major role played by living in a rural or urban environment for cancer of the liver, are coherent with literature. They emphasise the quality and the validity of material and methods put to work in this study

This study, by itself, does not allow us to establish a causal connection between the relationships taken in evidence. However, it furnishes arguments in favour of relationships already observed in other studies and brings a new element in suggesting an increase of the risk several cancers in women including cancer of the breast.

Conclusion

The first results of this study give evidence of a significant relationship between the place of residence under the discharge from an incinerator from 1972 to 1985 and the growth of risk of certain cancers: in women, all cancers and breast cancer, and without taking account of sex, cancer of the liver and malignant non- Hodgkins lymphomas. This last relationship is coherent with the results of a previous French study. The study also suggests a link between sarcomas of the soft tissues

The interpretation of this data necessitates further study and does not lead, at this stage, to recommending public health decisions.

The study analyses a previous situation, these results should not be applied to situations actually generated by today's less polluting and better controlled incinerators.