COMMITTEE ON CARCINOGENICITY OF CHEMICALS IN FOOD, CONSUMER PRODUCTS AND THE ENVIRONMENT

Paper by Knox on "Childhood cancers and atmospheric carcinogens" (J Epidemiol Community Health (2005) *59*:101-105).

Introduction

1. This recently published paper is being considered as part of the committee's current review on childhood cancer. The paper has stimulated some press and parliamentary interest. It is attached at Annex 1, together with a short web-only technical appendix.

Methods

2. The study used birth and death addresses of all children (aged 0-15) in Great Britain dying from leukaemia or other cancer between 1966 and 1980. The cancers were classified into 11 main groups (lymphatic, myeloid, monocytic and unclassified/other leukaemias; lymphomas, nephroblastoma, CNS tumours, neuroblastoma, bone cancers, other solid cancers, and fatal 'benign' tumours). [The author states that each leukaemia type and cancer type was analysed individually, together with the grouped reticuloendothelial cancers, the grouped 'solid' cancers and all cancers together, but results for individual cancers types or groups are not presented]. Home address at death was available for all children and, "where the parents were subsequently interviewed", the birth address was also obtained. Post codes (PCs) were identified and the map reference of the 'first' address within the PC was extracted from the Central Postcode Directory (1).

3. The atmospheric emissions data was taken from maps published on the Internet by the National Atmospheric Emissions Inventory (NAEI). The maps present atmospheric emissions of various pollutants across the UK (see Figure for example of the 2002 emission map for sulphur dioxide). The inventory is compiled from various sources, such as:

- The Environment Agency's Pollution Inventory, which is compiled from returns from various industrial processes for emissions of specified substances to air and water.
- Emissions from traffic estimated from traffic activity statistics and known emission factors
- Domestic emissions, estimated from DTI fuel consumption data.

The maps use surrogate statistics on population density and industrial activity to estimate emission levels for those pollutants for which the source location is unknown.

4. The author colour-coded the data corresponding to the emission-scale, with red indicating the highest emission levels. For each pollutant, the distances from the birth and death addresses of each child to the nearest, arbitrarily chosen "hotspot" (red

colour code) was measured. “Mean nearest (hotspot) distances (truncated to a maximum 50.0km), and means of individual distance differences, were tested against standard errors: and outward/inward ratios through χ^2 tests. All results subsequently quoted were extremely significant and p values and not individually set out.”

5. The author calculated estimates of the relative risks of being born close to, or distant from, an emission hazard among children who had moved more than 1 km between birth and death, and who had one address within 1 km of the nearest hazard point and the other address more than 1 km away from the nearest hazard point. Outward/inward ratios substantially greater than 1.0 were taken to represent the selective cancer-initiating effects of the birth locations themselves. These relative risks were then used to calculate the proportions of sub-1 km cancer births attributable to each hazard; and, through reference to the total number of sub-1 km births, to estimate the proportion of all cancers that might be so caused.

Results

6. There was a higher proportion of outward to inward migrations near hotspots for carbon dioxide, PM10, nitrogen oxides and carbon monoxide but not near hotspots for sulphur dioxide (see Annex 1, Table 1). There was also a higher proportion of outward to inward migrations near hotspots for all the volatile organic compounds (VOCs) studied, i.e. total nonmethyl VOCs, benzene, benz(a)pyrene, 1,3-butadiene and dioxins (as TEQs) (Annex 1, Table 2). The author comments that, for 1,3-butadiene and dioxins, the ratios increased at shorter address distances from hotspots. In the case of atmospheric emissions of those metals which were studied, the ratios of outward to inward migrations were all less than 1.0 (see Annex 1, Tables 3 and 4).

7. Attributable risks per 100 cases of childhood cancer are given in Annex 1, Table 5 for selected pollutants.

Comments

8. A number of comments can be made about the paper:

- The NAEI points out that the maps represent emissions but not ambient concentrations of pollutants. Therefore, they do not directly represent the air as breathed. Many of the largest emissions of some pollutants will come from tall chimneys.

- The data in the inventory are of differing quality for different pollutants. For sulphur dioxide, which is derived mainly from regulated processes, and nitrogen oxides, derived mainly from traffic, the data are reasonably good. For dioxins and PAHs, which come largely from non-regulated sources, they are limited (2).

- The data on childhood cancer deaths and air pollution are not contemporaneous. Air pollution patterns have changed between 1966, 1980 and 2001. The author comments that most changes were improvements in emissions and that most of those still existing in 2001 would be at least as active when these children were born. He also comments that the analyses were based on hotspot distances rather than levels. However, there are also changes in the types and patterns of air pollutants in this time – for example in traffic emissions in areas close to motorways and emissions from coal mining areas.

- There was no adjustment for socioeconomic confounding or other potentially confounding factors.

- The health data related to cancer deaths rather than cancer incidence, although the author has previously commented, in relation to the complete set of childhood cancer deaths from 1953 to 1980, from which the data in the current study were taken, that "..over 75% of the children died within 5 years of diagnosis..".

Questions for the committee

9. The committee is asked for comments on the methodology employed in this study:

- Is a study of outward and inward migration of children with cancer in relation to pollution sources likely to produce useful data on the aetiology of childhood cancer?
- Is the study flawed by the fact that 2001 data have been used for exposure estimation, whereas the health data are for 1966-1980?
- Does the committee consider that the results indicate a cause for concern? If so, what further work does the committee recommend?

Secretariat
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References

1. Knox EG, Gilman EA (1998). Migration patterns of children with cancer in Britain. J Epidemiol Community Health **52**: 716-726.

2. J Stedman, AEA Technology. Personal communication.