

COMMITTEE ON THE MEDICAL EFFECTS OF AIR POLLUTANTS

Statement on the Applicability of time-series coefficients to areas affected by emissions of air pollutants from industrial sources September 2000

Introduction

Members of COMEAP discussed this problem at the meeting on 16 June 2000. This statement is based on that discussion. Further information on the problem may be found in COMEAP paper 2000/10.

Statement

1. It was agreed that coefficients reported in time-series epidemiological studies linking concentrations of air pollutants and measures of ill-health, could be used to estimate the effects of air pollutants emitted by industrial processes on the health of people living in areas affected by such emissions, provided that the uncertainties of this approach were acknowledged. This advice relates to the coefficients used for sulphur dioxide, ozone and PM₁₀ in the quantification report published by COMEAP in 1998.¹
2. It was further agreed that whilst such an approach might well provide useful estimates of effects on health, the extent of these uncertainties could not, at present, be established.
3. Members identified a number of factors and assumptions that would contribute to the uncertainty of the estimates. These are listed below.
 - (i) In applying the above approach it is assumed that the spatial distribution of concentrations of the air pollutants considered is the same in the area under study as in those areas, usually cities or large towns, in which the studies which generated the coefficients were undertaken.

- (ii) It is also assumed that the temporal pattern of pollutant concentrations in the area under study is similar to that in the areas in which the studies which generated the coefficients were undertaken.

Both (i) and (ii) above are more likely to be met as the size and nature of the areas studied approach those used in the original coefficient-generating work (the reference areas).

- (iii) It should be recognised that a difference in the pattern of socio-economic conditions between the areas to be studied and the reference areas could lead to inaccuracy in the predicted level of effects.
- (iv) In the same way, a difference in the pattern of personal exposures between the areas to be studied and the reference areas will affect the accuracy of the predictions of effects.

It will be seen from (iii) and (iv) that some comparisons of the study areas and the reference areas should be undertaken before making calculations of effects. For instance, it might well be unwise to use coefficients derived from studies in towns undertaken in deprived urban areas to predict effects in comparatively affluent rural areas.

- 4. In all of the work of the kind considered here a number of assumptions regarding the toxicological properties of the air pollutants considered have to be made. These include:

- (i) Linearity of the relationship between ambient concentrations and effects. This assumption is well supported for key pollutants at common ambient concentrations.
- (ii) In the case of particles it is assumed that the toxicity of the ambient aerosol represented by a measure of the mass concentration of a specified fraction of the aerosol, eg, PM_{10} , in the study area is similar to that in the reference area. Most epidemiological studies have been conducted in urban areas where

transport-generated particles make a significant contribution to the ambient aerosol. Application of coefficients from such studies to areas in which transport-generated particles make only a small contribution will include an element of uncertainty.

- (iii) The annual average concentration of pollutants is frequently used as a basis for calculations: its use implicitly assumes that the effects of the pollutants are not characterised by a threshold of effect.
- (iv) If coefficients for several pollutants are applied and the calculated effects summed, it is assumed that the pollutants act independently and that the coefficients have been derived from studies in which this was tested and found to be supported by the evidence. Adding the effects attributed to particles and ozone is likely to be valid. The case for adding the effects attributed to particles and sulphur dioxide is less strong but probably acceptable. It would clearly be wrong to add the effects attributed to PM_{10} to those attributed to $PM_{2.5}$. Whether effects attributed to particles should be added to those that might be attributed to nitrogen dioxide or carbon monoxide seems dubious and this was not done in the COMEAP quantification report.¹

Finally, the following should be noted.

- (v) Estimates of effects made as described above exclude the possible effects of long-term exposure to air pollutants. Evidence to show that such effects may well be important has accumulated recently: the interpretation of such evidence is still under consideration.
- (vi) Coefficients are available for only a small group of air pollutants: no quantitative estimate of effect can be made for other pollutants.
- (vii) If estimates of effect are made for very small areas it is likely that only small numbers of for example, deaths or hospital admissions will be generated. It would be unwise to put too much weight on small differences between already small numbers: for example, 2 extra deaths as compared with 1 extra death.

5. Further research on this issue is important and should be considered for inclusion in future DH-DETR research programmes on the effects of air pollutants on health. The following should be considered:
 - (i) preparation of a detailed discussion paper exploring the problems that have been touched on above. This paper should review current knowledge of the distribution of personal exposure to pollutants at a city scale and at a local scale;
 - (ii) computer simulation of the effects of varying distributions of personal exposure on effects at a local level;
 - (iii) monitoring of personal exposure to pollutants especially in areas with different sources of pollutants, eg, roads as well as point sources such as industrial sites. Epidemiological studies relating personal exposures to effects on health would be valuable;
 - (iv) studies of the associations between concentrations of pollutants and effects on health at a local level. It may be that an approach similar to that used by the Small Area Health Statistics Unit would be suitable. The use of a classical time-series approach may be difficult because of the small population of local areas.

Reference

1. Department of Health. Committee on the Medical Effects of Air Pollutants. Quantification of the Effects of Air Pollution on Health in the United Kingdom. London: The Stationery Office, 1998.