

## 9.12 Surveys into the impact on health (epidemiological survey methods)

### 9.12.1 Introduction

Surveys in order to examine the impact of air pollutants on health, are broadly divided into epidemiological surveys on people and animal experiments. The results of animal experiments cannot be directly extrapolated to human, but animal experiment is highly suited to study on the damage mechanism, because it is possible to expose animals to various dose of a single pollutant and, further, is also useful especially into carcinogenic experiments. This chapter devotes itself to human epidemiological surveys, leaving methods of animal experiment for another occasion, and is centered on especially attention which should be paid when conducting those surveys into the impact of air pollution on human health.

### 9.12.2 Steps of epidemiologically evaluating air pollution

Pulmonary diseases induced by air pollutants are non specific diseases, and in many cases difficult to elucidate the causal relationship between air pollution and these diseases. For this reason, it is important to pay sufficient attention to the epidemiological design. Generally, a hypothesis is established as the epidemiological approach, and then examined for proof. Steps to this end can be cited as follows:

- ① Adequate understanding of the characteristics of the subjects.
- ② Understanding of the air pollutants exposure conditions cited hypothetically as being related to cause and effect.
- ③ Understanding of the distribution and frequency of the disease and the damage to health thought to be related to the cause and effect.
- ④ Understanding of the dose-response relationship, and estimating and determining the causal relationship.
- ⑤ Discussion of suitable countermeasures and preventive measures.

### 9.12.3 Actual process of epidemiological survey

#### (1) Preparing a protocol of survey

In order to examine the validity of the hypothesis, both a design and a protocol (written survey plan, written action plan) are necessary. Because the survey often involves many people, ideally everything should be put in writing, and all of the people can share and mutually understand the contents of the survey.

#### (2) Selecting subjective group

If examining the hypothesis that air pollution is bad effect on the health, the subjects should be selected from a region of high concentrations of air pollution, and the compared group should be from the countryside, or other areas where there is little air pollution. In this case, it is essential to understand the characteristics of the population. For example, it is important if the region does or does not have many work sites where people are exposed to the various causes of pulmonary disease. Further, there is the problem of disturbance factors such as smoking, age, sex,

and so forth. To process these out, the disturbance factors are accepted as they are, and the same methods and stratified sampling method as intended for the control group such as social class and age are stratified and equalized, thereby eliminating the disturbance factors.

### (3) Selecting the subjects of the survey

When the survey subjective group has been decided upon, a survey of the people belonging to that group is conducted. If possible, all subjects in the group should ideally be surveyed, but in many cases, a sample survey is conducted, due to the pressures of budget and staff numbers. Sampling methods are as follows: Case control study, and random sampling. Regardless of which, it is important that the subjects represent the population as far as possible. The proportion of numbers selected to the population is also important. During the analysis, it is important whether the examination is statistically correct or not. For this reason, because the necessary number of subjects can be determined by calculating backwards, if possible, it should be determined on that basis.

### (4) General items of a survey

- \* Items relating to the person: Sex, age, human race, physical condition, past history, social and economic status, residential history, occupation, religion, education, personal habits (smoking, dietary habits, etc.)
- \* Items relating to the person's residential environment: Residential site (beside a road, near a factory, etc.), detached house, multiple dwellings, airtight, age of building, types of coolers and heaters, etc.
- \* Items relating to the environment: Temperature, humidity, wind direction, topography, etc.

### (5) Survey into the respiratory symptoms

#### \* BMRC (British Medical Research Council) questionnaire

Following the problem of excessive deaths due to smog in London, the BMRC developed its standard questionnaire as a method of epidemiologically understanding chronic bronchitis, and published it in 1960. It was subsequently revised and the version actually in use dates from 1976. Because the BMRC questionnaire is for an interview, in order to obtain uniform results, the interviewers are required for training. To date, it has been translated into approximately 12 languages, but it is important to use appropriate terms suited to the customs and habits of the people in question, and if one part is changed, its suitability also needs to be discussed.

#### \* ATS-DLD (American Thoracic Society-Division of Lung Diseases) questionnaire

This questionnaire was compiled by experts in the Division of Lung Diseases at the American Thoracic Society, and made public in 1978. Because the American people felt somewhat alienated by the terms in BMRC questionnaire, an adults' version and children's version were both compiled with reference to the original. It is a self-completed questionnaire concerning both asthma-type symptoms and chronic bronchitis. In Japan, a version that has been partially amended from the original is used.

#### \* Test of pulmonary function

Both of the above are surveys based on subjective symptoms, but a test of pulmonary function is conducted as an objective index. Although it takes both time and effort, both objectivity and changes across the years can both be pursued. The indices are vital capacity, forced vital capacity, the forced expiratory volume % in one second, the

maximum peak flow, and so forth. Further, airway hyperreactivity in asthma can also be examined.

\* Immunological test

Blood is collected, and both IgE (Immunoglobulin E) and its complement, which form the allergy reaction indices, are measured.

(6) Exposure assessment

In the case of air pollution, because it is difficult to understand the individual exposure dose within a certain period, in many cases the local measurement point values are replaced with exposure levels for the local population. Recently, in some surveys, a personal sampler is used, and it is attempted to understand their exposure dose, but such factors as the limits to the sample numbers and that measurements can only be taken over one or two days at best are proving to be problematic.

(7) Analysis and evaluation

When investigating a hypothesis, a null hypothesis is established from the survey results, and as an opposing hypothesis to counter this, the alternative hypothesis is selected when the null hypothesis is rejected, and if it cannot be rejected, then the null hypothesis can be accepted. If a statistical correlation is identified, the quality of that data is sufficiently good, and if the disturbance factors are excluded as far as possible, it is possible to presume causal relationship between air pollutants and diseases.