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Maps that throw light on disease mortality

This article describes an atlas of disease mortality in the cities, towns and villages of Japan, based on data collected over a ten-year period. Copies have been distributed to medical schools, prefectural offices, and medical associations, where they are being used for the education of health workers and lay people, for planning purposes, and in epidemiological and other scientific studies.

Infectious diseases usually present peculiar geographical patterns and attempts to prepare distribution maps have been made by various workers. A group in Tohoku University School of Medicine made the first systematic study of the geographical distribution of diseases in Japan during the 1950s, computing age-adjusted cancer mortality rates for prefectures and publishing distribution maps for a number of cancer sites.

In 1975 a team at the United States National Cancer Institute completed a distribution map for cancer mortality among whites in small geographical areas. Work in Japan on the preparation of a detailed disease atlas was stimulated in part by this publication but mostly by mounting concerns over the health effects of environmental pollution and industrial activities in various parts of the country.

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Also important were the wider availability of computers and the development of data bases.

Making disease maps for Japan

We have tabulated death statistics for 3341 Japanese cities, towns and villages for the period 1969–78. The indirect method of age adjustment was used for each geographical unit in order to obtain stable results, even for towns and villages with small populations. Mortality was expressed by the standardized mortality ratio. The mortality rate for each 5-year age group during the period for the whole country excluding Okinawa Prefecture, which had been restored to Japan by the United States in 1972, was used as the standard. The numbers of people in 5-year age groups for each city, town and village, as determined in the 1970 and 1975 national censuses, were used to estimate the total population in 1973 by linear interpolation.

During the 10-year period there had been 290 instances of amalgamation of cities, towns and villages, establishment of wards

(administrative subdivisions of cities with populations of a million or more), or change of administrative status from town to city. Consequently, close attention had to be given to making adjustments for new boundaries. We employed the city, town and village subdivisions as they were on 31 December 1978 to cope with amalgamations during the period, and the subdivisions existing on 1 January 1969 for the establishment of wards.

The computation of standardized mortality ratios for each city, town and village in Okinawa Prefecture presented a difficulty because here death certificates were available for only the 6-year period from 1973 to 1978. To enable comparisons between Okinawa and the rest of Japan, the ratios for the cities, towns and villages of Okinawa were computed by using as standards the populations of these entities enumerated in the 1975 national census and the mortality rates for the 5-year age groups for Japan proper in 1973–78.

The resulting atlas *(1)* shows the distributions of deaths due to all causes, cancers of all sites taken together, cancers of the oesophagus, stomach, colon, rectum, liver, pancreas, lung, breast and uterus, ischaemic heart disease, hypertensive heart disease, cerebrovascular disease, cerebral haemorrhage, cerebral infarction, subarachnoid haemorrhage, cirrhosis of the liver, diabetes mellitus, and tuberculosis. It contains 51 plates, including maps, showing the standardized mortality ratios for each disease, in each sex where appropriate, and the results of tests of significance for 13 diseases in males. An automatic cartography system was developed by the authors for the purposes of the atlas.

The figure, an example of a disease map, shows the results of tests of significance for cancer of the oesophagus among males; the original was printed in two colours.

Because the atlas was based on data for cities, towns and villages there was a larger random error than there would have been

The atlas has stimulated local governments to prepare disease maps for their own areas.

using observations made at prefectural level — the number of deaths per geographical unit was small. In order to resolve this problem, the disease maps mainly use standardized mortality ratios for classification and the results of tests of significance are presented separately. These maps differ from those produced in other countries, where levels or percentiles of age-adjusted mortality rates and the results of tests of significance are combined in the classification of mortality data. Our method was employed to prevent exaggeration of the results of geographical units with large populations and to enable lay people, not versed in significance tests, as well as experts, to use the atlas.

In the disease maps produced in the USA, the boundaries between the units of observation, i.e., the counties, are not shown, whereas in the Japanese maps the boundaries between cities, towns and villages are indicated. This is intended to give a better understanding of the nationwide pattern of disease distribution and to stimulate interest in local patterns. Five different colours are used in the Japanese maps because adequate contrast cannot be attained by different shades of the same colour for very small areas in densely populated cities.

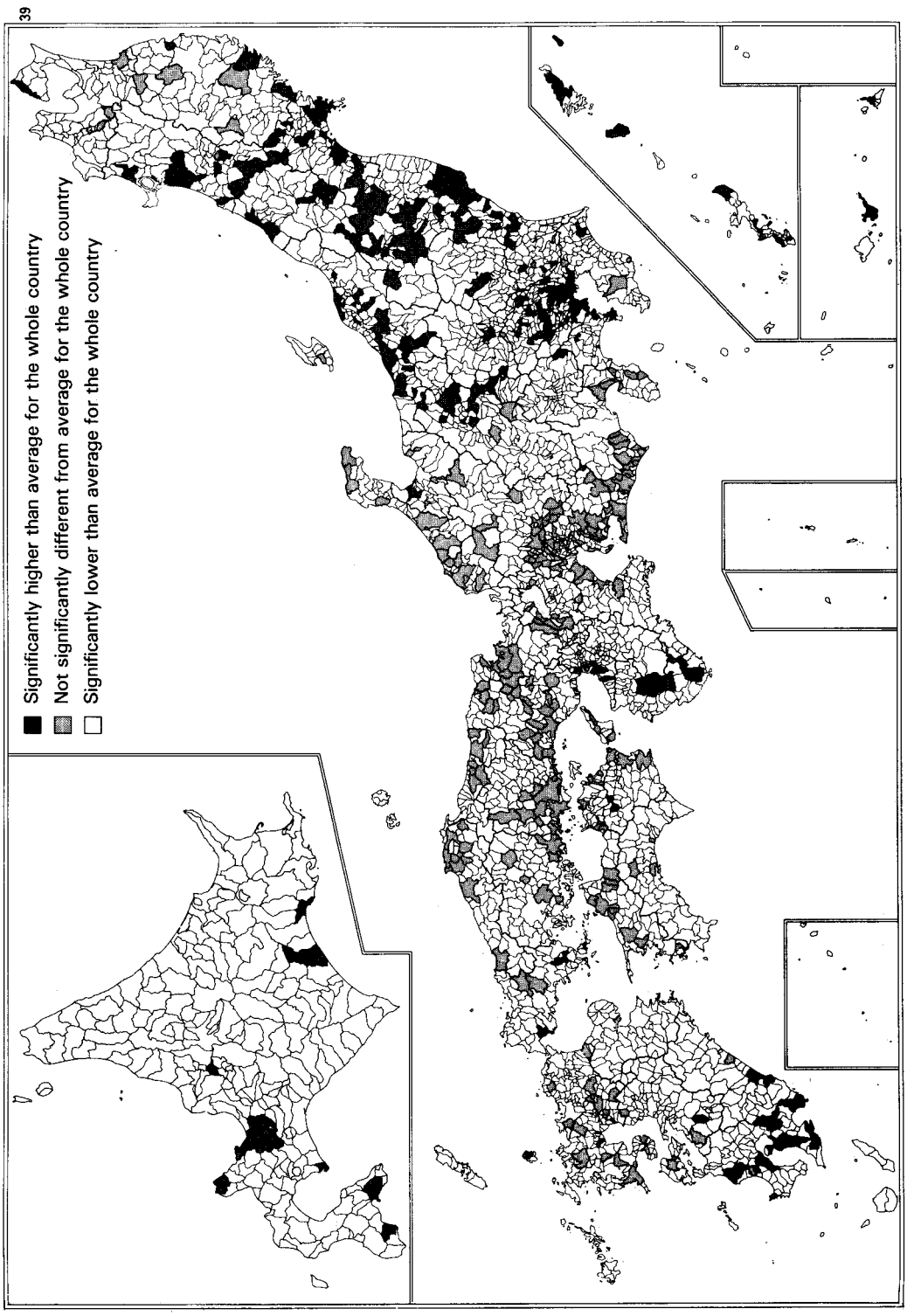

Fig. 1. Oesophageal cancer map. Results of significance test of standardized mortality ratio for cities, towns and villages in Japan, 1969–78 *(1)*.

A number of problems are shared by disease maps of this type. The maps for Japan, the United Kingdom, and the USA, though called disease maps, are in fact distribution maps of mortality rates. Thus with regard to such diseases as diabetes mellitus, breast cancer, and uterine cancer, which are not highly fatal, the maps may not accurately reflect the morbidity pattern. However, since morbidity statistics cannot be obtained with uniform accuracy throughout the country at present, there does not seem to be any alternative.

Another problem is that the maps relate to the place of residence at the time of death, no consideration being given to past residential history. Whether the geographical differences shown in the maps can be accepted at face value therefore requires prudent evaluation.

Geographical distribution of diseases

Each of the diseases recorded in the atlas has a specific geographical distribution. However, there are groups of diseases with some features of distribution in common.

Differences between east and west

The typical diseases causing high mortality in east Japan are cerebrovascular diseases, including cerebral haemorrhage and cerebral infarction; in the west, however, high mortality is caused by liver cancer, liver cirrhosis and tuberculosis.

Differences between coastal and mountainous regions

The diseases producing high mortality in the coastal regions are all cancers taken together, gastric cancer, and lung cancer, whereas those producing high mortality in the mountainous regions are cerebrovascular diseases, particularly cerebral haemorrhage.

Differences related to sex

In general, the geographical distribution of disease is almost identical in males and females. However, in southern Kyushu the mortality rate for oesophageal cancer is less high in females than males, while it is higher in females than males in the Kii Peninsula.

Local clustering

High mortality rates for liver cancer and cirrhosis occur in part of Yamanashi Prefecture where there was a high prevalence of schistosomiasis. Differences are often observed between the central and residential wards of Tokyo, the former showing a tendency for high mortality rates associated with lung cancer, hypertensive heart disease, cerebrovascular disease, liver cirrhosis, and tuberculosis, and the latter showing a high mortality rate for cancer of the colon.

Effect of mortality rate

In general, as diseases associated with high mortality have small random variation in mortality rates, they show a clear geographical pattern. On the other hand, for diseases associated with low mortality, such as cancer of the colon, rectal cancer, subarachnoid haemorrhage, and diabetes mellitus, the variation is large, the geographical distribution tends to be poorly defined, and the maps of tests of significance show significant differences in few cities, towns and villages. However, a relatively large number of areas show significant differences for oesophageal cancer, despite

its low mortality, suggesting that a geographical pattern can be established even for diseases causing few deaths, provided that regional differences are sufficiently large.

Uses of disease maps

Various geographical and epidemiological studies are in progress using these maps and/or the mortality statistics. We have studied the relationships between lung cancer and industrial activity, between food intake and cerebrovascular disease or cancers of the stomach and colon, and between prostatic cancer and manganese mining. One result, for example, was that standardized mortality ratios for lung cancer were comparatively high in urban areas and in those where there were metal refineries, coal mines and fishing harbours *(2)*. A study is being conducted in six prefectures to compare the environmental factors of areas with and without high rates of cerebrovascular disease and stomach cancer. In view of the high mortality rates associated with lung cancer in areas with fishing harbours, a case-control study was conducted in fishing areas; this revealed the mortality rate for lung cancer to be higher among fishermen even after adjustment for smoking history. A study has been made of the elevated mortality rate for cerebral apoplexy in cold areas.

The disease atlas was distributed free of charge to medical schools, prefectural offices, and prefectural medical associations, where it is being used in medical and nursing education, health planning, and health education for lay people, as well as for scientific purposes. The Ministry of Health and Welfare has published a disease atlas for cities, towns and villages as part of its activities aimed at evaluating the effectiveness of its health programme for the aged. This publication contains maps showing, for the period 1978–82, the distributions of the standardized mortality ratios for stomach cancer, cerebrovascular disease, and uterine cancer, the average life span, the average life expectancy at the age of 40 years, the participation rate in general health examinations and in stomach cancer and uterine cancer screening, and the per capita cost of medical care for the aged.

The atlas has stimulated local governments and related bodies to prepare disease maps for their own areas, to be used in local health programmes and health education. For example, Hiroshima Prefecture has prepared an atlas that is noteworthy for containing not only disease maps but also maps on the natural and social environment, with reference to climate, communications, population, medical care and other matters.

Thus a disease atlas can serve as a visual education tool and provide clues about etiological factors. The generation of interest in local disease patterns among the general population can be expected to promote public health activities with community participation.

The preparation of disease maps is not difficult if funds and data are available. The next stage — putting the maps to good use — requires careful thought. □

References

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