A Comparison between the Sciences of Epidemiology and Statistics Based on an Examination of Epidemiological or Statistical Studies on Diabetes in Japan

YASUO IIBUCHI, KEIKO HIGA, GORO MIMURA* and JOHN HASKEY†

*(Hygiene and Epidemiology), School of Health Sciences, Faculty of Medicine, Ryukyu University, Nishihara-cho, Okinawa-ken, Japan. 903-01. *The 2nd Department of Internal Medicine, School of Medicine, Faculty of Medicine, Ryukyu University, Naha, 902 and †Central Statistical Office, Cabinet Office, London SW1P3AQ, United Kingdom*

Iibuchi, Y., Higa, K., Mimura, G. and Haskey, J. *A Comparison between the Sciences of Epidemiology and Statistics Based on an Examination of Epidemiological or Statistical Studies on Diabetes in Japan*. Tohoku J. exp. Med., 1983, 141, Suppl., 313-318 — The authors selected 24 original papers which were regarded them as the epidemiological study and the statistical study from their titles, from the end of World War II to 1981. And these papers were selected from 3 medical journals of internal medicine, other medical journals and proceedings of 2 International Conferences (see Table 1), and also were the object of study, namely, theoretical considerations. Besides we classified these 24 papers into 2 sorts; papers for an epidemiological study and a statistical study, and made a comparative study of details of these papers theoretically. As the result we were able to clarify what the authors of 24 papers had considered about the natures of epidemiology and statistics as the science. It was clarified that two sciences, epidemiology and statistics, had been in the general trend without any recognition of the differences between twos. And as the conclusion we pointed out that the field of activity of statistics was broader than that of epidemiology, and the nature of statistics as the science might be changeable according to the object, moreover, statistical theory might be a branch of mathematics and so on. ——— comparison of statistics; epidemiology and mathematics; statistics as the science

At the "clinico-genetic genesis of diabetes mellitus" of International Symposium in 1982, the author and a collaborator (KASAGI, K) clarified the characteristic features of epidemiologic studies on diabetes mellitus in Japan after World War II. The author noted the differences between the terminology and methodology of statistics and epidemiology, and emphasized the need and significance of comparative study. In this paper, we intend to elucidate the sharp line drawn by

researchers between the scientific characteristics of statistical and epidemiological studies on diabetes in Japan after World War II.

MATERIALS and OBJECTS

From the EXCERPTA MEDICA JAPONICA from 1945-1981, we originally selected for study all original papers which seemed to be related to diabetic studies. In the next phase, we selected out original epidemiologic and statistical studies, and these papers comprised the data base for this study (see Table 1). By referring to the terminology used in the title of the papers (for example, Statistical Study of or Epidemiological study of") papers were categorized. Of the papers, 13 were categorized as "Epidemiologic," and 24 as "Statistical". The objects were as follows:

- 1) KAITO, I et al. (1952) Statistical studies on diabetes mellitus. 1st report. Tohoku Med. J., 47, 113-116.
- 2) ODA, K et al. (1954) Statistical studies on diabetes mellitus during and after world war II. Mod. Med., 9, 1861-1864.
- 3) ODA, S et al. (1956) Statistical studies on diabetes mellitus. J. Clinical Int. Med. Ped., 11, 219-223.
- 4) ADACHI, S et al. (1957) Statistical observation of diabetes mellitus. J. Yonago Med. Ass., 8, 886-897.
- 5) YOSHIKAWA, K et al. (1957) Statistical studies on diabetes mellitus. Tohoku Med. j., 55, 267-271.
- 6) IWABUCHI, K & MARUYAMA, K. (1958) Statistical studies on diabetes mellitus, Nigata Med. J., 72, 438-444.
- 7) KATSURA, E et al. (1958) Statistical studies on diabetes mellitus. Kyoto Med. Ass., 9, 13-19.
- 8) HATORI, M. (1964) Statistical studies on diabetes mellitus and clinical studies on prognosis. J. Chiba Med. Soc., 39, 528-541.
- 9) GOTO, Y & FUKUHARA, N. (1968) Cause of death in 933 diabetic autopsy cases. J. Japan Diab. Soc., 11, 197-206.
- 10) ISHIGUCHI, T et al. (1969) Clinical statistics of diabetes mellitus for recent 6 years in our clinic. J. Wakayama Med. Assoc., 20, 169-172.
- 11) KURIHARA, M et al. (1970) Diabetes mellitus mortality in Japan compared with other countries., Diabetes Mellitus in Asia 1970. Excerpta Medica edited by TSUJI, S & WADA, M, Amsterdam., 24-32.
- 12) MIMURA, G et al. (1970) Clinical statistical studies on childhood diabetes. Rep. Kumamoto Const. Med. Inst., 21, 1-9.
- 13) WAKAYAMA, E et al. (1972) Statistical observation of the outpatients with diabetes mellitus. J. Iwate Med. Ass., 24, 446-456.
- 14) KIMURA, T & SASAKI, T. (1972) A statistical study of clinical findings of diabetic inpatients in department of medicine II during the past ten years. J. Iwate Med. Ass., 24, 9-15.
- 15) HIRATA, Y et al. (1973) Statistical studies of 1885 death cases of diabetes in Japan. J. Japan Diab. Soc., 16, 290-299.
- 16) MIHARA, T & HIRATA, Y. (1974) Statistical studies on 1843 dead cases of diabetes in Japan. J. Japan Diab. Soc., 17, 232-239.
- 17) MIHARA, T et al. (1974) Causes of death in diabetics in the san-in area of Japan. J. Japan Diab. Soc., 17, 489-495.
- 18) MIHARA, T & HIRATA, Y. (1975) Statistical studies on 1739 dead cases of diabetes in Japan. J. Japan Diab. Soc., 18, 379-385.
- 19) SASAKI, A. (1975) Cause of death in Japanese diabetics -a comparative study. J. Japan Diab. Soc., 18, 506-516.

- 20) IIDA, K et al. (1976) Statistical studies on diabetes mellitus for past 19 years in our clinic., Japanese J. Clinical Exp. Med., 53, 1703-1710.
- 21) KOMURA, K et al. (1976) Statistical study on the cause of death of 603 diabetics in Kyushu, Japan., J. Japan Diab. Soc., 19, 344-352.
- 22) KUNO, S et al. (1977) Clinical statistics of diabetes mellitus in outpatient clinic. Japanese Red Cross Med., 29, 129-135.
- 23) MIKAME, H et al. (1978) Causes of death among deabetics in Ehime prefecture, Japan (1st. report). J. Japan Diab. Soc., 21, 1003-1010.
- 24) KUWASHIMA, K et al. (1980) Causes of death among diabetics in Ehime prefecture, Japan (2nd report)., J. Japan Diab. Soc., 23, 1081-1087.

METHODS

By means of a theoretical and analytic comparative study on the contents of the 37 papers, we attempted to discern differences in scientific character between the epidemiological and statistical studies, to determine whether these two sciences are distinct from one another.

OBSERVATIONS

Each of the 9 papers in Greop A (see Table 1) comes from "the Journal of the Japanese Diabetic Society". The results from the paper written by GOTO, Y., and FUKUHARA, N. (1968) in this group were based on 933 autopsy cases whose details were obtained from the Annual Reports 1958-1965, published by the Japanese Pathological Society. Amongst other findings, the distribution by type of disease was presented. The purpose of the paper by MIHARA, T et al. (1974) was to

TABLE 1. *Number of treatises according to categories of epidemiological concepts and journals*

Categories Journals	Epidemiological	Statistical	Pathogenesis	Frequency or Incidence
The Journal of the Japan Diabetic Society	10 (1)§	79 (9)	20	26 (1)
The Journal of the Japanese Society of Internal Medicine	1	8	3	2
Endocrinologia Japonica	1	7	1	1
A Total	12 (1)*	94 (9)†	24	29 (1)*
B Other journals	55 (6)*	76 (14)†	49 (1)*	30 (7)
C Proceedings‡	(4)*	(1)†	(1)†	(1)

Note : * The objects of former report (International Symposium was held in Kobe on Feb., 1982.)

† The object of this study.

‡ Diabetes Mellitus in Asia, 1970. Childhood Diabetes in Asia, 1978.

§ Numbers between brackets relate to original articles.

examine the causes of death of primary diabetics. A statistical significance test was performed on the observed and expected numbers of primary diabetics dying from each cause of death, the expected numbers of deaths being calculated from the mortality statistics of the general population in the T Prefecture in 1971. SASAKI, A (1975) examined some 200,000 certificates of death which had occurred between 1967 and 1971 and found that diabetes was mentioned as a cause of death in 3261. Diabetes was recorded as the underlying cause in 1883 cases and as a contributory cause of death in 1378 cases. The two sets of results derived from these figures were analysed and compared with those from corresponding studies in the United States (U S Public Health Service 1955 and Tokuhata et al. Pennsylvania 1968-69) in order to investigate the differences between the two countries in mortality due to diabetes.

As the title of the present paper suggests, statistics of death by cause have been used as the data upon which comparative studies have been based. Investigations to the data are in progress in which statistics will be utilized not as an independent science, but as the subsidiary science. In paper written by KOMURA et al. (1976), the causes of death of 603 diabetics were studied-the deaths occurred between January 1972 and December 1973 in a total of 111 medical institutions, including university, public and private hospitals. The causes of death of primary diabetics were analysed separately. Investigated into the meanings of a clause in the paper that "*statistically analysed* the characteristics of the classification by the causes of death in each medical institution and autopsies,", the probability of obtaining a particular result by chance, for example $p < 0.01$, is used as a test on the observed number of cases. Such a test is one of several statistical analyses employed. The paper gives a statistical distribution by cause of death of the cases in the study, and highlights those causes for which the numbers of deaths were significantly higher than expected. MIKAME, H et al. (1978) investigate the characteristics of 175 diabetic deaths (which occurred between January 1974 and December 1976 in a group of 15 medical institutions) pay special attention to the deaths of primary diabetics. Results are presented by disease category. 4 papers by HIRATA, A et al. (1973), MIHARA, T. & HIRATA, Y. (1974), MIHARA, T. & HIRATA, Y. (1975), and KUWASHIMA, K. (1980) present the results obtained from questionnaires on diabetics who died in hospital-both national and public-within a given period. The duration of the diabetes, the therapeutic methods employed and their duration of use were investigated as well as the reported causes of death, autopsy results and premortality stage of diabetes. Each of these papers includes an analysis of the distribution of disease of the diabetics. In both papers by MIHARA, T. & HIRATA, Y. (1974) and MIHARA, T et al. (1974) it is evident that control groups have been used for comparison purposes and that the appropriate mathematical analyses have been performed. Such analyses have only been used Since the End of the Second World War. The mathematical methods had been spread and applied without enough dispute and

discussion also in the field of medicine in Japan. An issue has been left in this place.

It is evident from a part of the Summaries of the 9 papers in Group A (see Table 1) that their main purpose is, in general, to examine the cause of death. This line of approach of necessity involves a strong interest in the anatomical classification of the human body, but a weak interest in connection with the natural and social environmental factors. Consequently, also information on, say, the cause of death in diabetics can only throw limited light upon pursuing of the true cause leading to the death.

Turning attention to the 14 papers in Group B (see Table 1), the majority of these papers are taken from scientific journals of the local universities of Japan and fall into 2 categories: a) Statistical observations/studies and b) clinical studies. 11 papers fall into the former category (nos 11-19, 22 and 24) and the remaining 3 into the latter (nos 20, 21 and 23). Certain features are common to the majority of papers in both categories-the following factors, evidently regarded as the more important ones-are investigated: frequency of occurrence, age/sex differentials, hereditary disposition, complications, however, attempts to understand the relationships between such factors as seasonal variation, living conditions, occupation, constitution, diet etc have been elusive.

Further, in 3 papers written by ODA, S et al. (1954), ODA, S et al. (1956), and HATORI, M. (1964), comparisons are made between the diabetic studies before the World War II and diabetic ones after the World War II. of diabetes, that is, using statistical information for clinical research. On the other hand, MIMURA, G et al. (1970) investigate "the cause and the inducement" in relation to the factor of heredity as a possible cause of diabetes. KIMURA, T. & SASAKI, T. (1972) propose that the most important thing for preventing diabetes be directed towards marriage, early detection during the prediabetic stage and health control. In the paper written by KUNO, S et al. (1977), 780 control patients are used in order to make inferences concerning the geographical distribution of cases, efficacy of medical examination, and the factors of age and therapeutic treatment. The authors report that they used clinical statistics wherever possible and one can thereby appreciate the use of statistics in social medicine. In the final paper written by KURIHARA, M et al. (1970), -which belongs to Group C-the use of statistical methodology is preeminent.

At the beginning of the present paper it was emphasised that Japanese epidemiological studies have a distinct tendency to adopt a biological approach. This tendency is also apparent when considering Japanese studies on diabetics. A statistical study or analysis is of course very different from a paper deriving statistical methodology. The latter may be applied to fields other than medicine, for example, economics etc. Thus, the field of application of statistical methods is broader, in one sense, than that of epidemiology. There are differences of opinion as to whether the study of statistics is that of an independent Science in

its own right, or whether it belongs to that of a more general scientific methodology or a subsidiary science. In the case of the statistical studies of data on diabetes, the statistics are analysed using general scientific methods. There is perhaps a parallel concerning the researchers' concept of epidemiology -some consider it a science in its own right, whilst others regard it as a particular type of methodology, a subsidiary science, within a broader scientific approach.

DISCUSSION

The methods of epidemiology and of statistical analysis can complement each other in the study of a particular disease in a given district. Statistical methodology by itself cannot suggest public health measures which, if undertaken, would be beneficial. An investigation may be carried out and the data analysed using statistical techniques, but it is the science of epidemiology which can produce ideas for preventive measures against hazards to health. Whether epidemiology is considered as a set of computational techniques, a subsidiary science, in a particular area of application or whether it is regarded as a free-standing science, a kind of an independent science, its success will be judged by its practical impact, as well as by its recognition as a useful contributor to advances in social and medical science. On the other hand, there is another opinion from English side that statistical theory is a branch of mathematics and that epidemiology is the application of mathematical and statistical techniques to a particular field of hygiene/medicine/population/public health. Of course, epidemiology was originally the application of the above-mentioned techniques to the narrow field of epidemics of infectious diseases, but it broadened to include applications to any subject concerning health, (personal communication with John Haskey, statistician). To conclude, the field of activity of statistics is broader than that of epidemiology. The nature of statistics as the science, however, might be more pliable than epidemiology. Because the former is rolled from side to side according to the nature of an object of study. The relationships between statistics and mathematics or epidemiology and mathematics will have to be thrown an objective light in the near future.

References

- 1) Yasuo, I. (1976) *Statistics*, edited by the Society of Economic Statistics, Japan, **30**, 212-229.
 - 2) Yasuo, I. Higa, K. & Mimura, G. (1982) The characteristic features of epidemiological studies on diabetes mellitus in Japan after World War II. In: *Proceedings of a Clinico-genetic Genesis of Diabetes Mellitus*, Excerpta Medica, Amsterdam, 3-14.
 - 3) Rintaro, M. (1974) *Ohgaizenshu*, edited by Iwanami Publishing Co., Tokyo, **28**, 220, 225, 236-339.
-