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– Content –

Epidemiology of Diabetes Mellitus

Changes in the economic conditions in Taiwan Area in the past 30 years have also brought about significant changes in disease patterns. Chronic diseases have now become major threats to the lives of the people. Since 1982, cerebrovascular diseases and malignant neoplasms have become the leading causes of death, and of all causes of death due to chronic diseases, diabetes mellitus has increased rather rapidly. Analysis of vital statistics by Lin, et al. in 1992 shows that the mortality rate of diabetes mellitus for male has increased from 3.32 per 100,000 population in 1960 to 17.84 in 1988; for female, from 4.05 to 30.01 in the same period[1]. Figure 1 shows that the trend of diabetes mellitus mortality has gone up sharply in the last ten years. Table 1 again shows that diabetes mellitus has become more a major threat to life in the past decades. A study by Tokuhata in 1975, however, reveals that only 26% of those who have died of diabetes mellitus are listed diabetes mellitus as the direct cause of death on their death certificates[2]. Another study by Bill, et al. also shows that of those who have history of diabetes mellitus, only 38% are listed diabetes mellitus as either direct or indirect cause of death on their death certificates[3]. A study of the seriousness of diabetes mellitus through the analysis of death certificates, therefore, is likely to underestimate the problem[4]. On the other hand, diabetes mellitus is a major cause of vascular diseases, renal failure, amputation of lower limbs and blindness[5,6]. The increase of diabetes patients may pose problems to the use of medical care resources, the social welfare programs and the health of the younger generations. There, however, is not yet a cure for diabetes mellitus. The prevention effort thus becomes very important. The present report intends to review some of the likely causes a diabetes mellitus.

The American Diabetes Association and the World Health Organization decided in 1985 on a set of new criteria for the chemical diagnosis of diabetes mellitus. According to these new criteria, diabetes mellitus is confirmed when a random testing of blood shows a sugar value in plasma of more than 200 mg/dl. Following laboratory testings are required if blood sugar does not reach the above criteria: (1) blood sugar value at empty stomach; (2) glucose-tolerance test. Diabetes mellitus is confirmed when blood sugar at empty stomach is higher than 120 mg/dl or when the whole blood sugar of glucose-tolerance two hours later is higher than 180 mg/dl (see Table 2)[7,8].

According to the classification of the American Diabetes Association, diabetes

mellitus is classified into: Type I (insulin-dependent diabetes mellitus, IDDM) and Type II (non-insulin-dependent diabetes mellitus, NIDDM), and other types.

IDDM rarely occurs to infants before the age of six months. Incidence increases after the age of nine months and reaches a climax at the age of 10 to 14 years. Incidence is lower in Japan and the Caribbean and higher in Scandinavia. In 1962, Adam reported a correlation between seasonal trends and IDDM, subsequent studies also indicated that IDDM is most likely to concentrate in winter and early autumn. Clinical observations make some researchers believe that infectious diseases are one of the causes of IDDM. Epidemiological evidences also suggest that infection of certain pathogens could be the cause of IDDM[9].

Yet, the age distribution of IDDM dose not correspond with peak ages of infectious diseases. Some researchers have used the sero-epidemiological approach to study the relation between coxasckie, B virus infection and IDDM. They find that the antibody levels of IDDM patients are higher than normal persons. However, other studies have failed to show the relationship. But, the role of infectious pathogens as a cause of IDDM cannot be ignored[10].

Some IDDM's seem to be family-oriented, and yet they do not necessarily follow the Mendel's law. Will this mean that environmental factors are the causes of IDDM? Both geneticists and epidemiologists have thus become involved in the studies to investigate the causes of IDDM. Harris and Steinberg report that diabetes families have more chances of developing diabetes mellitus than other families[11]. Studies of twins also show that identical twins have more chances to develop diabetes mellitus at the same time than fraternal twins. These studies seem to indicate that heredity is a major cause of the disease, though the extent of its contribution is hard to estimate.

Some researchers have studied the relation between histocompatibility leucocyte antigen (HLA) and the disease. This antigen is related to the resistance of organ in organ implantation, and the gene is in the short arm of the 6th chromosome. The antigen comes in the forms of A, B, C, and DR (D-related). Studies have focussed on either the adults or families. Findings so far have indicated relation between DR3, DR4 and IDDM. However, the prevalence rates of the HLA subtype differ from ethnic groups, they are lower in Japan and among the Eskimos for instance. Therefore, whether the role played by HAL in IDDM is active or supportive requires further study[12].

NIDDM: There are more cases of NIDDM than IDDM. Very few cases are found before the age of 30 years. NIDDM has a strong impact on public health. In USA and Europe, about 90% of diabetes patients are of NIDDM type. NIDDM has effect on the eyes, kidney and peripheral nerves of the patient. The incidence rate has increased in the last 20 years, and in USA for instance, the number of patients in 1936 was 500,000, it had increased to 5.4 million in 1981. Whether the increae is due to the improvement in diagnosis, in diagnostic equipment, in the improvement in the medical knowledge of the public, or the incidence itself has actually increased requires further study. The incidence, however, varies significantly by countries, ethnic groups and geographical regions. The Eskimos, for instance, have lower incidence; the Pima

Indians have, however, a higher incidence[13].

Diabetes patients are often also obese. As early as 1921, obesity was considered one of the causes of NIDDM. Joslin was the first one to suggest such speculation[14]. Subsequent epidemiological studies also supported the view. West and Kalbfleisch, among others, reported a linear relationship between body weight and NIDDM. Their studies included people of different ethnic backgrounds, and their findings did not reveal any difference in incidence by ethnic groups[15]. Other studies, however, were not quite in agreement with their view. In Jamaica, Tulloch found that a good proportion of the newly diagnosed diabetes were not obese. It could have been, however, that patients lost weight after becoming ill. Furthermore, whether it is appropriate to use body mass index (BMI) to measure the body weight of persons of different ethnic backgrounds is yet to be studied. Nowman in the study of identical twins found that body weight is not significantly related to NIDDM. While the relationship between obesity and diabetes is hard to confirm, and obesity is also related to cardiovascular diseases, it is likely that at the time of study many obese diabetes patients have already died. The relation between obesity and diabetes mellitus requires further investigation[15].

The relation between diet and NIDDM is another area of study. Trowell's observation and investigation concluded that low starch and fiber foods are causes of diabetes mellitus[15]. However, inhabitants of the Habuig island though consume a good amount of fiber-rich foods, have a high incidence of diabetes mellitus, whereas the Eskimos, though their consumption of fiber-rich foods is low, have lower incidence of diabetes mellitus. The most problem in the study of fiber-rich food and diabetes mellitus is the operational definition of fiber-rich foods. Other researchers believed that the excess intake of sucrose is likely to induce diabetes mellitus. West came up with a list of 21 studies supporting the relation between the amunt of sucrose and diabetes mellitus, and another 22 studies contrary to the view. These studies have failed to prove whether the relation between sucrose consumption and diabetes mellitus is either cause-and-effect or coincidental. The intake of high calory foods is considered another cause related to diabetes mellitus. Baird, using case-control method, studied the diets of diabetic and non-diabetic patients, found that the calory intake of diabetic patients was higher. Studies by Booyens, however, did not support this conclusion. The relation between obesity and excess intake of high calory food is complex and further investigation is needed. Some researchers tried to explain NIDDM from the genetic point of view. In the studies of Caucasians, no relationship was found between HLA and NIDDM. Pinus and White reported in 1930 that NIDDM was family-clustered, though no genetic pattern of diabetes mellitus has been identified. Identical twins are good subjects for the study of genetic and environmental factors on the disease. Barnett in his study of twins found NIDDM to be related to heredity. However, his subjects were basically diabetes patients and not twins, therefore, selection bias could occur. Furthermore, persons who visited hospitals were patients with symptoms, diabetes who had not developed symptoms had probably not been diagnosed yet. Referral bias could thus occur[15].

Studies by Tattersall, et al. of chlopropamide-alcohol flush intended to use it as a genetic label for NIDDM. They selected 126 family members of Mason-type diabetes, gave them initially 12 to 16 cc of Sherry wine as placebo, 250 mg of chlopropamide

48 hours later, and 40 cc of Sherry 12 to 36 hours after to observe the reactions of subjects. 89% of diabetes patients were, the studies reported, to flush, whereas 94% of non-diabetes cases did not flush. However, some quantitative biases could not be avoided in these studies. Though placebo was used to eliminate the subjective bias of cases, other factors, some researchers argued, related to flush such as room temperature and exercise were not controlled in advance in this study[15].

Some researchers maintained that the amount of exercise and activity is related to the metabolism of glucose and insulin, such as the study of Taylor, et al. of Indians and Melanesians on Fiji. The amount of exercise was classified into static, moderate, sufficient and heavy according to occuplations and by urban-rural to compare the amount of exercise and prevalence rates of diabetes mellitus. The findings were that rural residents of lower amount of exercise had higher prevalence of diabetes mellitus. However, in the study of White, no such relationship between the amount of exercise and blood sugar value was noted[16]. Whether exercise reduces the chances of developing diabetes mellitus is not conclusive yet.

Goto in his study in Japan found that in an economically developed and Westernized society in which the dietary habits of the population have changed, the obese population also increases. Between 1962 and 1973, the number of diabetes patients in Japan had increased five-folds, death rate in the same period had increased only by two to three times[17]. Study by Baba, et al. however, found that the prevalence rate of diabetes mellitus in the rural areas of Japan between 1960 and 1975 had not increased. This could mean that changes in dietary habits as a consequence of Westernization may increase the attack rate of diabetes mellitus. Studies by Reed, et al. of the inhabitants of two islands in the Marianas showed that the diabetes prevalence of inhabitants of the more Westernized Guam was higher than Rota, another island[18]. Cross boarder immigrants offer an opportunity for the study of environmental factors on this diseases. Kawate, et al. found that Japanese immigrants to Hawaii had higher prevalence rate of diabetes melllitus than their counterparts in Hiroshima of Japan[19].

The above review of relevant literatures shows that IDDM is related to infectious diseases, HLA and genetics; whereas, the NIDDM is related to genetics, diet, obesity, exercise and social-economic factors.

The incidence rate of diabetes mellitus has increased rather rapidly in recent years, and diabetes has become a major cause of death. To promote health, the study of diabetes mellitus is imperative. Study methods and criteria of diagnosis employed by previous researchers are not consistent, their findings are not readily comparable. If study methods of future studies could be coordinated, the findings present in this report would be of considerable value.

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Figure 1. Trends of Diabetes Mortality, Taiwan Area, 1960-1988

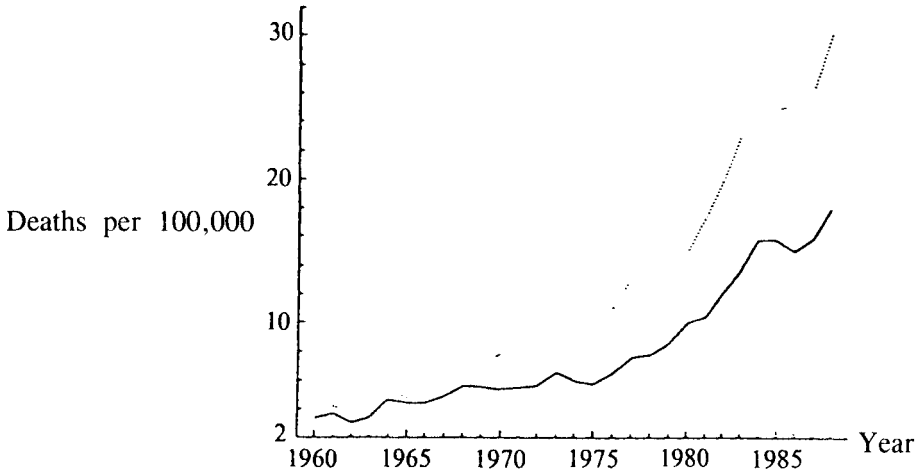

Table 1. Number of Diabetes Deaths, Taiwan Area, 1960-1988

Year	No. of Deaths	%	Order of Death Causes
1960	198	0.27	29
1970	482	0.71	18
1980	1396	1.67	13
1985	2903	3.22	7
1988	3883	3.84	5

Table 2. Diagnosis Value of Glucose Tolerance Test

	At empty stomach (mg/dl)	2 hours after meal (mg/dl)
1. Diabetic:		
veil whole blood	≥120	and/or ≥180
capillary whole blood	≥120	≥200
vein plasma	≥140	≥200
2. Poor glucose tolerance:		
vein whole blood	<120	and ≥120 — <180
capillary whole blood	<120	≥140 — <200
vein plasma	<140	≥140 — <200
3. Normal:		
vein whole blood	<120	and <120
capillary whole blood	<120	<120
vein plasma	<140	<120

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