

The Costs of Diabetes

Tseng Chin-Hsiao, MD, PhD

Department of Internal Medicine, National Taiwan University Hospital,

Taipei, Taiwan;

Abstract

The increasing number of diabetic patients has reached a level of epidemic globally. The mortality from diabetes mellitus is also increasing and has been ranked as one of the ten major causes of death in many countries. Diabetes is becoming one of the major public health problems because a great proportion of the healthcare expenditure has been spent on the treatment of its associated morbidity and mortality. In Taiwan, diabetes has been ranked as the fifth leading cause of death since 1987 and the number of mortality from diabetes keeps on increasing. The prevalence of diabetes is also increasing in Taiwan over the past decades. Chronic diabetic complications are common and glycemic control status has been poor. There are about 540 thousand drug-treated diabetic patients in Taiwan and they used up about 11.5% of the total healthcare expenditure reimbursed by the National Health Insurance. Most of the diabetic complications are preventable by controlling blood glucose and the associated atherosclerotic risk factors. A recent study also showed that even diabetes itself could be prevented by regular exercise and dietary control. In the war against diabetes, preventing the occurrence of chronic diabetic complications or diabetes itself seems to be the most efficient and effective way to reduce the great burden of diabetes.

Key words: Diabetes mellitus, healthcare cost, preventive medicine

Introduction

'The costs of diabetes', the theme of 1999 World Diabetes Day announced by the International Diabetes Federation, highlighted the great impact of diabetes on the lives of the patients and the financial and economical aspects of the patients' families and societies. Diabetes is a chronic, insidious, and non-communicable disease characterized by elevated blood glucose, which may affect the vascular and nervous systems if not satisfactorily lowered at an early stage. Evidence showed that the uprising number of diabetes has reached an epidemic status worldwide, especially in the developing countries [1,2]. The reasons for this uprising have been ascribed to the prolongation of life expectancy, the excessive intake of calories, and the less physical activity in modern societies [1,2]. Zimmet et al coined the term of 'Coca-colonization' for this transition of lifestyle [1,2]. Diabetes remains as the leading cause of death and the major cause of blindness, hemodialysis, and lower extremity amputation in most countries. Diabetes will surely be one of the most common and challenging health problems in the next millennium.

Increasing burden of diabetes mellitus

The global number of type 2 diabetic patients is increasing and is estimated to rise abruptly from 157 to 215 millions for the years 2000 and 2010, respectively [3]. More than 80% of the diabetic patients will be found in the developing countries. The top three countries that will have the greatest amount of diabetic patients are India, China and the USA [3]. Taiwan is a developing country with a population of about 22 millions. Although the absolute number of diabetic patients seems to be small when compared with other countries, the trends of increasing prevalence over the past three decades can not be overlooked. According to epidemiologic surveys, the prevalence of

diabetes increased steadily from 5.05% to 7.10% to 8.17% in the years 1970, 1979, and 1986, respectively, for those aged above 40 [4-7]. In the rural areas, a prevalence of 5.06% was found during the 1986 survey [7]. In more recent years, the prevalences of diabetes in community-based studies were found to be 12.4% in Pu-Li, Taiwan [8] and 6.5% in Kin-Hu, Kinmen [9] for residents ≥ 30 years of age.

Not only the prevalence trend was increasing during the past few decades in Taiwan, the trends in mortality from diabetes mellitus is also increasing. The data from the "Vital Statistics" published annually by the Taiwan Provincial Department of Health, ROC, showed an increasing number of diabetic deaths over these years; and the order in the leading causes of death ascribed to diabetes ranked from the 13rd in 1980, the 7th in 1985 and the 5th since 1987 [10]. The mortality rate of that year was 16.80 per 100,000 population. In the succeeding ten more years, diabetes mellitus has remained as the fifth leading cause of death. However, the mortality rate increased steadily to 34.49 per 100,000 population in 1998. In 1998, there were 7,532 cases of mortality from diabetes mellitus. This figure represented 6.18% of the total deaths. This is in great contrast to the number of diabetes deaths (198) and the proportion of total deaths of 0.27% in 1960 [11]. The age-adjusted death rate increased from 3.7 per 100,000 population in 1960 to a rate of 23.2 per 100,000 population in 1988, a 6.3-fold increase over a period of 30 years [11]. Diabetes clearly represents an important public health problem in Taiwan as well as in many other developed countries.

Diabetes is characterized by a variety of acute and chronic complications. The excess mortality observed among diabetic patients is usually associated with the chronic complications. In Caucasians, ischemic heart disease accounts for 50% of deaths, stroke for 15%, other cardiovascular conditions for 10%, and renal failure for about 8% [12]. In Japan, renal failure is more prominent and accounts for about 15%

of diabetic deaths [13]. The trends in the prevalence and incidence of diabetes, diabetes mortality, diabetic complications, and hospitalization were increasing in a diabetes surveillance system in the United States during 1980 to 1987 [14]. In a Finnish study, which used two sets of records from the healthcare system, diabetic patients were found to have substantially greater hospital use than the nondiabetic population. The main causes of hospital use in the diabetic patients were cardiovascular and microvascular complications [15]. A Swedish study showed that improved metabolic control by intensified treatment would save costs of production losses due to excess morbidity in both type 1 and type 2 diabetic patients [16].

In an epidemiologic study which compares the diabetic control status between urban and rural diabetic patients in Taiwan, we pointed out that about 30% of the patients in the rural areas and 40% in urban areas were poorly controlled and we urged for a strengthening in the diabetic control program [17]. Another study evaluating retinopathy, neuropathy and nephropathy in non-insulin-dependent diabetic patients found in an epidemiologic survey for adult diabetes in Taipei City showed that the respective prevalences were 24.0%, 23.5% and 12.9%, and that diabetic duration, glycemic control, hypertension and insulin treatment were positively associated with these complications [18]. Hypertension was found to be present in 33.3% of the diabetic patients and associated with various complications [19]. Diabetes mellitus was the most common cause (37.2%) of lower extremity amputations [20] and the prognosis after amputation was rather poor with median survival of about 5.2 years [21].

Healthcare costs of diabetes

The healthcare costs and economic impacts of diabetes are enormous. In the USA,

diabetes-associated costs were estimated to be US\$ 2.6 billion in 1969, 13.8 billion in 1984 [22] and 20.4 billion in 1987 [23]. In 1992, the healthcare expenditure for diabetes increased to 105.2 billion US\$ [24]. Diabetic patients constituted only 4.5% of the total population of the USA, however, 14.6% of the healthcare expenditure were spent to treat these patients [24]. Over 60% of the expenses were used in the inpatient setting, suggesting that much of the money was used to treat the complications of diabetes. Although there are limited data on the cost of diabetes from countries other than the USA, it was estimated to cost 1,317 million Swedish kronor in Sweden in 1978 [25]; 484 million pounds in UK in 1986~87 [26]; 7,711 French francs for each insulin-dependent diabetes mellitus patient and 5,892 French francs for each non-insulin-dependent diabetes mellitus patient in France in 1984 [27]; 1.2 billion Australian dollars in Australia in 1986 [28] and 1.8 billion Canadian dollars in Canada in 1985 [29].

The healthcare cost of diabetes has not been systematically studied in Taiwan. However, scattering reports can be found in some papers, theses, and abstracts of symposia. Tseng et al [20] analyzed the clinical characteristics of lower extremity amputations at the National Taiwan University Hospital, the average admission days for each operation was 41.3 ± 4.0 days and the average expense for each admission was 134.0 ± 16.0 thousand new Taiwan dollars for the diabetic patients. In a retrospective study [30], the direct and indirect costs of type 2 diabetic patients attending the out-patient clinic or having been discharged from the wards at the National Taiwan University Hospital between April and September of 1995 were evaluated by mailed questionnaire. The data of a total of 399 patients (response rate about 21%) were collected. The average total cost for each patient in that year was estimated to be NT\$52,532. Among this cost, 85.5% was direct and 14.5% was indirect. The average

numbers of out-patient clinic visiting and in-patient admission were 10.1 and 0.21 times for each patient, respectively, in that year. The average work loss days were 2.7 and 2.1 days, for the patients and their family members, respectively.

According to an analysis of the National Health Insurance data in Taiwan [31], there were 536,159 drug-treated diabetic patients reimbursed by the insurance between July 1997 and June 1998. Within these 12 months, the healthcare cost for the diabetic patients amounted to 11.5% of the total healthcare expenditure. The per-capita expenditure for the diabetic patients was 4.3 times higher than non-diabetic patients. Among them, 88.3% were receiving oral agents, 6.9% receiving insulin, and 4.8% receiving both oral agents and insulin. The average annual number of clinician visits was 35.8 times per patient, which represented 6.2% of out-patient clinic use in Taiwan. However, the diabetic patients represented 22.1% of the total admission days in Taiwan. The average durations of each course of admission for the diabetic and non-diabetic patients were 16.8 days and 7.7 days, respectively.

In Taiwan, diabetic patients represented 26.6% of the total incident number of end-stage renal disease requiring dialysis each year. However, because of the higher mortality in the diabetic patients, they represented only about 20.6% of the prevalent cases receiving dialysis [32]. In a prospective 2-year follow-up study comparing the cost, morbidity and mortality after hemodialysis between 107 pairs of diabetic and non-diabetic patients, diabetic patients had higher annual healthcare expenditure resulting from more frequent admissions and longer duration of in-patient care. The causes for admission in the diabetic patients were mainly coronary heart disease, congestive heart failure, sepsis, occlusion of vascular access, severe hyperglycemia, and peripheral arterial obstructive disease. The diabetic patients had a 1.5 times higher risk of mortality within 2 years (26.2% vs 12.1%, $p<0.02$). Good glycemetic control

with an average fasting plasma glucose level of below 150 mg/dL was associated with a better prognosis in the diabetic patients even at the stage of hemodialysis (2-year mortality 18.8% vs 37.2%, $p < 0.05$).

From treatment to prevention:

A strategy to win the war against diabetes

Millions of lives of diabetic patients have been saved and prolonged since the discovery of insulin in 1921 by Banting and Best. With the introduction of oral hypoglycemic agents in 1950s, the quality of life of the diabetic patients improved a great deal because of the convenient and painless route of oral intake. However, with the prolongation of life expectancy in the diabetic patients, there is greater chance of developing chronic complications involving the eyes, the kidney, the nervous system, the legs, the heart and the brain, etc. The great challenge then comes with how we can prevent these complications. Can they be prevented by glycemic control alone? Or should other measures not be ignored? The Diabetes Control and Complication Trial and the United Kingdom Prospective Diabetes Study [33,34] answered a lot of these questions. The major vascular complications of diabetes can be categorized as macrovascular and microvascular diseases. Macrovascular complications are due to atherosclerotic process involving various organ systems such as the brain, the heart and the peripheral arteries. Microvascular complications mainly involve the eyes, the kidneys and the nervous system. A clustering of traditional atherosclerotic risk factors such as obesity, hypertension and hyperlipidemia is usually observed in the diabetic patients [35,36] and diabetic patients tend to smoke as frequently as non-diabetic subjects [36]. It is clear that control of blood glucose and correction of many of the modifiable risk factors always observed in the diabetic patients can prevent both the

microvascular and macrovascular complications of diabetes [33-36].

Because of the insidious nature of diabetes, most diabetic patients are diagnosed 10 years after disease onset [37] and about half of the newly diagnosed patients in the United Kingdom Prospective Diabetes Study already had complications. In spite of the fact that there are a large number of diabetic patients being diagnosed and under treatment, there are still about the same number of patients remaining undiagnosed and untreated in the communities [17]. Early detection by screening program can identify these patients. However, detection alone can not reduce the morbidity and mortality associated with diabetes. Early treatment, regular follow-up, and tight control of blood glucose as well as other risk factors are necessary to prevent the occurrence of chronic complications. Now has come the time to advance into the primary prevention of diabetes, a final and long-lasting solution to decrease the burden of diabetes. From the Da Qing Study carried out in China, we learned that lifestyle modification by appropriate diet and increased physical activity can reduce at least one third in the development of diabetes in subjects with impaired glucose tolerance over a period of 6 years [38]. Studies on the effectiveness of other forms of intervention are being carried out [39,40].

Since there is no cure for diabetes and there is no way to eradicate diabetes either at the present time or in the foreseeable future, the increasing number of diabetic patients will surely cost increasing expense. The great advance in modern and costly techniques in diagnosis and treatment, the cost for developing new medications, and the requirement for an aggressive and intensive management of the disease involving different professionals will all increase the cost of medical care for the diabetic patients. Essential health economic data are crucial for decision making if policy makers intend to distribute the limited healthcare resource wisely. Different spectra of

costs such as direct medical cost, direct non-medical cost, indirect cost (productivity loss) and intangible cost should be studied. Analyses such as cost minimization, cost-benefit, cost-effectiveness, and cost-utility etc. can help a great deal in making proper decision.

Taking into account the great amount of the healthcare expenditure on diabetic patients being spent on the treatment for chronic complications and the fact that most of these complications and even diabetes itself are preventable, it is strongly advocated that preventive measures, either primary or secondary prevention, should be taken. Primary prevention by advocating a healthier lifestyle with more physical activity, reduction of excessive weight, and appropriate diet is effective and important. Early detection of diabetes and its complications with screening programs for the high risk group can help identifying patients requiring early treatment with great effectiveness and efficiency. The patients and subjects at risk should also be educated, motivated and empowered to actively participate in their treatment and prevention programs. The attempt to prevent the occurrence of diabetes and its complications will surely increase expenditure in the short term. However, in the long run, much more money will well be saved.

Conclusions

The global burden of diabetes is enormous. Evidence showed that the incidence and prevalence of diabetes have reached epidemic, especially in the developing countries. Epidemiological studies and vital statistic in Taiwan also revealed increasing trends of diabetic prevalence and mortality. The healthcare cost of diabetes is also increasing. Prolongation of the life of the patients is important, but compression of the onset of

morbidity into the latest possible years of the life-span leading to a disease-free and healthy life with good quality is much more important. Reducing the burden of diabetes by prevention, organization of care, education and training, etc, is mandatory. A unified and exclusive system may not be always perfect. Different communities, even within a small country like Taiwan, may need different local systems depending on their own social, geographical, cultural, and financial backgrounds. Resources should be used wisely such that duplication, wasting, and unnecessary investigations and programs can be avoided. 'Tactics may win a battle, but we need a strategy to win a war'.

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