CHAPTER II

LITERATURE REVIEW

2.1 Prevalence of Diabetes

The global prevalence of diabetes for all age-groups was estimated to be 2.8% in 2000 and 4.4% in 2030. The total number of people with diabetes is projected to rise from 171 million in 2000 to 366 million in 2030. Diabetic prevalence is higher in men than women, but there are more women with diabetes than men. In developing counties, the urban population with diabetes is projected to double between 2000 and 2030. The most important demographic influence on diabetes prevalence across the world appears to be the increase in the proportion of people >65 years of age. (Wild et al., 2004)

Prevalence of diabetes in adults worldwide was estimated to be 4.0% in 1995 and to rise to 5.4% by the year 2025. It is higher in developed than developing countries. The number of adults with diabetes in the world will rise from 135 million in 1995 to 300 million in 2025. The countries with the large number of people with diabetes are India, China and the U.S. (King et al., 1998)

In the Americas, the number of people with diabetes mellitus was estimated at 35 million in 2000 and is expected to increase to 64 million by 2025. Whereas currently 52% of these people from the Americas live in Latin Americas and the Caribbean, by 2025 the percentage will have reached 62%, representing 40 million persons. The North America, the recent estimate of the prevalence of diagnosed diabetes among adults in Canada was 3.2%. In the United States, the prevalence rate of diabetes increase from 11.4% in 1976-1980 to 14.3% in 1988-1994. Diabetes prevalence rates for Mexican-Americans were twice as high as for non-Hispanic whites. About 20% of non-Hispanic blacks in the United States were affected by diabetes. The prevalence rate in this group was the second highest after that of Mexican-Americans. The Pima Indians from the state of Arizona have shown the highest prevalence of diabetes in the Americas and one of the highest in the world. (Barcelo & Rajpathak, 2001)

The prevalence of diabetes and glucose intolerance is extremely high among adult Arab American in Michigan. The prevalence of diabetes was 15.5% in women and 20.1% in men. The prevalence of previously diagnosed diabetes was similar to that of undiagnosed diabetes. Impaired glucose tolerance (IGT) and/or impaired fasting glucose (IFG) were present in 16.8% of women and 29.7% of men. (Jaber et al., 2003)

The prevalence of diabetes in a representative rural area of Greece was 7.8%, with known diabetic being 5.3% of the population and undiagnosed diabetes being 2.5%. The prevalence was not difference between males and females. There was a significant increase in the prevalence of diabetes with increasing age; impaired glucose tolerance was diagnosed in 3.9%, while impaired fasting glucose was diagnosed in 1.9%. Age, obesity, family history of diabetes, arterial hypertension and elevated triglyceride levels were significantly associated with the presence of diabetes. (Melidonis et al., 2006) In the Kingdom of Tonga, the prevalence current of diabetes is 15.1%, of which 80% is undiagnosed. (Colagiuri et al., 2002)

According to the Inter99 study that determine the age and sex-specific prevalence of impaired fasting glucose, impaired glucose tolerance, screening-detected diabetes, and known diabetes in Danish, the age-specific prevalence in men were as follow:

impaired fasting glucose: 1.4-16.3%; impaired glucose tolerance: 6.9-17.8%; screen-detected diabetes:0.7-9.7%; and known diabetes; 0-5.8%. In the women, there are 0-5.1, 10.5-17.3, 0.6-6.3, and 0.5-9% respectively. Among individuals with diabetes, 65.6% were previously undiagnosed. This proportion was highest in the youngest age-group. (Glumer et al., 2003)

The study among nonpregnant adults 20-79 years of age in Adana, a southern province of Turkey, shows that the crude prevalence of diabetes in men and women were 12.9% and 10.9%, respectively. Total prevalence of diabetes was 11.6% and the prevalence of undiagnosed diabetes was 4.2%. Age, sex, BMI, waist circumference, hypertension, family history of diabetes, and triglycerides were associated with diabetes. (Gokcel et al., 2003)

The prevalence of diabetes has risen more rapidly in South Asia than any other large region of the world. India has a higher number of people with diabetes than any country, with estimates ranging from 19.4 million in 1995 to 32.7 million in 2000. Projection for 2020, based on modeled estimates by WHO show a marked escalation related burden in South Asia. The number of people with diabetes is expected to rise by 195% in India during 1995-2025 to reach 57.2 million in 2025. Pakistan is expected to have about 14.5 million people with diabetes by that year. (Ghaffar et al., 2004)

The World Health Organization (WHO) reports show that 32 million people had diabetes in the year 2000. The International Diabetes Federation (IDF) estimates the total number of diabetes to be around 40.9 million in India and this further set to rise to 60.9 million by the year 2025. The National Urban Diabetes Survey (NUDS) reported that the prevalence of type 2 diabetes in people aged 20 years and over was

12.1 percent and the prevalence of impaired glucose tolerance test (IGT) was 14 percent. (Mohan et al., 2007)

The study about incidence of type 1 diabetes (per 100,000 per year) from 1990 to 1994 that determined in children ≤14 years of age from 100 centers in 50 countries show the overall age-adjusted incidence of type 1 diabetes varied from 0.1/100,000 per year in China and Venezuela to 36.8/100,000 per year in Sardinia and 36.5/100,000 per year in Finland. The incidence increased with age and was the highest among children 10-14 years of age. (Karvonen et al., 2000)

In Italy, the study among people aged 30-49 years in the period 1999-2001 show that the incidence rate of diabetes is 58.0 per 100,000 person-years. The incidence of type 1 diabetes was 7.3 per 100,000 person-years, comparable with the rate in subjects aged 0-14 and 15-29 years (10.3 and 6.8). (Bruno et al., 2005)

In situation of gestational diabetes, the study in Victoria show the estimate incidence of gestational diabetes was 3.6%. Gestational diabetes is associated with women who are older, Aboriginal, non-Australian born, or who give birth in a larger hospital. Women with gestational diabetes had increased rates of hypertension, pre-eclampsia, induced labour, and interventional delivery. Their offspring had a higher risk of macrosomia, neonatal jaundice and hyaline membrane disease. (Stone et al., 2002) Women who have had gestational diabetes have a high risk of subsequently developing diabetes. The relative risk for developing diabetes after gestational diabetes was calculated to be 6.0. Applying this to the studies of gestational diabetes prevalence, the population-attributable risk (PAR) for gestational diabetes ranged from 0.10 to 0.31. (Cheung & Byth, 2003)

The estimated national prevalence of diabetes in Thai adults aged 35 years and over was 9.6%, which included 4.8% previously diagnosed and 4.8% undetected before the survey. The prevalence of impaired (borderline high) fasting glucose was an additional 5.4%. The mean duration of disease in those with known diabetes was 6.4 years. The prevalence of type 1 diabetes was estimated to be 0.2%. The number of diabetic Thai adults aged 35 years and over in 2000 was estimated to be 2.4 million. (Aekplakorn et al., 2003) The Third National Health Examination survey 2004 that determined the prevalence of diabetes and impaired fasting glucose (IFG) in sample aged 15 years and over in Thailand showed the prevalence of diabetes and IFG was 6.7% (6.0% in men and 7.4% in women) and 12.5% (14.7% in men and 10.4% in women). More than half of those with diabetes had not been previously diagnosed. Diabetes was more common in urban compared to rural men but otherwise prevalence was relatively uniform across geographical regions. (Figure 2)

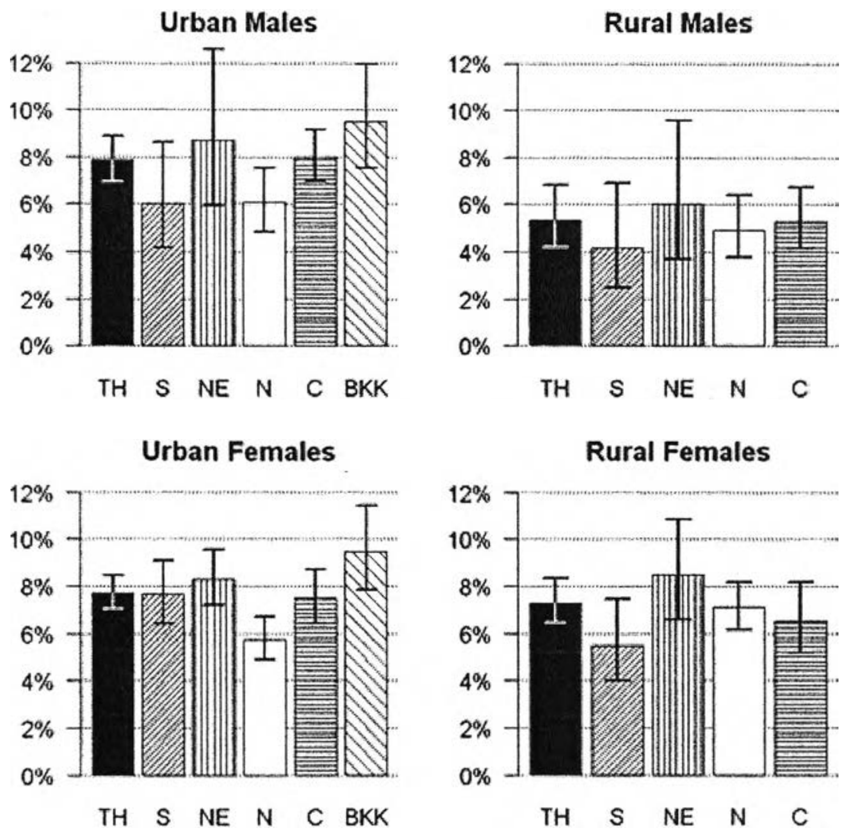

Figure 2: Age-standardized prevalence of diabetes (diagnosed and undiagnosed) by sex, area of residence (urban/rural), and geographic region, Thailand 2004. *Top*: Men. *Bottom*: Women. BKK, Bangkok; C, Central; N, North; NE, Northeast; S, South; TH, Thailand (Aekplakorn et al., 2007)

2.2 Risk Factors

There are many studies show that obesity, hypertension and lifestyle factors such as diet, physical activity, smoking and drinking habits are related to diabetes. According to the study among people age 20 years and over in Oman, the over all prevalence of diabetes was 11.6% and varied according to urban or rural residence, age, marital status, educational level, smoking status, measure of obesity, cholesterol and systolic blood pressure. The prevalence of hypertension is 21.1. Urban residence was significantly associated with diabetes (adjusted odds ratio (OR) =1.7, 95% confidence interval (CI): 1.4-2.1), as was age (OR=1.2, 95% CI:1.1-1.2), obesity (OR=1.8, 95% CI:1.5-2.1), and systolic blood pressure(SBP) 120-139 (OR=1.4, 95% CI:1.04-1.8), SBP 140-159 (OR=1.9, 95% CI:1.4-2.6), SBP $\geq$ 160 (OR=1.7, 95% CI:1.2-2.5). Stratified analyses revealed higher education was associated with reduced likelihood of diabetes in rural areas (OR=0.6, 95% CI: 0.4-0.9). (Al-Moosa et al., 2006)

Among the Zuni Indians, the prevalence of diabetes was 57% higher among female than male member of the population. The prevalence of newly diagnosed diabetes was similar among female Zuni Indians and male Zuni Indians. Obesity was associated with diabetes among both female and male Zuni Indians (OR=2.88, 95% CI: 1.83-4.54). But physical inactivity was not associated with diabetes among either female or male Zuni Indians. Gestational diabetes was a risk factor among female Zuni Indians. (Scavini et al., 2003)

A prospective cohort study in Taiwan assessed the relationship between overweight and obese status and the incidence of type 2 diabetes. The prevalence of overweight and obesity were 17.6% and 14.5%, respectively. Obese subjects with baseline BMI $\geq$ 25kg/m^2 had a significant multivariate-adjusted relative risk of 14.8 (unadjusted RR = 12.22) for diabetes and the relative risk was higher in women than in men. (Hwang et al., 2006). A cross-sectional survey in South Korea showed that overweight (BMI, $\geq$25.0 to <30.0) and obesity (BMI, $\geq$30) were positively and statistically significantly associated with diabetes (OR=2.34 and 2.64 in men, respectively, and OR=3.20 and 4.03 in women, respectively). (Kim et al., 2004)

According to the study of The Study to Help Improve Early evaluation and management of risk factors leading to Diabetes (SHIELD) 2004 screening questionnaire and the National Health and Nutrition Examination Surveys (NHANES) 1999-2002 (interview, clinical and laboratory data) that were conducted in nationally representative samples aged 18 years and over. Increase BMI was associated with increased prevalence of diabetes mellitus, hypertension and dyslipidaemia in both studies ($p<0.001$). More than 75% of patients had BMI $\geq$ 25 kg/m^2. In both studies, prevalence of diabetes mellitus, hypertension and dyslipideamia occurred across all ranges of BMI, but increased with higher BMI. (Bays et al., 2007)

In a prospective study in the U.S., (Gress et al., 2000) found that during six years of follow up, the incidence rates of diabetes in subjects with and without hypertension were 29.1 and 12.0 per 1000 person-years, respectively (relative risk of hypertension for diabetes = 2.43).

The study about the associations between type 2 diabetes and fiber, glycemic load (GL), dietary glycemic index (GI), and fiber-rich foods shows that the odds ratio (OR) for the highest quartile of white bread intake compared with the lowest was 1.37 (95% CI 1.04-1.81; P for trend=0.001). Intake of carbohydrate (OR per 200g/day 0.58, 0.36-0.95), sugars (OR per 100g/day 0.61, 0.47-0.79), and magnesium (OR per 500mg/day 0.62, 0.43-0.90) were inversely associated with incidence of diabetes, whereas intake of starch (OR per 100g/day 1.47, 1.06-2.05) and dietary GI (OR per 10 units 1.32, 1.05-1.66) were positively associated with diabetes. (Hodge et al., 2004) The cohort study in Finland supports the hypothesis that development of type 2 diabetes may reduced by the intake of antioxidants in the diet. Intake of vitamin E, α-tocopherol, γ-tocopherol, δ-tocopherol , and β-tocotrienol were inversely related to a risk of type 2 diabetes. Among single carotenoids, β-cryptoxanthin intake was significantly associated with a reduced risk of type 2 diabetes. No association was evident between intake of vitamin C and type 2 diabetes. (Montonen et al., 2004)

According to the study about alcohol consumption and risk for development of impaired fasting glucose or type 2 diabetes in middle-aged Japanese men, there was a U-shaped association between alcohol consumption and the incidence of IFG of type 2 diabetes, with the lowest incidence at alcohol intake of 23.0-45.9g ethanol/day. These results indicate that moderate alcohol consumption among healthy Japanese men is associated with reduced risk for development of IFG or type 2 diabetes. (Nakanishi et al., 2003)

The study among U.S. adults, smoking shares a robust association with incidence diabetes. The study divided the samples into 5 groups by number of cigarettes smoked daily and years of smoking: never, former smokers with <20 pack-years, former smokers with≥20 pack-years, current smokers with <20 pack-years and current smokers with≥20 pack-years. Current smokers exhibited increased incidence of diabetes compared with never smokers (odds ratio [OR] 2.66, P=0.001). (Foy et al., 2005)

The study in the island nation of Mauritus, located in the southwest Indian Ocean, that has a high prevalence of type 2 diabetes shows that a statistically significant inverse relationship between physical activity and 2-h post load glucose concentration was found for both males and females. These data are supportive of a potentially important role of physical activity in the prevention of type 2 diabetes. (Pereira et al., 1995)

Several prospective studies have shown that measure of lifestyle modification help in preventing the onset of diabetes. The Indian Diabetes Preventing Program (IDPP), a preventive study done in India based on the Diabetes Preventing Program (DPP) has recently developed the Indian Diabetes Risk Score (IDRS) using four simple variables namely, age, family history, regular exercise and waist circumference. The people were classified as high risk, moderate risk and low risk. IDRS has sensitivity and specificity of over 60 percent for a cut-off > 60 and can be use to do a selective screening for Indian population. (Mohan et al., 2007)

According to the Oslo study that wanted to investigate the relationship between leisure time physical activity and smoking measured in middle age and the occurrence of the metabolic syndrome and diabetes in men that participated in two cardiovascular screening of the Oslo study 28 years apart. Leisure time physical activity adjusted for age and educational attendance was significant predictor of both the metabolic syndrome and diabetes in 2000 (odds ratio for moderately vigorous versus sedentary/light activity was 0.65 [95% CI, 0.54-0.80] for the metabolic syndrome and 0.68 [0.52-0.9] for diabetes, p-values<0.05). Smoking was associated with the metabolic syndrome but not with diabetes in 2000.

The study in Thailand, a Thai cohort of 2677 individuals aged 35-55 years without diabetes at baseline was resurveyed after 12 years. Sex, overweight, obese, abdominally obese, hypertension and to have a parent of sibling with diabetes were associated with diabetes. Alcohol and smoking were not associated with diabetes. (Aekplakorn et al., 2006)