CHAPTER 2

LITERATURE REVIEW

This chapter is composed of four sections. The first section describes regarding diabetes disease. The second section reviews related literatures that studied regarding influenced factor on diabetes treatment and treatment outcome. The third section offers theoretical framework. The last section presents conceptual model of this study

2.1 Diabetes disease

Before reviewing of Type 2 diabetes literatures, it is necessary to know what is diabetes, diabetic symptoms, how to diagnosed diabetes and diabetes treatment.

2.1.1 What is diabetes?

Firstly, Diabetes mellitus is a metabolic disorder characterized by hyperglycemia (high blood sugar) and other signs, as distinct from a single illness or condition. The World Health Organization (WHO) recognizes three main forms of diabetes as Type 1, Type 2, and Gestational diabetes (occurring during pregnancy) [36], which have similar signs, symptoms, and consequences, but different causes and population distributions. Ultimately, all forms are due to the beta cells of the pancreas being unable to produce sufficient insulin to prevent hyperglycemia [37]. Type 1 is usually due to autoimmune destruction of the pancreatic beta cells which produce insulin. Type 2 is characterized by tissue-wide insulin resistance and varies widely; it sometimes progresses to loss of beta cell function. Gestational diabetes is similar to Type 2 diabetes, in that it involves insulin resistance; the hormones of pregnancy cause insulin resistance in those women genetically predisposed to developing this condition.

Types 1 and 2 are incurable chronic conditions, but have been treatable since insulin became medically available in 1921, and today are usually managed with a combination of dietary treatment, tablets (in Type 2) and, frequently insulin supplementation. Gestational diabetes typically resolves with delivery.

Cause of disease is abnormal glucose metabolism. Insulin production is more or less constant within the beta cells, irrespective of blood glucose levels. It is stored within vacuoles pending release via exocytosis, which is triggered by increased blood glucose levels.

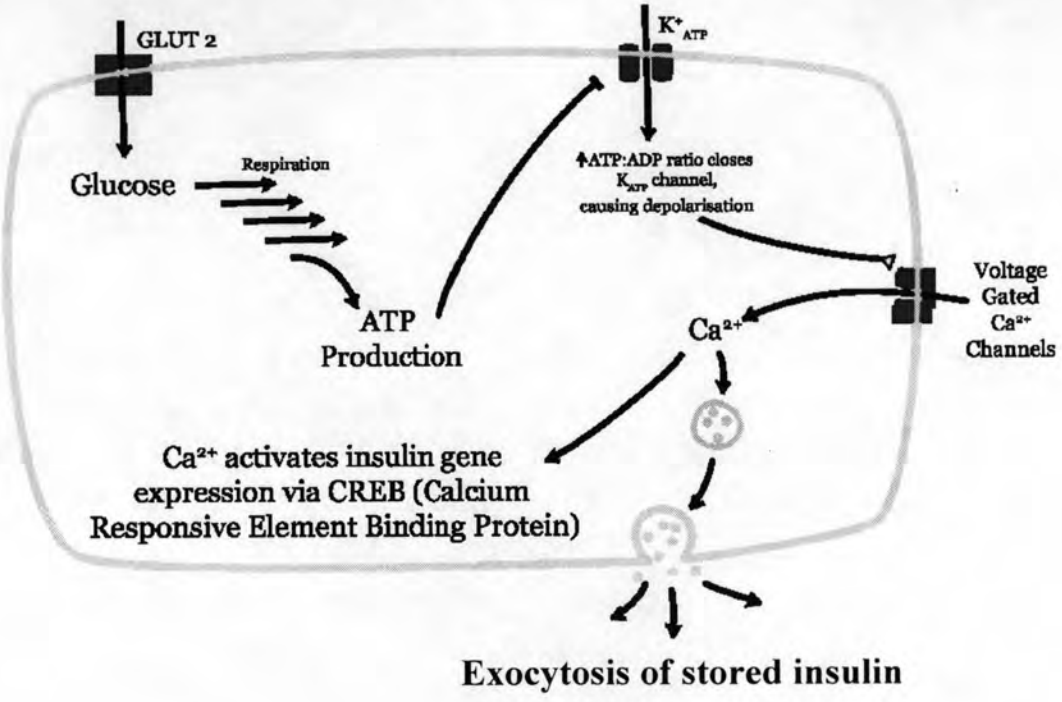
Because insulin is the principal hormone that regulates uptake of glucose into most cells from the blood (primarily muscle and fat cells, but not central nervous system cells), deficiency of insulin or the insensitivity of its receptors plays a central role in all forms of diabetes mellitus.

Much of the carbohydrate in food is converted within a few hours to the monosaccharide glucose, the principal carbohydrate found in blood. Some carbohydrates are not converted. Notable examples include fruit sugar (fructose) that is usable as cellular fuel, but it is not converted to glucose and does not participate in the insulin / glucose metabolic regulatory mechanism; additionally, the carbohydrate cellulose (though it is actually many glucose molecules in long chains) is not converted to glucose, as humans and many animals have no digestive pathway capable of handling cellulose.

Insulin is released into the blood by beta cells (β-cells) in the pancreas in response to rising levels of blood glucose (e.g., after a meal). Insulin enables most body cells (about 2/3 is the usual estimate, including muscle cells and adipose tissue) to absorb glucose from the blood for use as fuel, for conversion to other needed molecules, or for storage. Insulin is also the principal control signal for conversion of glucose (the basic sugar used for fuel) to glycogen for internal storage in liver and muscle cells. Reduced glucose levels result both in the reduced release of insulin from the beta cells and in the reverse conversion of glycogen to glucose when glucose levels fall, although only glucose thus recovered by the liver re-enters the bloodstream as muscle cells lack the necessary export mechanism.

Higher insulin levels increase many anabolic ("building up") processes such as cell growth and duplication, protein synthesis, and fat storage. Insulin is the principal signal in converting many of the bidirectional processes of metabolism from a catabolic to an anabolic direction, and vice versa. In particular, it is the trigger for entering or leaving ketosis for example, the fat burning metabolic phase.

If the amount of insulin available is insufficient, if cells respond poorly to the effects of insulin (insulin insensitivity or resistance), or if the insulin itself is defective, glucose will not be handled properly by body cells (about ⅔ require it) or stored appropriately in the liver and muscles. The net effect is persistent high levels of blood glucose, poor protein synthesis, and other metabolic derangements, such as acidosis.



Picture 1: Mechanism of insulin releasing in normal pancreatic beta cells. Insulin production is more or less constant within the beta cells, irrespective of blood glucose levels. It is stored within vacuoles pending release, via exocytosis, which is triggered by increased blood glucose levels.

2.1.2 Diabetic symptoms

The classical triad of diabetes symptoms is polyuria (frequent urination), polydipsia (increased thirst and consequent increased fluid intake), and polyphagia (increased appetite). However, weight loss may occur in diabetes patient. These symptoms may develop quite fast in Type 1, particularly in children (weeks or months) but may be subtle or completely absent—as well as developing much more slowly—in Type 2. In type 1 there may also be weight loss (despite normal or increased eating) and

irreducible fatigue. These symptoms may also manifest in Type 2 diabetes in patients whose diabetes is poorly controlled.

When the glucose concentration in the blood is high (i.e., above the "renal threshold"), re-absorption of glucose in the proximal renal tubuli is incomplete, and part of the glucose remains in the urine (glycosuria). This increases the osmotic pressure of the urine and thus inhibits the re-absorption of water by the kidney, resulting in an increased urine production (polyuria) and an increased fluid loss. Lost blood volume will be replaced osmotically from water held in body cells, causing dehydration and increased thirst.

Prolonged high blood glucose causes glucose absorption and so leads to changes in the shape of the lenses of the eyes (diabetic retinopathy), leading to vision changes. Blurred vision is a common complaint leading to a diabetes diagnosis; Type 1 should always be suspected in cases of rapid vision change whereas Type 2 is generally more gradual, but should still be suspected.

Patients (usually with type 1 diabetes) may also present with diabetic ketoacidosis (DKA), an extreme state of metabolic dysregulation eventually characterized by the smell of acetone on the patient's breath, Kussmaul breathing (a rapid, deep breathing), polyuria, nausea, vomiting and abdominal pain, and any of many altered states of consciousness or arousal (e.g., hostility and mania or, equally, confusion and lethargy). In severe DKA, coma (unconsciousness) may follow, progressing to death. In any form, DKA is a medical emergency and requires expert attention.

Diabetes can cause many complications. Acute complications (hypoglycemia, ketoacidosis or nonketotic hyperosmolar coma) may occur if the disease is not adequately controlled. Serious long-term complications include cardiovascular disease (doubled risk), chronic renal failure (diabetic nephropathy is the main cause of dialysis in developed world adults), retinal damage (which can lead to blindness and is the most significant cause of adult blindness in the non-elderly in the developed world), nerve damage (of several kinds), and microvascular damage, which may cause erectile dysfunction (impotence) and poor healing. Poor healing of wounds, particularly of the feet, can lead to gangrene which can require amputation — the leading cause of non-

traumatic amputation in adults in the developed world. Adequate treatment of diabetes, as well as increased emphasis on blood glucose control and lifestyle factors (such as not smoking and keeping a healthy body weight), may improve the risk profile of most aforementioned complications.

This study focuses on Type 2 diabetes because it is the most common form; about 90 percent to 95 percent of patients with diabetes have Type 2 [3]. This disease—previously known as adult-onset diabetes, maturity-onset diabetes, or non-insulin-dependent diabetes mellitus (NIDDM)—is due to a combination of defective insulin secretion and insulin resistance or reduced insulin sensitivity (defective responsiveness of tissues to insulin), which almost certainly involves the insulin receptor in cell membranes. In the early stage the predominant abnormality is reduced insulin sensitivity, characterized by elevated levels of insulin in the blood. At this stage hyperglycemia can be reversed by a variety of measures and medications that improve insulin sensitivity or reduce glucose production by the liver, but as the disease progresses the impairment of insulin secretion worsens and therapeutic replacement of insulin often becomes necessary. There are numerous theories as to the exact cause and mechanism for this resistance, but central obesity (fat concentrated around the waist in relation to abdominal organs, and not subcutaneous fat, it seems) is known to predispose individuals for insulin resistance, possibly due to its secretion of adipokines (a group of hormones) that impair glucose tolerance. Abdominal fat is especially active hormonally. Eberhart et al (2004) reported that obesity is found in approximately 55% of patients diagnosed with Type 2 diabetes [38]. Other factors include aging (about 20% of elderly patients are diabetic in North America) and family history (Type 2 is much more common in those with close relatives who have had it), although in the last decade it has increasingly begun to affect children and adolescents, likely in connection with the greatly increased childhood obesity seen in recent decades in some places.

Type 2 diabetes may go unnoticed for years in a patient before diagnosis, as visible symptoms are typically mild or non-existent, usually without ketoacidotic episodes, and can be sporadic as well. However, severe long-term complications can result from unnoticed Type 2 diabetes, including renal failure due to diabetic nephropathy, vascular disease (including coronary artery disease), vision damage due to

diabetic retinopathy, loss of sensation or pain due to diabetes neuropathy, liver damage from non-alcoholic steatohepatitis, etc.

2.1.3 How to diagnosed diabetes?

WHO addressed that diabetes mellitus is characterized by recurrent or persistent hyperglycemia, and is diagnosed by demonstrating any one of the following:[36]

1. Fasting Blood Glucose level at or above 126 mg/dL (7.0 mmol/l).
2. Blood glucose at or above 200 mg/dL or 11.1 mmol/l two hours after a 75 g oral glucose load as in a glucose tolerance test.
3. Random plasma glucose at or above 200 mg/dL or 11.1 mmol/l.

A positive result should be confirmed by another of the above-listed methods on a different day, unless there is no doubt as to the presence of significantly-elevated glucose levels. Most physicians prefer measuring a Fasting Blood Glucose level because of the ease of measurement and the considerable time commitment of formal glucose tolerance testing, which can take two hours to complete. By current definition, two fasting glucose measurements above 126 mg/dL or 7.0 mmol/l is considered diagnostic for diabetes mellitus.

Patients with fasting glucose between 6.1 and 7.0 mmol/l (ie, 110 and 125 mg/dL) are considered to have "impaired fasting glycemia" and patients with blood glucose at or above 140 mg/dL or 7.8 mmol/l two hours after a 75 g oral glucose load are considered to have "impaired glucose tolerance". "Prediabetes" is either impaired fasting glucose or impaired glucose tolerance; the latter in particular is a major risk factor for progression to full-blown diabetes mellitus as well as cardiovascular disease.

While not used for diagnosis, an elevated level of glucose irreversibly bound to hemoglobin (termed glycosylated hemoglobin or HbA1c) of 6.0% or higher (the 2003 revised U.S. standard) is considered abnormal by most labs; HbA1c is primarily used as a treatment-tracking test reflecting average blood glucose levels over the preceding 90 days (approximately). However, some physicians may order this test at the time of diagnosis to track changes over time. The current recommended goal for HbA1c in patients with

diabetes is <7.0%, which as defined as "good glycemic control", although some guidelines are stricter (<6.5%). Diabetes patients who have HbA1c levels within this range have a significantly lower incidence of complications from diabetes, including retinopathy and diabetic nephropathy.[39]

2.1.4 Diabetes treatment

Type 2 diabetes is usually first treated by attempts to change physical activity (generally an increase is desired), the diet (generally to decrease carbohydrate intake), and weight loss. These can restore insulin sensitivity, even when the weight loss is modest, for example, around 5 kg (10 to 15 lb), most especially when it is in abdominal fat deposits. Some Type 2 diabetics can achieve satisfactory glucose control, sometimes for years, as a result. However, the underlying tendency to insulin resistance is not lost, and so attention to diet, exercise, and weight loss must continue. The usual next step, if necessary, is treatment with oral anti-diabetic drugs. As insulin production is initially only moderately impaired in Type 2 diabetics, oral medication (often used in various combinations) can still be used to improve insulin production (e.g., sulfonylureas), to regulate inappropriate release of glucose by the liver (and attenuate insulin resistance to some extent (e.g., metformin), and to substantially attenuate insulin resistance (e.g., thiazolidinediones). According to one study (UKPDS 34), overweight patients treated with metformin compared with diet alone, had relative risk reductions of 32% for any diabetes endpoint, 42% for diabetes related death and 36% for all cause mortality and stroke [40]. When oral medications fail (cessation of beta cell insulin secretion is not uncommon amongst Type 2), insulin therapy will be necessary to maintain normal or near normal glucose levels. A disciplined regimen of blood glucose checks is recommended, most particularly and necessarily when taking medications.

2.2 Related literature reviews

There were many factors that make people develop to Type 2 diabetes or treatment outcome was unsuccessful such as diet, patient eating behavior, exercise, patient life behavior change, diabetes knowledge of patient and medical regimen compliance.

2.2.1. Diet and Patient eating behavior

Diet and patient eating behavior were important factor that influence risk of Type 2 diabetes and treatment outcome. Cromie et al (1997) studied in more than 65,000 women, 40 to 65 years old and concluded that too much sugar and not enough fiber eating habit could double a female's risk of developing adult-onset diabetes. Manson et al (1997) reported that high-sugar and low-fiber intake increased the chances that women would develop the diabetes disease. Diets high in sugar and low in fiber could lead to a chronically high demand for insulin, which converted blood glucose into energy. As long as the pancreas turned out enough insulin to meet the extra demand, tolerance for blood glucose stayed normal. But failure of the pancreas to respond properly could lead to adult-onset diabetes, also known as non insulin-dependent diabetes mellitus, or Type 2 diabetes. Hu et al (2006) found that people who drank three to six cups of coffee were 23% less likely to develop diabetes than somebody who consumed two or less cups a day. Those who had seven or more cups of coffee per day were 34% less likely to develop diabetes than drinkers of two or less cups per day. Coffee drinking was associated with a reduced risk of Type 2 diabetes in both men and women, and this association was observed regardless of the levels of physical activity, BMI and alcohol consumption [(42)]. Iso et al (2006) reported that consumption of green tea, coffee, and total caffeine was associated with a reduced risk for Type 2 diabetes after adjustments for age, sex, body mass index, and other risk factors. No association was found between consumption of black or oolong teas and the risk for diabetes. Total caffeine intake from these beverages was associated with a 33% reduced risk for diabetes. These inverse associations were more pronounced in women and in overweight men [(43)]. Van Dam et al (2002) found that the prudent dietary pattern (characterized by higher consumption of vegetables, fruit, fish, poultry and whole grains) score was associated with a modestly lower risk for Type 2 diabetes. In contrast, the western dietary pattern (characterized by higher consumption of red meat, processed meat, French fries, high-fat dairy products, refined grains, and sweets and desserts) score was associated with an increased risk for Type 2 diabetes [(44)]. Halton et al (2006) found that potato and French fry consumption were both positively associated with risk of Type 2 diabetes after adjustment for age and dietary and non-dietary factors. The association between potato consumption and risk of Type 2 diabetes was more pronounced in obese women. Researcher concluded that a modest positive association between the consumption of potatoes and the risk of Type 2 diabetes in women. This

association was more pronounced when potatoes were substituted for whole grains [45]. Yunsheng et al (2006) concluded that Type 2 diabetic patients with poorly controlled reported a low-carbohydrate, low-fiber, high-fat (especially saturated) diet, although they stated they were not following any of the popular low-carbohydrate diets. Patients with Type 2 diabetes might find the current trend toward reducing weight through low-carbohydrate diets attractive for control of blood glucose, despite ADA recommendations. This dietary pattern might represent a popular trend that extends beyond their particular study and, if so, had serious cardiovascular implications in this vulnerable population of Type 2 diabetic patients [46]. Gillen et al (2005) recommended that dietary assessment for individuals with diabetes should consider the type of fat in the overall diet. Advice for both reducing saturated fat and providing adequate amounts of unsaturated fatty acids was necessary [47]. Chandalia et al (2000) found that a high intake of dietary fiber, particularly of the soluble type improved glycemic control, decreased hyperinsulinemia, and lowers plasma lipid concentrations in Type 2 diabetic patients [48]. Miller et al (2003) concluded that choosing low glycemic index (GI) foods in place of conventional or high-GI foods had a small but clinically useful effect on medium-term glycemic control in patients with diabetes. The incremental benefit was similar to that offered by pharmacological agents that also target postprandial hyperglycemia. [49]. Nielsen et al (2006) revealed that advice on a 20 % carbohydrate diet with some caloric restriction to obese patients with Type 2 diabetes had long term effect on body weight and glycemic control [50].

2.2.2. Regular physical activity (Exercise)

The American council on exercise addressed that regular physical activity (exercise) was put at the forefront in the prevention, control and treatment of diabetes. Exercise also helps to decrease risk of cardiovascular disease by decreasing blood pressure, cholesterol level and body fat. Morrato et al (2007) found that a total of 39% of adults with diabetes were physically active versus 58% of adults without diabetes. The proportion of active adults without diabetes declined as the number of risk factors increased until dropping to similar rates as people with diabetes. After adjustment for socio-demographic and clinical factors, the strongest correlates of being physically active were income level, limitations in physical function, depression, and severe obesity (BMI $\geq$40 kg/m^2). Several traditional predictors of activity (sex, education level, and having

received past advice from a health professional to exercise more) were not evident among respondents with diabetes. The majority of patients with diabetes or at highest risk for developing Type 2 diabetes do not engage in regular physical activity, with a rate significantly below national norms. There was a great need for efforts to target interventions to increase physical activity in these individuals [51]. Harry et al (2002) studied regarding exercise in diabetes patient and concluded that after adjustment for other variables, patients without exercise had an odds ratio of 2.71 (95% CI, 1.38-5.32) for poor diabetic control compared with patients with exercise. These findings suggested that exercise by itself is important for Type 2 diabetes management [52]. The recent Surgeon General's Report on Physical Activity and Health underscores the pivotal role physical activity plays in health promotion and disease prevention. It was recommends that individuals accumulate 30 min of moderate physical activity on most days of the week. In the context of diabetes, it was becoming increasingly clear that the epidemic of Type 2 diabetes sweeping the globe was associated with decreasing levels of activity and an increasing prevalence of obesity. Thus, the importance of promoting physical activity as a vital component of the prevention as well as management of Type 2 diabetes must be viewed as a high priority. It must also be recognized that the benefit of physical activity in improving the metabolic abnormalities of Type 2 diabetes was probably greatest when it was used early in its progression from insulin resistance to impaired glucose tolerance to overt hyperglycemia requiring treatment with oral glucose-lowering agents and finally to insulin. ADA (2004) recommended that people with Type 2 diabetes must be on adjusting the therapeutic regimen to allow safe participation in all forms of physical activity consistent with an individual's desires and goals. Ultimately, all patients with diabetes should have the opportunity to benefit from the many valuable effects of physical activity [53]. Henrik Wagner et al (2006) found that addition of acarbose to exercise improved glycemic control. In subjects with mild Type 2 diabetes, exercise training improved insulin sensitivity but had no effect on glycemic control. The addition of acarbose to exercise, however, was associated with significant improvement of glycemic control and possibly cardiovascular risk factors [54]. Sanguanrungsirikul (2004) indicated that moderate aerobic exercise training could improve cardiac autonomic function in asymptomatic cardiac autonomic neuropathy Type 2 diabetes [55]. Thomas et al (2007) found that exercise improved blood sugar control and that this effect is evident even without weight loss. Furthermore, exercise decreased body fat content, thus the failure to lose weight with exercise programmers' was probably explained by the conversion of fat

to muscle. Exercise improved the body's reaction to insulin and decreased blood lipids. Castaneda et al (2002) reported that progressive training as an adjunct to standard of care was feasible and effective in improving glycemic control and some of the abnormalities associated with the metabolic syndrome among high-risk older adults with Type 2 diabetes [57]. Tanasescu et al (2003) demonstrated that physical activity was associated with a reduced risk of both cardiovascular and total mortality among men with Type 2 diabetes. Researcher found that walking was associated with reduced risk of total mortality and concluded that physical activity was associated with reduced risk of CVD, cardiovascular death, and total mortality in men with Type 2 diabetes. Walking and walking pace were associated with reduced total mortality [58]. Boulé et al (2001) reviewed 12 aerobic training studies and found that exercise training reduces HbA1c by an amount that should decrease the risk of diabetic complications, but no significantly greater change in body mass was found when exercise groups were compared with control groups [59].

2.2.3. Making Life behavior changes

Lifestyle changes or non-pharmacological treatment was the choice in the treatment of patients with Type 2 diabetes. Gillies et al (2007) concluded that life behavior and pharmacological interventions reduced the rate of progression to Type 2 diabetes in people with impaired glucose tolerance [60]. So Hun Kim et al (2006) found that a 6-month intensive lifestyle modification intervention in patients with Type 2 diabetes mellitus resulted in improved glycemic control and decreased progression of carotid intima-media thickness (IMT) [61]. Dam et al (2003) found that changed in diet and physical activity could protect against Type 2 diabetes. Diet and physical activity could affect the development of Type 2 diabetes through changes of body fatness, but also through other pathways [62]. Israni et al (2007) reviewed studies which measured the effects of different interventions -- lifestyle, diabetes drug and anti-obesity drug -- on people with impaired glucose tolerance. Research found that lifestyle changes (e.g. switching to a healthier diet) and increasing exercise to be at least as effective as taking prescription drugs. On average, lifestyle changes helped to reduce the risk of developing Type 2 diabetes by around half. Lifestyle changes were also less likely to have adverse side-effects. However, the researcher also reported that both lifestyle changes and prescription drug taking must be sustained in order to prevent the development of Type 2

diabetes [63]. Knowler et al (2002) found that the lifestyle intervention was significantly more effective than metformin. Researcher concluded that Life behavior changes and treatment with metformin both reduced the incidence of diabetes in persons at high risk. The lifestyle intervention was more effective than metformin [64]. Tuomilehto et al (2001) concluded that Type 2 diabetes can be prevented by changes in the lifestyles of high-risk subjects [65].

2.2.4. Patient education

Patient education was an important component of diabetic care. Ko et al (2007) studied effectiveness of structured intensive diabetes education program (SIDEP) for patient with Type 2 diabetes mellitus and found that intensive patient education program was necessary for patient with diabetes. However, regular and sustained reinforcement with encouragement was also required to maintain optimal glycaemic control, especially in insulin-treated patients [66]. Glasgow et al (1989) compared two diabetes education programs which were compared to a control condition. Type 2 diabetic patients were randomly assigned to nutrition education, nutrition education plus social learning intervention. Both interventions involved five weekly meetings that focused on reducing calorie intake, increasing dietary fiber, and decreasing fat consumption. The social learning condition also included individualized goal setting and feedback and training in problem-solving and relapse prevention. Within-group analyses and between-group comparisons generally revealed greater improvement in targeted goals (e.g., calorie intake, fat reduction) among intervention conditions than the control condition. There were few differences in more distal measures of outcome such as weight or glycosylated hemoglobin. The social learning component did not improve outcome more than the nutrition education program. Possible reasons for the observed findings and the advantages and limitations of focused time-limited diabetes education efforts were discussed [67]. Gagliardino et al (2001) suggested that an educational approach promoting healthy lifestyle habits and patient empowerment was an effective strategy with the potential to decrease the development of complications related to diabetes as well as the socioeconomic costs of the disease [68]. Prasaichaimontri (2003) found that patient who received health education had significant higher knowledge score better than patient who did not receive. The result from this study suggested that it was important for pharmacist to identify patient's barrier to adhere with medical regimen. Health education should be

focus on patient's skill to reduce barrier to adhere medical regimen [69]. Wangkladkaew (2002) suggested that nutrition counseling was important for Type 2 diabetes patients [70]. Lohavisavapanich (2003) found that provide education and counselling had significant effect to knowledge, attitude, quality of life in mental component, satisfaction , plasma glucose level and health care utilization of diabetes patients[71]. Ghazanfari et al (2007) concluded that their designed educational program could improve the lifestyle of the patients suffering from Type 2 diabetes mellitus [72]. Deakin et al (2005) reviewed 11 studies involving 1,532 patients with Type 2 diabetes to assess the effects of group-based (six or more participants) patient-centered diabetes training in both the short (four to six months) and long term (12 to 14 months). The researchers also assessed the effects of training on clinical, lifestyle and psychosocial outcomes. Researcher concluded that patients with Type 2 diabetes who participate in group education programs to manage their disease show measurable improvement and require less medication, according to a systematic review of current evidence [73].

2.2.5. Medical regimen compliance

Medical regimen compliances were important factor that effected to treatment outcome. Wijenaike (2005) concluded that non-compliance with oral hypoglycemic drugs (blood sugar lowering tablets) was a central issue in patients with Type 2 diabetes, as it reduced the efficacy of treatment. It also added considerably to the cost of care in the Northern Sydney Health Diabetes Services (NHS) [74]. Blanca Rosa Duran-Varela studied in 150 Type 2 diabetic patients of the Mexican Institute of Social Security in Chihuahua, Mexico. Compliance to drug therapy was measured by counting tablets at home. Metabolic control was measured through glycosilated hemoglobin. The result of this research concluded that pharmacological therapy compliance was 54.2%. Factors associated with non-compliance were elementary schooling and lack of information about the disease. Pharmacological therapy compliance was low. Researcher suggested that factors related to non-compliance could be modified through education [75]. Lau et al (2004) found that patients with Type 2 diabetes who did not obtain at least 80% of their oral antihyperglycemic medications across 1 year were at a higher risk of hospitalization in the following year [76]. Grant et al (2007) found that Type 2 diabetes patients with worse adherence to their first prescribed oral hypoglycemic drug were less likely to have their regimen intensified after an elevated HbA1C than similarly hyperglycemic patients

with good baseline adherence. Increased focus on the patient's role in medication intensification might provide greater insight and lead to more effective solutions to the problem of clinical inertia.

2.3 Theoretical Framework

This study was based on conceptual of "Theory of Reasoned Action" (TRA). TRA was first proposed by Azjen and Fishbein [78] (1975 & 1980). The components of TRA were three general constructs- 1) Behavioral Intention (BI), 2) Attitude (A), and 3) Subjective Norm (SN). TRA suggest that a person's behavioral intention depend on a person's attitude about the behavior and subjective norms (BI = A +SN. If a person intend to do a behavior then it was likely that the person would do it). Furthermore a person's intentions were themselves guided by two things: the person's attitude toward the behavior and the subjective norm. Behavioral intention measured a person's relative strength of intention to perform a behavior. Attitude was comprised of beliefs about the consequences of performing the behavior multiplied by his or her valuation of these consequences. Subjective norm was seen as a combination of perceived expectations from relevant individuals or groups along with intentions to comply with these expectations. In other words, "the person's perception that most people who were important to her or him thought s/he should or should not perform the behavior in question" (Azjen and Fishbein, 1975).

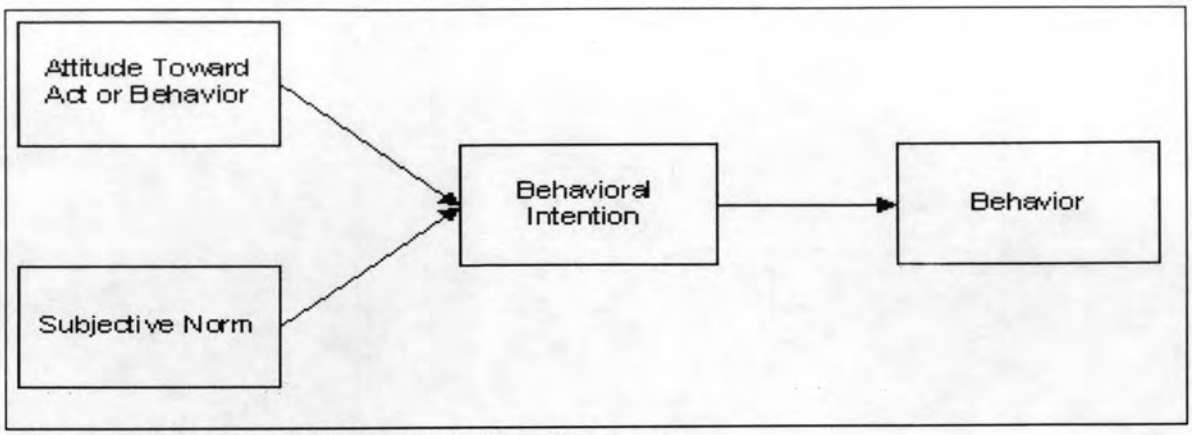
To put the definition into simple terms: a person's volitional (voluntary) behavior was predicted by his/her attitude toward that behavior and how he/she think other people would view them if they performed the behavior. A person's attitude, combined with subjective norms, forms his/her behavioral intention. Fishbein and Ajzen said, though, that attitudes and norms were not weighted equally in predicting behavior. "Indeed, depending on the individual and the situation, these factors might be very different effects on behavioral intention; thus a weight was associated with each of these factors in the predictive formula of the theory. For example, you might be the kind of person who cares little for what others think. If this was the case, the subjective norms would carry little weight in predicting your style" (Miller, 2005).

Miller (2005) defines each of the three components of the theory as follows and used the example of embarking on a new exercise program to illustrate the theory:

Attitudes: the sum of beliefs about a particular style weighted by evaluations of these beliefs. You might have the beliefs that exercise is good for your health, that exercise makes you look good, that exercise taken too much time, and that exercise is uncomfortable. Each of these beliefs could be weighted (e.g., health issues might be more important to you than issues of time and comfort).

Subjective norms: Look at the influence of people in one's social environment on his/her behavioral intentions; the beliefs of people, weighted by the importance one attributes to each of their opinions, would influence one's behavioral intention
You might have some friends who were avoiding exercisers and constantly encourage you to join them. However, your spouse might prefer a more sedentary lifestyle and scoff at those who work out. The beliefs of these people, weighted by the importance you attribute to each of their opinions, will influence your behavioral intention to exercise, which would lead to your behavior to exercise or not exercise.

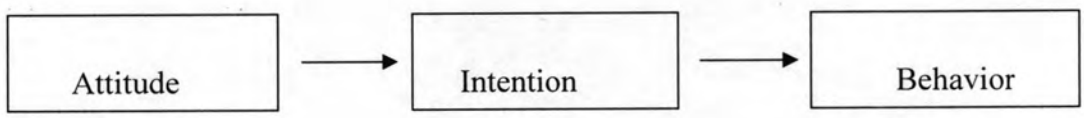
Behavioral intention: a function of both attitudes toward a behavior and subjective norms toward that behavior, which has been found to predict actual behavior. Your attitude about exercise combined with the subjective norms about exercise, each with their own weight, would lead you to your intention to exercise (or not), which would then lead to your actual style. The theory of Reasoned Action diagram as shown in Picture 2



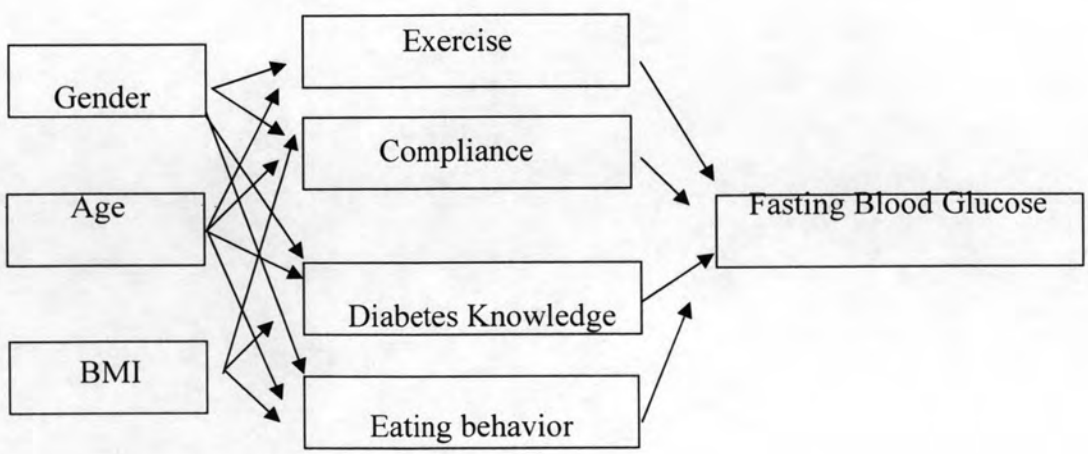
Picture 2: Theory of Reasoned Action diagram

Source: Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention, and style : An introduction to theory and research.

This deductive research was based on the gist of "Theory of Reasoned Action" by Ajzen and Fishbein (1975) which in brief stated that "Attitude toward anything led to intention to do it then impacted behavior."



2.4 Conceptual model



Additional variables such as demographic data (i.e. gender, age and BMI), and "health behaviors" specifically—exercise, compliance, diabetes knowledge and eating behavior were integrated to the model predicting Fasting Blood Glucose (FBG).

The objectives of this study were to: 1. Compare means of calories burnt by exercise, compliance, eating behavior score, diabetes knowledge, age, BMI and Fasting Blood Glucose between gender. 2. Find correlations between calories burnt by exercise, compliance, eating behavior score, diabetes knowledge, age, BMI and Fasting Blood Glucose. 3. Estimate Hierarchical Stepwise Multiple Regression Analysis Model to predict FBG.

Research questions, In the Type 2 diabetes patients, when controlling for drug

1. Did Type 2 diabetes patients male and female have different calories burnt by exercise, compliance, eating behavior score, diabetes knowledge, age, BMI and Fasting Blood Glucose?,
2. Could (calories burnt by exercise, compliance, eating behavior score, diabetes knowledge, BMI and age) individually predict Fasting Blood Glucose in Type 2 diabetes patients? In other words were there any significant correlation between (calories burnt by exercise, compliance, eating behavior score, diabetes knowledge, BMI and age) and Fasting Blood Glucose?
3. What factors significantly predicted Fasting Blood Glucose in Type 2 diabetes patients?