Chapter

Effect of Lifestyle Modification on Glycemic Control of Type 2 Diabetic Patients at Suez Canal University Hospitals

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Abstract

Type 2 Diabetes mellitus, as one of the major universal public health disorders wide spread, requires patients' lifestyle modulation which would be conducive in dominating blood glucose. The aim of the study was to evaluate the effect of lifestyle modification on glycemic control of type 2 diabetic patients at Suez Canal University Hospitals at Ismailia city. A quasi-experimental design made up of a control group and a study group with pre- and post-test administration was applied. This study was carried out at the Family Medicine Outpatient Clinic and the Diabetic Outpatient Clinic of Suez Canal University Hospitals at Ismailia city in Egypt. 92 type 2 diabetic patients were included in this study. The Diabetes Knowledge Questionnaire; Health promoting lifestyle profile II Scale; and Physical assessment sheet were used for data collection in the two groups. After implementing of the program, those patients who received lifestyle modification intervention achieved better total score of knowledge & knowledge related practice about DM, health promoting lifestyle domains values and glycated hemoglobin, compared with the control group. Factors related to lower glycated hemoglobin in the present study were lower fasting blood sugar level and increasing physical activity. Overall, lifestyle modification program has a positive influence on blood glucose control of patients with type 2 diabetes mellitus. Therefore, it is recommended to that lifestyle modification interventions should be integral part of the curative management of type 2 diabetic patients, and further study in other places to investigate the effect of lifestyle modification on glycemic control of those patients.

Keywords: "lifestyle modification", "type 2 diabetes mellitus", and "glycemic control"

1. Introduction

Diabetes Mellitus (DM) is one of the widespread and universal health problems that affect many people worldwide. It is defined as a metabolic disorder caused by different factors, which is characterized by hyperglycemia (elevated blood glucose level) and is usually associated with carbohydrate, fat and protein metabolism

abnormalities [1]. There are two main types of DM: Type 1diabetes mellitus (T1DM) and Type 2 diabetes mellitus (T2DM). T2DM is the commonest form of diabetes, constituting nearly 90% of the diabetic patients in any country [2].

Type 2 diabetes mellitus is a heterogeneous and progressive illness, with an underlying mechanism ranging from predominantly insulin resistance with relative insulin deficiency, to predominantly an insulin secretory defect with lesser degrees of insulin resistance. The spread of T2DM is increasing all over the world, probably due to the expectations of population's long life, a sedentary lifestyle and above all, the increasing rates of obesity. There are two sub-divisions of T2DM. The "Not Insulin Requiring" diabetes, managed by lifestyle measures alone and sometimes oral drugs, and the "Insulin requiring for diabetes control", where insulin is required to control, rather than survival [3].

A recent study proved that the uncontrolled diabetes, particularly elevated blood sugar over a prolonged period of time could lead to a number of short and long-term health complications. Such complications were divided traditionally into two main subtypes: the diabetes specific micro-vascular complications of retinopathy, nephropathy, and neuropathy which were caused by injuries to the small blood vessels; and the thrombotic macro-vascular complications of myocardial infraction, hypertension, and peripheral arterial disease which were presented due to arterial damage [4].

Many chronic diseases, as proved by recent studies, are associated with poor lifestyle and unwise human conduct. Lifestyle is an individual's typical way of life which includes activities and attitudes that influence man's health, whether healthy or unhealthy. A healthy lifestyle often results in better health and happiness. In contrast, an unhealthy lifestyle may cause illness and morbidity. Lifestyle related risk factors are associated with the development and progression of T2DM. These risk factors such as sedentary lifestyle, smoking, alcohol consumption, dietary choices and overweight are modifiable. The cornerstone of DM management includes appropriate lifestyle choices supported by regular medication and blood glucose self-monitoring, where necessary [5, 6].

The core of Type 2 diabetes mellitus treatment depends mainly on physical activity and nutrition therapy. The recent studies have proved the benefits of physical activity on individuals who maintain a physically active lifestyle and therefore, they are less likely to develop insulin resistance, impaired glucose tolerance, or T2DM. The effects of exercise training on glycemic control and related physiological parameters have also been extensively studied in type 2 diabetic patients. On the same line, healthy nutrition is the basis for the treatment of T2DM. It positively maintains blood glucose to be within normal limits and effectively minimizes the complications of the T2DM and weight loss is also an important goal because it improves glycemic control [7, 8].

The community health nurse had an effective role in patient education about all newly lifestyle modification for T2DM. No matter that encouraging and supporting lifestyle modifications could help in enabling type 2 diabetic patients to feel more satisfied in controlling of their disease. Pender's health promotion model (HPM) is one of the widely used models to plan for changing unhealthy behaviors and promote general hygiene. Pender's model was developed after the health belief model, to assist nurses in understanding the major determinants of health behaviors as a basis for behavioral counseling to promote healthy lifestyles. According to Pender's model, health promotion is a dynamic and positive process that encompasses conducts supporting a healthy lifestyle, including physical activity, dieting, spiritual growth, interpersonal relationships, health responsibility, and stress management. In nutshell, a health-promoting lifestyle is a multi-dimensional pattern of voluntary behaviors needed for promoting one's health conditions, self- growth, and perfection [9].

Moreover, a great importance should be paid for the patients' regular follow-up with the health care provider so as to avert any long-term complications. In diabetes Mellitus care, lifestyle modification can prevent or delay the complications and also decrease the need for medication. Because of the alarming and danger threaten DM statistics, the sacred role of nurses in assisting patients to control associated morbidity and mortality is becoming increasingly significant. Nurses, who are always on the front line, can screen patients for early diabetes identification, recognize and initiate corrective measures for inadequate treatment regimens, help patients set and achieve therapeutic goals and assess diabetes-related complications as soon as they arise [10]. DM, as a chronic disease, often has a relapsing and remitting course with substantial impact on function and quality of life (QOL). For chronic illnesses where there is no cure, it is important to establish that therapy which really makes people feel better.

1.1 Diabetes mellitus

1.1.1 Definition

Diabetes Mellitus (DM) is a complex, chronic disease that caused by inherited and/or acquired deficiency in production of insulin by the pancreas or by the ineffectiveness of the insulin produced; both require continuous medical care with multifactor risk-reduction strategies beyond glycemic control. It is defined as a metabolic disorder caused by different factors and is characterized by hyperglycemia (elevated level of blood glucose) with disturbances in carbohydrate, fat and protein metabolism. The chronic hyperglycemia is associated with long-term damage, dysfunction and degeneration/deterioration of various organs, particularly eyes, kidney, nerves, heart and blood vessels [8, 11].

1.1.2 Etiologic classification of DM

This classification includes four types:(1) Type 1 diabetes mellitus (T1DM), (2) Type 2 diabetes mellitus (T2DM), (3) Other specific forms of diabetes: Genetic defects of beta cell function; Genetic defects of insulin function; exocrine pancreatic diseases; Endocrinopathies; drugs and chemicals; infections; rare immunologic forms of diabetes; other genetic syndromes associated with diabetes; Latent autoimmune diabetes in adults (LADA); Maturity-onset diabetes of the young (MODY) and (4) Gestational diabetes mellitus (GDM) [8].

The majority of cases of diabetes can be broadly classified into 2categories: T1DM– autoimmune which is primarily a result of pancreatic beta cell destruction with consequent insulin deficiency, which is prone to ketoacidos is. This form includes cases due to an autoimmune process and those for which the etiology of beta cell destruction is unknown; T2DM – may range from predominant insulin resistance with relative insulin deficiency to a predominant secretory defect with insulin resistance. Ketosis is not as common. GDM refers to glucose intolerance with onset or first recognition during pregnancy. Other specific types include a wide variety of relatively uncommon conditions, primarily specific genetically defined forms of diabetes or diabetes associated with other diseases or drug use [12].

1.1.3 Latent autoimmune diabetes in adults

Latent autoimmune diabetes in adults (LADA) is a late manifesting autoimmune form of diabetes in adults, most commonly diagnosed in patients above35years of age, characterized by clinical insulin independence in the first months after the

diagnosis, with the presence of serum antibodies against glutamic acid decarboxylase (anti-GAD65) and/or other anti-islet antibodies and a low serum peptide C level. LADA is a form of T1DM with slowly progressive autoimmune-mediated destruction of beta cells. This diabetes subtype is present in 5–10% of subjects with diabetes diagnosed after 35 years of age and categorized asT2DM. Clinical manifestations of LADA do not always allow a definite diagnosis, presenting diagnostic challenges when differentiating with T2DM. A definite diagnosis of LADA requires identification of auto-antibodies typical for T1DM, mostly antiGAD65, and/or a low serum peptide C level [13].

1.1.4 Monogenic diabetes

Monogenic diabetes amounts to 1–2% of all diabetes cases. It is caused by single gene mutations. Most forms are associated with a defect of insulin secretion, and the most common ones are maturity-onset diabetes of the young (MODY), mitochondrial diabetes, and neonatal diabetes. Considering the monogenic forms in the differential diagnosis of diabetes may contribute to treatment optimization and proper evaluation of prognosis in the patient and his family members. A definite diagnosis of monogenic diabetes is a result of genetic testing. The most common form of MODY is associated with HNF1A and glucokinase gene mutations [13].

Typical clinical presentation of MODY due to an HNF1Agene mutation includes: (1) Early onset of diabetes (typically before 25 years of age; (2) No insulin dependence and keto acidosis, low insulin requirement, detectable peptide C levels despite the disease being present for several years or even longer; (3) Diabetic family history over at least 2 generations, with early-onset diabetes in at least two family members. OGTT performed at an early stage of diabetes usually shows high postprandial glucose level elevation with often normal fasting blood glucose; (4) Absence of auto antibodies typical for T1DM; and (5) Glycosuria higher than expected based on blood glucose levels [13].

1.2 Type 2 diabetes mellitus

1.2.1 Type 2 diabetes mellitus (T2DM)

It is universally known that Type 2 diabetes mellitus is considered a modern-day epidemic of epic proportions, affecting all classes of the society. The prevalence is becoming alarmingly high among younger age groups. Global prevalence of diabetes mellitus is about 9%. The prevalence of diabetes is expected to double by 2030 from 8.3 to 17.6% globally, excluding the high numbers of undiagnosed cases estimated as 175 million. Approximately 1.9% of the global disability adjusted life years (DALY) is attributed to diabetes. The International Diabetes Federation (IDF) estimates that 450 million people are living with diabetes, with 5.1million dying from it annually worldwide. T2DM is the greatest contributor to the burden of diabetes globally accounting for up to 90% of people with diabetes worldwide [14].

T2DM is a chronic and progressive medical condition which results from two major metabolic dysfunctions: insulin resistance and a relative insulin deficiency. Insulin resistance in which clinical signs may include: acanthosisnigricans–characterized by hyper pigmentation (darkening of skin pigment) especially in the neck and axillae; skin tags – benign (non-cancerous) skin growths on the body or face; central obesity – defined by a high waist-to-hip ratio, waist-to-thigh ratio and waist circumference; menstrual irregularities; and hirsutism– excess facial and body hair, especially on women. A relative insulin deficiency in which chronic hyperglycemia

with multiple disturbances in carbohydrate, protein and fat metabolism develops when a person's beta cell function is no longer sufficient to meet his/her insulin requirement [15].

1.3 Risk factors of T2DM

Several factors contribute to the high incidence of DM, such as population growth rate, ageing population, age structures, urbanization, unhealthy diet habits, obesity, sedentary lifestyles, lack of physical activities, failure to access to healthcare facilities both in rural and urban areas in addition to the economic and health transition of the country. Moreover, the increased case of DM is also triggered by the positive family history of the disease [16]. The literature reveals three interrelated spheres of risk factors that contribute to the development of T2DM: (1) genetics, (2) environment or lifestyle, and (3) metabolic abnormalities. It is imperative to implement appropriate interventions for the prevention and treatment of T2DM among adult patients, where there is an understanding of the risk factors predisposing adults to this disease [17].

1.3.1 Genetic factors

Although research has not clarified a single gene that is alone responsible for the development of T2DM, there are many findings in literature that support the genetic hypothesis. Higher concordance rates are found among identical (96%) than dizygotic twins in some but not all twin studies which have been a compelling evidence of a significant genetic component in T2DM. Moreover, 40% of first-degree relatives of T2DM patients may develop diabetes, whereas the incident rate is only 6% in the general population [5].

- Environmental or lifestyle factors:

  There are a wide range of lifestyle factors which are of great importance to the development of T2DM disease, such as smoking, alcohol consumption, physical inactivity, obesity, obstructive sleep apnea, unhealthy diet (dietary fiber (a low-fiber diet with a high glycemic index), dietary fat (total and saturated fat intake) and frequent consumption of processed meat [5].

- Metabolic abnormalities or changes:

  A recent study proved that resistance to insulin was the underlying abnormality in most people who develop T2DM. Such resistance resulted from an interaction between both genetic and environmental factors. Those factors were associated with the development of insulin resistance. The initial reaction of the beta cells was to increase output of insulin in order to overcome the insulin resistance and to maintain normal blood glucose levels. Unless insulin resistance was reversed, hyper secretion of insulin was insufficient to maintain normoglycemia indefinitely and progression to the states of impaired glucose metabolism (impaired fasting glucose (IFG), impaired glucose tolerance (IGT) and eventually T2DM) [18].

1.4 Pathophysiology of T2DM

The main pathophysiological cause of T2DM is the failure of pancreatic beta cells which leads to inadequate secretion of insulin and increased insulin resistance

which refers to decreased tissue (especially the liver, adipose tissues and muscle) sensitivity to insulin. Normally, insulin binds to special receptors on cell surfaces and initiates a series of reactions involved in glucose metabolism. In T2DM; intracellular reactions are diminished, making insulin less effective at stimulating glucose uptake by the liver. Physical inactivity and obesity lead to insulin resistance, increased production of glucose by the liver and decreased glucose uptake in skeletal muscles. In order to compensate beta cells, increase insulin secretion, but the progressive failure of beta cells leads to hyperglycemia and finally T2DM [19, 20].

The inappropriately increased alpha-cell function and consequent hyperglucagonemia, in addition to insulin resistance and beta cell dysfunction, they all have long contributed to hyperglycemia in diabetic patients, by stimulating hepatic glucose production. In fasting state, hyperglycemia is directly related to increase hepatic glucose production while in postprandial state, hyperglycemia results from the combination of insufficient suppression to glucose output and defective insulin stimulation of glucose disposal in target tissues, mainly skeletal muscles. Antihyperglycemic agents are directed to one or more of the pathophysiological defects of T2DM; they modify physiological processes related to appetite, nutrient absorption or excretion [21, 22].

1.5 Clinical manifestation of T2DM

It is almost traditionally known that classic symptoms of diabetes are polyuria (the need to urinate frequently), polydipsia (increased thirst & fluid intake), polyphagia (increased appetite) and weight loss and the symptoms that may provide cause for testing T2DM include increased thirst or urination, numbing of extremities, impotence, blurred vision and fatigue [23]. Other symptoms that are commonly present at diagnosis include; a history of blurred vision, itchiness, peripheral neuropathy, recurrent vaginal infections, poor healing skin wounds and fatigue. Patients with T2DM may rarely present with non-ketonic hyperosmolar coma, a condition of very high blood sugar associated with a decreased level of consciousness and low blood pressure. Many people however have no symptoms during the first few years which are diagnosed on routine testing [24].

1.6 Diagnosis of T2DM

The diagnostic criteria for diabetes mellitus are at least one of the following: [1] Glycated hemoglobin test (HbA1c) ≥ 6.5%. That test should be performed in a laboratory using the National Glycohemoglobin Standardization Program (NGSP) method which was certified by the NGSP standardized to the Diabetes Control and Complications Trial (DCCT) assay; [2] The Fasting Plasma Glucose Test (FPG) ≥ 126 mg/dl. Fasting is defined as no caloric intake for at least 8h; [3] 2-hour plasma glucose ≥ 200 mg/dl during an Oral Glucose Tolerance Test (OGTT). This test should be performed as described by the WHO, using a glucose load containing the equivalent of 75 g, anhydrous glucose dissolved in water; or [4]. In a patient with classic symptoms of hyperglycemia (polyuria, polydipsia, weight loss) or hyperglycemic crisis (Diabetic ketoacidosis (DKA), Hyperglycemic Hyperosmolar State (HHS)), a random plasma glucose ≥200mg/dL (11.1mmol/L). In the absence of unequivocal hyperglycemia, results should be confirmed by repeat testing [25].

1.7 Complications of T2DM

T2DM is considered as one of the most leading causes of premature morbidity and mortality worldwide as a result of the long-term micro vascular and macro

vascular complications associated with this disease. For instance, diabetic retinopathy is the most leading cause of blindness among adults aged 20-74 years; diabetic nephropathy, which affects approximately 40% of type 2 diabetic patients, is the leading cause of chronic kidney disease in patients starting replacement therapy; and diabetic neuropathy, which affects up to 50% of individuals with diabetes, increases the risk of foot ulcers and limb amputation [26].

In fact, more than 80% of non-traumatic limb amputations follow a foot ulcer or injury, and the risk of amputation in individuals with diabetes is up to 25 times greater compared with patients without diabetes. Although micro vascular complications increase morbidity and lead to premature mortality, the major cause of death in individuals with diabetes is cardiovascular disease (CVD), which in turn accounts for approximately 65% of all diabetes-related deaths. For example, transient ischemic attacks are 2-6 times more common in patients with T2DM, while the risk of developing heart failure is a startling 2- to 8-fold higher [26].

The sudden development of short-term complications, such as hyperglycemic crisis (DKA, HHS and severe hypoglycemia) that can lead to coma and, if untreated, death, are a daily threat to the many people worldwide with diabetes who have major difficulty in accessing essential treatment supplies (including insulin) [27].

Recent studies have shed the light on "hypoglycemia" (blood glucose < 3.9 mmol/L or 70 mg/dL) as a common unwanted effect in people treated with insulin and occurs when there is an imbalance in insulin dose, food consumed and activity. Usually the condition is manageable, but occasionally, it can be severe or even life threatening, particularly if the patient fails to recognize the symptoms, especially while continuing to take insulin or other hypoglycemic drugs. The signs of hypoglycemia can vary from person to person and may occur suddenly such as: hunger, perspiration, rapid heartbeat, weakness, feeling sleepy, feeling drunk, difficulty speaking, trembling, dizziness, confusion, and anxiety [28, 29].

DKA results from absolute insulin insufficiency, leading to metabolic acidosis (pH <7.3), hyperglycemia (blood glucose >11 mmol/L). DKA may also be present in up to 25% of young people presenting with T2DM. DKA should be treated as a medical emergency by an experienced medical team [30]. Hyperglycemic Hyperosmolar Non ketonic Syndrome (HHNS) usually occurs with T2DM and can occur with T1DM. It is often triggered by a serious infection, another severe illness, or by medications that lower glucose tolerance or increase fluid loss (especially in people who are not drinking enough fluids). Symptoms of HHNS include; high blood sugar levels, dry mouth, extreme thirst, dry skin and high fever. HHNS leads to loss of consciousness, seizures, coma and death [31].

No doubt, early detection and good glycemic control can slow the progression of the acute and chronic complications of DM, which cause significant mortality and morbidity in both developing and developed countries. Such chronic complications of DM if once developed are irreversible except by early detection and management [4].

1.8 Management of T2DM

Both patients and health care professionals are partners in managing T2DM, in which the health professionals support the patients in self-managing their disease. Management of every patient should start with a detailed evaluation of the initial diagnosis including diabetes complications and its risk factors. This, of course, provides basis for continuing treatment plan, treatment administration, monitoring, and review [32]. The main goals of treatment of DM are to reduce complications through control of glycaemia, blood pressure, macro vascular (i.e., coronary,

S.no	Category	Examples
1	Sulfonylureas First generation	Acetohexamide,Chlorpropamide, Tolbutamide, Tolzamide
	Second generation	Glyburide,Glimepiride Glipizide.
2	Biguanides	Metformin
3	Meglitinides	Repaglinide,Nataglinide
4	Thiazolidinediones	Pioglitazone,Rosiglitazone
5	Alpha-glucosidase Inhibitors	Acorbose, Miglitol
6	Glucagon like peptide-1-agonist	Exenatide, Liraglutide
7	Amylinomimetics	Pramlintide acetate

Table 1.
Oral antihyperglycemic agents for T2DM [35].

cerebrovascular, peripheral vascular), control of lipids, hypertension and smoking cessation. Metabolic and neurological complications can be reduced through control of glycaemia [33].

The treatment of hyperglycemia should start with the establishment of a target HbA1c that, in most cases, will be ≤ 7.0%, as this has been shown to reduce long-term microvascular complications in newly diagnosed patients with T2DM. HbA1c targets may be higher (up to 8.5%) if the benefits of intensive glycemic control are unlikely to outweigh the risks and burden, such as in individuals with limited life expectancy, high risk of hypoglycemia, multimorbidity, or based on the values and preferences of the person with diabetes. It should be emphasized to people with T2DM that reductions in HbA1c levels are associated with better outcomes even if recommended glycemic targets cannot be reached, and inability to achieve HbA1c target should not be considered a treatment failure [34].

If the level of HbA1c at diagnosis is less than 1.5% above target and the person with T2DM, lacks metabolic decompensate and/or symptoms of hyperglycemia, the first step of treatment should be healthy lifestyle conduct. If healthy behavior interventions are insufficient to achieve target HbA1c levels within 3 months, they should be combined with oral antihyperglycemic medications (**Table 1**) [35].

In the face of significant hyperglycemia (i.e., HbA1c >1.5% above target), pharmacotherapy is usually required at diagnosis concurrent with healthy behavior interventions. People who have evidence of metabolic decompensation (e.g., marked hyperglycemia, ketosis or unintentional weight loss) and/or symptomatic hyperglycemia should be started immediately on insulin, regardless of HbA1c level. Insulin may later be tapered or discontinued once stability is achieved [34].

2. Glycemic control

Glycemic control is extremely fundamental to the management of T2DM. Diabetes management aims to delay the onset of disease complications, and to hinder its progression, mostly by improving glycemic control and controlling the risk of cardiovascular disease. Previous studies have provided evidence of the power of good glycemic control to restrict the micro-vascular and macro-vascular complications of diabetes [36].

2.1 Assessment of glycemic control

Glycemic control is a very important instrument that prevents or delays the complications associated with DM, such as peripheral vascular disease, vision loss,

and renal failure. There are two primary techniques available for both health providers and patients to assess effectiveness of management plan on glycemic control: patient self-monitoring of blood glucose (SMBG) and HbA1c [37].

2.1.1 Self-monitoring of blood glucose (SMBG)

The first primary technique to assess the effectiveness of glycemic control plan for diabetic patients is the self-monitoring of blood glucose since most people with diabetes get benefit from monitoring of blood glucose for a various reasons. SMBG is the optimal way to confirm and appropriately treat hypoglycemia. It can provide feedback on the results of healthy behavior interventions and antihyperglycemic pharmacological treatments. It can increase patient's empowerment and adherence to treatment. It can also provide information to both the diabetic patient and the diabetes health-care team to facilitate longer-term treatment modifications and titrations as well as shorter-term treatment decisions, such as insulin dosing for people with T1DM or T2DM. Finally, in situations where HbA1c does not accurately reflect glycaemia, monitoring of blood glucose is necessary to monitor glycaemia adequately [38].

For people with T2DM treated with healthy behavior interventions, with or without non-insulin antihyperglycemic agents, the effectiveness and frequency of monitoring of blood glucose in improving glycemic control is less clear. The evidence is less certain in people with T2DM treated with insulin, although the above principle likely applies. In a large, non-randomized study of individuals with stable T2DM using insulin, testing at least 3 times a day was associated with improved glycemic control [38].

2.1.2 Glycated hemoglobin (HbA1c)

Glycated hemoglobin (HbA1c) can be used as a diagnostic test for diabetes providing that strict quality assurance tests. An HbA1c of 6.5% is recommended as the cut point for diagnosing diabetes. A value of less than 6.5% does not exclude diabetes diagnosed using glucose tests. HbA1c is a reliable estimate of mean plasma glucose levels over the previous 8 to 12 weeks. The mean blood glucose level in the 30 days immediately preceding the blood sampling (days 0 to 30) contributes 50% of the result and the prior 90 to 120 days contributes 10%. HbA1c is a valuable indicator of treatment effectiveness and should be measured at least every 3 months when glycemic targets are not being met and when diabetes therapy is being adjusted or changed. It is a measure of long-term blood glucose concentration and is not affected by acute changes in glucose levels due to stress or illness. Testing at 6-month intervals may be considered in situations where glycemic targets are consistently achieved. In some circumstances, such as when significant changes are made to therapy, or during pregnancy, it is appropriate to check HbA1c more frequently [38].

An appropriate level of HbA1c is difficult to define exactly; therefore Target HbA1c should be defined based on personal assessment of risks and benefits of treatment. The factors limiting the benefit of tight control are co-morbidities (e.g., end-stage cancer, severe heart failure), advanced diabetes complications (e.g., proliferative retinopathy, renal failure), inability to safely carry out treatment regimen, and limited life expectancy; or factors that heighten the risk of tight control: history of severe hypoglycemia (inability to treat without assistance), hypoglycemia unawareness and advanced cardiovascular or cerebrovascular disease, in addition to autonomic neuropathy (especially cardiac), comorbidities that impair the detection of hypoglycemia (e.g., alteration in mental status, alcoholism, etc...), and/or poor social support [39].

Patients who do not have any of these factors possibly would generally have a target HbA1c of ≤ 7%. Patients who do have one or more of these factors should have a goal of minimizing symptoms of hyperglycemia and to control glucose as well as possible without incurring side effects or excessive treatment burden; while an appropriate HbA1c is difficult to define exactly, treatment should be aimed to keep the HbA1c under 9% [39].

2.2 Type 2 diabetes mellitus lifestyle modification

Lifestyle modification or modification of unhealthy lifestyle choices such as: physical inactivity, unhealthy diet, harmful use of tobacco and/or alcohols can reduce the risk of complications and premature death of T2DM, by contributing to a better glycemic control. At diagnosis, highly motivated patients with HbA1c levels (<7.5%) could be given opportunity to engage in lifestyle modification for 3-6 months before staring pharmacotherapy. Encouraging and supporting people to make the best choices about their health can lead to a real difference to people's quality of life. Some studies have conclusively shown that reducing hyperglycemia decreases the onset and progression of microvascular complications and individualized dietary plan, regular physical activity and weight loss, when required, have been recognized as key components of diabetes management [22, 40].

The required lifestyle changes in managing DM are influenced by patient's knowledge, attitudes, practices, culture and values. Lack of knowledge about diabetes has been identified as one of the barriers to self-management of diabetes. Lack of understanding of how to manage diabetes also has a significant impact on limited diabetes knowledge in this population. Lifestyle modification counseling or education is the key component to achieve good glycemic control, to reduce the risk of diabetes complications, improve self-management and enhance the quality of life of type 2 diabetic patients including medical nutrition therapy, regular physical activity, weight reduction, and diabetes self-management education and support. Lifestyle interventions with oral hypoglycemic agents are often effective [8, 41].

2.3 Components of the lifestyle modification program

2.3.1 Medical nutrition therapy (MNT) for T2DM

Type 2 diabetic patients should consult a registered dietician (RD) to know about nutrition therapy for managing DM. MNT for type 2 diabetic patients encourages meal choices based on the patient's own needs and preferences, while awareness of the importance of dietary control promotes planning of meals and adherence to dietary regimen. There are some of the general dietary guidelines to follow to help manage diabetes are not to skip meals, to evenly distribute the meals throughout the day in small portions and to have a diet low in saturated fat [42, 43].

The goals of MNT include improving control of blood glucose levels, lipid profiles, and blood pressure to reduce the risk of cardiovascular disease in patients with T2DM through implementing lifestyle changes which reduce intakes of energy, saturated and trans fatty acids, cholesterol, and sodium and increase physical activity. Achieving these goals requires the dietitian and other professionals to teach and otherwise assist type 2 diabetic patients to modify or manage their nutritional intake in the light of a variety of individual factors such as: medication, exercise. Plasma glucose monitoring can be used to determine whether adjustments to foods and meals will be sufficient to achieve glycemic control or if medication(s) needs to be combined with MNT. MNT has been shown to reduce glycosylated hemoglobin (HbA1c) by 1% to 2% in patients with T2DM [44].

2.4 Diet composition

2.4.1 Carbohydrates (CHO) in T2DM management

Type 2 diabetic patients are persuaded to keep track of the amount of CHO they eat. The amount and the type of CHO ingested usually affects postprandial response. The recommended daily allowance (RDA) for CHO (130 g/day) is an average minimum requirement but less than 130 g/day of CHO is not recommended because the brain and central nervous system have an absolute requirement for glucose as an energy source. About 45-60 grams of carbohydrate can be consumed at a meal. Perhaps more or less CHO needed at meal depending on how diabetes is being managed [37].

Carbohydrate intake should be from sources like: fruits, vegetables, whole grains, lentils and legumes, and low-fat dairyproducts. However, carbohydrates should not be avoided completely as carbohydrate containing food is also a good source of fiber, vitamins and minerals which are extremely essential for the proper functioning of the body [45].

2.4.2 Glycemic index(GI)

Glycemic Index concept has best described the type of CHO. Researchers developed the GI of food to compare the physiologic or postprandial effects of carbohydrates (usually 50 g carbohydrate portion) on glucose. Glucose is given a value of 100; other CHOs are given a number relative to glucose. A ranking system indicates how quickly CHO food raises blood glucose15level. The higher the blood glucose responses, the higher the GI ranks carbohydrate foods according to their effect on blood glucose levels. GI ranges, in general: low GI foods < 55, intermediate GI foods 55 – 70, and high GI foods > 70. Foods with low glycemic indexes such as: oats, barely, lentils, beans, fiber... etc., Substituting high GI foods with lower GI foods at mealtime reduces postprandial blood glucose [46]. Detailed lists can be found in the International Tables of Glycemic Index and Glycemic Load Values [47].

2.4.3 Dietary fiber

It is scientifically well known that fibers are non-digestible carbohydrates. Soluble fibers help to slow down the digestion of starches and absorption of glucose. Example: fruit pectin (guava, apples, and plums), oats fiber, and legume fiber (beans & lentils). Some studies proved that consuming a high-fiber diet (50 g fiber/day) improves the postprandial glycemic response, reduces hyperinsulinemia, and lipemia in type 2 diabetic patients. Dietary Reference Intakes (DRI) recommended consumption of 14 g dietary fiber per 1000 kcal (or 25 g for adult women and 38 g for adult men) based on epidemiologic studies but usual fiber intake (up to 24 g daily) not shown to have beneficial effects on glycaemia. Good sources of fibers are: whole grain cereals, fruits, vegetables, beans and peas. Whole grains (contains the entire grain seed, bran, germ & endosperm) are not associated with improved glycemic control but may reduce systemic inflammation. The diabetic patient should consume at least half of all grains as whole grains [48, 49].

2.4.4 Nutritive and non-nutritive (calorie-free) sweeteners

Nutritive sweeteners contain sucrose and fructose. Sucrose (table sugar), a disaccharide-containing glucose and sucrose-containing foods have proven not to have a significant effect on glycemic levels of diabetic patients and therefore, do not need to

be restricted but fat ingested with sucrose (ice cream) will increase calories. Fructose produces a lower postprandial glucose response when it replaces sucrose or starch in the diet; however, fructose may adversely affect plasma lipids. Therefore, the use of added fructose as a sweetener in the diabetic diet is not recommended. It is founded in fruits, honey and vegetables. The US Food and Drug Administration (FDA) approved non-nutritive sweeteners such as: aspartame and saccharin are safe for diabetic patients when consumed within the acceptable daily intake levels established by the FDA. Diabetic patients should limit/avoid intake of sugar sweetened beverages to reduce risk for weight gain and worsening of cardio metabolic risk profile [37].

2.4.5 Protein in T2DM management

No ideal amount of protein recommended for patients without evidence of diabetic kidney disease except (protein intake typically 1-1.5 g/kg body weight) so as to optimize glycemic control or to improve one or more CVD risk measures. In T2DM: ingested protein increases insulin response without increasing plasma glucose concentrations. Therefore: CHO sources high in protein should not be used to treat or prevent hypoglycemia. For those with albuminuria and reduced glomerular filtration rate, dietary protein should be maintained at 0.8g/kg body weight/day. Reducing the amount of dietary protein below the recommended daily allowance is not advocated because it does not alter glycemic measures, cardiovascular risk measures or the rate at which glomerular filtration rate declines. Meals with > 75 g protein can raise post prandial glucose at 3-5 hours following consumption. The effect of protein & fat is additive (high fat increases insulin resistance). Protein from fish and chicken may also be included in the diet, however consumption of red and processed meat should be avoided [50, 51].

2.4.6 Dietary fat and cholesterol in T2DM management

It is recommended for type 2 diabetic patients to follow the guidelines for the recommended intakes of saturated fat dietary cholesterol and trans-fat since the type of fatty acids consumed is more important than total amount offal when looking at metabolic goals and CVD risk. Monounsaturated fats may improve glucose metabolism and lower CVD risk and can be an effective alternative to a diet low in total fat but relatively high in CHO. Eating foods rich in Omega-3 fatty acids (fatty fish, nuts and seeds) is recommended to prevent or treat CVD (not supplements though). Monounsaturated and polyunsaturated fats are recommended over saturated fat. In general, trans-fat should be avoided. In animal & observational studies, higher intakes of total dietary fat produce greater insulin resistance. In clinical trials saturated & trans-fats have been shown to cause insulin resistance whereas mono- & polyunsaturated and omega-3 fatty acids do not have an adverse effect. Polyunsaturated fats are as beneficial as monounsaturated fats. Individuals with diabetes and Dyslipidemia may be able to modestly reduce total and low-density lipoprotein (LDL) cholesterol by consuming 1.6-3 g/day of plant stanols or sterols typically found in enriched foods such as: corn and soy <300 mg dietary cholesterol/day is recommended [50, 51].

2.4.7 Sodium

Generally, diabetic patients are advised to limit their sodium consumption to < 2.300 mg/day. Lowering sodium intake (i.e., 1.500 mg/day) could improve blood pressure in certain circumstances. However, other studies suggested caution for universal sodium restriction to 1.500 mg in diabetic patients [8].

2.4.8 Micronutrients and herbal supplements in T2DM management

There is no clear evidence that supplementation in diabetic patients without deficiencies with vitamins, minerals, herbs or spices can improve diabetes. There is insufficient evidence to support the routine use of chromium, magnesium and vitamin D to improve glycemic control in people with diabetes. There is insufficient evidence to support the use of cinnamon for diabetes treatment. May be safety concerns regarding long-term use of antioxidant supplements such as: vitamin E, vitamin C and carotene [51].

2.4.9 Meal planning

There is no ideal meal plan that works for everyone with diabetes. Regardless of which meal planning method is used, it should be individualized and modified to put into practice with less difficulty. Meals and snacks should be distributed that is consistent with each individual's way of life, activity patterns and diabetes medication at regular meal times. Spacing of meals: MNT as monotherapy: 3 moderate meals or 4 smaller meals, snacks based on pt's schedule and preferences; MNT with oral anti-diabetes agents: moderate to small in size, snacks not needed unless risk of low BG, and maintain the consistent timing of meals and carbohydrates; and MNT with insulin: keep meals moderate to small in size. Avoid skipping meals. Varieties of eating patterns (combinations of different foods or food groups) are acceptable. Meal planning method ranges from simple guidelines to more complex counting methods. A simple diabetes meal planning approach such as: portion control or healthful food choices may be better suited to individuals with T2DM identified with health and numeric literacy concerns [45, 52].

It is widely acceptable that the healthy nutrition is a basis for T2DM treatment. It contributes positively to the maintenance of blood glucose within normal range and minimizes the disease complications. A balanced diet consisting of 45–60% energy from carbohydrate, 15–20% energy from protein and 20–35% energy from fats is encouraged. There is no ideal eating pattern that is expected to benefit all diabetic patients, but the total energy intake (and thus portion size) is an important factor no matter which eating pattern is chosen [8].

2.5 Physical activity for T2DM

Physical activity and exercise are just as important as nutrition for type 2 diabetic patients. Physical activity includes any movement that increases energy use; whereas exercise is considered a more specific form of physical activity designed to improve physical fitness. Exercise has been shown to have several benefits including: improved blood glucose control, reduced cardiovascular risk, increased energy as well as burning extra calories and fat to help manage weight and improve wellbeing. Exercise interventions of at least8 weeks also have shown to lower HbA1c in those with T2DM [42].

2.6 The basic principles of an effective exercise program

The basic principles of an effective exercise program are its intensity, its duration, and its exercise frequency. The intensity of exercise should be sufficient to cause changes in the cardiorespiratory system and is determined either by the physical condition of each patient or by the heart rate. In non-fit patients, the intensity can be set to 50-60% of maximum heart rate or to the intensity that increases the resting heart rate by 20 pulses per minute. The duration of the exercise should

be 30 minutes in the beginning, starting with 5-10 minutes of warm-up and finish always with recovery exercises. The lower frequency recommended is 3 times/week. Usually, low intensity and long-duration exercise programs are considered the most appropriate and safe for diabetic patients. Finally, the subjective perception of fatigue should be continuously assessed throughout the whole exercise session [53].

There are other important parameters that need to be estimated during exercise sessions are the levels of blood glucose before and during the exercise, the type of food and the time prior to exercise that it was consumed, the time and point of administration of medication. An appropriate environment during exercise is also required. Excessive heat leads to intense sweating and dehydration. Another factor that should not be underestimated during exercise is the use of proper footwear and maintenance of foot cleanness so as to prevent infection [53].

2.7 Weight reduction for T2DM

There is solid proof to help lifestyle alterations for those patients with DM who are overweight or obese to enhance glycemic control and lessen the requirement for medications with T2DM. A few examinations have demonstrated a decrease in HbA1c esteems and in addition fasting glucose with low-calorie eats fewer carbohydrates in stout patients with T2DM. Overweight and obese people with DM who are prepared to accomplish weight reduction ought to have an objective of somewhere around 5%weight misfortune through way of life changes [42].

Weight loss is also an important goal because it improves insulin resistance, glycemic control, blood pressure, and lipid profiles. Modest weight loss is defined as a sustained reduction of 5% of initial body weight and has been shown to improve glycemic control & reduce the need for glucose-lowering medications. 5% loss shows benefits but sustained loss of > 7% is optimal. A structured lifestyle plan that combines dietary modification, activity, and behavioral modification, along with ongoing support, is necessary for weight reduction. Lifestyle programs: reduce calories by 500-750/day or provide: For women 1.200-1.500 calories/day, adjusted for baseline weight. For men 1,500-1.800 calories/day adjusted for baseline weight. A reduction in the total calorie intake should allow gradual but systematic body weight reduction (by about 0.5–1 kg/week). The diet choice should be based on health status & preferences [8].

2.8 Diabetes self-management education and support for T2DM

Self-management is defined as a set of skilled behaviors engaged in to manage one's own illness. This emphasizes the responsibility and role of the diabetic patients in managing the disease. Self-management of DM can be achieved by self-management education. As part of this education, people with diabetes should receive instruction on how and when to perform self-monitoring; how to record the results in an organized fashion; the meaning of various blood glucose (BG) levels and how behavior and actions affect BG results [38].

Self-management education (SME) is the process of providing the person with diabetes the knowledge and skills needed to perform self-care, manage crisis and make lifestyle changes required to manage the disease. The goal of the process is to enable the patient to become the most knowledgeable and hopefully the most active participant in his or her diabetes care. It provides the information regarding various treatment options and the benefits and costs of each of these strategies, how to make changes in their behaviors and to solve problems [54]. Several meta-analyses have demonstrated that SME is associated with clinically important benefits in

people with diabetes, such as reductions in glycated hemoglobin and improvements in cardiovascular risk factors and reductions in foot ulcerations, infections, and amputations [55].

People with diabetes should know how to prevent potential foot problems, recognize early presentation without losing time before referral to doctors. Some tips for preventing problems such as inspecting feet daily and washing for changes in color, texture, odor and firm or hardened areas which may indicate infection and potential ulcers. When washing the feet, the water should be warm (not hot), feet and areas between toes should be thoroughly dried afterward, applying moisturizers, but not between the toes, trimming toenails short and file the edges to avoid cutting adjacent toes and Well-fitting footwear is very important. Be sure the shoe is wide enough [56].

Self-management support (SMS) includes activities that support the implementation and maintenance of behaviors for ongoing diabetes self-management, including education, behavior modification, and psychosocial and/or clinical support. The objective of SME and SMS is to cultivate open doors for individuals with diabetes to end up educated and inspired to take part in viable diabetes self-administration practices and practices ceaselessly. To date, a developing assemblage of research proof shows that the blend of both SME and SMS is most profitable for enhancing glycemic control, self-viability, self-care practices (i.e., observing of blood glucose and good dieting) and decreasing diabetes distress and foot complications [55].

3. Conceptual framework

Health promotion theories and models can encourage building up, keeping up, and enhancing solid practices by anticipating factors affecting unsafe practices. The theoretical framework for this study is Pender's health Promotion model (HPM). This model is ideally suited to this study since health-promoting behaviors, especially when coordinated into a healthy lifestyle, result improved health, enhanced functional ability, and better quality of life. Healthy lifestyle behaviors are: health responsibility (one's paying attention to and accepting responsibility for one's own health, being educated about health, and seeking professional assistance when necessary), physical activity, nutrition, spiritual growth (one's sense of self-actualization and purpose), interpersonal relations (one's ability to develop intimacy and closeness), and stress management One's ability to identify and mobilize psychological and physical resources to control (including sleep) or reduce anxiety [57].

Pender et al. [58] believed that, health behavior might be persuaded by a desire to protect one's health by avoiding illness or a desire to increase one's level of health in either the presence or absence of illness. Understanding the mechanisms or the mediators for behavior change and sustainability of these changes is necessary to develop effective health promotion and prevention interventions. Health promotion is the art and science of enabling people to move toward a state of optimal health through lifestyle change and is considered a combination of educational and ecological supports for actions and conditions of living conducive to health. A combination of health promotion strategies is needed to address the multiple determinants of health. Ecological strategies address the social, economic, and physical environments that influence health.

Health promotion has moved from being viewed as an objective or wanted endpoint to a process or tool to facilitate movement toward accomplishment of goals. It balances individual health behavior choices with creating environments where

healthier choices become easier choices. The nurse's role is to advance a positive atmosphere for change, fill in as an impetus for change, assist with various steps of the change process, and increase the individual's capacity to maintain change [59].

3.1 Pender's health promotion model (HPM)

Pender et al. [60] proposed a framework for coordinating nursing and behavioral science points of view with elements affecting health behaviors. This model offered a guide to investigate the complex biopsychosocial processes that motivate individuals to take part in practices coordinated toward improving health. This model aimed to help nursing professionals comprehend the major determinants of health behaviors as a reason for behavioral counseling to advance sound ways of life. The HPM integrated constructs from expectancy-value theory and social cognitive theory, within a nursing perspective of holistic human functioning. The expectancy-value theory is based on the idea that the course of action will likely lead to the desired outcome, and that this outcome will be of positive personal value. The social cognitive theory describes the concept of perceived self-efficacy which is a judgment of one's ability to carry out a particular course of action. The domains of this model include (a) individual characteristics and experiences (previous behaviors and personal factors); (b) behavior specific cognitions and affects (perception of benefits, barriers, self-efficacy, activity related affect, interpersonal influences, and situational influences); and (c) behavioral outcomes (commitment to the plan of action, and demands and preferences).

The first zone, as found in (**Figure 1**) is individual characteristics and experiences, which consists of two aspects that affect the willingness to take health actions. The first aspect is prior related behavior that is related to the health practices and behaviors in the past that influence the existing behavior. The second aspect: personal factors that are related to the biological, psychological, and sociocultural of the individual. These factors affect the individual's behavior. Examples such as age, gender, body mass index comprises biological factors. Psychological factor variables such as; self- esteem, motivation, personal competence, and perceived health status are also represented along with race, ethnicity, education and socioeconomic status [61].

The second zone, behavior-specific cognitions and affect consist of six other aspects: perceived benefits of action, perceived barriers to action, perceived

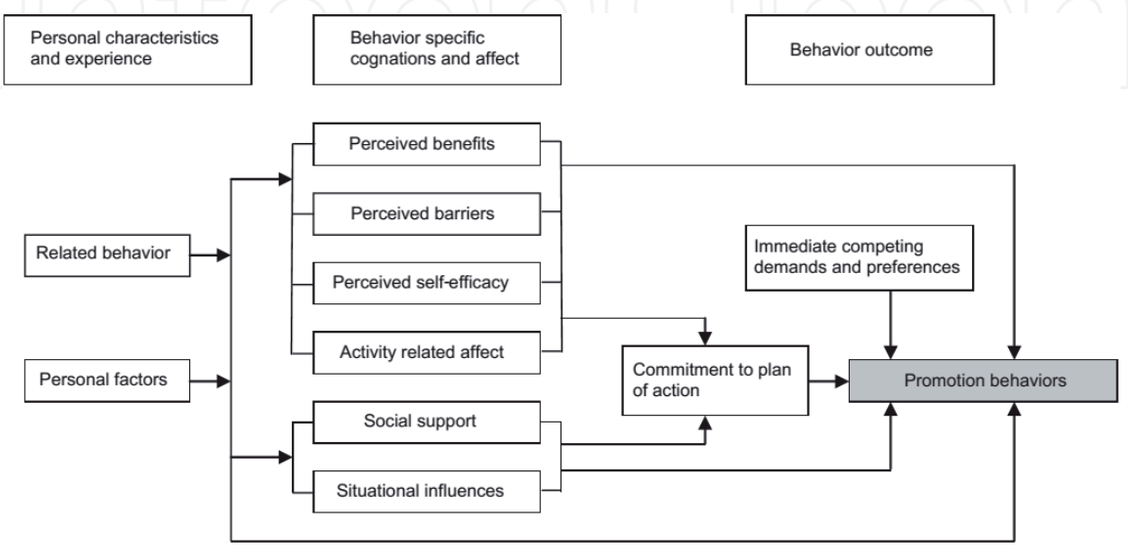

Figure 1.
Diagram of Pender's health promotion model. Source: [61].

self-efficacy, activity-related affect, interpersonal influences, and situational influences. Perceived benefits are perceptions of the positive or reinforcing benefits of practicing healthy behaviors. Perceived barriers to action suggest that hindrances or obstacles may occur on the process of undertaking healthy behavior. Perceived self-efficacy is the personal capability and self-confidence of performing the health behavior successfully and believing that change is possible. Being self-efficient decreases the perception of barriers to achieving a positive outcome [61].

Activity- related affect is defined as the person's subjective feeling states or emotions before, during and after associated to a specific behavior. A person with positive subjective feeling tends to be self-efficient leading to a positive effect. Interpersonal influences are behaviors, beliefs and attitudes of family, peers, and relevant others in relation to norms, social support and modeling greatly influence undertaking such health behaviors. Lastly, situational influences include options available, demand characteristics and aesthetic features of the behavior environment that influence the action [61].

The third zone, behavioral outcome, has three aspects: immediate competing demands and preferences, commitment to a plan of action and health promoting behavior. The first aspect, immediate competing demands and preferences are behaviors that an individual has low or high control of. Individuals have low control with regards to competing demands such as work and family responsibilities and high control on the competing preferences such as selection of food or diet. These factors infringe the course of action prior to the planned healthy behavior. Second, commitment to a plan of action is the intention to implement health behavior including recognition of strategies to achieve a positive outcome. Lastly, health-promoting behavior is the final, desired, and positive outcome [61].

The HPM recommended that people have one of a kind individual quality and encounters that influence resulting subsequent behavior. The set of variables related to behavior specific cognitions and affect are highly motivational to the individual. Health promoting behavior is the desired outcome although it can be hindered by immediate competing demands and preferences [58]. Individual characteristics are generally viewed as indirect influencers of health promoting behaviors while behavior-specific cognitions and affect are viewed as direct influencers of behavior. Personal factors can be altered by intervention; however, they are generally viewed as fixed factors of HPBs. Behavior-specific cognition variables of the HPM, such as perceived benefits and barriers, are considered to have major motivational significance because they can be altered by nurse intervention [62].

This study concentrated on individual characteristics which are subdivided into prior related behavior and personal factors– demographic, socio-economic, clinical variables and type 2 diabetic patients' knowledge regarding diabetes are considered to be a personal factor; Regarding to the behavior specific cognitions of perceived benefits, the awareness of the lifestyle modification and its positive effect on glycemic control are believed to influence the need to undertake a health behavior, Perceived self-efficacy, social support, and situational influences.; and the behavioral outcomes of health responsibility, physical activity, nutrition, spiritual growth, interpersonal relations, and stress management.

3.2 The role of family and community health nursing

The community health nurses play a pivotal role in the detection, monitoring, treatment and prevention of diseases and in health promotion in the whole community. They help patients to learn or relearn lifestyle practices, as concentrating on the patient's reaction to health and illnesses rather than on the disease itself [63, 64]. The focus of community health nursing includes not only the individual, but

also the family and the community, meeting these multiple needs requires multiple roles. The seven major roles of a community health nurse are: Care provider, educator, advocate, manager, collaborator, leader and researcher.

The community health nurse as a care provider assists the patient in implementing nursing care plan for disease management. The patient should take an active role in disease management, it is the responsibility of the community health nurse to promote this self-management and to instill the confidence in the patient that they can manage their disease process to remain healthy and decrease the risk of potentially deadly complications [17].

During the treatment process, they follow the progress of the patient and act accordingly with the patient's best interests in mind and therefore leading to improve diabetes coping skills of those patients. They help their patients adjust treatment regimens to ease the burden of diabetes management and to maintain good glycemic control and good health. They are responsible for the holistic care of patients, which includes a wide range of approaches, including medication, education, communication, self-help, and complementary treatment. Holistic care increases self-awareness and self-confidence in patients and causes nurses to better understand the effects of an illness on a person's entire life and his/her true needs. It also improves harmony between mind, body, emotions and spirit in an ever-changing environment [65, 66].

The community health nurse ought to guarantee that the patient is on a strict dietary regimen and that they are checking blood glucose levels regularly. The nurse should also ensure that the patient is complying with medication regimen, checking their feet and getting standard eye examinations, not smoking, and practicing routinely. The community health nurse should monitor the patient's health status and motivate them to be compliant with the prescribed treatment regimen. The nurse should encourage and motivate the patient to take active role in avoiding further complications and to remain compliant with the prescribed treatment regimen and follow up arrangements [17].

The community health nurse as an educator provides health teaching and education through health promotion programs and services. Diabetic health teaching in regard to health promotion and prevention is an ideal role of them because of the overwhelming rate of diabetes and knowledge deficit of the individuals. Concerning diabetes, an individual must be committed to self-health promoting behaviors and to adopting a lifestyle change or else non-compliance will result and complications of the disease process could follow [17].

The community health nurse educates about health and wellness activities such as healthy diet, regular exercise, smoking cessation. The patient should be encouraged and expected to take active role in creating and maintain healthy behaviors. Concerning individualized characteristics and experiences, the patient must examine his or her own behaviors including diet, and level of physical activity, body fat and weight, and settle on a decision to change unhealthy behaviors to health promoting behaviors. The patient will be instructed to be proactive in their own health. The patient will be made to understand that maintain a healthy lifestyle will decrease the chances of getting diabetes. Personal responsibility is the key to diabetes prevention and treatment [17].

The community health nurse assists the patient in early recognition of the signs and symptoms of diabetes and to take control of the disease before potential complications emerge. For those who are prediabetic, it is imperative for community health nurse to clarify the signs and symptoms of hyperglycemia besides what to report to the physician. It is critical to screen those at risk for diabetes. The early diagnosis is similarly as vital. If diabetes is caught prior to the point where complications arise then it will be easier for the patient to be proactive in health

promotion. Besides, as blood glucose levels are controlled, the risk of complications diminishes. During educational treatment they are responsible for ensuring that patients are able to understand their health, illnesses, medications, and treatments to the best of their ability. It is fundamental to assess whether the individual with diabetes or a close relative has comprehended the messages and has adequate self-care abilities or skills [17].

The community health nurse as advocator advocates for the patients' rights and maintains the patient's dignity. Every patient has the right to receive, just, equal, and human treatment. This is particularly important for patients who are the poor, the disadvantaged, those without health insurance because they become frustrated, confused, degraded, and unable to cope with the system on their own. The community health nurse often acts as an advocate for patients, pleading their cause or acting on their behalf, Clients may need some one: To explain which services to expect, which services they ought to receive; to make referrals as needed; to write letters to agencies or health care providers for them; and to assure the satisfaction of their needs. The advocate role incorporates four characteristics actions: Being assertive; taking risks; communicating & negating well; and identifying recourses and obtaining results. The community health nurse support the patient and represent the patients best interests at all times, especially when treatment decisions are being made [67].

The community health nurse as a manger exercises administrative direction toward the accomplishment of specified goals by: Assessing patients' needs; planning and organizing to meet those needs; controlling; and evaluating the progress to ensure that goals are met. These activities are sequential and yet also occur simultaneously for managing service objectives. As other health professionals are usually responsible for making the final treatment decisions, nurses should be able to communicate information regarding patient health effectively. In this, the community health nurse facilitates collaboration, coordination, and cooperation among caregivers for continuity of care for the patient and promoting the best patient health outcomes [67].

The community health nurse as a collaborator enables and promotes the interprofessional teamwork and comprehensive care provided by healthcare professionals, paraprofessionals, and volunteers. The collaborator role also may involve functioning as a consultant with other healthcare colleagues to inform decision-making and planning to meet healthcare consumer needs therefore, provide proper care and improve patient outcomes. This role requires communication skills, skill in interpreting the nurse's unique contribution to the team and acting assertively as an equal partner [67, 68].

The community health nurse as a leader focuses on affecting change, thus the nurse becomes an agent of change. The community health nurse seeks to initiate changers that positively affect people's health. They also seek to influence people to think and behave differently about their health and the factors contributing to it. The care for diabetic patients includes adopting a healthy lifestyle where the diet plan represents an important support of care so they can meet their goals. At the community level, the leadership role may involve working with a team of professionals to direct and coordinate such as a campaign to eliminate smoking in public areas [67, 69].

The community health nurse as a researcher engages in systematic investigation, collection, and analysis of data for solving problems and enhancing community health practice. The community health nurse often participates in agency and organizational studies to determine such matters as risks associated with home visiting. The researcher role helps to determine needs, evaluate effectiveness of care, and develop theoretic bases for community health nursing practice. Nurses

must become responsible users of research, keeping up-to-date of new knowledge and applying it in practice. Nurses must learn to evaluate nursing research articles critically, assessing their validity and applicability to their own practice. A commitment to use and conduct of research will move the nursing profession forward and enhance its influence on the health of at-risk populations [67].

The main results of the present study could be outlined in the following points:

Results revealed that 68.5% of the studied sample groups were females and 64.1% of them aged from 45-64 years with mean 49.76 ± 9.19 years.

Regarding educational level, 42.4% of the studied sample groups were illiterate. Whereas, 63.0% were unemployed, 68.5% of them came from urban areas, and 76.2% of them had low social class level.

Regarding diabetes history, 43.5% of the studied sample had rare attacks, 96.7% of them have taken oral hypoglycemic agents, 94.6% of them were not following planned diet regimen and 76.1% of them did not do physical activities.

Independent t-test demonstrated high significant difference (P-value < 0.005) between pre-test study and control groups' total score of knowledge & knowledge related practice about DM. Though, this result was of unnecessary inconsistency between the two groups, both levels of their pre-test knowledge and practices about diabetes mellitus were still inadequate. Independent t-test demonstrated also that there was only statistical significant difference (P-value < 0.023) between the two groups regarding pre-test health responsibility domain. It can be concluded from outputs that the mean scores between control and study were successful in achieving homogeneity of most sub-class groups.

However, differences regarding clinical data between pre-test study and control groups were statistically insignificant. Generally, the mean scores of groups between control and study were homogeneous for all sub-class groups.

Results of Paired t-test between total score of knowledge & knowledge related practice about DM, health promoting lifestyle domains values and clinical data, before and after the program intervention in the study group revealed high significant differences represented in (P-value < 0.009 or P-value < 0.001 or P-value < 0.0001). Patients who received lifestyle modification intervention program achieved better total score of knowledge & knowledge related practice about DM, health promoting lifestyle domains values and clinical data.

Statistical results of Paired t-test that was computed between total score of knowledge & knowledge related practice about DM pre- and post-tests in the control group, have illustrated high significant differences (P-value < 0.0001). Those patients were still having inadequate and insufficient total score of knowledge & knowledge related practice about DM.

Statistical results of Paired t-test that were computed between health promoting lifestyle domains pre- and post-tests pre- and post-tests in the control group, have illustrated statistical significant differences of all domains except that for the physical activity and interpersonal relations domains. Patients though didn't receive a lifestyle modification intervention, have had slight increases (with no trend change) in their total scores of overall health promoting lifestyle score, health responsibility, nutrition, spiritual growth, stress management domains.

Statistical results of Paired t-test that were computed between clinical data pre- and post-tests in the control group have not revealed any statistical significance regarding clinical data.

Glycated Hemoglobin multiple linear regressions demonstrated a statistical significant positive independent predictor (fasting plasma glucose; P-value < 0.0001), whereas the Physical Activity Domain was the only statistical significant negative independent predictor (P-value < 0.015) after employing the program in the study group.

4. Conclusions

Based on the findings of the current study, it could be concluded that: Type 2 diabetic patients who have received lifestyle modification program (dietary modification, physical activity, self-blood glucose monitoring and diabetes self-care education) and attended to the Family Medicine Outpatient Clinic & the Diabetic Outpatient Clinic of Suez Canal University Hospitals at Ismailia city in Egypt has a positive effect on glycemic control (HbA1c) among patients with type 2 diabetes mellitus and also improved their knowledge and practices about DM post lifestyle modification program.

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Acronyms and abbreviations

ADA	American Diabetes Association
BG	Blood Glucose
BMI	Body Mass Index
CHO	Carbohydrates
CVD	Cardiovascular Disease
DALY	Disability Adjusted Life Years
DCCT	Diabetes Control And Complications Trial
DKA	Diabetic Ketoacidosis
DKQ	Diabetes Knowledge Questionnaire
DM	Diabetes Mellitus
DRI	Dietary Reference Intakes
FDA	Food and Drug Administration
FPG	Fasting Plasma Glucose
GDM	Gestational Diabetes Mellitus
GI	Glycemic Index
HbA1c	Glycated Hemoglobin

HHNS	Hyperglycemic Hyperosmolar Non KetonicSyndrome
HHS	Hyperglycemic Hyperosmolar State
HPLP II	Health Promoting Lifestyle Profile II
HPM	Pender's Health Promotion Model
IDF	International Diabetes Federation
IFG	Impaired Fasting Glucose
IGT	Impaired Glucose Tolerance
LADA	Latent Autoimmune Diabetes In Adults
LDL	Low-Density Lipoprotein
MNT	Medical Nutrition Therapy
MODY	Maturity-Onset Diabetes of The Young
NCDs	Non-Communicable Diseases
NGSP	National Glycohemoglobin Standardization Program
OGTT	Oral Glucose Tolerance Test
QOL	Quality of Life
RDA	Recommended Daily Allowance

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