Introduction

Diabetes mellitus is a major emerging clinical and public health problem accounting currently for 5.2 % of all deaths world-wide ***(Lorenzo, 2007).***

According to ***WHO*** estimates 190 million people suffer from diabetes world-wide and about 330 million ones are expected to be diabetic by the year 2025 ***(WHO, 2007)***.

It is the most common non-communicable disease worldwide and the fourth to fifth leading cause of death in developed countries ***(IDF, 2009)***, the complications of diabetes account for the major part of the direct medical costs of treating diabetic patients ***(Caro et al., 2002).***

Egypt had been estimated to be the 9th country in the prevalence of diabetes, recent changes in physical activity and dietary patterns have promoted the development of diabetes and if different preventive and control activities are not adopted, by the year 2025, more than 9 million Egyptians **(13%** of the population above 20 years old) will have diabetes ***(The World Diabetes Market Report, 2009).***

One critical component of initial diabetes care is patient education ***(Norris et al 2001)*** education has an overall beneficial impact on health and psychosocial outcomes. Specifically, improving patient knowledge and behavior has been shown to improve glycemic control in diverse settings ***(Tan et al., 1997)***

A part from the impact on health, the economic costs of diabetes mellitus and its complications are enormous both in health care and loss of productivity to society. Appropriate lifestyle intervention and/or drug

treatment are effective in delaying or preventing both diabetes and its complications ***(Ramachandran et al., 2006).***

Management of diabetes is dependent to a great extent on the affected person's own abilities to carry out self-care in his daily lives, and patient education is considered an essential component of clueing this objective ***(Tan et al., 1997)***. There is further evidence that people affected with the disease often have inadequate knowledge about the nature of diabetes, its risk factors and associated complications and that this lack of awareness may be the underlying factor affecting attitudes and practices towards its care.

Diabetes education, with consequent improvement in knowledge, attitudes and skills, leads to better control of the disease, and is widely accepted to be an integral part of comprehensive diabetes care ***(Upadhyay et al., 2008).***

Basic knowledge of diabetes, importance of good and comprehensive control, life style interventions, use of medications, recognition and management of acute and chronic complications, foot care, pregnancy, smoking and alcohol, and psychosocial issues should all be covered during the education **(JEMDSA, 2011).**

Increased diabetes awareness and education will undoubtly help reduce the health complications which have long been associated with the disease, as well as diabetes related healthcare costs whether an individual suffers from diabetes for years or is newly diagnosed. Diabetes education programs can enlighten and motivate person to live a happier healthier lifestyle **(ISPAD, 2007).**

In many countries, only a minority of patients receives diabetes education**,** limited knowledge of the disease is frequently observed among

diabetic patients this deficiency of the patient knowledge and skills could be attributed to low priority of patient education among practitioners or even among patients themselves. In Egypt, although the relatively high prevalence of diabetes, there is no caring for patient's education on a systematic approach, except in some settings like the national institute of diabetes.

Therefore, this intervention study was conducted to evaluate the effectiveness of health education among diabetic patients.

Objectives

1- To design a health education program for type 2 diabetic patients attending outpatient clinics of the Egyptian Company for Electricity Transmission.

2- To apply the program on diabetic patients attending outpatient clinics of the Egyptian Company for Electricity Transmission.

3- To evaluate the effectiveness of the applied health education program.

Chapter 1:
Diabetes Mellitus

Definition:

Diabetes mellitus (DM) is a metabolic disease characterized by absolute or relative insulin deficiency. WHO defined diabetes to be chronic elevation of the concentration of glucose in the blood that results from deficient production or action of insulin, a hormone that controls glucose, fat, and amino acid metabolism with the long term risk of developing progressive disease of retina &kidney, damage to peripheral nerves and aggravated atherosclerotic disease of the heart, legs and brain ***(WHO, 2009)***

Classification of diabetes:

- Type 1 diabetes:

An auto-immune disease where the body's immune system attacks the insulin-producing cells of the pancreas. People with type 1 diabetes cannot produce insulin and require lifelong insulin injections for survival. The disease can occur at any age, although it mostly occurs in children and young adults. Type 1 diabetes is sometimes referred to as 'juvenile onset diabetes' or 'insulin dependent diabetes' ***(ADA, 2011).***

- Type 2 diabetes:

Type 2 diabetes is associated with hereditary factors and lifestyle risk factors including poor diet, insufficient physical activity and being overweight or obese. People with type 2 diabetes may be able to manage their condition through lifestyle changes; however, diabetes medications or insulin injections may also be required to control blood sugar levels.

Type 2 diabetes occurs mostly in people aged over 40 years old; however, the disease is also becoming increasingly prevalent in younger age groups.

- Gestational diabetes mellitus:

Occurs during pregnancy, the condition usually disappears once the baby is born; however, a history of gestational diabetes increases a woman's risk of developing type 2 diabetes later in life. ***(ADA, 2011).***

- Although there are three main types of diabetes**,** there is also a stage before diabetes called **pre-diabetes**. Pre-diabetes, also known as impaired glucose tolerance, it is a condition where blood sugar level elevates higher than the normal range for most people, but is still low enough not to be considered diabetes ***(Kishawi et al., 2003).***

Epidemiology of diabetes:

Diabetes mellitus is a major public health problem accounting currently for 52% of all deaths world wide. It is one of the most common chronic diseases in nearly all countries; diabetes mellitus is a major emerging clinical and public health problem. According to WHO estimates, 190 millions people suffer from diabetes worldwide and about 330 millions are expected to be diabetic by the year 2025 ***(Shaw et al., 2010).***

Each year more than 231,000 people in the United States and more than 3,96 million people worldwide die from diabetes and its complications ***(IDF, 2006)***. Egypt had been estimated to be the 9th country in the prevalence of diabetes, recent changes of physical activity and dietary pattern have promoted the development of diabetes, and if different preventive and control activities are not adopted by the year

2025 more than 9 million Egyptian (13% of the population above 20 years old) will have diabetes ***(Arafa and Essam-eldin, 2010).*** Diabetes is the eleventh cause of pre mature mortality in Egypt and it is responsible for 2.4% of all years of life loss (YLL) and it is the sixth most important cause of disability***(NICHP, 2004).***

The global burden of diabetes:

There is a global increase in DM worldwide, most of which occurs in developing countries due to population growth, ageing, unhealthy diets, obesity and sedentary lifestyles, in addition there is a growing incidence of Type 2 diabetes – which accounts for about 90% of all cases – at a younger age. In developed countries most people with diabetes are above the age of retirement. In developing countries those most frequently affected are in the middle, productive years of their lives, aged between 35 and 64 **(*WHO, 2009).***

The international diabetes federation IDF (the world organization to which diabetes organization in 134 countries in the world are affiliated) estimates that there are around 151 million people in the age group 20 -79 years with clinically diagnosed diabetes in these 134 countries, Which gives an overall global prevalence of 4.6% the vast majority of these patients having type 2 diabetes ***(IDF, 2006)***.

Potential risk factors for NIDDM:

Many studies have elaborated the associations between several risk factors and the risk of type 2 diabetes, Body mass index (BMI), lipids, hypertension, smoking, low physical activity, low education, dietary pattern, family history, and recently also specific genes are the most frequently risk factors for type 2 diabetes ***(Meisinger et al., 2002).***

BMI:

Many longitudinal studies have reported that increased BMI is a strong risk factor for type 2 diabetes a strong positive association between obesity and type 2 diabetes is found both in men and women, obesity is associated with increased risk of developing insulin resistance and type 2 diabetes. in obese individuals adipose tissue releases increased amounts of non estrified fatty acids, glycerol, hormones, pro inflammatory cytokines and other factors involved in the development of insulin resistance is accomplished by dysfunction of the beta cells, the following fall in insulin secretion results in failure to control blood glucose level leading to type 2 diabetes ***(Almdal et al., 2008)***. Many genes interact with the environment leading to obesity and also to diabetes. Many genes have been shown to be involved in determining the whole range of BMI in a population with each gene only explaining a few hundreds grams difference in body weight ***(Hebebrand & Hinney, 2009)***

Lipids:

Unfavourable blood lipids have been reported as a risk factor for type 2 diabetes. An inverse relationship between HDL cholesterol and risk of type 2 diabetes have been documented in several trials, some prospective studies found low HDL cholesterol to be a stronger risk factor for type 2diabetes in women only ***(Colditz et al., 1990).*** An independent risk of type 2 diabetes connected to elevated triglyceride levels, high plasma triglycerides and low plasma HDL cholesterol levels are both seen in the insulin resistance syndrome, which is a prediabetic state ***(Taskinen, 2003).***

Cross sectional studies have shown that high BMI is associated with a higher level of total cholesterol and unfavourable lipids pattern,

with low concentrations of HDL cholesterol and high triglycerides concentrations, BMI change over time to be positively associated with changes in total cholesterol, triglycerides, and low density lipoprotein (LDL) cholesterol and negatively associated with HDL cholesterol change. Apart from triglycerides, all these lipids have been shown to convey diabetes risk independently of BMI ***(Czernichow et al., 2002).***

Hypertension:

Previous prospective and case control studies have shown that hypertension progression is an independent predictor of type 2 diabetes. Several possible factors are likely causes of the association between type 2 diabetes and hypertension. Endothelial dysfunction could be one of the common patho- physiological pathways explaining the strong association between blood pressure and incident type 2 diabetes ***(Kumari et al., 2004).***

Studies have shown that markers of endothelial dysfunction are associated with new-onset of diabetes, and endothelial dysfunction is closely related to blood pressure and hypertension. Markers of inflammation such as C-reactive protein have been consistently related to incident of type 2 diabetes, and to increasing blood pressure levels, suggesting that inflammation might be another explanatory factor for the association between blood pressure, the metabolic syndrome, and incident type 2 diabetes ***(Ridker et al., 2003).***

A causal relationship between hypertension and type 2 diabetes is further strengthened by a recent randomized clinical trial study showing a 14% reduction of risk of diabetes in subjects with glucose intolerance by allocation to 5 year treatment with valsartan, an angiotensin II blocker with antihypertensive properties ***(McMurray et al., 2010).***

Smoking:

Several prospective studies reported that current smoking is a risk factor for developing type 2diabetes **(*Willi et al., 2007).***

The association between smoking and type 2 diabetes was stronger for heavy smokers (20 cigarettes/day) compared with light smokers or former smokers, some studies found an increased risk of type 2 diabetes the first 2-3 years after smoking cessation, Smoking leads to insulin resistance and inadequate compensatory insulin secretion response ***(Yeh et al., 2010).*** This could be due to a direct effect of nicotinic or other components of cigarette smoke on beta cells of the pancreas as suggested by the association of cigarette smoking with chronic pancreatitis and pancreatic cancer ***(Willi & Bodenmann et al., 2007).*** Also, some studies suggest that heavy smokers with evidence of increased systemic inflammation, who gain substantial in weight after quitting, are at high risk of developing type 2 diabetes. However over longer follow up, smoking cessation is associated with a reduction in risk of developing type 2 diabetes ***(Sairenchi et al., 2004).***

Physical inactivity:

Longitudinal studies have found physical inactivity to be a strong risk factor for type 2diabetes, prolonged television watching as a surrogate marker of sedentary lifestyle was reported to be positively associated with diabetes risk in both men and women ***(Jeon et al., 2007).***

Moderate and vigorous physical activity was associated with a lower risk of type 2 diabetes, Evidence from clinical trials which included physical activity as an integral part of life style intervention suggested that onset of type 2 diabetes can be prevented or delayed as a result of successful lifestyle interventions that included physical activity as a part

of this interventions ***(Weinstei et al., 2004).*** Physical activity plays an important role in delaying or prevention of development of type 2diabetes in those at risk both directly by improving insulin sensitivity and reducing insulin resistance, and indirectly by beneficial changes in body mass and body composition ***(Hamman et al., 2006).***

Low education:

Many prospective studies have examined the association between educational attainment and the incidence of diabetes and found that low education is significant predictor of type 2 diabetes ***(Maty et al., 2005).***

A cross sectional study from the National Health Interview Survey found that women with low education had a higher prevalence of diabetes than the better educated, Furthermore; the association varied by race ethnicity and gender, with Whites, Hispanics and women exhibiting a stronger association between education and diabetes than blacks and men ***(Borrell et al., 2006).*** Anther recent cross sectional study found that type 2 diabetes risks was higher in the least educated who were obese and inactive compared to the more educated. These studies suggest that educational attainment promote an interest in own health and acquisition of knowledge that strongly influence people's ability to reduce risk by successfully adopting a healthier life style ***(Dasgupta et al., 2010).***

Dietary pattern:

An important life style factor associated with the development of type 2 diabetes is dietary habits. Positive association has been reported between the risk of type 2 diabetes and different patterns of food intake ***(Schulze et al., 2004)***. Higher dietary glycemic index has been consistently associated with elevated risk of type 2 diabetes, cereal fiber intake was associated with a decreased risk of diabetes. It was also found

that regular consumption of white rice is associated with an increased risk of type 2 diabetes whereas replacement of white rice by brown rice or other whole grains was associated with a lower risk ***(Sun & Spiegelman et al., 2010)***

A review which included 19 studies on diet and risk of type 2 diabetes, concluded that a higher intake of poly unsaturated fat and long-chain fatty acid is beneficial, where as higher intake of saturated fat adversely affects glucose metabolism and insulin resistance ***(Hu & van Dam et al., 2001)***

High consumption of butter, potatoes and whole milk is associated with increased risk of type 2 diabetes while higher consumption of fruits and vegetable was associated with reduced risk of type 2 diabetes ***(Montonen et al., 2005).*** The possible mechanisms suggested are that insoluble fiber intake was consistently associated with improved insulin sensitivity and decreases risk of type 2 diabetes ***(Meyer et al., 2000).***

Furthermore large observational studies have suggested an association between low vitamin D status or low vitamin D intake and increased incidence of type 2 diabetes, the suggested mechanisms are that vitamin D deficiency may contribute to beta cell dysfunction, insulin resistance and inflammation that may result in type 2 diabetes ***(Pittas et al., 2006).***

Genetics:

A study on twins have demonstrated that concordance estimate for type 2 diabetes is high in monozygotic compared to dizygotic and the rate increases with duration of follow up ***(Amini and Janghorban, 2007).***

Also, diabetes prevalence varies substantially among different ethnic groups, this observation of substantial variation of disease prevalence across ethnic groups that share a similar environment supports the idea that genetic factors contribute to disease predisposition , data from multiple laboratories support that genetic factors predispose to development of type 2 diabetes by reducing insulin sensitivity and insulin secretion which deteriorate in parallel in most human type 2 diabetes cases ***(Swapan Kumar Das and Steven CElbein, 2006).***

Complications of diabetes:

Diabetes complications can be classified as:

Acute complications:

- **Hypoglycemia:**

If there is too much insulin in the body compared to the amount of blood sugar, and the blood sugar falls below normal levels, a condition known as hypoglycemia occurs. The problem of hypoglycemia either due to insulin or oral hypoglycemic drugs is much more common in type 1diabetes than type 2 diabetes since the type 1 diabetic is directly injecting insulin. If too much insulin is administered, or the person misses a meal or over-exercises, hypoglycemia may result. In this condition, commonly referred to as insulin shock, the brain is deprived of an essential energy source ***(Ryan et al., 2005).***

- **Ketoacidosis:**

Another acute complication more likely to occur is ketoacidosis, a condition caused by a lack of insulin leading to a build-up of ketoacids, excessive ketone bodies are formed by the biochemical imbalance in uncontrolled or poorly managed diabetes, the condition known as diabetic

ketoacidosis can directly cause an acute life-threatening event ***(Wolfsdorf et al., 2009).***

Chronic complications:

A-Microvascular complications:

1- Diabetic retinopathy:

American diabetes association has stated that up to 21% of patients with type 2 diabetes have recently been found to have retinopathy at the time of the first diagnosis of diabetes and most develop some degree of retinopathy over subsequent decades ***(ADA, 2001).*** Diabetic eye disease is the leading cause of new cases of legal blindness in adults ***(Madsen-Bouterse and Kowluru, 2008).***

There are two major types of retinopathy: nonproliferative and proliferative.

- **Non proliferative retinopathy:**

Is the most common form of retinopathy, can move through three stages mild, moderate, and severe, although it does not usually cause vision loss at early stage, the capillary walls may lose their ability to control the passage of substances between the blood and the retina, Fluid can leak into the macula; a condition called macular edema, vision blurs and can be lost entirely ***(ADA, 2007).***

- **Proliferative diabetic retinopathy:**

Involves the formation of new blood vessels that develop from the retinal circulation and extend into the vitreous cavity of the eye and cause

hemorrhage into the vitreous, resulting in visual loss as they can cause tractional retinal detachments ***(Frank, 2004).***

2- Diabetic nephropathy:

Diabetic nephropathy is a clinical syndrome characterized by albuminuria hypertension& progressive renal insufficiency ***(Herman &Green 1996).*** Persons with diabetes are at a greater risk of end stage renal disease (ESRD) than non diabetic persons ***(Perneger et al 1994).*** Diabetic nephropathy is responsible not only for a tremendous amount of mortality and morbidity but also for huge economic costs related to dialysis and kidney transplantation that reach approximately 1.5 billion dollars per year in USA ***(Bate and Jerums, 2003).***

3-Diabetic neuropathy:

Diabetic neuropathy can be defined as peripheral nerve dysfunction that occurs in persons with established diabetes. It is probably the most common cause of neuropathy in the USA; it is a major cause of suffering, disability and lower extremity amputation ***(Aring et al., 2005).***

Neuropathy affects at least half of all people with diabetes, there are different types of nerve disease which can result in a loss of sensation in the feet or in some cases the hands, pain in the foot and problems with the functioning of different parts of the body including the heart, the eye, the stomach, the bladder and the penis, the lack of sensation in the feet can lead to people with diabetes injuring their feet without realizing it, these injuries can lead to ulcers and possibly amputation ***(IDF, 2009)***.