Review Article

An Overview of Diabetes Mellitus in Egypt as a Major Public Health Problem

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Abstract: Introduction: The prevalence of diabetes mellitus is rising rapidly in Egypt with major health and socioeconomic consequences. The shortage of endocrinologists is another important issue in Egypt that must be taken into consideration.

Objective: To review and discuss the epidemiology, risk factors, and different ways of diabetes care in Egypt. In addition, the aim is also to analyze the problem of the shortage of endocrinologists and how it can be solved.

Methods: Searching and reviewing medical literature using PubMed, Google scholar, and some other gray literature from the World Health Organization (WHO), International Diabetes Federation (IDF), and Centers for Disease Control and Prevention (CDC).

Results: Egypt is ranked ninth in the prevalence of diabetes worldwide according to IDF with a prevalence of 15.2% in the adult population in early 2020. The prevalence is expected to continue rising to more serious levels. This high prevalence is attributed to common risk factors in Egypt such as obesity, physical inactivity, chronic hepatitis C infection, pesticides, smoking, and bad eating habits. Moreover, we are in an increased demand for more endocrinologists in the Egyptian health care system.

Conclusion: Understanding and avoiding the risk factors of diabetes is a crucial step towards reducing its prevalence and minimizing its healthcare and socioeconomic burdens in Egypt. Effective strategies should be applied for proper diabetes management and improving the quality of life in diabetic patients. Increasing the number of endocrinologists is also a key element for better diabetes care.

Keywords: Diabetes in Egypt, Diabetes epidemiology, Hepatitis C virus, Obesity, Smoking, Pesticides.

INTRODUCTION

Diabetes Mellitus (DM) is a serious leading cause of death worldwide ranked among the top 10 causes. The incidence and prevalence of DM have been growing significantly, constituting a major health and socioeconomic burden [1]. The high prevalence has made it reach the level of an epidemic. DM is a chronic metabolic disorder of carbohydrate metabolism due to either insulin deficiency or inability to respond to insulin leading to elevated blood glucose. It has three main types: Type 1 DM, type 2 DM (the most common), and gestational DM. In the long term, if not well-controlled, it may lead to serious micro-vascular and macro-vascular complications resulting in morbidity and mortality in diabetic patients.

Egypt is a transcontinental country and considered a Mediterranean, North African, and Middle Eastern country. Being known as the cradle of civilization, it has one of the longest and greatest histories evidenced by the earliest development witnessed and documented in ancient Egypt in agriculture, urbanization, writing, construction, religion, and even medicine. Thousands of years ago, ancient Egyptians had good knowledge about the human body and medicine. Interestingly, the concept of medical specialties is not new. Ancient Egypt had physicians who were specializing in certain body parts like the head, teeth, eye, or abdomen.

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When it comes to the discovery of DM, we must mention the ancient Egyptian physician called "Hesy-Ra" who was the first to give humanity a hint about DM in 1552 BC. He documented his description of diabetes symptoms on the Egyptian Papyrus.

DM is a dilemma and rapidly-growing problem in Egypt. According to UN data, the population of Egypt is estimated at 102,334,404 in mid-2020. According to the International Diabetes Federation (IDF), the prevalence of DM in adults in Egypt is 15.2% which may even be underestimated. Therefore, DM should be studied thoroughly regarding its risk factors, prevention, management, and complications. In addition, the general population should have awareness and sufficient knowledge about all aspects of diabetes.

EPIDEMIOLOGY OF DIABETES IN EGYPT

The available data about the epidemiology of DM in Egypt is limited. However, according to IDF, Egypt is ranked ninth in the prevalence of DM worldwide, and the number of adult diabetic patients was 8,850,400 with a prevalence of 15.2% in early 2020. Egypt is one of the countries of IDF Middle East and North Africa (MENA) region. According to IDF, the MENA region has 55 million patients with DM and by 2045 this number will double to reach 108 million. Although these numbers seem so high, the truth is that 40-50% of patients with diabetes or pre-diabetes are undiagnosed. It is expected that the number of diabetic patients in Egypt will reach 13.1

million by 2035 [2, 3]. DM is the main culprit of chronic renal failure, blindness, leg amputation, stroke, and myocardial infarction in Egypt.

THE ECONOMIC INFLUENCE OF DIABETES IN EGYPT

In general, DM is recognized as a major socioeconomic burden. Diabetes-related costs are divided into three classes:

Direct: Represents the direct medical cost and the cost of health care facilities and hospitals.

Indirect: Refers to the resources lost as a result of illness, in the form the time lost as a result of workdays missed (absenteeism), decreased productivity at work (presentism), decreased workforce participation due to disability, and productivity losses due to early retirement and mortality.

Intangible: Refers to the associated changes in the quality of life of patients and relatives due to the disease like the cost of pain, grief, and suffering on individuals and their families [4].

In 2013, the diabetes-related cost in the Middle East region was estimated at 13.6 billion dollars (14% of its total health care costs). In 2010, Annual cost analysts reported that the economic loss of Type 2 DM in Egypt is 1.29 billion dollars per year (regardless of the cost associated with pre-diabetes and reduced productivity). In comparison with other MENA countries, Egypt is the lowest country regarding diabetes-related expenditure ($116 per patient per year). The general spending in other MENA region countries ranges from $160 to $3000 per patient per year. This is even less than that of developed countries which range from $2000 to $7000 per patient per year.

THE MOST COMMON RISK FACTORS IN EGYPT

Obesity

Obesity is the most common risk factor for DM. In obesity, especially central obesity, adipose tissue, by different molecular mechanisms, releases non-esterified fatty acids, pro-inflammatory cytokines, glycerol, and hormones that contribute to the development of insulin resistance.

Egypt is one of the countries with the highest rates of obesity in the world, especially women, which affects the health of the individual, and costs the state huge sums of money, whether in spending on medication or surgeries resulting from the complications of obesity. Egypt has the third-highest prevalence of obesity in the MENA region, after Saudi Arabia and the United Arab Emirates. The prevalence of obesity in Egypt is approximately similar to that of the Native American and Hispanic populations. In 2008, the Egypt demographic and health survey reported that about 50% of Egyptian men and 65%-80% of Egyptian women are overweight or obese [5]. The World Health Organization (WHO) report in 2010 demonstrated that 30.3% of Egyptian adults are suffering from obesity. Obesity in Egypt is a common cause of cardiovascular disease, DM, and osteoarthritis. The most common risk factors of obesity are hereditary which is non-modifiable and bad eating habits and physical inactivity which can be controlled.

Lack of Physical Activity/ Sedentary Lifestyle

Lack of physical activity was documented among 81% of the 4918 households surveyed in Cairo in 1995 [6]. The main causes of these findings are lack of awareness and proper education about the importance of exercise and limited exercise facilities that are not available to everyone, especially in rural areas. Overcrowding with people and cars makes Egyptians avoid walking or running in public areas which may be their only option because of limited and expensive access to gyms or sports clubs. Vitamin D deficiency is prevalent in Egypt due to lack of sun exposure and it is found to be associated with obesity and DM [7-10].

Hepatitis C Infection

Egypt has the highest prevalence of chronic hepatitis C infection in the world. This is due to the campaigns of mass bilharzias is therapy between 1960 and 1980 with intravenous drugs using poorly-sterilized needles. This incident leads to the transmission of infection among a huge number of Egyptians. The Egypt Demographic and Health Survey reported that approximately 15% of Egyptians are serologically positive for HCV antibodies and 10% have an active infection [11].

Type 2 DM is found to be prevalent among patients with chronic hepatitis C infection. A study was done on 9841 persons older than 20 years of age for whom data on HCV infection and DM were obtained. It was found that 8.4% had type 2 DM and 2.1% were positive for anti-HCV antibodies [12]. Chronic hepatitis C infection also increases the risk of developing diabetic complications. A study of 438 patients with Type 2 DM (113 Egyptians and 325 Kuwaitis) showed that poor glycemic control was mostly seen in patients with hepatitis C infection [13]. In another cross-sectional study of 489 patients with Type 2 DM attending an outpatient clinic and dialysis unit in Egypt, the prevalence of HCV infection was 12.9% among patients attending that outpatient clinic and 18.7% among patients in the dialysis unit [14].

Eradication and early treatment of hepatitis C infection can prevent the occurrence of type 2 DM and improve glycemic control and reduce the probability of progression to type 2 DM in patients with pre-diabetes.

Pesticides

DM is a multi-factorial disease including genetic and environmental elements. The role of environmental chemicals as a risk factor cannot be ignored. Exposure to pesticides used in agriculture is a possible risk factor for developing type 2 DM. Egypt is ranked as the 5th highest country using pesticides in Africa, so the correlation between pesticides and DM must be taken into consideration in Egypt [15-17].

A systematic review and meta-analysis of 22 observational studies assessing the link between pesticides and type 2 DM concluded that there is an association between type 2 DM and exposure to organ chlorine, DDT, and heptachlor [18].

Another population-based case-controlled study was conducted among farmers in Thailand including 866 cases with DM and 1021 healthy controls with adjusting the other DM risk factors. It has shown a significant association between pesticides exposure and the occurrence of diabetes [19].

It has been suggested that pesticides can interfere with normal pancreatic function decreasing insulin secretion or damage the mitochondria cells [20]. Exposure to pesticides can be through two ways; the direct way occurs usually among farmers and the indirect way affects most Egyptians due to continuous long-term exposure to low amounts of pesticides in contaminated food. Dichlorodiphenyltrichloroethane (DDT), which is an organ chlorine compound, Malathion, and chlorpyrifos which are organ phosphorus is the most commonly used pesticides in Egypt and the high prevalence of DM in Egypt in the past years can be due to excessive use of these pesticides in agriculture [21-24].

Smoking

Smoking is considered a risk factor for type 2 DM. According to the 2014 Surgeon General's Report, the risk of developing type 2 DM is much higher in smokers than nonsmokers, and this risk increases with increasing the number of cigarettes smoked per day. Moreover, smoking reduces the response to anti-diabetic treatment and increases the risk of developing diabetic complications such as end-stage kidney disease, ulcers, amputation, peripheral neuropathy, retinopathy, blindness, coronary artery disease, and stroke [25-32].

The mechanism is that smoking and its chemicals trigger an inflammatory condition in the body. This inflammation causes cell injury, swelling and consequently interferes with proper cell function. In addition, smoking results in oxidative stress, which occurs when chemicals present in cigarette smoke combine with oxygen in the body generating free radicals which lead to tissue damage [33].

Another mechanism is that smoking has been shown to be associated with central obesity which, in turn, is a risk factor of DM. It was found that smokers usually have higher serum cortisol concentrations than nonsmokers. Cortisol is involved in central obesity and diabetes.

Despite the high cost of cigarettes, hazards of smoking, and the increase in public health education, cigarette smoking is still a common serious problem in Egypt. The number of smokers in Egypt is about 11 million Egyptians who are over 15 years old, according to a study recently disclosed by the Central Agency for Mobilization and Statistics, according to the 2018 population census data. The prevalence of smokers among males was 34.2%, compared to 0.2% among females. The study also indicates that the number of passive smokers in Egypt reaches about 30 million people.

CULTURAL FACTORS PREDISPOSING TO DIABETES

Bad Dietary Habits

Since Egypt is a Mediterranean country; Egyptians tend to follow the Mediterranean diet which mainly consists of vegetables, legumes, fruits, and fish, with moderate amounts of animal proteins. However, Egyptians consume large quantities of white bread and polished rice that are of high carbohydrate content and high glycemic index. In addition, Egypt is among the highest trans-fat consumers worldwide. Trans fat causes dyslipidemia by increasing LDL cholesterol and decreasing your HDL cholesterol, hence increases the risk of type 2 DM. Trans-fat is found in a variety of food products Egyptians consume in large quantities such as margarine, cakes, cookies, biscuits, and fried foods. Moreover, junk food is a bad phenomenon that is widely spread in cities. Junk food is high in calories, salt, and fats with little nutritional value leading to central obesity and type 2 DM. On the other hand, in rural areas with a higher rate of poverty, their diet mainly consists of foods with high carbohydrate and high-fat content and fewer animal proteins. The above-mentioned bad dietary habits absolutely end by developing type 2 DM in susceptible individuals if followed on a frequent basis for a long time.

Decreased Level of Health Awareness

Many diabetic patients, especially the illiterate and those living in rural poor areas, are not aware of the hazards and complications of obesity and DM. They are not aware of the importance of continuous glucose monitoring, and eye and foot examination to screen for complications. There is no routine check-up policy or wellness check in Egypt. The first line of management of DM is diet control, weight reduction, and exercise before starting any medication. However, the vast majority of patients do not follow these instructions and they are reluctant to change their lifestyle and eating habits. Even with medications, non-compliance with anti-diabetic

drugs is common in Egypt in the form of missing some doses, overdosing, or taking some chemicals or herbs prescribed by a friend or someone, not a physician. Except in very few centers, there is no policy in governmental hospitals for regular follow-up and evaluation of diabetic patients in terms of their hemoglobin A1C level, eye, foot, or kidney function. Patients visit the governmental hospitals only for requesting the medication for free or less cost, and the majority of patients go to private clinics where they can find better health service and care than that of government hospitals but with expensive cost. Because of the high cost of private practice, patients rarely perform regular check-up or evaluation. All those discussed problems make glycemic control a pretty challenging issue in Egypt.

SHORTAGE OF ENDOCRINOLOGISTS IN EGYPT

In general, Egypt suffers from a big problem regarding the shortage of doctors. The Egyptian Medical Syndicate reports that half the Egyptian physicians, or 110,000 out of 220,000 registered doctors, have left the country. This is attributed to several causes such as the inconvenient workplace, very low salaries, and insufficient medical facilities. According to the World Bank, there are 8 physicians for every 1000 persons in Egypt.

Among all medical specialties, endocrinology is the most common specialty with a significant shortage of specialists in Egypt. Endocrinologists are those physicians who specialize in diagnosing and treating the various hormonal and endocrine system disorders such as DM, obesity, lipid disorders, thyroid dysfunction, infertility, adrenal gland disorders and, metabolic abnormalities, bone and growth disorders. The prevalence of DM, as well as other common endocrine diseases like osteoporosis and infertility, is rising remarkably, putting the health care system in urgent need of more and more endocrinologists.

The main cause of such a shortage of endocrinologists, in particular, is that there are very limited places offering endocrinology fellowship training after internal medicine residency. Hence, the ministry of health has to address this problem by increasing the postgraduate seats in internal medicine and endocrinology fellowship. Opening more private medical universities will not solve the problem as long as the circumstances which oblige the physicians to leave and the limited spots of endocrinology training are not well-addressed.

HOW TO HANDLE DIABETES MELLITUS IN A BETTER WAY IN EGYPT

1. The ministry of health, through public health insurance, should establish a screening and follow-up program for diabetic patients at the governmental and university hospitals. It should also provide glucose monitoring devices at an affordable cost.
2. Increasing the public awareness about healthy lifestyle, obesity control, DM prevention, and good nutrition through proper health education at schools, universities, and mass media.
3. Physicians should communicate with patients in an empathetic way, encourage them to discuss their concerns freely, engage them in the management plan, and design a convenient DM management program that is suitable for each patient and help them to be compliant with.
4. Including certified diabetes educator and register dietician, and well-trained primary care physicians in the management of diabetic patients to overcome this metabolic pandemic.
5. Early treatment and eradication of hepatitis C infection.
6. Regulation of pesticides use in agriculture, providing protective equipment for farmers or any person in direct contact with pesticides, and surveying of pesticides remnants in food and water. In addition, education about the proper way of handling these pesticides and how to avoid their hazards is necessary.
7. Introduction of the concept of "telemedicine" can be effective in improving the care of diabetic patients through facilitating the interaction between physicians and patients.
8. The government should increase the seats of endocrinology training and fellowship to increase the number of endocrinologists who are the best to manage DM.

CONCLUSION

DM is recognized as a modern epidemic worldwide and it is a major health care issue in Egypt. The prevalence of DM is duplicating over years reaching scary numbers. Therefore, it is worth paying attention to the risk factors that are commonly present in Egyptian society and contributed to this inflating problem. Obesity, sedentary lifestyle, hepatitis C infection, pesticides, smoking, and bad eating habits are the main culprits of the rapidly rising prevalence of DM that require effective strategies for DM care as well as collaboration between people, physicians, and government.

With a rising prevalence of several endocrinal diseases, it is important to shed the light on the shortage of endocrinology specialists as a major issue that is faced globally and particularly in Egypt. Providing Egypt's health care system with a good number of endocrinologists will have a great impact on DM care and other endocrine disorders.

ABBREVIATIONS

WHO: World Health Organization.
IDF: International Diabetes Federation.
CDC: Centers for Disease Control and Prevention.
DM: Diabetes Mellitus.

MENA: Middle East North Africa.

AUTHORS' CONTRIBUTION

Mohamed Riad and **Shorouk Elshafei** performed literature search, data collection, writing the manuscript, and critical revision of the manuscript.

CONFLICT OF INTEREST

Declared none.

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