



## Life Style Related Risk Factors of Type 2 Diabetes Mellitus and Its Increased Prevalence in Saudi Arabia: A Brief Review

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### ABSTRACT

**Aims:** Role of life style related risk factors is very important in the pathogenesis and progression of Type 2 Diabetes Mellitus. The aim of this article is to review the disease burden of Type 2 diabetes mellitus (T2DM) among the population of Saudi Arabia due to unhealthy life style. **Methods:** In this review, the information was collected from published literatures related to risk factors like unhealthy dietary pattern and sedentary life style leading to T2DM. Additionally, some epidemiological information for the prevalence of T2DM in Saudi Arabia was also collected. **Results:** Earlier studies have depicted that unhealthy life style and dietary patterns are risk factors involved in the development of insulin resistance in the body cells. In Saudi Arabia, rapid economic growth has provided a luxurious life style to the masses eventually leading to decrease in the physical activities and adoption of unhealthy dietary patterns. The increased prevalence of T2DM in Saudi Arabia is very much implicated to the life style related risk factors which needs to be improvise for the prevention of this disease. **Conclusion:** Since the increased prevalence of T2DM is associated with the sedentary life style and unhealthy dietary pattern, so it is recommended that creating awareness about the life style related risk factors for T2DM among general population and patients, will effectively contribute in lowering its incidence rate.

**Keywords:** Type 2 Diabetes Mellitus, unhealthy dietary pattern, sedentary life style, Saudi Arabia

### INTRODUCTION

Type 2 diabetes mellitus (T2DM) is a metabolic disorder that is characterized by high blood sugar due to insulin resistance (reduced ability of insulin to stimulate utilization of glucose in the cells of the body system) and also relatively reduced secretion of insulin from the beta cells of pancreas. Obesity, unhealthy dietary habits, sedentary life style and genetic factors are considered as important risk factors in the development of T2DM.

Worldwide, approximately 5.1 million people aged between 20 and 79 years died from diabetes in 2013, accounting for 8.4% of mortality among people in this age group [1]. In Kingdom of Saudi Arabia (KSA), the epidemiologic transition has been fast and complete. During the last 4 decades, rapid economic growth has led to a remarkable increase in living standards and adoption of a 'Westernized' lifestyle, characterized by decreased physical activity and unhealthy dietary patterns [2]. Increase in the risk of T2DM is attributed to the intake of dietary energy in excess of expenditure resulting in weight gain and obesity.

In this review, risk factors like unhealthy dietary pattern, sedentary life style, oxidative stress and complications of T2DM are discussed. Additionally, the increased prevalence of T2DM in Saudi Arabia due to these risk factors is depicted. The information presented in the review is collected after an extensive search of the Medline database (PubMed) using the key words 'dietary pattern and type 2 diabetes mellitus', 'physical inactiveness and insulin resistance', 'oxidative stress and insulin resistance', 'complications of type 2 diabetes mellitus', 'type 2 diabetes

mellitus in Saudi Arabia'. Similar searches were carried out on Google Scholar. We also collected information from the official Diabetes Atlas of International Diabetes Federation.

### **Diabetes Mellitus**

Carbohydrates are digested by humans to simpler forms of sugars such as glucose, a monosaccharide which is the primary carbohydrate energy source used by the body. Pancreatic beta cells release insulin which is a principal hormone that regulates uptake of glucose from the blood into most cells, where glucose is used either for generation of ATP or storage as glycogen and fat [3]. Insulin deficiency or insensitivity of its receptors may cause persistent or recurrent hyperglycaemia, which eventually leads to diabetes mellitus. Symptoms of diabetes mellitus include hyperglycaemia, polyuria, polydipsia, weight loss, sometimes with polyphagia, and blurred vision. Growth impairment and susceptibility to some infections may also be the symptoms of chronic hyperglycaemia [4].

People with impaired fasting glucose levels (100 mg/dl to 125 mg/dl or 5.6 mmol/L to 6.9 mmol/L), and those with impaired glucose tolerance (140 mg/dl to 200 mg/dl or 7.8 mmol/L to 11.1 mmol/L) and with an HbA1c levels ranging between 5.7% to 6.4% are considered prediabetic and are at considerable risk for developing diabetes mellitus as well as cardiovascular diseases [5].

### **Type 1 Diabetes Mellitus**

This form of diabetes accounts for only 5% to 10%, previously it was known as insulin dependent diabetes or juvenile-onset diabetes. It results from a cellular-mediated autoimmune destruction of the beta cells of the pancreas, eventually leading to Insulin deficiency which can occur at any age. People with T1DM usually require daily insulin treatment to sustain life [6].

### **Type 2 Diabetes Mellitus**

This form of diabetes accounts for 90% to 95%, previously it was known as non-insulin dependent diabetes or adult-onset diabetes, which affects individuals who have insulin resistance and usually have relative insulin deficiency initially, and often throughout their lifetime, these individuals do not need insulin treatment to survive. The patients with this form of diabetes are mostly obese and some degree of insulin resistance is caused by obesity itself. Patients of this form of diabetes generally go undiagnosed for many years because the hyperglycaemia develops gradually and it is often not severe enough for the patient to notice any of the symptoms of diabetes at earlier stages. Life style factors, dietary pattern and physical inactiveness are associated with the aetiology of this type of diabetes [6].

### **Risk factors and complications of Type 2 Diabetes Mellitus**

There are two categories of the risk factors associated with T2DM: modifiable and non-modifiable risk factors. Modifiable risk factors include diets rich in saturated fats and simple carbohydrates, impaired glucose tolerance, metabolic syndrome, high blood pressure ( $\geq 140/90$  mmHg), elevated plasma triglycerides ( $\geq 250$  mg/dl), and low levels of physical activity ( $< 3$  times a week). The non-modifiable risk factors are age (older than 45 years), family history of diabetes, ethnicity, and diabetes during a previous pregnancy (gestational diabetes) [7]. Serious complications can be caused by T2DM if it is not properly managed: most of these complications are related to complications arising from microvascular (e.g. nephropathy, neuropathy, and retinopathy [8,9] and macrovascular complications (e.g. coronary artery disease (CAD), peripheral artery disease (PAD), and cerebrovascular disease). Although, controlling blood sugar in diabetic patients is very crucial, but treating high blood pressure and dyslipidaemia is also important to prevent cerebro-cardiovascular complications. For patients of T2DM, the risk of stroke is increased by 150% to 400%, while the risk of stroke related dementia increases by more than 3 fold [10,11]. Metabolic alterations such as dyslipidaemia, insulin resistance and hyperglycaemia eventually lead to atherosclerosis through endothelial cell and vascular smooth muscle dysfunction combined with impaired platelet function and abnormal coagulation [12,13].

### **Role of oxidative stress in Type 2 Diabetes Mellitus**

Many earlier studies depicted that the oxidative stress plays a key mediatory role in the development and progression of T2DM and its complications, due to increased production of free radicals and impaired antioxidant defenses [14-18]. Lipid peroxidation of low density lipoprotein (LDL) by a superoxide-dependent pathway resulting in the generation of free radicals is found to be associated with Hyperglycaemia [19,20]. Oxidative damage of lipids, proteins, and nucleic acids and other types of biological damage are caused by the free radicals which are formed during the glucose

autoxidation process [21,22]. Insulin resistance and its progression to glucose intolerance is known to be mediated by oxidative stress, subsequently favouring the appearance of atherosclerotic complications which contributes to rise in many micro- and macrovascular complications [23]. Reactive oxygen species (ROS) is generated by hyperglycaemia, which in turn cause damage to the cells, eventually resulting in secondary complications of T2DM [24,25]. Oxidative stress plays a crucial role in cellular injury from hyperglycaemia. Weak defence system of the body due to T2DM, becomes unable to counteract the enhanced ROS generation and as a result, condition of imbalance between ROS generation and neutralisation occurs, which leads to domination of the condition of oxidative stress [26,27].

### **Role of dietary pattern in Type 2 Diabetes Mellitus**

Dietary pattern influences the amount of insulin required to meet blood glucose target goals to maintain optimal blood-glucose levels. The dietary pattern, especially carbohydrate intake could contribute to the pathology of diabetes. Dietary carbohydrate influences postprandial blood glucose levels the most and is the major determinant of meal-related insulin levels. It has been observed that a ketogenic diet which is low on carbohydrate effectively reduces damaging consequences of diabetes [28].

Dietary factors have a major influence on metabolic syndrome. The primary risk factors associated with diet for the occurrence of T2DM are nutritional imbalance due to high energy, fat and cholesterol [29]. Higher fat intake was thought to induce insulin resistance and weight gain contributing to the overall burden of diabetes. However, metabolic studies in human beings do not support this argument [30]. Though uptake of polyunsaturated fatty acids (PUFA) like omega-6 does contribute in lowering diabetes risk [31].

Fibre rich diets have been shown unequivocally to be associated with a reduced risk of obesity and diabetes in many observational studies [32-34]. Wholegrain intake has been consistently associated with a lower risk of diabetes even after adjustment for BMI [35]. Conversely, Asian populations, which consume white rice, with little fibre content, as a staple food and a main source of calories, is at increased risk of developing diabetes [36]. Routine intake of red meat was also associated with increased risk of diabetes [37]. Fruits and vegetables consumption was not found to be associated with risk of diabetes while a higher intake of green leafy vegetables was associated with lower risk [38,39]. Further, consumption of specific whole fruits, such as blueberries, grapes, and apples, was significantly associated with a lower risk of diabetes on the basis of findings from three large prospective cohort studies [40]. Higher intake of dairy products, especially yoghurt is associated with moderately lower risk of [41]. In a meta-analysis higher intake of sugar-sweetened beverages was found to be associated with greater risk of T2DM, while substitution of these beverages with water, coffee, or tea was associated with a lower risk of diabetes [42,43]. Some prospective studies documented that dietary patterns favouring fruits, vegetables, wholegrains, legumes and avoiding red meats, refined grains, and sugar-sweetened beverages are beneficial for diabetes prevention [44-46]. Consumption of diets high in plant based protein and fat and low in total carbohydrate was associated with lower diabetes risk, conversely a diet low in carbohydrate but high in animal fat and protein was associated with higher risk of diabetes [47].

### **Role of physical inactiveness in Type 2 Diabetes Mellitus**

Regular physical activity has been shown to associated with several beneficial physiological changes, key among them are its favourable effect on muscle and liver insulin sensitivity, muscle glucose uptake and utilization, and overall glycaemic control [48,49]. Physically active lifestyle leads to improvements in insulin action and glycaemic control. Physical activity could help in delaying the development of long-term diabetes complications, such as neuropathy, retinopathy, and nephropathy, and decrease the progression rate of existing complications [50]. Physical activity and resulting metabolic adaptations has been shown to improve glycaemic control for diabetic patients [6]. However, physical activity may lead to substantial blood glucose variation and management challenges for those who require insulin. In such cases, self-management training can reduce potential for excessive glucose variability related to exercise [51].

Some meta-analysis studies indicate significantly greater risk for T2DM and metabolic syndrome in people having a sedentary lifestyle [52,53]. Physical activity contributes positively in delaying or preventing progression towards T2DM either by improving insulin sensitivity or affecting BMI [50,54]. Apart from its positive impact on the development of T2DM regular physical activity is associate with several other benefits for the individual with diabetes [6]. and is suggested as the first step towards glycaemic control in individuals with T2DM. The American College of Sports Medicine and American Diabetes Association joint position statement [55], and the American Heart

Association [56] exercise guidelines has recommended exercising no less than every 48 hours to manage blood glucose levels and insulin resistance for people suffering with T2DM. The effects of exercising on insulin resistance may be lost after 48 to 72 hours [57], and short and vigorous bouts of exercise has been shown to improve insulin sensitivity in diabetic patients [58].

### **Type 2 Diabetes Mellitus in Saudi Arabia**

According to report of International Diabetes Federation, 2013 [1] the prevalence of Diabetes among the adult population (age 20-79 years) of Saudi Arabia is 24%. A national survey in 2004 estimated that 23.7% of Saudi adults (age 30-70 years) suffered from T2DM, and another 14.1% had impaired fasting glucose levels [59]. In Saudi Arabia, the burden of T2DM may likely to increase to disastrous levels, unless an approved comprehensive epidemic control program is implemented, which could rigorously promote healthy diet, exercise and active lifestyles, and curbing obesity [60,61].

Over the last few decades, the tremendous surge in socioeconomic growth probably contributed to unhealthy dietary habits in Saudi Arabia. In addition to the consumption of high-calorie traditional food (e.g. dates), excessive consumption of high calorie and fat based diets (e.g. fast food) is very common in Saudi Arabia [2]. Moreover, the management of diabetes and its risk factors is still suboptimal [62]. Some clinical studies from Saudi Arabia, it is reported that not only the Saudi patients have poor knowledge of diabetes [63], but the physicians at primary care centres also have suboptimal awareness of proper diabetes management [64]. 66% of adult men and 71% of adult women are either overweight or obese in Saudi Arabia [65]. The prevalence of diabetes in Saudi Arabia as demonstrated by Al-Nozha et al. [66] show a higher ratio in females than in males, with 42%, and 37.2%, respectively. Due to westernization of the Saudi Arabian diet, the increased intake of high levels of fat, free sugars, sodium and cholesterol have become much more common in the daily dietary pattern [67,68]. Al-Nozha et al. [69] reported a lower level of leisure time physical activity among the Saudis (6.1% in men and 1.9% in women). An increase in the prevalence of T2DM is also observed during the same period, which is attributed to the dramatic changes in lifestyle, in addition to genetic predisposition of Saudi people to diabetes, and a high prevalence of consanguineous marriages [70].

Indeed, diabetes is preventable through a healthy lifestyle and early detection; however, Saudis do not seem to use medical preventive services, despite the fact that they are covered by a free national health system [71]. In Saudi Arabia, 25.5% of the urban population is diabetic in comparison with 19.5% in rural areas. There are also regional differences in the prevalence of T2DM, with the Northern (27.9%) and Eastern (26.4%) provinces experiencing greater rates than the Southern region (18.2%), where a rural lifestyle is more common [59] and the population less prone to obesity than those on the Northern and Eastern provinces [72]. In a study of married couples from Saudi Arabia, there is a positive correlation between consanguine marriages and T2DM, where 80% of all related marriages had a positive family history of T2DM as compared to 20% in nonrelated marriages [73].

There is a 31% prevalence of retinopathy in Saudi patients who had T2DM for at least 10 years [74]. Another study from the western part of Saudi Arabia, indicates that the prevalence of neuropathy in diabetic patients is about 82% (which is considered one of the highest in the world) with another 57% being asymptomatic [75]. A cross sectional study was conducted by Al-Rubeaan, et al. [76] among a cohort of 50464 Saudi patients suffering from T2DM registered in National Survey for Diabetes, they found the overall prevalence of diabetic retinopathy was 19.7%. Diabetic nephropathy is the major contributor to the need for dialysis in Saudi Arabia, where the number of diabetic patients entering renal replacement therapy increased dramatically from 4% in the early 1980s to 14.8% in the mid-1990s and shockingly to 40% in the late 1990s. The majority of deaths (60%) in Saudi patients entering dialysis are diabetic patients [77,78]. The burden of diabetes upon the Saudi society continues to be on the rise; the more newly diagnosed diabetes the more population at risk of developing heart disease, stroke, hypertension, blindness, kidney disease, nervous system disease, amputations, and dental disease [79]. Knowledge and awareness about T2DM, its risk factors, complications and management are important aspects for better control and better quality of life [80].

### **CONCLUSION**

Saudi Arabia has witnessed unprecedented economic growth in the last few decades due to the production and export of petroleum. A consequent rise in the socioeconomic status of its population has resulted in the adoption of an altered lifestyle as compared to previous generations. Sedentary lifestyle and consumption of fat based diets has led to an enormous increase in cases of T2DM, which has now reached epidemic proportions. Diabetes related complications

are also showing a substantial increase in Saudi populations. The disease is affecting all age groups and gender. The problem is compounded by the fact that middle-eastern ethnicities are genetically inclined towards the development of diabetic conditions. A culture of consanguineous marriage is also contributing towards the rise of diabetic cases. Suboptimal awareness about T2DM among patients and primary care physician continues to be a stumbling block in the proper care and management of this condition. Diabetes and diabetes related complications could only be effectively countered by creating a long-term road map. Such a plan must emphasise the role of physical activity and plant and wholegrain based diets in stemming the tide of this disease. Creating awareness about the disease among patients and training primary care physician will contribute in lowering the risk of T2DM. Such a long term strategy would be beneficial not only in controlling the disease but also lead to an overall increase in the health and quality of life of the Saudi population.

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