

SCIENTIA

Peer Reviewed National Science Journal

Volume 15. No.1 ♦ Jan-Dec.2019 ♦ ISSN: 0976-8289



Published by

MERCY COLLEGE

PALAKKAD 678006, KERALA, INDIA



Scientia (Annual)

Jan. - Dec. 2019

Volume 15. No. 1

ISSN: 0976-8289

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Mercy College

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Kerala, India.

Govt. Aided Arts and Science College

Affiliated to university of Calicut, re-accredited with 'A' grade in third cycle by NAAC

Diabetes mellitus: Type1, Type2, and Gestational Diabetes

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Abstract

Diabetes mellitus an endocrinological or metabolic disorder in which the blood sugar level goes high when the body does not produce enough insulin to meet the needs or due to lack of insulin-directed mobilization of glucose by target cells. Diabetes is also a common lifestyle disease that affects a large population. TYPE 1, TYPE 2, and gestational diabetes being the different types of diabetes that are seen in people belonging to different age groups, if not given much attention might increase the complexity of the disease and have a rooted impact on diabetic patients.

Keywords: Diabetes Mellitus, TYPE1 DM, TYPE2 DM, GDM

Introduction

Diabetes mellitus is a heterogeneous disease with multiple etiologies¹. It is a common chronic disease in children². Hyperglycemia being one of the defining features of this disease³, Death from this crisis is significantly high in older adults. According to the international diabetes federation 'Diabetes is one of the largest global health emergencies of the 21st century, moreover occurrence of depression is two to three times higher in people with diabetes mellitus⁵.

As per the reports published by The WHO around 1.6million people die from diabetes every year and the number of cases has been increasing over the past few years. Diabetes mellitus causes destruction and damages the heart, blood vessels, eyes, kidneys and nerves⁶. Both genetic and environmental factors contribute to the pathogenesis of this disease⁷. It is characterized by increased levels of blood sugar as a result of insufficient insulin in the body⁸. Due to the action of insulin on target tissue, there occur abnormalities in carbohydrate, fat and protein metabolism. The inadequate insulin secretion or diminished tissue responses to insulin

at one or more points in the complex pathways of hormone action results in insulin deficiency⁹.

Severity of this disease increases, depending on type and duration. Some even remain asymptomatic. In unrestrained conditions, it might even lead to stupor, coma and even death due to ketoacidosis or from non ketotic hyperosmolar syndrome¹⁰. If much attention is not given it can lead to both micro as well as macro vascular complications, including kidney failure amputation blindness and cardiovascular disease¹¹. This disease includes a range of hyperglycemic conditions which is categorized by American Diabetes Association (ADA). The first type1 Diabetes mellitus (T1DM) is an autoimmune disease with progressive β cell destruction, leading to polyuria, polydipsia, weight loss, and hyperglycemia. Those affected with this become completely dependent on non-endogenous insulin. Type2 diabetes mellitus (T2DM) is caused by the combination of insulin resistance and impairment of insulin secretion. The third category encompasses forms with specific known, genetic and non-genetic etiologies, these monogenic diabetes are highly penetrant moreover have similar clinical presentations to that of T1DM or T2DM. The

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final and fourth category of diabetes is gestational diabetes¹².

Diabetes mellitus can affect the brain; the term diabetic encephalopathy itself expresses an intimate relationship between DM and brain dysfunction, especially for aging, Alzheimer's disease, and depression¹³. Those patients with uncontrolled BP despite antihypertensive therapy are at increased risk of developing Diabetes mellitus¹⁴. Diabetes-associated with cardiovascular autonomic neuropathy, can damage the autonomic nerve fibers that innervate the heart and blood vessels, in turn causing abnormalities in heart rate and vascular dynamics. Moreover it affects the multiple organ systems. It is also a major cause of morbidity as well as mortality in diabetic patients¹⁵. Changing lifestyles such as unhealthy diet and physical inactivity etc. accelerate the growth of this disease¹⁶. Epigenetic modifications considered as the byproducts of environmental stimuli can influence the genetic susceptibility to diabetes¹⁷.

Acupoint therapy has proved to have specific curative effects and notable advantages in the treatment of diabetes and its common chronic complications. It has superior efficacy and minimal side effects than western medicine alone¹⁸. According to the available literature, ChromograninA, contributes to the pathogenesis of DM¹⁹.

Precision medicine incorporates information about the genetic makeup of an individual; it can also improve the diagnosis and treatment of diabetes. Because of all these reasons, it becomes a part of personalized or individualized medicine. This focuses on the psychosocial and dietary components of management²⁰. Diabetes mellitus most commonly occurs after the neonatal period, resulting from complex interactions between both environmental and incompletely-penetrant genetic factors. Advances in molecular genetics over the past decade hastened the realization that the diabetes that occurs in very early life is most often due to the underlying monogenic defects - disorders caused by mutation(s) in a single gene²¹. The percentage of types of diabetes diagnosed²² is shown in Figure 1 (Source:- <https://diabetesmellitusucd.wordpress.com/what-exactly-is-diabetes/>)

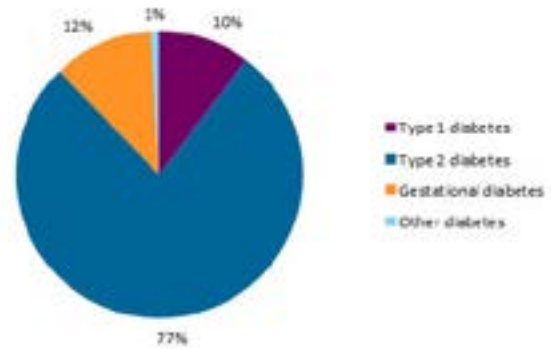


Fig.1 Pie chart showing the percentage of types of diabetes

Type1 Diabetes Mellitus

Type1 diabetes also called juvenile diabetes or insulin dependent diabetes, where the body is unable to make insulin as a result Blood sugar level goes high and makes the person ill²³. Type 1 DM is the result of autoimmune destruction of the insulin-producing pancreatic β -cells²⁴, due to which the body fails to produce insulin; hence the patients with T1DM remain insulin-dependent for their lifetime²⁵. This autoimmune disease represents 5-10% of all cases of diabetes²⁶. Constant hunger, blurred vision²⁷, polyuria, polydipsia, weight loss, fatigue etc. are the symptoms of T1DM²⁸, which are shown during childhood or adolescence and can sometimes even develop even in the later stages²⁹. Type 1 diabetes can be more variable in adults³⁰. The development of T1DM varies with seasons and birth month where more cases are diagnosed in autumn and winter; moreover those born in the spring have a higher chance of being affected with Type 1 diabetes³¹. This chronic multifactorial disease³² can result from both environmental and genetic factors³³.

Both genetic and non-genetic factors are involved to the same extent in the pathogenesis of this disease³⁴. Innate immunity and inflammatory mediators have a role in T1DM; they inhibit or stimulate the β -cell regeneration and cause peripheral insulin resistance³⁵. The world health organization initiated "The DIAMOND project"; in order to describe the occurrence of T1DM in children³⁶. Early diagnosis can improve the therapeutic strategies and overall health span³⁷. Therapy

concept consists of insulin therapy, gene therapy, nutritional knowledge, training, glucose self-monitoring, psychosocial care etc.³⁸. Immunomodulatory properties of vitamin D, is beneficial for the prevention and treatment of T1DM³⁹. Isolated islet cell transplantation is an effective treatment of type 1 diabetes in those who suffer from hypoglycemia⁴⁰. Monitoring carbohydrate intake and balancing carbohydrate intake and insulin levels might help in controlling T1DM⁴¹.

Type2 Diabetes mellitus

Type 2 Diabetes mellitus which is a non-insulin dependent DM⁴² characterized by hyperglycemia, insulin resistance, and relative insulin deficiency that results from the interaction between genetic, environmental and behavioral factors⁴³. There has been a rapid increase in T2DM over the past three decades, especially in developing countries⁴⁴. It is increasingly seen in children, adolescents,

younger adults (due to the increase in obesity, physical inactivity, and energy-lacking diets) and in persons older than 45 years⁴⁵. Smokers are at increased risk of developing T2DM⁴⁷. Moreover High alcohol consumption increases the risk of abnormal glucose regulation in men⁴⁸. Vitamin K2 has a significant effect on T2DM⁴⁹. High intake of red meat, sweets etc. contribute to the increase of this disease⁵⁰. Intake of foods with high glycemic index and glycemic load, especially rice, increases the risk of type 2 diabetes mellitus especially in Chinese women⁵¹.

Vitamin D is a potential and inexpensive therapy that decreases the risk and improves the glycemic parameters in patients⁵². Thus, vitamin D is a possible therapeutic agent in the prevention and treatment of this disease where the Glucose tolerance is restored when the level of vitamin D is normalized⁵³. Consumption of fruits and vegetables might prevent the development of T2DM⁵⁴.

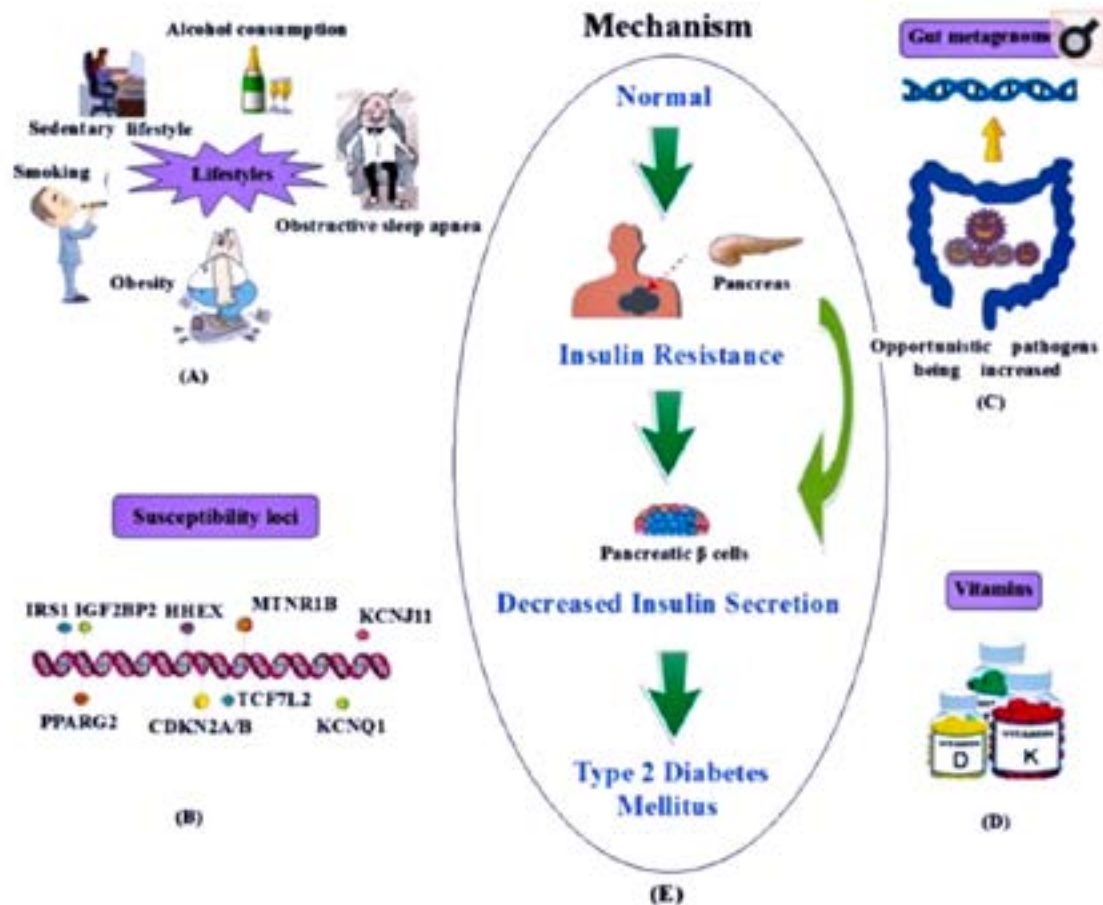


Fig. 2. Summary of the influencing factors and mechanisms of T2DM

Compared with brown rice, white rice is protective against type 2 diabetes⁵⁵. Moreover, Diet and exercise may be an initial adequate treatment to prevent the further growth of this disease⁵⁶. As shown in Figure 2 (Source: <https://www.semanticscholar.org/paper/COMPARITIVE-EFFECT-OF-SYZGI-UMCUMINI-AND-Thatneem-Rajasulochana/7cd-3d0cdc7bb937010ac279956a910cb86660449/figure/1>),

lifestyle factors like sedentary lifestyle, physical inactivity etc. contribute to T2DM that cause macro vascular as well as micro vascular diseases and cancers⁴⁶.

Gestational diabetes mellitus

Gestational diabetes mellitus (GDM) is any degree of hyperglycemia, recognized for the first time during pregnancy⁵⁷. That occurs when the pregnant woman is unable to produce an adequate insulin response to compensate for the normal insulin resistance⁵⁸. GDM being the most common medical complication of pregnancy⁵⁹ is restricted to those women where there is a development of glucose intolerance or is discovered during pregnancy⁶⁰.

Management without medication or nutritional therapy is called diet-controlled gestational diabetes (A1GDM) and that managed with medication to achieve adequate glycemic control is known as A2GDM⁶¹. Risk factors of GDM include insulin resistance diseases (like PCOS) genetic polymorphisms, intrauterine environment⁶², obesity etc.⁶³. Since the disease can be transmitted to the next generation⁶⁴, offspring of mothers with GDM are at a high risk of developing GDM, diabetes, obesity, cardiovascular disease and structural hypothalamic changes⁶⁵. The initial treatments include nutrition therapy⁶⁶, which includes treatments that restrict the intake of carbohydrate⁶⁷, Glucose monitoring, Pharmacotherapy, Obstetrical management

of GDM (that concentrate on foetal surveillance, evaluation of foetal growth, timing and mode of delivery, and care during labour and postpartum etc.)⁶⁸, physical activities etc.⁶⁹. Above all, insulin therapy becomes a necessity in 40% of cases to obtain glycemic control⁷⁰.

Conclusion

Diabetes mellitus is a chronic metabolic disease that can be controlled on keeping the blood sugar level normalized. Hyperglycaemia, a common effect of uncontrolled diabetes, over time leads to serious damage to many of the body's systems, especially the nerves and blood vessels. The prevalence of diabetes has been rapidly increased. As per the statistics of World Health Organization, 8.5% of adults aged 18 years and older had diabetes in 2014, whereas diabetes was the direct cause of 1.6 million deaths in 2016. Between 2000 and 2016, there was a 5% increase in premature mortality from diabetes. People with type 1 diabetes require insulin, people with type 2 diabetes can be treated with oral medication, but may also require insulin. The International Federation Diabetes Atlas (9th Edition), reported that the global diabetes prevalence in 2019 is estimated to be 9.3% (463 million people), rising to 10.2% (578 million) by 2030 and 10.9% (700 million) by 2045. The prevalence is higher in urban (10.8%) than rural (7.2%) areas, and in high-income (10.4%) than low-income countries (4.0%). Unhealthy eating habits, lack of exercise; accelerate the growth of this disease as well as many other diseases. Healthy lifestyle, weight control, exercise, dietary changes, avoiding tobacco use, proper medications and regular screening and treatment for complications are the steps that can be adopted to manage this disease. We are the one who have the control over this and our activities can have an effect on this metabolic disease, as a result of which the disease can be brought to its normalcy.

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