

MINI REVIEW

Risk Factors of Type 2 Diabetes Mellitus: Non-Modifiable and Modifiable Risk Factors

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ABSTRACT

Diabetes mellitus can arise from other diseases or due to drugs such as genetic syndromes, surgery, malnutrition, infections, and corticosteroids intake. The non-modifiable risk factors are age (older than 45 years), family history of diabetes, ethnicity, and diabetes during a previous pregnancy (gestational diabetes). Individuals who have a family history of diabetes can have two to six times the risk of type 2 diabetes compared with no family history of the disease. 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 (≥ 250 mg/dl), and low levels of physical activity. Metabolic syndrome has been associated with type 2 diabetes mellitus due to its high prevalence worldwide since it is both related to the increase in obesity and a sedentary lifestyle. Insulin resistance often is the primary metabolic abnormality leading to the development of type 2 diabetes mellitus.

KEYWORDS

High blood pressure; Metabolic syndrome; Modifiable risk factors; Non-modifiable risk factors; Type 2 diabetes mellitus

INTRODUCTION

Diabetes mellitus (DM) is a combination of two words, “diabetes” Greek word derivative, means siphon - to pass through and the Latin word “mellitus” means honeyed or sweet [1]. DM can arise from other diseases or due to drugs such as genetic syndromes, surgery, malnutrition, infections, and corticosteroids intake. T2DM factors which can be irreversible such as age, genetic, race, and ethnicity or revisable such as diet, physical activity and smoking [2]. A number of lifestyle factors are known to be important to the development of type 2 DM. These are physical inactivity, sedentary lifestyle, cigarette smoking and generous consumption of alcohol [3,4]. 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 (≥ 250 mg/dl), and low levels of physical activity (< 3 times a week) [5,6]. Non-modifiable and modifiable risk factors of type diabetes mellitus are discussed in turn below.

NON-MODIFIABLE RISK FACTORS

The non-modifiable risk factors are age (older than 45 years), family history of diabetes, ethnicity, and diabetes during a previous pregnancy (gestational diabetes) [7,8].

AGE (OLDER THAN 45 YEARS)

Deficiency of insulin secretion developing with age, and growing insulin resistance caused by a change in body composition and sarcopenia. The process of aging of the human body leads to impairment of energy homeostasis and abnormalities in carbohydrate metabolism. The sensitivity of pancreatic beta cells for incretins decreases in the elderly [9,10].

FAMILY HISTORY OF DIABETES

Family history of type 2 diabetes is recognized as important risk factors of the disease [11]. Individuals who have a family history of diabetes can have two to six times the risk of type 2 diabetes compared with no family history of the disease [12]. Family medical history provides valuable genomic information because it represents the combination of inherited genetic susceptibilities and shared environmental and behavioral factors [13]. There is a strong inheritable genetic connection in type 2 DM, having relatives (especially first degree) with type 2 DM increases the risks of developing type 2 DM substantially. Concordance among monozygotic twins is close to 100%, and about 25% of those with the disease have a family history of DM [14].

ETHNICITY

African-Americans tend to have less potassium in their bodies than whites. A potassium deficiency is linked to a higher risk for developing type 2 diabetes mellitus [15]. People from South Asian backgrounds for example are more likely to experience insulin resistance at a younger age because they have higher rates of obesity, central fat distribution [16]. African-Americans have genes that make them more susceptible to type 2 diabetes [17].

GESTATIONAL DIABETES

Women diagnosed with gestational diabetes in early pregnancy, before insulin resistance begins to rise are likely to have a greater degree of hyperglycemia, and therefore an increased likelihood of progression to abnormal glucose tolerance [18]. A previous diagnosis of gestational diabetes carries a lifetime risk of progression to type 2 diabetes upto 60% [19]. Gestational diabetes is associated with both insulin resistance and impaired insulin secretion and shares the same risk factors with type 2 diabetes. Prevalence of gestational diabetes closely resembles that of type 2 diabetes in a population [20].

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 (≥ 250 mg/dl), and low levels of physical activity [21,22].

LOW LEVELS OF PHYSICAL ACTIVITY

Low physical activity associated with obesity, which is independent risk factor for type 2 diabetes [23]. The excessive free fatty acid released by adipose tissue leads to a decrease in insulin sensitivity of muscle, fat and liver, which is followed by raised glucose levels, insulin resistance and type 2 diabetes mellitus [24]. Sitting down for long periods can result in changes in the body's metabolism, including insulin resistance, which can lead to type 2 diabetes mellitus [25].

SATURATED FATS AND SIMPLE CARBOHYDRATES

High intake of saturated fat is associated with insulin resistance and development of type 2 diabetes [26-28]. This is because an uncontrolled state of insulin resistance leads to a higher risk of getting type 2 diabetes mellitus. Dietary fat does not have an immediate effect on blood sugar levels, but consuming a meal high in fat can slow digestion and make it more difficult for insulin to work effectively. Simple or refined carbohydrates are easily and quickly utilized for energy by the body because of their simple chemical structure, often leading to a faster rise in blood sugar and insulin secretion from the pancreas; which can have negative health effects.

METABOLIC SYNDROME

Metabolic syndrome has been associated with type 2 diabetes mellitus due to its high prevalence worldwide since it is both related to the increase in obesity and a sedentary lifestyle [29]. Insulin resistance often is the primary metabolic abnormality leading to the development of type 2 diabetes [30]. Type 2 diabetes can be viewed as the consequence of a series of pathophysiologic changes, each of which makes the patient vulnerable to subsequent disruption of normal glucose homeostasis [31]. Impaired glucose tolerance means that blood glucose is raised beyond normal levels, but not high enough to warrant a diabetes diagnosis [32]. Impaired fasting glycemia was the commonest metabolic abnormality followed by microalbuminuria, low HDL cholesterol, high LDL cholesterol, hypercholesterolaemia and hypertriglyceridaemia in decreasing frequency [33].

HIGH BLOOD PRESSURE

People with high blood pressure usually have insulin resistance and have an increased risk of developing diabetes compared to those with typical blood pressure [34]. This may be due to bodily processes that link both conditions, such as: Inflammation, oxidative stress, activation of the immune system, disease or thickening of the blood vessels and obesity [35,36].

ELEVATED PLASMA TRIGLYCERIDES

High serum triglycerides may be increased levels of high blood glucose [37]. The accumulation of visceral adipose tissue among smokers may be due to increased plasma cortisol levels induced by the stimulation of sympathetic nervous system activity [38]. Smoking decreases testosterone level leading to adiposity [39]. High consumption of alcohol leads to excess caloric intake and obesity, which in turn accelerates propensity for diabetes [40].

CONCLUSION

Diabetes mellitus is a combination of two words, “diabetes” Greek word derivative, means siphon-to passes through and the Latin word “mellitus” means honeyed or sweet. There are two categories of the risk factors associated with type 2 diabetes mellitus: 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 (≥ 250 mg/dl), and low levels of physical activity (< 3 times a week). High intake of saturated fat is associated with insulin resistance and development of type 2 diabetes mellitus.

COMPETING INTERESTS

The author has no financial or proprietary interest in any of material discussed in this article.

REFERENCES

1. Sami W, Ansari T, Butt NS et al. (2017) Effect of diet on type 2 diabetes mellitus: A review. *International Journal of Health Sciences* 11(2): 65.
2. Pillon NJ, Loos RJ, Marshall SM et al. (2021) Metabolic consequences of obesity and type 2 diabetes: Balancing genes and environment for personalized care. *Cell* 184(6): 1530-1544.
3. D’Isanto T, Manna A, Altavilla G (2017) Health and physical activity. *Sport Science* 10(1): 100-105.
4. Gaetano A (2016) Relationship between physical inactivity and effects on individual health status. *Journal of Physical Education and Sport* 16(4): 1069-1074.
5. Fareed M, Salam N, Khoja AT et al. (2017) Life style related risk factors of type 2 diabetes mellitus and its increased prevalence in Saudi Arabia: A brief review. *International Journal of Medical Research & Health Sciences* 6(3): 125-132.
6. Boles A, Kandimalla R, Reddy PH (2017) Dynamics of diabetes and obesity: Epidemiological perspective. *Biochimica et Biophysica Acta (BBA)-Molecular Basis of Disease* 1863(5): 1026-1036.
7. Farahvar S, Walfisch A, Sheiner E (2019) Gestational diabetes risk factors and long-term consequences for both mother and offspring: A literature review. *Expert Review of Endocrinology & Metabolism* 14(1): 63-74.
8. Bereda G (2022) Complication of diabetes mellitus: Microvascular and macrovascular complications. *International Journal of Diabetes in Developing Countries* 3(1): 123-128.
9. Serin Y and Tek NA (2019) Effect of circadian rhythm on metabolic processes and the regulation of energy balance. *Annals of Nutrition and Metabolism* 74(4): 322-330.
10. Guillot SJ, Bolborea M, Dupuis L (2021) Dysregulation of energy homeostasis in amyotrophic lateral sclerosis. *Current Opinion in Neurology* 34(5): 773-780.
11. Bereda G (2022) Risk factors, classifications and pathogenesis of diabetic retinopathy. *Journal of Diabetes and Clinical Practice* 5(149): 2.
12. Dorman JS, Valdez R, Liu T et al. (2012) Health beliefs among individuals at increased familial risk for type 2 diabetes: Implications for prevention. *Diabetes research and clinical practice* 96(2): 156-162.
13. Constantino JN, Charman T, Jones EJ (2021) Clinical and translational implications of an emerging developmental substructure for autism. *Annual Review of Clinical Psychology* 17: 365-389.

14. Bereda G (2022) Hyperosmolar hyperglycemic state: Background, precipitating factors, pathophysiology and management. *International Journal of Diabetes & Its Complications* - 101.
15. Chatterjee R, Slentz C, Davenport CA et al. (2017) Effects of potassium supplements on glucose metabolism in African Americans with prediabetes: A pilot trial. *The American Journal of Clinical Nutrition* 106(6): 1431-1438.
16. Bereda G (2022) Risk factors and pathogenesis of diabetic nephropathy. *International Journal of Diabetes & Metabolic Disorders* 7(1)05: 7.
17. Lau W, Andrew T, Maniatis N (2017) High-resolution genetic maps identify multiple type 2 diabetes loci at regulatory hotspots in African Americans and Europeans. *The American Journal of Human Genetics* 100(5): 803-816.
18. Ta S (2014) Diagnosis and classification of diabetes mellitus. *Diabetes Care* 37(1): 81-90.
19. Zhu Y and Zhang C (2016) Prevalence of gestational diabetes and risk of progression to type 2 diabetes: A global perspective. *Current Diabetes Reports* 16(1): 1-11.
20. Bereda G and Bereda G (2021) The incidence and predictors of poor glycemic control among adults with type 2 diabetes mellitus in ambulatory clinic of Mettu Karl referral hospital, South Western, Ethiopia: A prospective cross-sectional study. *International Archives of Endocrinology Clinical Research* 7: 024.
21. Fareed M, Salam N, Khoja AT et al. (2017) Life style related risk factors of type 2 diabetes mellitus and its increased prevalence in Saudi Arabia: A brief review. *International Journal of Medical Research & Health Sciences* 6(3): 125-132.
22. Bereda G (2022) Diabetic ketoacidosis: Precipitating factors, pathophysiology, and management. *Biomedical Journal of Scientific & Technical Research* 44(5): 35843- 35848.
23. Power C, Pereira SMP, Law C et al. (2014) Obesity and risk factors for cardiovascular disease and type 2 diabetes: Investigating the role of physical activity and sedentary behaviour in mid-life in the 1958 British cohort. *Atherosclerosis* 233(2): 363-369.
24. Smith U and Kahn BB (2016) Adipose tissue regulates insulin sensitivity: Role of adipogenesis, de novo lipogenesis and novel lipids. *Journal of Internal Medicine* 280(5): 465-475.
25. Bereda G (2022) Clinical management of gestational diabetes mellitus. *Journal of Diabetic Nephropathy and Diabetes Management* 1(1): 1-10.
26. Morio B, Fardet A, Legrand P et al. (2016) Involvement of dietary saturated fats, from all sources or of dairy origin only, in insulin resistance and type 2 diabetes. *Nutrition Reviews* 74(1): 33-47.
27. Wondmkun YT (2020) Obesity, insulin resistance, and type 2 diabetes: Associations and therapeutic implications. *Diabetes, metabolic Syndrome and Obesity: Targets and Therapy* 13: 3611.
28. Hirabara SM, Curi R, Maechler P (2010) Saturated fatty acid-induced insulin resistance is associated with mitochondrial dysfunction in skeletal muscle cells. *Journal of Cellular Physiology* 222(1): 187-194.
29. Saklayen MG (2018) The global epidemic of the metabolic syndrome. *Current Hypertension Reports* 20(2): 1-8.
30. Mercurio V, Carlomagno G, Fazio V et al. (2012) Insulin resistance: Is it time for primary prevention?. *World Journal of Cardiology* 4(1): 1.
31. Zaccardi F, Webb DR, Yates T et al. (2016) Pathophysiology of type 1 and type 2 diabetes mellitus: A 90-year perspective. *Postgraduate Medical Journal* 92(1084): 63-69.

32. Bereda G (2022) Risk factors, complications and management of diabetes mellitus. *American Journal of Biomedical Science & Research* 16(4): 409-412.
33. Mikolasevic I, Žutelija M, Mavrinac V et al. (2017) Dyslipidemia in patients with chronic kidney disease: Etiology and management. *International Journal of Nephrology and Renovascular Disease* 10: 35.
34. Sinha S and Haque M (2022) Insulin resistance is cheerfully hitched with hypertension. *Life* 12(4): 564.
35. Szczepanik FSC, Grossi ML, Casati M et al. (2020) Periodontitis is an inflammatory disease of oxidative stress: We should treat it that way. *Periodontology 2000* 84(1): 45-68.
36. Bereda G (2022) Pathophysiology and management of dyslipidaemia. *Biomedical Journal of Scientific & Technical Research* 43(2): 34369-34375.
37. Boden G, Sargrad K, Homko C et al. (2005) Effect of a low-carbohydrate diet on appetite, blood glucose levels, and insulin resistance in obese patients with type 2 diabetes. *Annals of Internal Medicine* 142(6): 403-411.
38. Kyrou I and Tsigos C (2009) Stress hormones: Physiological stress and regulation of metabolism. *Current Opinion in Pharmacology* 9(6): 787-793.
39. Chrysohoou C, Panagiotakos D, Pitsavos C et al. (2013) Low total testosterone levels are associated with the metabolic syndrome in elderly men: The role of body weight, lipids, insulin resistance, and inflammation; the Ikaria study. *The Review of Diabetic Studies: RDS* 10(1): 27.
40. Roden M and Shulman GI (2019) The integrative biology of type 2 diabetes. *Nature* 576(7785): 51-60.