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DABETES MELLITUS: AN EMERGING RISK FACTOR TO PUBLIC HEALTH

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INTRODUCTION

Epidemiology is a fundamental science of public health. Epidemiology has made major contributions to improving population health. Epidemiology is essential to the process of identifying and mapping emerging diseases.[1]

Diabetes is a huge subject, which occupies the working life of several thousand health workers in this country alone.[2] Diabetes is a serious, chronic disease that occurs either when the pancreas does not produce enough insulin (a hormone that regulates blood sugar, or glucose), or when the body cannot effectively use the insulin it produces. Diabetes is an important public health problem, one of four priority non-communicable diseases (NCDs) targeted for action by world leaders. Both the number of cases and the prevalence of diabetes have been steadily increasing over the past few decades.

Epidemiology

Epidemiology is the study of the determinants, distribution, and frequency of disease (who gets the disease and why).

- Epidemiologists study sick people.
- Epidemiologists study healthy people.
- To determine the crucial difference between those who get the disease and those who are spared.
- Epidemiologists study exposed people.
- Epidemiologists study non-exposed people.
- To determine the crucial effect of the exposure.[3]

Uses of Epidemiology

- To determine, describe, and report on the natural course of disease, disability, injury, and death.
- To aid in the planning and development of health services and programs.
- To provide administrative and planning data.
- To study the cause (or etiology) of disease(s), or conditions, disorders, disabilities, etc.
- To determine the primary agent responsible or ascertain causative factors.
- To determine the characteristics of the agent or causative factors.
- To determine the mode of transmission.
- To determine contributing factors.
- to identify and determine geographic patterns.[3]

Purpose of Epidemiology

- To provide a basis for developing disease control and prevention measures for groups at risk.
- This translates into developing measures to prevent or control disease.[3]

Two Broad Types of Epidemiology

Descriptive epidemiology: Examining the distribution of disease in a population, and observing the basic features of its distribution.

Analytic epidemiology: Investigating a hypothesis about the cause of disease by studying how exposures relate to disease.

Three essentials characteristics of disease that we look for in descriptive studies are

- Person
- Place
- Time

Person

- age, gender, ethnic group
- genetic predisposition
- concurrent disease
- diet, physical activity, smoking

- risk taking behavior
- SES, education, occupation

Geographical place

- presence of agents or vectors
- climate
- geology
- population density
- economic development
- nutritional practices
- medical practices

Time

- calendar time
- time since an event
- physiologic cycles
- age (time since birth)
- seasonality
- temporal trends[3]

Type of studies

Studies may be classified as prospective or retrospective. In a prospective study measures of exposures and covariates are made before illness occurs. In a retrospective study these measurements are made after the cases have already occurred.

- **Cross-sectional study**

A study that includes all persons, in the population, at the time of ascertainment, or a representative sample of such persons. Disease and exposure are observed simultaneously.

- **Cohort study**

Two groups (or more) groups of people that are free from the disease and that differ according to the extent of their exposure to a potential cause of the diseases are studied during a time interval.

- **Case-Control study**

A case control study includes people with a disease and a suitable control group of people unaffected by the disease. The occurrence of the possible cause (exposure) is compared between cases and controls. A relevant situation is to think of a case-control study as a cohort study where exposure is investigated for all cases and for a sample of the non-cases.[4]

Case study

Case study method enables a researcher to closely examine the data within a specific context. In most cases, a case study method selects a small geographical area or a very limited number of individuals as the subjects of study. Case studies, in their true essence, explore and investigate contemporary real-life phenomenon through detailed contextual analysis of a limited number of events or conditions, and their relationships. Yin defines the case study research method "as an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between phenomenon and context are not clearly evident; and in which multiple sources of evidence are used."[5]

Diabetes mellitus

Diabetes mellitus, more simply called diabetes, is a chronic condition that occurs when there are raised levels of glucose in the blood because the body cannot produce any or enough of the hormone insulin or use insulin effectively.[6] Insulin is an essential hormone produced in the pancreas gland of the body, and it transports glucose from the bloodstream into the body's cells where the glucose is converted into energy. The lack of insulin or the inability of the cells to respond to insulin leads to high levels of blood glucose, or hyperglycemia, which is the hallmark of diabetes. Hyperglycemia, if left unchecked over the long term, can cause damage to various body organs, leading to the development of disabling and life-threatening health complications such as cardiovascular disease, neuropathy, nephropathy and eye disease, leading to retinopathy and blindness. On the other hand, if appropriate management of diabetes is achieved, these serious complications can be delayed or prevented.

The classification and diagnosis of diabetes is complex and have been the subject of much consultation, debate and revision stretching over many decades, but it is now widely accepted that there are three main types of diabetes, type 1 diabetes, type 2 diabetes and gestational diabetes (GDM).

There are also some less common types of diabetes which include monogenic diabetes and secondary diabetes. Monogenic diabetes is the result of a single genetic mutation in an autosomal dominant gene rather than the contributions of multiple genes and environmental factors as seen in type 1 and type 2 diabetes. Examples of monogenic diabetes include conditions like neonatal diabetes mellitus and maturity-onset diabetes of the young (MODY). Around 1-5% of all diabetes cases are due to monogenic diabetes.[8,9,10,11,12,13] Secondary diabetes arises as a complication of other diseases such as hormone disturbances (e.g., Cushing's disease or acromegaly), diseases of the pancreas (e.g., pancreatitis) or as a result of drugs (e.g., corticosteroids).

For diagnosing diabetes, diagnostic criteria have been debated and updated over decades but the current criteria from the World Health Organization (WHO) state that diabetes is diagnosed by observing raised levels of glucose in the blood.

Type 1 diabetes

Type 1 diabetes is caused by an autoimmune reaction where the body's immune system attacks the insulin-producing beta cells in the islets of the pancreas gland. As a result, the body produces none to very little insulin with a relative or absolute deficiency of insulin. The causes of this destructive process are not fully understood but a combination of genetic susceptibility and environmental triggers such as viral infection, toxins or some dietary factors have been implicated.[14] The disease can develop at any age but type 1 diabetes occurs most frequently in children and adolescents. People with type 1 diabetes need daily insulin injections in order to maintain a glucose level in the proper range and without insulin would not be able to survive.

People with type 1 diabetes, with proper daily insulin treatment, regular blood glucose monitoring and maintenance of a healthy diet and lifestyle can live a healthy life and delay or avoid many of the complications associated with diabetes.

Symptoms of type 1 diabetes

- Abnormal thirst and dry mouth
- Frequent urination
- Lack of energy, fatigue
- Constant hunger
- Sudden weight loss

- Bedwetting
- Blurred vision

Type 1 diabetes is diagnosed by an elevated blood glucose level in the presence of the symptoms. However, diagnosing type of diabetes is sometimes difficult to determine and additional testing may be required to distinguish between type 1 or type 2 diabetes or other forms of diabetes.[15] The incidence of type 1 diabetes is increasing worldwide, but there is huge variation by country with some regions of the world having much higher incidence than others.[14] The reasons for this are unclear but an interplay between genetic and environmental factors is suspected.[16]

Type 2 diabetes

Type 2 diabetes is the most common type of diabetes, accounting for around 90% of all cases of diabetes.[17,18,19] In type 2 diabetes, hyperglycemia is the result of an inadequate production of insulin and inability of the body to respond fully to insulin, defined as insulin resistance. During a state of insulin resistance, insulin is ineffective and therefore initially prompts an increase in insulin production to reduce rising glucose levels but over time a state of relative inadequate production of insulin can develop. Type 2 diabetes is most commonly seen in older adults, but it is increasingly seen in children, adolescents and younger adults due to rising levels of obesity, physical inactivity and poor diet.

The symptoms of type 2 diabetes may be identical to those of type 1 diabetes including in particular, increased thirst, frequent urination, tiredness, slow-healing wounds, recurrent infections and tingling or numbness in hands and feet. However, the onset of type 2 diabetes is usually slow and its usual presentation without the acute metabolic disturbance seen in type 1 diabetes means that the true time of onset is difficult to determine.

Symptoms of type 2 diabetes

- Excessive thirst and dry mouth
- Frequent and abundant urination
- Lack of energy, extreme tiredness
- Tingling or numbness in hands and feet
- Recurrent fungal infections in the skin
- Slow healing wounds
- Blurred vision

As a result, there is often a long pre-detection period and as many as one-third to one-half of type 2 diabetes cases in the population may be undiagnosed because they may remain without symptoms for many years. When unrecognized for a prolonged time period, the complications of chronic hyperglycemia may develop. Some patients with type 2 diabetes are first diagnosed with this condition when they present with a complication due to hyperglycemia such as a foot ulcer, change in vision, renal failure or infection. The causes of type 2 diabetes are not completely understood but there is a strong link with overweight and obesity and with increasing age as well as with ethnicity and family history. Some important modifiable risk factors include: excess adiposity (obesity), poor diet and nutrition, physical inactivity, prediabetes or impaired glucose tolerance (IGT), smoking and past history of GDM with exposure of the unborn child to high blood glucose during pregnancy. Among dietary factors, recent evidence has also suggested an association between high consumption of sugar-sweetened beverages and risk of type 2 diabetes.[20,21,22]

Other factors include inadequate intake of fruit and vegetables, whole grains and dietary fibre and high intake of energy as saturated fat. Overall, according to the latest research, emphasis for diet should move away from that on nutrients to consuming whole foods and instead following dietary patterns such as, but not limited to, the Mediterranean-type diet pattern and others.[23,24] The cornerstone of type 2 diabetes treatment is healthy lifestyle which includes the adoption of a healthy diet, increased physical activity, smoking cessation plan and maintenance of a healthy body weight. If attempts to change lifestyle are not adequate to control blood glucose levels, oral medication is usually initiated for treatment of hyperglycemia with metformin being the most commonly used initial treatment worldwide. If treatment with a single anti-diabetic medication is not adequate, a range of combination therapy options are now available, including; sulphonylureas, thiazolidinediones, DPP-4 inhibitors, SGLT2 inhibitors, GLP-1 agonists, and acarbose. When oral hypoglycemic medications are unable to control hyperglycemia to recommended targets, insulin injections may be prescribed. Beyond the control of raised glucose levels, it is vital to manage blood pressure and to screen regularly (at least annually) and manage the risk for or development of renal (kidney) complications, retinopathy (eye disease) and foot ulcer. It is important to note that with regular check-ups and good management with lifestyle and medications when needed, it is possible for people with type 2 diabetes to lead long and healthy lives.

Management of diabetes

For those diagnosed with diabetes, a series of interventions can improve health outcomes and these can be cost-effective or even cost-saving over time.[25] Diabetes is a chronic, progressive disease but people who have diabetes can live long, high quality lives with good diabetes management. This includes management of not only glycaemia but also cardiovascular disease risk factors such as hypertension and hypercholesterolemia with a healthy diet, recommended levels of physical activity and correct use of medicines as appropriately prescribed by a physician.[26,27,28]

People with diabetes require access to systematic, regular and organized healthcare delivered by a team of skilled providers. Outcomes can be improved at the primary care level with basic interventions such as medication, health and lifestyle counseling and individual and/or group education with regular and appropriate follow-up. This systematic care should include a periodic review of metabolic control and complications, a continually updated diabetes care plan and access to patient-centered care provided by a multidisciplinary team when indicated. Such care is especially needed if resources are limited in many parts of the world, where self care may be more difficult due to lack of education and limited or no availability of monitoring of glycaemia with home devices or programmes to detect diabetes complications.[29,30] Such limitations may be effectively addressed by local adaptations of comprehensive lifestyle programmes or new technology innovations such as telemedicine and mobile health tools.

Periodic referral may be needed for specialist care such as comprehensive eye examinations, treatment of eye complications (retinopathy) if needed, measurement of urine albumin and creatinine and estimated glomerular function (eGFR) for kidney health, foot examinations, and assessment and treatment of cardiovascular diseases. In addition, the availability of inpatient hospitalization is necessary when needed to manage acute and chronic complications such as stroke, myocardial infarction, critical limb ischemia, ketoacidosis, hyperosmolar coma, kidney failure, serious foot infections requiring amputation, treatment of hypoglycemic episodes or stabilization of poor control of hyperglycemia.

Uninterrupted supply of high quality insulin is essential for survival in people with type 1 diabetes. Regular short-acting human insulin and long–acting NPH or isophane insulin should be available to everyone in all parts of the world. Versus more recently developed and costly insulin analogs, commonly available in more economically developed countries.[31] Insulin is

also frequently prescribed for treatment of type 2 diabetes and hyperglycemia in pregnancy if other hypoglycemic medication and lifestyle intervention don't succeed in reaching glycaemic treatment goals.

The commonly used medications for type 2 diabetes are metformin, sulphonylureas, GLP-1 analogues and DPP4 inhibitors. These treatments both enhance the body's natural response to ingested food, and reduce glucose levels after eating.

Unfortunately, insulin is not readily available in many regions of the world. According to the IDF Access to Medicines and Supplies report, no low income country had full government provision (at no or low cost) of essential insulin to children or adults. Even for those who can pay for their insulin, less than half of middle income countries and only one low income country reported that insulin was always available. Additionally, full provision and availability of injection and monitoring equipment is even lower than it is for insulin especially for adults with diabetes. The cost of blood glucose supplies often exceeds the cost of insulin especially in some of the poorest countries.[31] Through IDFs Life for a Child programme, IDF provides insulin to over 18,000 of the poorest children and adolescents with type 1 diabetes in over 41 countries.[32]

Complications of diabetes

Diabetes complications can be divided into acute and chronic complications.

Acute complications include hypoglycemia, diabetic ketoacidosis (DKA), hyperglycemic hyperosmolar state (HHS), hyperglycemic diabetic coma, seizures or loss of consciousness and infections.

Chronic micro vascular complications are nephropathy, neuropathy and retinopathy, whereas chronic macro vascular complications are coronary artery disease (CAD) leading to angina or myocardial infarction, peripheral artery disease (PAD) contributing to stroke, diabetic encephalopathy and diabetic foot. In addition, diabetes has also been associated with increased rates of cancer, physical and cognitive disability,[9,11] tuberculosis[12,13] and depression.[33]

Persistently high blood glucose levels cause generalized vascular damage affecting the heart, eyes, kidneys and nerves. Diabetes is one of the leading causes of cardiovascular disease (CVD), blindness, kidney failure and lower-limb amputation. In pregnancy, poorly controlled

diabetes increases the risk of maternal and fetal complications. There are no detailed global estimates of diabetes-related complications, but where data are available – mainly from high income countries – prevalence and incidence vary hugely between countries.[6,8]

People with diabetes should be regularly screened for potential complications and provided with close monitoring by healthcare professionals. A majority of people with diabetes are unaware of having diabetes complications.[34] However; most complications can be detected in their early stages by screening programmes, allowing for early treatments and prevention of disease progression. Diabetes requires a comprehensive management plan where patients are educated to make informed decisions about diet, exercise, and weight; effectively monitor their blood glucose, lipids, blood pressure and cholesterol; access and correctly use medications; and regularly attend screening for complications.

Cardiovascular disease

People with diabetes are at increased risk of cardiovascular disease (CVD). High levels of blood glucose can make the blood coagulation system more active, increasing the risk of blood clots. Diabetes is also associated with high blood pressure and cholesterol levels, which lead to increased risk of cardiovascular complication such as angina, coronary artery diseases (CADs), myocardial infarction, stroke, peripheral artery disease (PAD), and congestive heart failure.

Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels and they include:

• **Coronary heart disease:** disease of the blood vessels supplying the heart muscle;
• **Cerebrovascular disease:** disease of the blood vessels supplying the brain;
• **Peripheral arterial disease:** disease of blood vessels supplying the arms and legs;
• **Rheumatic heart disease:** damage to the heart muscle and heart valves from rheumatic fever, caused by streptococcal bacteria;
• **Congenital heart disease:** malformations of heart structure existing at birth; deep vein thrombosis and pulmonary embolism – blood clots in the leg veins, which can dislodge and move to the heart and lungs.

People with diabetes are two to three times more likely to have cardiovascular disease (CVD) than people without diabetes.[35,36] The incidence of CVD increases with age and there is

variation between countries with higher rates being observed in low and middle income settings compared to high income countries.[36]

Prevention and management of CVD

Blood glucose self-management must be accompanied by the adoption of healthy lifestyle, characterized by reduced intake of sugar, salt and fat; improved fruit and vegetable intake; increased physical activity; smoking cessation; and avoidance of excessive alcohol. Furthermore, medications are needed for tight control of the metabolic parameters including glucose lowering drugs, antihypertensive, statins and aspirin in those patients with very high risk.[37,38,39]

Diabetic eye disease (DED)

Diabetic eye disease (DED) occurs as a direct result of chronic high blood glucose levels causing damage to the retinal capillaries, leading to capillary leakage and capillary blockage. It may lead to loss of vision and eventually, blindness. The spectrum of DED comprises diabetic retinopathy (DR), diabetic macular edema (DME), cataract, glaucoma, loss of focusing ability, and double vision. DME is a further complication of retinopathy, which can occur at any stage. It is characterized by a swelling of the macula due to ischemia.[40] The risk for retinopathy is increased among people with type 1 diabetes, people with longer duration of diabetes, and possibly among people of lower socioeconomic status.[41] DR is the leading cause of vision loss in working age adults (20 to 65 years) and approximately one in three people living with diabetes have some degree of DR and one in ten will develop a vision threatening form of the disease.

Prevention and management of DED

The primary prevention intervention for DED is good diabetes management. This can be achieved through intensive blood glucose self-management via diet with medication if required which can prevent the onset of DR by 76% and its progression by 54% for insulin treated patients.[42] Moreover, for people with type 2 diabetes more intensive blood glucose control can improve eye health outcomes by 13% compared to regular care.[43]

The effective treatments available include laser coagulation treatment, intravitreal anti-VEGF drugs, intravitreal steroid injections, and vitrectomy. These treatments can prevent vision loss, stabilize vision and in some cases, improve vision if provided early.

Unfortunately, in many low and middle income countries, there is a lack of available screening and treatment for DR.[44]

It is also essential that people with diabetes are educated about the importance of regular retinal screening and given efficient and timely access to those services. Furthermore, people with diabetes should implement personal management strategies such as healthy lifestyle choices regarding nutrition and exercise, and have proper support and education for tight blood glucose and blood pressure management as these efforts play an important role in reducing the risk of the development and progression of DR.[44]

Kidney disease in diabetes (nephropathy)

Chronic kidney disease (CKD) among patients with diabetes can be true diabetic nephropathy, but can also be caused indirectly by diabetes due mostly to hypertension, but also polyneuropathic bladder dysfunction, increased incidence of relapsing urinary tract infections or macro vascular angiopathy.

Diabetes, hypertension and kidney failure are highly interlinked. On the one hand, type 2 diabetes is among the leading causes of kidney failure which is a risk for hypertension and on the other hand, hypertension can often precede CKD and contribute to progression of kidney disease.[45] Hyperglycemia induces hyper filtration, a predictor of progressive kidney disease, and morphologic changes in the kidneys that ultimately lead to podocyte damage and loss of filtration surface.[46]

Prevention and management of kidney disease

Both diabetes and chronic kidney disease (CKD) are strongly associated with CVD and therefore, the major component in their management is control of cardiovascular risk factors such as hypertension and hyperglycemia. It is important to control blood glucose and blood pressure in order to reduce the risk of nephropathy. Screening for abnormal quantities of albumin in the urine (albuminuria) and starting treatment with drugs that reduce the activity of the rennin angiotensin aldosterone system when albuminuria is persistently found, even in the absence of hypertension, is very effective to prevent the development and progression of CKD in people with diabetes.

Screening for albuminuria should be done every year since diagnosis in people with type 2 diabetes and the same after the first five years in people with type 1 diabetes.[47]

The fundamental care for CKD is to avoid progression to kidney failure requiring dialysis and/or transplant. This can be achieved by tight management of blood glucose and blood pressure and also a healthy lifestyle. When CKD has advanced to stage 3 special considerations may be needed regarding selection and dosage of glucose lowering drugs and other medications. Once the disease has advanced to stage 4 and 5, the patient requires the care of specialist renal teams for planning of renal replacement therapy including dialysis, and monitoring and management of the metabolic consequences such as anemia and lack of potassium or phosphate. In some cases, consideration of pancreas and kidney transplant should take place. Currently, only a minority of people have access to dialysis and renal replacement therapy on a global scale.[48]

Nerve damage (neuropathy) and diabetic foot

High blood glucose can cause damage to the nerves throughout the body. Neuropathy is a frequently encountered complication of diabetes. Nerve damage can be quite significant and allow injuries to go unnoticed, leading to ulceration, serious infections and in some cases amputations.

Diabetic neuropathy is an impairment of normal activities of the nerves throughout the body and can alter autonomic, motor and sensory functions. Peripheral neuropathy is the most common form of diabetic neuropathy which affects the distal nerves of the limbs, particularly those of the feet.

It alters mainly the sensory function symmetrically causing abnormal feelings and progressive numbness which facilitates the development of ulcers (diabetic foot) because of external trauma and/or abnormal distribution of the internal bone pressure. Neuropathy can also lead to erectile dysfunction, as well as digestive and urinary problems, and some other problems such as cardiac autonomic dysfunction.

Diabetic foot is a severe chronic complication and it consists of lesions in the deep tissues associated with neurological disorders and PVD in the lower limbs. The reported prevalence of diabetic peripheral neuropathy ranges from 16% to as high as 66%.[49,50] Amputation in people with diabetes is 10 to 20 times more common compared to those of non-diabetic people.[51] Every 30 seconds a lower limb or part of a lower limb is lost to amputation somewhere in the world as a consequence of diabetes.[52] The incidence of diabetic foot is

increasing due to the increased prevalence of diabetes and the prolonged life expectancy of diabetic patients.

Prevention and management of diabetic foot

Similar to other diabetes related complications, the preventive strategy for diabetic foot is adequate diabetes management, characterized by glycaemic control. Intensive blood glucose management (HbA1c<7%) can lead to a 35% risk reduction of amputation compared to less intensive glycaemic management. Moreover, intensive management is also associated with slower decline in sensory vibration threshold.[53] People with diabetes should regularly examine their feet, use appropriate footwear and treat any non-ulcerative pathology correctly.

Regarding management of diabetic foot, two strategies should be prioritized:

1. Increase awareness and knowledge among healthcare professionals on management and treatment of diabetic foot.
2. Conduct periodical screening and risk stratification for at-risk feet.

Less than one-third of physicians recognize the manifestations of diabetic peripheral neuropathy, even when symptomatic.[54] Moreover, there is a lack of understanding of the comprehensive management and treatment of diabetic foot amongst healthcare professionals.[55]

All people with diabetes should be screened for risk and placed in the appropriate risk stratification which is the clinical pathway for treatment and prevention. Comprehensive diabetic foot risk assessments and foot care based on prevention, education and a multi-disciplinary team approach will reduce foot complications and amputations by up to 85%. To address this, IDF has developed Clinical Practice Recommendation on the Diabetic Foot.[56]

Oral health

People with diabetes have increased risk of inflammation of the gums (periodontitis) or gingival hyperplasia if blood glucose is not properly managed. Periodontitis is a major cause of tooth loss and is associated with an increased risk of CVD. Other diabetes-related oral conditions include dental decay, candidiasis, lichen planus, neurosensory disorders (burning mouth syndrome), salivary dysfunction and xerostomia, and taste impairment.

Those with diabetes have a higher risk of developing periodontal disease compared to those without diabetes.[57,58,59] The prevalence of periodontal disease is more common among

people with diabetes (92.6%) than those without the disease (83%).[60] Diabetes is associated with a greater prevalence of lichen planus,[61] fissured tongue, traumatic ulcers, irritation fibroma,[62] recurrent aphthous stomatitis[62] and oral fungal infections.[63] These complications might be caused by chronic immunosuppressant, delayed healing or salivary hypofunction.[64]

Prevention and management of oral complications

The use of an electric toothbrush and a strict dental maintenance schedule are important in long-term oral health and for the prevention of complications. Regular oral check-ups should be established to ensure early diagnosis especially among previously undiagnosed diabetes patients and prompt management of any oral complications among patients with diabetes. Annual visits are recommended for symptoms of gum disease such as bleeding when brushing teeth or swollen and red gums.[65]

To improve oral health, salivary function must be maintained. Common dry or burning sensation in the mouth among people with diabetes can be a side effect of medication use which can be managed by modifying drug scheduling, dose adjustment and changing medications or simply by chewing sugar-free gum. A high fluid intake should be encouraged. Patients should avoid bulky, spicy or acidic foods, alcoholic and carbonated beverages, and tobacco use. The use of mouthwashes that are specific to the treatment of dry mouth and alcohol free may also alleviate the oral discomfort. Also, therapy with immunologically active saliva substitutes can be helpful for reducing bacterial plaque, gin gingivitis and positive oral yeast counts.[66]

Pregnancy-related complications

Pregnant women with any type of diabetes are at risk for many devastating consequences for both mother and child. High blood glucose levels increase the risk for foetal loss, congenital malformations, stillbirth, perinatal death, preeclampsia, eclampsia, obstetric complications and maternal morbidity and pregnancy related mortality. High blood glucose can cause both macrosomia and low birth weight, shoulder dystocia and thus lead to problems during delivery, injuries to the child and mother, and lower blood glucose in the child after birth. The child might be born with low blood sugar, breathing problems and jaundice. Those exposed to a diabetic intrauterine environment are at higher risk of developing type 2 diabetes earlier in life than those without this exposure.[67,68]

Prevention and management of pregnancy complications

It is important for women with diabetes in pregnancy or gestational diabetes (GDM) to carefully control and monitor their blood glucose levels to reduce the risk of adverse pregnancy outcomes with the assistance of the healthcare provider. Medical nutrition therapy with 33% to 40% intake of carbohydrate with a preference for complex carbohydrate and regular physical activity helps better manage glucose levels and achieve optimal weight during pregnancy, based on the maternal body mass index (BMI).[69,70,71,72]

The oral glucose tolerance test (OGTT) is typically used for the diagnosis and monitoring of hyperglycemia in pregnancy.[73] It measures the body's ability to use glucose. Special testing and monitoring of the baby may include foetal movement counting, ultrasound to view internal organs or to detect macrosomia or disproportional foetal growth, no stress testing to measure the baby's heart rate in response to movements, biophysical profile to check foetal movements, heart rate, and amniotic fluid, and Doppler flow studies to measure blood flow. In the collaboration between the mother and healthcare team, the timing and mode of delivery should be determined based on gestational age, glucose control, and estimated foetal weight.\ the overall efficacy and decreases the incidence of adverse effects.[74,75]

Diabetes Medicines

The different kinds of diabetes medicines are listed along with their brand name and common side effects. These medicines are most often used to treat type 2 diabetes.[76]

- **Alpha-glucosidase inhibitors (acarbose, miglitol)**

Available as Glyset (miglitol); Precose (acarbose)

Help to slow down the breakdown of starches (such as bread and potatoes) and certain types of sugar (such as table sugar) from your food in your intestines: this slows down increases in blood glucose.

Common Side Effects

- Stomach Pain
- Diarrhea
- Gas
- Abnormal Liver Tests

- **Biguanide (metformin)**

Available as Fortamet, GLUCOPHAGE, GLUCOPHAGE XR, Glycomet, Glumetza, Riomet (metformin).

Helps to decrease the amount of glucose made by your liver. Helps to improve the way that insulin works in your muscles: if your muscles are more sensitive to insulin, it is easier for insulin to bring glucose from your blood into your muscles where glucose can be used for energy.

Common Side Effects

- Diarrhea
- Gas
- Indigestion Feeling Weak
- Nausea and Vomiting Headache

- **Dopamine receptor agonist (bromocriptine mesylate)**

Available as CYCLOSET

The mechanism by which dopamine receptor agonists improve blood sugar is unknown.

Common Side Effects

- Nausea
- Headache
- Feel Very Tired
- Feel Dizzy
- Vomiting

- **DPP-4 inhibitors (alogliptin, linagliptin, saxagliptin, sitagliptin)**

Available as Januvia (sitagliptin); NESINA (alogliptin); Onglyza (saxagliptin); Tradjenta (linagliptin).

Help your pancreas to make more insulin: insulin helps to lower blood glusoce. Help to decrease the amount of glucose made by your liver.

Common Side Effects

- Upper Respiratory Infection
- Headache

- **Meglitinides (nateglinide, repaglinide)**

Available as Prandin (repaglinide); Starlix (nateglinide)

Help your pancreas to make more insulin: insulin helps to lower blod glucose.

Common Side Effects

- Hypoglycemia (blood sugar that is too low).

- **SGLT2 inhibitors (canagliflozin, dapagliflozin, empagliflozin)**

Availble as FARXIG (dapagliflozin), INVOKAN (canagliflozin), Jardiance (empagliflozin)

Help to stop glucose from being reabsorbed into your kidneys. The kidneys help to remove glucose from your blood. In people with type 2 diabetes, the kidneys can hold on to glucose which can cause blood glucose levels to increase.

Common Side Effects

- Vaginal Yeast Infections
- Urinary Tract Infections
- Changes in Urination

- **Sulfonylureas (glimepiride, glipizide, gliburide)**

Available as Amaryl (glimepiride); DiaBeta, Glynase PresTab, or Micronase (gliburide); Glucotrol, Glucotrol XL (glipizide).

Helps pancreas to make more insulin: insulin helps to lower blood glucose.

Common Side Effects

- Hypoglycemia (blood sugar that is too low)
- Weight Gain
- Headache
- Dizziness

- **Thiazolidinediones (pioglitazone, rosiglitazone)**

Available as ACTOS (pioglitazone); Avandia (rosiglitazone)

Helps to decrease the amount of glucose made by your liver. Help to improve the way that insulin works in your muscles and fat: if your muscles are more sensitive to insulin, it is easier for insulin to bring glucose from your blood into your muscles and fat where glucose can be used for energy.

Common Side Effects

- Fluid Retention
- Weight Gain
- Heart Failure (heart cannot pump blood well)
- Anemia (low red blood cell counts)
- Upper Respiratory Tract Infection[76]

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