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Introduction to Diabetes

Diabetes mellitus is a chronic metabolic disorder that compromises the bodily functions to control blood sugar levels effectively. The disorder develops when the body tissues does not respond to insulin or become less responsive to the insulin that is produced. Insulin is a vital anabolic hormone that enables glucose enters body cells from the bloodstream, where it is metabolised to produce the energy required for normal body functions. Reduced insulin production or decreased insulin sensitivity prevents glucose from being used effectively by body cells, causing it to accumulate in the bloodstream and resulting in hyperglycaemia. If left unattended over time, prolonged hyperglycaemia can damage blood vessels, nerves and several major organs, increasing the likelihood of serious long-term health complications (World Health Organization, 2024).

Symptoms of Diabetes

The symptoms of diabetes may start gradually and differ from one individual to another. Common clinical features include excessive thirst, frequent urination, ongoing tiredness, blurred vision and unexplained weight loss. These symptoms develop because glucose is unable to enter body cells efficiently, leaving excessive amounts of sugar circulating in the bloodstream rather than being used for energy production (NHS, 2025).

Complications of Diabetes

If diabetes is not managed effectively, persistently high blood glucose levels can cause damage to several organs and body systems. Long-term hyperglycaemia affects both small and large blood vessels, increasing the risk of complications involving the eyes, kidneys and peripheral nerves. Impaired circulation, particularly in the legs and feet, delays wound healing and makes infections more likely, which may result in diabetic foot ulcers. In severe cases, untreated ulcers or infections can progress to tissue death, making limb amputation necessary (NHS, 2025).

Type 1 Diabetes

Type 1 diabetes is an autoimmune condition in which pancreatic beta cells are destroyed by the immune system, resulting in little or no insulin production. As these cells break down, insulin production falls dramatically or stops completely, causing blood glucose concentrations to increase. Individuals with this condition depend on lifelong insulin replacement therapy to regulate their blood glucose levels. Although Type 1 diabetes is most diagnosed in children and young people, it can occur at any age. The exact cause of the disease has not yet been established, and there are currently no proven methods to prevent its development (World Health Organization, 2024; Diabetes UK, 2025).

Type 2 Diabetes

is the most prevalent form of diabetes and typically develops in adulthood, although it is increasingly being diagnosed in younger people. slowly over several years. The condition arises when the body's tissues no longer respond effectively to insulin, in Type 2 diabetes, the body is unable to produce enough insulin, or the insulin available cannot meet the body's needs to keep blood glucose within the normal range. Unlike Type 1 diabetes, the condition develops through a combination of inherited susceptibility and environmental or behavioural influences. A person's likelihood of developing Type 2 diabetes increases with factors such as obesity, excess body fat, low levels of physical activity, an unhealthy eating pattern, advancing age, a family history of diabetes, and belonging to ethnic groups with a greater incidence of the condition. Although some of these risk factors cannot be changed, many cases can be avoided or their onset postponed by adopting healthier behaviours, including maintaining an appropriate body weight, eating a balanced and nutritious diet, and engaging in regular physical activity. balanced diet, participating in regular exercise and avoiding smoking (Diabetes UK, 2025; NHS, 2025).

Risk Factors for Type 2 Diabetes

The likelihood of developing Type 2 diabetes results from a complex interaction between inherited factors, environmental conditions, and individual lifestyle choices. Individuals that are overweight or obese have a greater risk of developing the condition, particularly when excess body fat is stored around the abdomen. Other significant risk factors include low levels of physical activity, poor dietary habits, a genetic history of diabetes, high blood pressure, high cholesterol levels, previous gestational diabetes, being over the age of 45, and being part of a certain ethnic populations with a higher risk of getting the disease (Diabetes UK, 2025). Identifying these risk factors is important because it supports early diagnosis, appropriate treatment and effective prevention strategies. In many cases, adopting healthier lifestyle habits can substantially reduce the risk of developing Type 2 diabetes (Diabetes UK, 2025).

Physiology of Insulin and Glucose Regulation

The pancreas is an organ in our body that has multifunctional attributes. The pancreas is positioned behind the stomach, and it has an important role in the digestive system and endocrine systems. It contains specialised clusters of endocrine cells known as the islets of Langerhans. Within these clusters, beta cells are accountable for producing insulin, while alpha cells secrete a substance named glucagon. These hormones work together to regulate blood glucose concentrations and maintain the body's metabolic balance (Norton *et al.*, 2022).

When carbohydrates are consumed, they are broken down into glucose during digestion and absorbed into the bloodstream through the small intestine. As blood glucose levels begin to rise, the beta cells detect this change and release insulin into the circulation. Insulin binds to receptors on the surface of muscle, liver and adipose cells, allowing glucose to enter these tissues. Once inside the cells, glucose is either used immediately to produce energy or converted into glycogen for storage, helping to lower blood glucose levels back to a healthy range (Norton *et al.*, 2022).

Conversely, when blood glucose levels fall, for example between meals or during prolonged exercise, alpha cells within the pancreas release glucagon. This hormone acts mainly on the liver, stimulating the breakdown of glycogen into glucose. The newly released glucose enters the bloodstream, preventing blood glucose concentrations from dropping too low and ensuring that body tissues continue to receive an adequate supply of energy (Norton *et al.*, 2022).

Maintaining stable blood glucose levels depends on the coordinated actions of insulin and glucagon. Together, these hormones continuously adjust glucose concentrations according to the body's energy requirements. In people with diabetes, this regulatory process is impaired because insulin is either not produced in sufficient amounts, is completely absent or the body's cells respond poorly to it. Consequently, glucose remains in the bloodstream instead of being efficiently absorbed by cells, leading to persistent hyperglycaemia and increasing the risk of complications affecting multiple organs over time (Norton *et al.*, 2022).

Cellular Respiration and Energy Production

Cellular respiration is the process by which cells generate energy from glucose in the presence of oxygen. Glucose ($C_6H_{12}O_6$), which is obtained from dietary carbohydrates, enters body cells with the assistance of insulin. At the same time, oxygen (O_2) is transported from the lungs to the tissues through the bloodstream. Within the mitochondria, glucose undergoes a sequence of aerobic biochemical reactions that release stored chemical energy (Patel and Sharma, 2022).

The energy produced during this process is stored in the form of adenosine triphosphate (ATP), which serves as the main energy source for cells' activities. ATP is essential for a wide range of physiological functions, including muscle contraction, protein production, active transport across cell membranes, cell division, tissue repair and normal growth. As glucose

is metabolised, carbon dioxide (CO₂) and water (H₂O) are generated as by-products. Carbon dioxide is carried to the lungs and expelled during exhalation, while water is either utilised by the body or eliminated through normal excretory processes. Thus, cellular respiration is fundamental for sustaining cellular metabolism and supplying the energy required for normal body function (Dunn and Grider, 2023).

How Diabetes Affects the Body (Pathophysiology)

Diabetes develops when the body is unable to effectively regulate the blood glucose, caused by issues with insulin production or insulin action. In individuals with Type 1 diabetes, the immune system attacks and destroys the pancreatic beta cells, that produce insulin, leading to a complete or near-complete lack of this hormone. In Type 2 diabetes, the body's cells become less sensitive to insulin, and over time the pancreas loses its ability to produce enough insulin to meet the body's increasing demands. These changes result in persistent elevations in blood glucose levels (American Diabetes Association, 2025; Kumar, Abbas and Aster, 2023).

Long-term hyperglycaemia initiates several pathological processes that gradually damage tissues and organs throughout the body. Elevated glucose levels increase oxidative stress, stimulate chronic inflammatory responses and promote the formation of advanced glycation end-products (AGEs). Collectively, these mechanisms injure blood vessels and nerve fibres, contributing to microvascular complications such as diabetic retinopathy, nephropathy and neuropathy. They also accelerate the development of macrovascular conditions, including coronary artery disease, cerebrovascular disease and peripheral arterial disease (Forbes and Cooper, 2013).

The harmful effects of prolonged hyperglycaemia extend beyond the cardiovascular and nervous systems. High blood glucose impairs the body's immune response and reduces its capacity to repair damaged tissues efficiently. Consequently, wounds take longer to heal, making infections more common, particularly in the lower limbs. Without prompt treatment, diabetic foot ulcers can deteriorate, increasing the possibility of severe infection and, in advanced cases, limb amputation. Appropriate diabetes management, including regular monitoring of blood glucose, adherence to prescribed medication, a nutritious diet and routine physical activity, is essential for preventing these complications and supporting better long-term health outcomes (NICE, 2024; American Diabetes Association, 2025).

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