**Diabetes Mellitus and Hypertension: The Global causative Factor for Morbidity and Mortality**

**ABSTRACT**

Diabetes mellitus (DM) and Hypertensionare widely recognized as the two major risk factors for the development of heart-related diseases and have been found to be more common in developing nations. They pose a serious threat to global public health due to rising rates of morbidity and mortality. Diabetes mellitus is a chronic, non-communicable syndrome that is linked to a number of impairments, including hyperglycemia, insulin insufficiency, or receptor cell defects. When diabetes is present, elevated hyperglycemia can result in acute microvascular complications. The pathophysiology of diabetes mellitus can be adequately recognized with a basic understanding of glucose metabolism and the feedback mechanism of insulin action. About 40% of diseases related to the cardiovascular system are caused by hypertension, which is the most significant risk factor for complications like atherosclerosis and coronary artery diseases. The stage of obesity, advanced age, and prolonged atherosclerosis are associated with the co-occurrence of diabetes mellitus and hypertension. Effective blood pressure control is important for diabetic patients. As part of routine diagnosis on each scheduled diabetes check, blood pressure monitoring, a thorough medical history with a focus on cardiovascular risk factors, and the onset of diabetes complications should all be included in the initial screening, proper evaluation, and diagnosis of hypertensive and diabetic patients.

***Keywords***; Diabetes, mellitus, Hypertension, Risk factors

**INTRODUCTION**

Diabetes mellitus is a chronic syndrome of glucose metabolism, lifelong abnormality caused as a result of deficient secretion of hormone (insulin) and or insulin action. Insulin defect may lead to metabolic syndrome such as diabetes with disruption of carbohydrate, protein and fat metabolism [7]. International Diabetes Federation (IDF) and global advocate of diabetes care (GADC) define diabetes as a raise in blood glucose level (hyperglycemia) and it’s associated with premature mortality. Diabetes mellitus is a metabolic syndrome resulting from hyperglycemia in the fasting state due to absolute or relative deficiency of insulin or defect in its receptors or other abnormalities [35]. The marked hyperglycemia associated with diabetes give rise to serious microvascular complications (retinopathy, nephropathy and neuropathy) and macrovascular complications (ischaemic heart disease, stroke and peripheral vascular disease) and damage of many body’s systems [15].

Almost all metabolic pathways, including those involving the metabolism of carbohydrates, proteins, lipids, minerals, and water, are significantly impacted by insulin deficiency or inefficiency. Consequently, metabolic instabilities arise, and chronic disturbances lead to structural and functional changes in the body's cells, frequently resulting in irreversible or permanent damage. This causes several kinds of complications associated with diabetes, such as biochemical, functional, symptomatic, and morphological changes [36].

The prevalence of diabetes mellitus was 8.8% worldwide in 2015, affecting 415 million people. By 2040, it was predicted that the prevalence would rise to 10.4%, or 642 million people, many of whom would reside in metropolitan areas

[17]. Data from the International Diabetes Federation (IDF) from 2017 indicates that approximately 425 million people worldwide have diabetes [28]. Furthermore, one in two persons with diabetes mellitus go undiagnosed; in Africa, the prevalence is significantly higher at 66.7%, which poses a significant risk to the disease's successful care [17]. Due to its increasing prevalence worldwide, diabetes mellitus has been deemed a 21st-century global emergency. As of 2015, 14.2 million people (3.8%) in Africa had diabetes mellitus, and by 2040, the prevalence is predicted to rise to 34.2 million (4.2%)[17, 8]. According to estimates, 77% of the world's diabetes mellitus epidemic in the 21st century would occur in developing nations due to factors like population increase, sedentary lifestyles, obesity, and the consumption of bad foods [7]. The prevalence of hypertension is expected to rise by 60% by 2025, reaching 1.56 billion people globally [5].

The prevalence of hypertension in Cameroon ranges from 5.7% in rural areas to 21.9% in semi-urban areas to 47.5% in urban areas, with a national average survey finding 31.0%. Although urban areas tend to have better blood pressure control than rural ones, reports of sufficient blood pressure control in urban areas have been as low as 2 to 27.5% for males and 38.7% for women[5]. Microvascular (retinopathy, nephropathy, and neuropathy) and macrovascular (atherosclerotic) consequences of diabetes are facilitated by hypertension. Because it affects target organs like the brain, heart, eye, and kidney through structural changes in the microcirculation brought on by oxidative stress, inflammation, or endothelial dysfunction, it is a significant risk factor for cardiovascular mortality and morbidity. Peripheral vascular disease, renal illness or failure, heart attack, stroke, eyesight loss, and sexual dysfunction are all consequences of uncontrolled hypertension [2].

It is widely acknowledged that diabetes mellitus and hypertension are two of the most significant risk factors for the development of cardiovascular disease and that they are more common in developing nations. They are also major global public health issues linked to higher rates of morbidity and mortality [36, 8, 28]. In 2012, non-communicable diseases (NCDs) caused 38 million fatalities, of which 28 million occurred in low- and middle-income countries. Of these deaths, cardiovascular diseases accounted for 48% (18.2 million) and diabetes mellitus for 3.5% (1.33 million) [8].

**Diabetes Mellitus**

Among all chronic diseases, diabetes, commonly known as diabetes mellitus, is the leading cause of death. Along with coronary artery disease, it is currently the fourth most prevalent cause of death. Numerous factors, including physiology, genetics, health practices, and social and economic status, influence diabetes mellitus, which is becoming more and more common at an alarming rate [38].

Either insufficient insulin production by the pancreas or inefficient insulin utilization by the body is the two main causes of diabetes. Consequently, hyperglycemia a condition in which the blood's glucose concentration rises occurs [6].

**Type 1 diabetes**

Insulin injections are essential for the survival of individuals with type 1 diabetes, which is characterized by a lack of insulin synthesis [38]. This kind of diabetes is also known as idiopathic or immune-mediated diabetes. The majority of type 1 diabetes is immune-related, with beta cell loss being an autoimmune attack mediated by T cells [26]. Although type I diabetes only makes up 5–10% of all cases, its incidence is rising globally and it has major short- and long-term effects. Type I denotes the pancreatic beta-cell loss process that may eventually result in diabetes mellitus, where "insulin is required for survival" to avoid the onset of ketoacidosis, coma, and death. A multidisciplinary health team is the ideal setting for managing Type I diabetes, which necessitates ongoing attention to numerous areas such as insulin administration, blood glucose monitoring, meal planning, and diabetes-related problem screening. The primary morbidity and mortality linked to Type I diabetes are caused by these consequences, which include microvascular and macrovascular disease [34].

**Type 2 diabetes**

The body uses insulin inefficiently, which results in type 2 diabetes. It frequently results from being overweight and not exercising. Since it makes up to 90% of all cases of diabetes worldwide, type 2 diabetes is the most prevalent kind of the disease. Type 2 diabetes was previously typically reported in adults over 40, but it is now more common in children worldwide. According to research, types 2 diabetes is more common in younger people who are overweight as a result of lifestyle changes that lead to unhealthy eating habits and a sedentary lifestyle.

Obesity, poor diet, physical inactivity, advancing age, family history of diabetes, ethnicity, and inadequate nutrition during pregnancy that impacts the developing child are just a few of the significant risk factors for the disease that have been identified. The relationships between a number of risk factors and the chance of developing type 2 diabetes have also been extensively studied. Body mass index (BMI), lipids, high blood pressure, smoking; low levels of education, dietary habits, and recently identified genes are some of these factors [6].

Type II diabetes is caused by either insufficient insulin production by the body or cell disregard for it. The body cannot utilize glucose as an energy source without insulin. Following a meal, the body converts all sugars and starches into glucose, the fundamental energy source for cells. Insulin transports blood sugar into the cells. Diabetes complications may result from the accumulation of glucose in the blood rather than in the cells [26, 38].

**Gestational diabetes**

Initially identified during pregnancy, hyperglycemia is a hallmark of gestational diabetes. Diabetes discovered during pregnancy is known as gestational diabetes [14]. Gestational diabetes is more likely to occur in women who are overweight, have a strong family history of the condition, or have previously experienced gestational diabetes. Gestational diabetes can harm the unborn child if left untreated. Both the mother and the infant have a higher lifetime risk of developing Type II diabetes [34].

**History and Discovery of Diabetes**

The cardinal features of a polyuric state were first described in an Egyptian papyrus called "Ebers papyrus" that dates back to 1550 BCE [30]. The term "diabetes" was first used by Aretaeus of Cappadocia, a Greek physician in the second century, who provided the first comprehensive clinical description of the disease, describing its symptoms as extreme thirst, "the melting down of flesh and limbs into urine," and short survival [10, 18]. The word diabetes comes from the Greek word for siphon, "diabaino," which also means "to go or run through," referring to the frequent micturition [24].

A Hindu document from 400–500 BCE contains the earliest written record of diabetic urine's sweetness. Thomas Willis, an Oxford professor, wrote a treatise titled "Diabetes, or the pissing evil" in 1675 after re-discovering the sweetness of urine and the taste of sugar or honey. Matthew Dobson, a Liverpool physician, published the first account of hyperglycemia in 1776. One of his patients had sweet-tasting urine and serum, he discovered [30, 18].

To treat diabetes, Scottish doctor John Rollo developed the first medical diet, which included blood pudding, rancid meat, and a concoction of milk and limewater. Additionally, he added the word "mellitus," which means honey in Greek, to "diabetes" to differentiate it from diabetes insipidus [31]. The pancreatic islet cells were discovered in 1869 by German medical student Paul Langerhans, but he was unable to describe their composition and purpose. The term "islets of Langerhans" was later applied to these cells (13, 18). A dog's pancreas was completely removed in 1889 by researchers Oskar Minkowski and Joseph von Mering of the University of Strasbourg, which resulted in diabetes [32, 18].

Frederick Banting, Charles Best, J.J.R. Macleod, and James Collip were the four researchers at the University of Toronto who made the discovery of insulin in 1921. In May 1922, Macleod was assigned to present the findings at a meeting in Washington, DC, where the researchers had given the extract the name "insulin." The term insulin was first proposed by Jean de Meyer in 1909, but none of them knew about it [33]. A 14-year-old boy was the first patient to receive insulin treatment in January 1922 [30]. In 1923, Macleod and Banting received the Nobel Prize. Macleod shared his prize with Collip, but Banting shared his with Best because he didn't like the Nobel committee's choice [30].

A chronic disease with major long-term complications was treated as a result of the discovery of insulin, which also saved many lives. The distinction between "insulin-sensitive" and "insulin-insensitive" types of diabetes mellitus was initially made in the 1930s thanks to research conducted by Sir Harold Himsworth in London. These days, they are frequently referred to as Type 1 (insulin-sensitive) and Type 2 (insulin-insensitive) diabetes [22]. In addition to lifestyle modifications, oral hypoglycemic medications were required as type 2 diabetes became more common. Biguanid and sulphonylurea were the first two classes of oral medications to be introduced to the market in the 1950s; other drug classes were subsequently introduced [30].

The United Nations established World Diabetes Day in December 2006 after recognizing diabetes as a global health concern. The United Nations designated November 14, Frederick Banting's birthday, as a day to be commemorated annually beginning in 2007 [37].

**Symptoms of Diabetes Mellitus**

Symptoms of diabetes mellitus can include blurred vision, excessive thirst, polyuria, and rapid weight loss. Additional symptoms include rashes, itching, fatigue, and recurrent infections. In its most severe forms, ketoacidosis or a non-ketotic hyperosmolar state may develop, which can result in coma, stupor, and, if treatment is not received, death. The long-term consequences of diabetes mellitus include the progressive emergence of certain complications, such as retinopathy, which can result in blindness, nephropathy, which can cause renal failure, and neuropathy, which increases the risk of foot ulcers, amputation, Charcot joints, and autonomic dysfunctional symptoms, including sexual dysfunction. Diabetes raises the risk of peripheral vascular, cerebrovascular, and cardiovascular disease [1].

**Diagnosis of Diabetes Mellitus**

When a patient exhibits the typical signs of hyperglycemia and has a random blood glucose level of 200 mg/dL (11.1 mmol/L) or greater, diabetes mellitus can be diagnosed with ease and confirmed again.

Blood glucose is measured using a fasting plasma glucose test in individuals who have not eaten for at least eight hours. The purpose of this test is to identify prediabetes and diabetes. After a person fasts for at least eight hours and consumes a glucose-containing beverage for two hours, their blood glucose is measured using an oral glucose tolerance test (OGTT). It is possible to diagnose prediabetes and diabetes with this test. For the diagnosis of diabetes, the FPG test is the recommended method due to its affordability and ease of use. Nevertheless, it might overlook certain cases of diabetes or prediabetes that the OGTT can detect. When performed in the morning, the FPG test is the most accurate. Diabetes, not prediabetes, is diagnosed with this test and a symptom assessment. Glycated hemoglobin (HbA1c) measurement is the most widely accepted method of diagnosing diabetes. When a test results in diabetes, a second test on a different day should be performed to confirm the diagnosis [34]. Diabetes should be diagnosed using the current WHO criteria, which are HbA1c 6.5% and fasting plasma glucose ≥ 7.0 mmol/l (126 mg/dl) or 2-hour plasma glucose ≥ 11.1 mmol/l (200 mg/dl).

**Glucose Regulation**

The body maintains blood glucose levels at a steady level through a process known as glucose homeostasis or regulation. In healthy people, the blood glucose level typically falls between 3.9 and 5.5 mmol/l, or 4 g of glucose. The rate at which glucose enters the bloodstream—primarily from the liver and the stomach after meals—and is absorbed by the peripheral tissues determines the level [18]. While other tissues can use different kinds of energy sources, the brain requires constant access to glucose in order to function normally. Endogenous glucose production is regulated by hormonal and neurological factors, which also determine the precise regulation of plasma glucose concentrations [27]. The regulation of blood glucose is influenced by hormones; glucagon raises blood glucose levels, while insulin lowers them. These hormones are made in the pancreatic islets of Langerhans. In β-cells, insulin is produced, while in α-cells, glucagon [18].

**Pathophysiology of Diabetes**

The foundation of understanding the pathophysiology of diabetes is an understanding of how insulin works and how carbohydrates are metabolized. Carbohydrates are converted into glucose molecules in the gut after food consumption. Blood glucose levels are raised when glucose is absorbed into the circulation. Insulin is secreted by the pancreatic beta cells in response to this increase in blood sugar. Most cells need insulin in order to let glucose in. When insulin binds to particular cellular receptors, it makes it easier for glucose to enter the cell, where it is used as fuel.

The pancreas secretes more insulin, which lowers blood glucose levels because of the subsequent cellular use of glucose. Insulin secretion then declines as glucose levels fall [1, 34]. Disease-related changes in insulin secretion and production will also affect blood glucose dynamics. Hyperglycemia will occur if insulin production is reduced because this will prevent glucose from entering cells. Insulin secreted by the pancreas but improperly utilized by target cells will have the same effect. Since a lot of glucose enters tissue cells and little stays in the bloodstream, elevated insulin secretion can result in hypoglycemia, or extremely low blood glucose levels [1].  Glycaemia may be influenced by several hormones. The only hormone that lowers blood glucose is insulin. Among their other effects, the counter-regulatory hormones glucagon, catecholamines, growth hormone, thyroid hormone, and glucocorticoids all raise blood glucose levels [27, 34].

**Risk Factors of Diabetes**

Diabetes is linked to preventable risk factors, such as obesity and a sedentary lifestyle. But there are also other uncontrollable risk factors that have a significant impact, like genetics and ethnicity. A family history of type I diabetes, a chronic, lifelong condition, is the main risk factor. One significant risk factor is having family members who have diabetes. Anyone with a mother, father, sister, or brother who has type I diabetes is advised to get screened for the disease by the American Diabetes Association (Standards of medical care in diabetes, 2007). A straightforward blood test can identify Type I diabetes.

Type I diabetes can also result from the pancreas's inability to produce insulin due to damage or illness. Type I diabetes can result from a variety of relatively uncommon infections and diseases that harm the pancreas [34].

Obesity, diet and physical inactivity, aging, insulin resistance, a family history of diabetes, genetic factors, and race and ethnicity are risk factors for type II diabetes. In terms of genetic factors, studies have indicated that specific gene variations increase the risk of diabetes.

Reduced insulin production, an elevated risk of obesity, and insulin sensitivity in bodily tissues can all be linked to these genes. However, in some ethnic groups, such as African Americans, Mexican Americans, American Indians, Native Hawaiians, and some Asian Americans, race and ethnicity are the cause of higher diabetes rates. Heart disease and diabetes are more common in the aforementioned groups. Higher rates of diabetes, obesity, and high blood pressure in these groups are partially to blame for this. Additionally, Type II diabetes is more common in African Americans than in other ethnic groups [9].

Diabetes is not exclusively determined by a person's ethnicity or genes, although these factors are risk factors. The number of people with diabetes has sharply increased due to dietary changes and a decrease in physical activity brought on by urbanization and rapid technological advancement. According to reports, a history of substance use is a significant factor linked to an earlier age at which Type II diabetes first appears. Recent studies conducted in the United States have also linked it to illicit drug use [20].Amphetamines, heroin, hallucinogens, and nonmedical inhalants are among the illicit substances that diabetic primary care patients frequently use, but marijuana and cocaine are the most commonly used drugs.

**Infections**

Diabetics are also more likely than healthy individuals to get infections. On the other hand, diabetic patients are more susceptible to a number of specific infections, some of which are nearly exclusive to them. The severity of subsequent infections is higher, and complications are more likely. Gram-negative septicemia, pyelonephritis, perinephric abscess, emphysematous cystitis, and renal papillary necrosis are among the severe infections that are more prevalent in individuals with diabetes mellitus. It is also more common for people with diabetes mellitus to get infections such as rhinocerebral mucormycosis, monilial skin infections, and pseudomonas "malignant" otitis externa. There are several immune-related factors that change in diabetics [1].

**Complications of Diabetes**

A systemic disease, diabetes affects the majority of the body's organs, particularly the heart, blood vessels, kidneys, eyes, nerves, and teeth. Chronic heart disease, renal failure, blindness, and non-traumatic lower limb amputation are all primarily caused by diabetes in high-income nations [15].

**Cardiovascular Diseases**

One of the main causes of atherosclerosis, which can result in a fatal myocardial infarction or cerebral stroke, is chronic hyperglycemia and dyslipidemia that affect the blood vessels. The leading cause of death for diabetics is cardiovascular disease [15].

**Diabetic Nephropathy**

Glomerular sclerosis and fibrosis can result from the metabolic and hemodynamic alterations linked to diabetes. Progressive albuminuria, elevated blood pressure, and even end-stage renal disease are symptoms of diabetic nephropathies. Twenty to thirty percent of patients with type 2 diabetes develop renal failure, particularly those who have had the disease for a longer period of time (typically ≥10 years) [15].

**Diabetic eye disease:** Diabetes complications can include a variety of eye issues, such as:

**Diabetic retinopath**y: Blindness or poor visions are caused by damage to the retina's tiny blood vessels.

**Cataract**: Cataract, or clouding of the eye lenses, is accelerated by diabetes.

**Glaucoma**: damage to the optic nerve, retinal detachment, and vision loss due to an increase in the pressure of vitreous fluid.

An estimated 248 million diabetics are visually impaired, and diabetes is thought to be the cause of 39 million cases of blindness globally [12].

**Diabetic Neuropathy**

Neuronal dysfunction results from diabetes's effects on the tiny blood vessels that supply the nerves, particularly in the peripheral nerves and the autonomic nervous system. Diabetic neuropathy can lead to erectile dysfunction in men, diabetic gastropathy, diabetic foot ulcers, and lower limb amputation. Moreover, it might conceal the signs of ischemic heart disease, leading to the clinically unclear silent angina [15].

**Hypertension**

Blood pressure exceeding 140/90 mm Hg is known as hypertension, and it is one of the most prevalent conditions that affect people. It is a prevalent condition in diabetes that affects 20–60% of patients, depending on age, ethnicity, and obesity. High blood pressure is a symptom of hypertension. It can be brought on by stress, nutrition, and heredity [4]. Hypertension is a significant public health concern due to the morbidity, mortality, and societal costs that are linked to it.

According to estimates, 20% of adults worldwide suffer from hypertension, and the prevalence rises sharply in those over 60. The most frequent cause of cardiovascular disease in Africa is hypertension, which is currently the subject of numerous reports. Malaria is now the leading cause of outpatient morbidity, with hypertension coming in second [11].

High blood pressure accounts for approximately 40% of all cardiovascular diseases and is the most important risk factor for the development of atherosclerotic coronary artery disease. Extensive atherosclerosis, advanced age, and the degree of obesity are associated with the incidence of hypertension in diabetes mellitus [29]. Long-term vascular complications of type 2 diabetes, including stroke, chronic renal failure, heart disease, peripheral vascular diseases, and death, are made more likely by hypertension. Nephropathy and essential hypertension are common causes of hypertension in diabetic patients, and obesity is especially common in type 2 diabetes mellitus. Generally speaking, hyperinsulinemia in diabetes is the cause of hypertension, which is accompanied by increases in sympathetic nervous system activity and/or renal sodium retention. By increasing insulin resistance, causing renal tubular reabsorption of water and Na+, increasing sympathetic nervous system activity, causing vascular smooth muscle cells to proliferate, and altering transmembrane cation transport, hyperinsulinemia causes hypertension [19, 29].

Essential, nephropathy-related, isolated systolic, and supine hypertension with orthostatic fall are among the types of hypertension associated with diabetes mellitus [4].

**Stages of Hypertension**

A consistent reading of 140/90 to 159/99 mmHg, or two or more consecutive readings, is considered stage one hypertension. Readouts of 160/100 mmHg or greater are indicative of stage two hypertension. Consistent measurements of 120–139/80–89 mmHg indicate pre-hypertension [4].

**Relationships between Diabetes and Hypertension**

People with diabetes are about twice as likely to have hypertension as people without the disease, and up to 70% of them have it [21].

Compared to people without diabetes, people with diabetes mellitus have a higher prevalence of hypertension. Heart disease, particularly hypertension and stroke, is the cause of death for 80% of diabetics. Diabetes patients have a higher prevalence of hypertension, which is linked to insulin resistance, dyslipidemia, and hyperglycemia [2]. By causing vascular inflammation, endothelial cell dysfunction, abnormalities of different cell types, such as platelets, and coagulation, these factors all compromise the blood vessel wall and cause atherosclerosis to develop and worsen [35].

These cause blood vessel narrowing and an increase in peripheral arterial resistance, which results in hypertension. Because insulin increases sympathetic nervous system activity and is known to encourage sodium retention, hyperinsulinemia and insulin resistance are factors that lead to high blood pressure [40].   
Inappropriate activation of the Renin-Angiotensin-Aldosterone System is linked to insulin resistance; once this system is triggered, several mechanisms that raise blood pressure are triggered.

For example, the Renin-Angiotensin-Aldosterone System stimulates the production of aldosterone, a hormone that causes the kidneys to retain water and salt, and vasoconstriction when angiotensin II is produced [16].

**Risk Factors of Hypertension and Diabetes**

**Body Mass** *–* Obesity raises the risk of high blood pressure and diabetes considerably.

**Diet** *–* Diets high in fat, processed sugars and salt are known to exacerbate organ problems that can result in high blood pressure and diabetes.

**Activity Level** – In addition to decreasing the effectiveness of insulin, which can result in diabetes, a lack of physical activity can also cause stiff blood vessels, which raises the risk of high blood pressure [4].

**Pathogenesis of Diabetic Kidney Disease**

Changes in kidney hemodynamics and hyperfiltration cause the glomerular filtration rate to rise early in diabetic nephropathy. Characteristic pathologic alterations that accompany the development of nephropathy include arteriosclerosis, glomerular basement membrane enlargement, extracellular matrix accumulation, and a certain amount of interstitial fibrosis. After 10 to 15 years of diabetes, microalbuminuria (20 to 200 ug/min) is the initial clinical sign of diabetic nephropathy. If untreated, this condition can develop into overt nephropathy and serve as a marker for cardiovascular disease. Thirty to forty percent of diabetic nephropathy patients may have albuminuria. Delays in diagnosis and inadequate blood pressure and plasma glucose management, however, lower the likelihood that microalbuminuria will improve and go away. However, hypertension and inadequate glycemic control are the main risk factors that accelerate the development of renal disease [25].

**Pathogenesis of Hypertension and Kidney Disease**

Kidney impairment is rare until the patient has had chronic hypertension for at least ten years, but essential hypertension is usually identified in individuals aged 25 to 45. Increased blood pressure causes arteriolar nephrosclerosis and impaired kidney function in these patients. If intrinsic kidney disease is accompanied by hypertension, this exacerbates the progressive decline in kidney function. There is proteinuria in progressive hypertensive nephrosclerosis, but it is typically less than 2 grams per day. Proteinuria, however, can reach nephrotic ranges (> 3.5 g/day) in patients with poorly controlled blood pressure or malignant hypertension [25].

**Management of Hypertension in Diabetes**

Managing blood pressure effectively is a crucial objective for individuals with diabetes. Patients who have both high blood pressure and diabetes are more likely to develop cardiovascular disease [4].

Finding the arterial blood pressure: Lowering the risk of cardiovascular disease and the morbidity and mortality that go along with it is the goal of diagnosing and treating high blood pressure. In order to identify high-risk individuals and to provide treatment and follow-up guidelines, it is necessary to classify blood pressure in adults [23].

At the time of diagnosis and at every planned diabetes visit, blood pressure should be taken as part of the screening and initial assessment of patients with diabetes. A thorough medical history, with particular attention to cardiovascular risk factors and the existence of diabetes complications, should be part of the initial evaluation of a patient with hypertension and diabetes. A thorough assessment of arterial circulation as well as height and weight should be part of the physical examination. Urinary albumin excretion, fasting lipid profile, serum creatinine, and electrolytes should all be part of the initial laboratory examination [4].

Management of behavior and nutrition: People with essential hypertension have shown success in lowering their blood pressure through moderate sodium restriction. Reducing weight can improve normal blood glucose and lipid levels and lower blood pressure regardless of sodium intake [19]. Systolic blood pressure has dropped by 10–12 mmHg when daily sodium intake is reduced to 10–20 mmol (230–460 mg) per day. To lower blood pressure, it's also advised to quit smoking and drink alcohol in moderation [4].

## Conclusion

Diabetes mellitus and its associated risk factors, along with their high prevalence worldwide, pose a threat to the burden on global health. Age, obesity, a family history of diabetes or hypertension, a sedentary lifestyle, excessive alcohol use, and smoking all of which are prevalent in developing nations are risk factors for both diseases. Reviewing the WHO NCD Global Action Plan 2013–2020 will help lessen the effects of hypertension and diabetes.

**Disclaimer (Artificial intelligence)**

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

# REFERENCES

1. Abubakar, L. Y. (2012). Prevalence and correlates of diabetes mellitus and glucose intolerance among adults in Kano metropolis. *A dissertation submitted to the national postgraduate medical college of Nigeria for the award of fellowship in faculty of internal medicine (fmcp) endocrinology, diabetes and metabolism.* Aminu Kano Teaching Hospital, Kano

2. Akalu, Y. & Belsti, Y. (2020). Hypertension and Its Associated Factors Among Type 2 Diabetes Mellitus Patients at Debre Tabor General Hospital, Northwest Ethiopia. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*. 13: 62–163

3. American Diabetes Association (2014). “Diagnosis and classification of diabetes mellitus,” *Diabetes Care*, 37 (1), pp. S81–S90.

4. Anwer, Z., Sharma,P.K., Garg, V.K., Kumar, N. & Kumari, A. (2011). Hypertension management in diabetic patients. *European Review for Medical and Pharmacological Sciences,* 11 (15): 1256-1263

5. Arrey, W.T., Dimala, C.A., Atashili, J., Mbuagbaw, J. & Monekosso, G.L. (2016). Hypertension, an Emerging Problem in Rural Cameroon: Prevalence, Risk Factors, and Control. *International Journal of Hypertension,* 16 (56); 391-466

6. Asiimwe, D., Mauti, G. O. & Kiconco, R. (2020). Prevalence and Risk Factors Associated with Type 2 Diabetes in Elderly Patients Aged 45-80 Years at Kanungu District, *Journal of Diabetes Research.* 51 (5) 21-46

7. Aynalem, S.B. & Zeleke, A. J. (2018).Prevalence of Diabetes Mellitus and Its Risk Factors among Individuals Aged 15 Years and Above in Mizan-Aman Town, Southwest Ethiopia, 2016: A Cross Sectional Study, *International Journal of Endocrinology* ID 9317987, 7 pages

8. Bello-Ovosi, B.O., Asuke, S., Abdulrahman, S.O., Ibrahim, M.S., Ovosi, J.O., Ogunsina, M.A. & Anumah, F.O. (2018). Prevalence and correlates of hypertension and diabetes mellitus in an urban community in North-Western Nigeria. *Pan African Medical Journal*. 29:97

9. Boulton, A.j., Vinik, A.I., Arezzo, J.C., Bril, V., Feldman, E. I., Freeman, R., Malik, R.A., Maser, R.E., Sosenko, J.M. & Ziegler, D. (2005) Diabetic neuropathies: a statement by the American Diabetes Association. *Diabetes Care* 28:956-962.

10. Christopoulou-Aletra, H. & Papavramidou, N. (2008). 'Diabetes' as described by Byzantine writers from the fourth to the ninth century AD: the Graeco-Roman influence. *Diabetologia*, 51 (5):892-6.

11. Cook-Huynh, M., Steckelberg, R.C., Seligman, K. & Kumar, N. (2012). Prevalence of Hypertension and Diabetes Mellitus in Adults from a Rural Community in Ghana. *Ethnicity & Disease.* 22, (3):347–352.

12. Courtright, P. & Lewallen, S. (2011), Global blindness 2010: what do we know? *Expert Review of Ophthalmology* 6 (3):385-392.

13. Davidson, J.K. (1999). Clinical diabetes mellitus: a problem-oriented approach. *New York: Thieme*

14. Egbe, T. O., Tsaku, S. E., Tchounzou, R. & Ngowe, N.M. (2018). Prevalence and risk factors of gestational diabetes mellitus in a population of pregnant women attending three health facilities in Limbe, Cameroon: a cross-sectional study. *The Pan African Medical Journal*, 31:195.

15. Elhendi, M.Y. (2015). Assessment of Type 2 Diabetes management practice: A study in public hospitals outpatient clinics, Khartoum and Gezira, Sudan. *Thesis submitted as a part of Master of Philosophy Degree in International Community Health, Oslo*

16. Grillo, A., Salvi, L., Coruzzi, P. & Paolo-Salv G.P. (2019). Sodium intake and hypertension. *Nutrients*. 11(1970):1–16.

17. International Diabetes Federation (IDF) (2015). Diabetes Atlas - *7th edition, Brussel, Belgium. International Diabetes Federation.*

18. Jansson, S. P. O. (2014). A Longitudinal Study of Diabetes Mellitus with Special Reference to Incidence and Prevalence, and to Determinants of Macrovascular Complications and Mortality. *Digital Comprehensive Summaries of Uppsala Dissertations from the Faculty of* *Medicine*, Uppsala: Acta Universitatis Upsaliensis 9 (55): 132.

19. Kadiri, S. & Onwubere, B.J.C. (2005). Guidelines for the management of Hypertension in Nigeria. Recommendation for health care providers prepared by the Nigeria Hypertension society and adopted at the consensus meeting held 28th April 2000 during the *8th Annual and scientific meeting of the society in Lagos and revised by the guidelines committee*. 2005, pg 1-4

20. Karlon, H. J., Mohsen, B. & Cherpitel, J.C. (2001). Alcohol, Tobacco, and Drug Use and the Onset of Type 2 Diabetes among Inner-city Minority Patients, *Journal of the American Board of Family Practice*, 14(6)430-436.

21. Katte, J., Dzudie, A., Sobngwi, E., Mbong, E., Fetse, G.T., Kouam, C.K. & Kengne, A.P (2014). Coincidence of diabetes mellitus and hypertension in a semi-urban Cameroonian population: a cross-sectional study, *Biomedical center Public Health*, 14(6) 96

22. Kim, S.H. (2011). Measurement of insulin action: a tribute to Sir Harold Himsworth*. Diabetic Medicine,* 28 (12):1487-93.

23. Kumar, A. (2000). Indian scenario–hypertension. In: *Das S Ed. Complications of Diabetes in Indian Secnario. Union Square Venture Ltd Mumbai*

24. Laios, K., Karamanou, M., Saridaki, Z. & Androutsos, G. (2012). Aretaeus of Cappadocia and the first description of diabetes. *Hormones (Athens)*, 11 (1):109-13.

25. Lea, J.P. & Nicholas, S.B (2002). Diabetes mellitus and hypertension: key risk factors for kidney disease. Journal of the National Medical Association, 94 (8): 8-15

26. Mahmud, R. (2012). Diabetes mellitus associated with Hypertension. *A thesis submitted to the department of pharmacy, East West University, Bangladesh, in partial fulfillment of the requirements for the degree of Bachelor of Pharmacy,* 1-70-060

27. Mealey, B., Oates, T. (2006). Diabetes Mellitus and Periodontal Diseases, *Journal of Periodontology Online*, 77(8)1289-1303.

28. Njonnou, S. R.S., Boombhi, J., Etoga, M. C. E., Timnou, A. T.,Jingi, A. M. *et al.,* (2020). Prevalence of Diabetes and Associated Risk Factors among a Group of Prisoners in the Yaoundé Central Prison. *Journal of Diabetes Research.* 20: 5016327, P8.

29. Onuoha, F.M. & Jideoma, E. (2017). Hypertension Amongst the Diabetic Patients Assessing Care in A Primary Care Setting in South-Eastern, Nigeria. *Journal of Diabetes and Clinical Studies*. 1(1): 001-006.

30. Pickup, J.C. & Williams, G. (2003). Diabetes. *Textbook of diabetes. Vol. 1. Oxford: Blackwell Science P7-10*

31. Poretsk, L. (2010). Principles of diabetes mellitus *2nd Ed. New York: Springer*.

32. Poulsen, J.E. (1982). Features of the history of diabetology. Copenhagen: *Munksgaard*.

33. Rosenfeld, L. (2002). Insulin: discovery and controversy. *Clinical Chemistry*, 48 (12):2270- 88.

34. Skiadopoulos, D. (2013). Diabetes mellitus. *Diploma Thesis Charles University in Prague Faculty of Pharmacy in Hradec Kralove Department of Biological and Medical Sciences*

35. Thiruvoipati, T. (2015). Peripheral artery disease in patients with diabetes: epidemiology, mechanisms, and outcomes. *World Journal of Diabetes*. 6 (7): 961.

36. Tsabang, N., Fongnzossie, E., Donfack, D., Yedjou, C.G., Tchounwou, P.B. *et al*. (2016) Comparative Study of Epidemiological and Anthropological Aspects of Diabetes and Hypertension in Cameroon. *Forest Resource* 5: 165.

37. United Nations General Assembly (2006). Resolution 61/225. World Diabetes Day United Nations*; (cited 2020, 20 November). Available from: http://www.un.org/Depts/dhl/resguide/r61.htm*.

38. Wefuan, F.K. (2013). The escalating diabetes epidemic: determinants of prevalence disparity between country income groups. *HEL-3950 Master’s thesis in Public Health, Faculty of health sciences Department of community medicine University of Tromsø, Norway.*

39. World population review (2020). Cameroon population 2020. Retrieved 1st November, 2020 *https://worldpop ulationreview.com/countries/cities/cameroon#sources*

40. Zhou, M., Wang, A. & Yu, H. (2014). Link between insulin resistance and hypertension: what is the evidence from evolutionary biology? *Diabetology Metabolic Syndrome*. 6(12):1–8.