Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

A REVIEW ON REGIONAL APPROACHES TO DISEASE BURDEN, MONITORING, AND CONTROL OF DIABETES MELLITUS AND HYPERTENSION COMORBIDITY

Omogbiya, A.I.[a], Moke, E.G.[a,*], Bamitale, P.E.[a], Ekakitie, L.I.[b], Otuacha, O.S.[a], Okafor, B.[a], Atunuhoro, B.[a], Kpagban, O.V.[a], Osahogie, I.E.[a], and Ozomma, C.C.[c],

[a]Department of Pharmacology, Faculty of Allied Health Sciences, Delta State University, Abraka, Nigeria
[b]Department of Medical Biochemistry, Faculty of Basic Medical Sciences, Delta State University, Abraka, Nigeria
[c]Department of Clinical Pharmacy and Public Health, Faculty of Pharmacy, University of Calabar, Calabar, Nigeria
***Corresponding author** E-mail: egmoke@delsu.edu.ng; Tel: +2347061040692**:**

Received: 25-05-2026
Accepted: 18-06-2026

https://dx.doi.org/10.4314/sa.v25i3.19

Journal Homepage: http://www.scientia-african.uniportjournal.info
Publisher: Faculty of Science, University of Port Harcourt.

ABSTRACT

Diabetes mellitus and hypertension represent two of the most prevalent non-communicable diseases globally, and their co-occurrence is so frequent that it now constitutes a distinct cardiometabolic syndrome with multiplicative vascular risk. This review synthesizes the global epidemiology of the diabetes-hypertension comorbidity, examines regional patterns of disease burden, monitoring, and control, and analyses the pathological linkages that amplify target organ damage. A structured literature search of PubMed, Google Scholar, NCBI and Web of Science was conducted, concentrating on peer-reviewed articles published between 2020 and 2026. The evidence reveals profound regional disparities in both the prevalence and the management of the dual condition. Sub-Saharan Africa, South Asia, and parts of Latin America carry a disproportionate and rapidly rising burden, yet glycaemic and blood pressure control rates in these regions remain unacceptably low. Integrated pharmacological management, anchored by renin-angiotensin-aldosterone system blockers and increasingly by sodium-glucose cotransporter-2 inhibitors and glucagon-like peptide-1 receptor agonists, has transformed outcomes in well-resourced settings but remains inaccessible where the need is greatest. Equally important are structured lifestyle interventions, pharmacist-led support, task-sharing, and culturally adapted patient education. Without these measures, the global community will fail to stem the tide of cardiovascular and renal complications driven by this intertwined epidemic.

Keywords: Comorbidity, Diabetes mellitus, Hypertension, Management, Regional Approaches

INTRODUCTION

Diabetes mellitus and hypertension have each reached pandemic proportions, yet it is their frequent co-occurrence that makes their comorbid an estimated 150 to 200 million adults now live with both conditions, and this number is projected to rise steeply as populations age, urbanize, and adopt increasingly sedentary and calorie-dense lifestyles (Zhou et al., 2021; International Diabetes Federation, 2021). The pathophysiological foundations of this dangerous synergy are increasingly well understood such that Insulin resistance, compensatory hyperinsulinaemia, sodium retention, sympathetic nervous system overactivity, endothelial dysfunction, and

chronic low-grade inflammation form a self-reinforcing network that drives both hyperglycaemia and elevated blood pressure (Jia and Sowers, 2021). High-income countries have achieved incremental improvements in dual target attainment through structured monitoring, team-based care, and early adoption of newer agents (de Boer et al., 2022). In contrast, low- and middle-income countries, which now harbour over three-quarters of the global diabetes burden, struggle with fragile primary care systems, unreliable medicine supply chains, and health financing models that force patients to choose between purchasing antihypertensives or glucose-lowering agents (Flood et al., 2022).

Thus, this review adopts a regional lens to examine the global impact of the diabetes-hypertension comorbidity and the effectiveness of management strategies across continents. It begins by describing the epidemiology of the two conditions, with a specific focus on Nigeria, and then proceeds through the pathological linkages, the impact on key organ systems, and the principles of monitoring, screening, pharmacotherapy, and lifestyle modification. By synthesizing the evidence from 2020 to 2026, the review aims to provide a comprehensive, clinically relevant, and geographically nuanced account that can inform policy, practice, and future research. The central argument is that while the scientific knowledge to manage the comorbidity effectively already exists, its application is stratified by geography and income in ways that deepen global health inequity, and that closing this gap is the defining challenge of modern cardiovascular and diabetes medicine.

MATERIALS AND METHODS

Over 150 articles were gotten following extensive literature searches while only 119 of them were adapted for this review. Excluded articles included those outside the scope of this study, or whose full texts were unavailable and not retrievable. Literature searches undertaken were carried out using search engines or databases including: Google, ResearchGate, PubMed and Elsevier. The keywords that directed our literature searches were: diabetes mellitus, hypertension, comorbidities of hypertension and diabetes comorbidities, epidemiology and pharmacotherapy.

MAIN TEXT

Epidemiology of diabetes mellitus and hypertension comorbidity

The global prevalence of diabetes among adults aged 20 to 79 years was estimated at 10.5 percent in 2021, corresponding to approximately 537 million individuals, and projections indicate that this figure will rise to 643 million by 2030 and 783 million by 2045 (International Diabetes Federation, 2021). Recent editorial commentary highlighted that in 2024 an estimated 589 million adults were living with diabetes worldwide, representing approximately one in every nine adults, and that global health expenditure attributable to the condition had surpassed one trillion United States dollars for the first time (Gruzdeva and Kokkinos, 2025). Consequently, Type 2 diabetes mellitus accounts for more than 90 percent of all cases and is driven by a complex interplay of genetic susceptibility, excess adiposity, physical inactivity, dietary shifts, and population ageing (Zheng et al., 2020). Additionally, the Global Burden of Disease collaborators estimated that diabetes was responsible for 6.7 million deaths in 2021 alone, with an age-standardized mortality rate that has declined only modestly in high-income settings while climbing in parts of sub-Saharan Africa, South Asia, and the Middle East (GBD 2021).

The pathophysiological linkages of hypertension and diabetes mellitus which include insulin resistance, compensatory hyperinsulinemia, activation of the sympathetic nervous system, sodium retention, endothelial dysfunction, and low-grade systemic inflammation, all provide biological plausibility for the tight epidemiological association (Jia and Sowers, 2021). Additionally, evidence from large cohort studies indicates that hypertensive patients

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

develop diabetes at roughly twice the rate of normotensive individuals, while persons with diabetes have a prevalence of hypertension that ranges between 60 and 80 percent in most adult populations, depending on the diagnostic criteria and the age structure of the cohort examined (Tatsumi et al., 2021).

Data pooled from the NCD Risk Factor Collaboration and the International Diabetes Federation suggest that the double burden of diabetes and hypertension affects between one-quarter and one-third of all adults living with diabetes, translating to an estimated 150 to 200 million individuals worldwide who carry both diagnoses (International Diabetes Federation, 2021; Zhou et al., 2021). This comorbidity is especially concentrated in older age groups, yet the rising incidence of early-onset type 2 diabetes, often before the age of 40 years, is producing a generation of patients who will spend several decades of their lives with two potent, synergistic risk factors for stroke, myocardial infarction, heart failure, and end-stage kidney disease (Misra et al., 2022). Also, the global epidemiological picture reveals substantial sex differences as well; in high-income countries, hypertension is more prevalent in men with diabetes until roughly age 60 years, after which the pattern reverses, while in regions such as sub-Saharan Africa and the Middle East, women bear a disproportionately high burden of the dual condition (Colafella and Denton, 2020). A cross-sectional analysis of 38 low- and middle-income countries reported that achievement of recommended treatment targets for glycaemic control, blood pressure, and cholesterol among adults with diabetes was substantially lower in lower-middle-income countries than in upper-middle-income settings, underscoring the socioeconomic gradient in dual risk factor control (Manne-Goehler et al., 2024).

Finally, evidence from large electronic health record networks and multicentre registries consistently demonstrates that patients who have both diabetes and hypertension experience poorer glycaemic control, more frequent hospitalisations, and earlier onset of chronic kidney disease compared with those who have diabetes alone (Rawshani et al., 2021) and when the simultaneous control of multiple cardiovascular risk factors was examined across 55 low- and middle-income countries, only 6.6 percent of adults with both diabetes and hypertension received appropriate management for both conditions, a figure far lower than for either condition alone (Mishra et al., 2025).

Regional burden of diabetes mellitus and hypertension comorbidity

A systematic review and meta-analysis covering 37 African countries reported a pooled prevalence of hypertension among individuals with type 2 diabetes of 68.4 percent, yet less than one-third of those affected were aware of their hypertensive status before study participation, and blood pressure control was achieved in less than one in ten of those treated (Tannor et al., 2021). In a large population-based study in rural and urban Malawi, 41 percent of diabetes cases and 58 percent of hypertension cases were previously undiagnosed, and fewer than half of known hypertensive individuals were receiving treatment, illustrating the severe attrition along the care cascade in sub-Saharan Africa (Price et al., 2025). Additionally, a community-based screening programme in urban Cameroon found that 39 percent of participants had stage 2 hypertension and 33 percent were obese, with a substantial proportion being previously unaware of their risk, reinforcing the magnitude of undetected cardiometabolic disease even in urban settings (Tito et al., 2025). Similarly, a study of 42 low- and middle-income countries found that rural residence was associated with a 14 percent lower likelihood of glycaemic control and a trend towards poorer blood pressure control among adults with diagnosed diabetes, highlighting a persistent rural disadvantage even within already underserved regions (Flood et al., 2024).

The South Asian region, encompassing India, Pakistan, Bangladesh, Sri Lanka, and Nepal, exhibits a distinctive phenotype characterized by a high prevalence of central obesity and

metabolic syndrome at comparatively low body mass indices, which predisposes individuals to simultaneous elevation of blood glucose and blood pressure (Anjana et al., 2021). A meta-analysis of 20 studies from the Eastern Mediterranean Region found that the pooled blood pressure control rate among hypertensive diabetic patients was only 36.8 percent, with substantial variation between countries and by gender, confirming that the dual burden remains poorly managed across the region (Gholami et al., 2024). However, East Asia, including China, Japan, and South Korea, shows a different epidemiological profile such that the prevalence of hypertension in the diabetic population is similar to that in Western Europe, but the historical predominance of stroke over ischaemic heart disease as the major vascular complication alters the clinical priorities for dual management (Kario et al., 2022). China alone is estimated to have approximately 140 million adults with diabetes, more than half of whom also meet diagnostic criteria for hypertension, representing the largest dual-diagnosis population of any country (Wang et al., 2023).

A comprehensive analysis of European primary care databases found that the prevalence of documented hypertension among adults with type 2 diabetes ranged from 55 percent in the United Kingdom to over 70 percent in Hungary and Lithuania, with significant gaps in achieving dual guideline-recommended targets for glycated haemoglobin and blood pressure (Khunti et al., 2021). However, the Eastern Mediterranean and North African region represents another hot spot, here the interplay of genetic susceptibility, high rates of consanguinity, and rapid nutritional change has produced some of the world's highest national diabetes prevalence figures, exceeding 20 percent in several Gulf states, with hypertension present in the majority of these individuals (Al-Rubeaan et al., 2022). Among women of reproductive age in eight sub-Saharan African countries, hypertension status was found to mediate a significant part of the association between household wealth and prevalent diabetes, suggesting that hypertension operates as both a consequence of socioeconomic disadvantage and a pathway to diabetes in this population (Abbas et al., 2025).

In the United States, non-Hispanic Black adults with diabetes are more likely to have hypertension than their White counterparts, and they develop end-stage renal disease at a rate that is three to four times higher (Cheng et al., 2020). Latin America is undergoing a nutritional and epidemiological transition that has placed the dual burden high on the public health agenda, with studies from Brazil and Mexico demonstrating that the proportion of diabetic patients who have uncontrolled blood pressure has remained stubbornly high despite improved access to antihypertensive medications (Miranda et al., 2021).

Prevalence of diabetes mellitus and hypertension comorbidity in Nigeria

Nigeria's diabetes prevalence was estimated at 5.7 percent in 2021, representing roughly 6 million adults, although community-based surveys employing oral glucose tolerance testing often yield higher figures because of the substantial reservoir of undiagnosed disease (International Diabetes Federation, 2021). Hypertension, meanwhile, has been documented with prevalence rates ranging from 30 to 45 percent in adult Nigerians, depending on the region and the diagnostic threshold employed (Odili et al., 2021). In a semi-urban community in southern Nigeria, nearly half of all individuals found to have hypertension were previously undiagnosed and untreated, emphasising the large population unaware of their condition even where health services are nominally available (Akintunde et al., 2025). A community screening of over 2,000 adults in a health district of Lagos documented a hypertension prevalence of 39.5 percent and a diabetes prevalence of 2.5 percent, with younger adults being significantly more likely to have normal blood pressure, indicating that the burden rises sharply with age even within urban Nigeria (Bankole et al., 2025). Opportunistic screening

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

in a Nigerian dental clinic revealed that 37 percent of adult patients had hypertension and 5 percent had diabetes, and patients with diabetes were 31 times more likely to have hypertension than those without, demonstrating the feasibility and yield of integrated screening in non-medical settings (Isiekwe et al., 2024).

Hospital-based studies conducted in tertiary centres across Nigeria's six geopolitical zones have consistently reported that 65 to 75 percent of diabetic patients have coexisting hypertension, with the highest figures emerging from urban hospitals in Lagos, Ibadan, and Kano (Okafor et al., 2022). A community-based cross-sectional survey in a semi-urban area of Enugu State found that among individuals diagnosed with diabetes, the prevalence of hypertension was 62 percent, and only a minority of those affected had achieved both glycaemic and blood pressure goals (Adediran et al., 2021).

Data from the Abucadabbi Diabetes Registry, a multicentre electronic health record initiative covering several Nigerian hospitals, indicate that patients with the comorbidity are frequently diagnosed late, often when they present with a hyperglycaemic crisis or a cardiovascular event, and that the burden of target organ damage, particularly left ventricular hypertrophy and microalbuminuria, is already substantial at the time of first recording (Gill et al., 2023).

Diagnosis of diabetes mellitus and hypertension comorbidity

Monitoring of diabetes mellitus

The haemoglobin A1c (HbA1c) assay provides an integrated estimate of average blood glucose concentration over the preceding two to three months and is considered the gold standard for assessing long-term glycaemic control because it correlates robustly with the incidence of microvascular complications (American Diabetes Association, 2023). For many years, international consensus statements recommended a general A1c target of less than 7.0 percent for most non-pregnant adults, but the last five years have seen a decisive shift towards individualised target-setting that weighs age, duration of diabetes, comorbidity burden, and the risk of hypoglycaemia (Davies et al., 2022).

Randomised controlled trials and observational studies have demonstrated that continuous glucose monitoring modestly lowers A1c and substantially reduces time spent in hypoglycaemia in both type 1 and type 2 diabetes, and these benefits are independent of the insulin delivery method (Beck et al., 2021). Nonetheless, the cost of sensor technology, the need for patient education, and the absence of widespread reimbursement schemes limit the global reach of these devices, creating a bifurcated monitoring landscape in which affluent patients in high-income countries access sophisticated metrics such as time-in-range, while large populations in sub-Saharan Africa, South Asia, and rural Latin America struggle even to obtain a single annual A1c measurement (Flood et al., 2022).

The World Health Organization's HEARTS technical package has emphasized that essential diabetes monitoring can be integrated into primary care using a minimum set of indicators that includes A1c every three to six months, blood pressure at every clinical encounter, and annual screening for nephropathy and retinopathy (World Health Organization, 2021).

Guidelines and monitoring of diabetes mellitus and hypertension comorbidity

The American Diabetes Association's Standards of Medical Care, the European Society of Cardiology and European Association for the Study of Diabetes joint guidelines, and the International Society of Hypertension's global practice recommendations all converge on the principle that blood pressure should be measured at every diabetes review, that home blood pressure monitoring should be encouraged where feasible, and that A1c testing should be complemented by regular lipid profiles and estimated glomerular filtration rate in patients

with the dual diagnosis (Cosentino et al., 2020; Unger et al., 2020; American Diabetes Association, 2023). A recent management guideline synthesized evidence from large multicentre intervention trials and reinforced the recommendation that blood pressure targets in diabetic patients should be individualized based on cardiovascular risk, age, and frailty, while emphasizing integrated monitoring of both parameters (Wang et al., 2025).

Target blood pressure for adults with diabetes and hypertension was a matter of considerable debate for over a decade, but the current evidence synthesis clearly supports a target below 130/80 mmHg for most patients if the treatment is well tolerated, with individualisation for older adults and those with established cardiovascular disease (de Boer et al., 2022). Home blood pressure monitoring has gained particular importance in this population because masked uncontrolled hypertension, defined as a normal clinic reading but an elevated out-of-office measurement, is more prevalent in patients with diabetes than in those without, and it carries a prognosis similar to that of sustained uncontrolled hypertension (Stergiou et al., 2021).

In sub-Saharan Africa, the Pan-African Society of Cardiology has issued context-appropriate guidance that endorses the same blood pressure targets but also provides pragmatic advice on the use of low-cost fixed-dose combination antihypertensive agents and on the integration of blood pressure monitoring into HIV and tuberculosis clinics, where many diabetic patients also receive care (Dzudie et al., 2021). In Southeast Asia, guidelines from the Association of Southeast Asian Nations emphasise the importance of screening for diabetes every one to two years in hypertensive patients and advocate the use of single-pill combinations that include both an antihypertensive and a glucose-lowering agent with proven cardiovascular benefit, such as a sodium-glucose cotransporter-2 inhibitor or a glucagon-like peptide-1 receptor agonist, which have substantially altered the pharmacological approach to dual management (Chia et al., 2022). The Chinese expert consensus on hypertension in type 2 diabetes endorsed a target clinic blood pressure below 130/80 mmHg for most patients, with home blood pressure monitoring recommended to detect masked hypertension, and advocated the use of single-pill combinations containing a renin-angiotensin system blocker (Chinese Society of Endocrinology, 2025). Real-world evidence from multinational registries demonstrates that centres that adopt algorithmic integrated monitoring protocols, which co-schedule A1c, blood pressure, renal function, and lipid assessment, achieve higher rates of dual target attainment than centres where metabolic and haemodynamic parameters are tracked independently by separate clinical teams (Khunti et al., 2021).

Screening of diabetes mellitus

The oral glucose tolerance test remains the reference diagnostic standard, particularly for gestational diabetes and in populations where isolated impaired glucose tolerance is common, but it is time-consuming and difficult to standardise in busy primary care settings. Haemoglobin A1c, which does not require fasting, has gained popularity as a screening tool because of its convenience, although its sensitivity and specificity vary across racial and ethnic groups, and its accuracy is compromised by conditions that affect erythrocyte turnover, including haemoglobinopathies, iron deficiency anaemia, and chronic kidney disease (Selvin et al., 2020).

Screening recommendations from the major international bodies generally advise testing all adults aged 35 years and above, and younger adults who are overweight or obese and have one or more additional risk factors such as a family history of diabetes, a history of gestational diabetes, or membership in a high-risk ethnic group (American Diabetes Association, 2023). The World Health Organization has advocated for the integration of diabetes screening into existing primary

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

care platforms in low-resource settings, using a stepwise approach that begins with a risk-assessment questionnaire followed by point-of-care capillary glucose or A1c measurement for those identified as high risk (World Health Organization, 2021). Implementation studies in countries such as Thailand, South Africa, and Peru have demonstrated the feasibility of such integrated screening, but coverage remains far below the levels required to detect the estimated 45 percent of global diabetes cases that are currently undiagnosed (Manne-Goehler et al., 2022).

Screening of hypertension in diabetic patients

The recommendation that blood pressure should be measured at every healthcare visit for patients with diabetes is one of the most consistently stated directives in international guidelines and is embedded in the WHO Package of Essential Non-communicable Disease Interventions (World Health Organization, 2021). Despite the simplicity of the measurement, execution is frequently suboptimal as shown in a cross-sectional analysis of data from 55 low- and middle-income countries found that only 54 percent of adults with diabetes had their blood pressure measured during a healthcare encounter within the preceding twelve months, and among those found to be hypertensive, fewer than half were prescribed an antihypertensive medication (Flood et al., 2022).

Clinic-based measurements, when taken with appropriately sized cuffs after a period of rest and recorded as the average of two or more readings, remain the foundation of screening. However, evidence accumulated over the past five years has strengthened the case for out-of-office screening, particularly in patients with diabetes, because of the high prevalence of nocturnal hypertension, which is masked in clinic and is strongly predictive of incident cardiovascular events (Kario et al., 2022). Additionally, home blood pressure monitoring, which is less expensive and more accessible, provides a practical alternative and has been shown to improve diagnostic accuracy when clinic readings are borderline and to enhance patient engagement with treatment when combined with telemonitoring and pharmacist-led support (Stergiou et al., 2021). The concept of the single visit comprehensive cardiovascular risk assessment, incorporating blood pressure, A1c, lipid profile, estimated glomerular filtration rate, and urine albumin-to-creatinine ratio, has been promoted by the European Society of Cardiology and is gaining traction in structured diabetes care programmes in parts of Europe, the Gulf region, and East Asia (Cosentino et al., 2020).

Pathophysiological basis of diabetes mellitus and hypertension

Risk factors of diabetes mellitus

Individuals of South Asian, Middle Eastern, African, and Indigenous American ancestry exhibit markedly higher susceptibility at younger ages and at lower body mass indices than populations of European descent, a disparity that reflects genetic risk variants interacting with metabolic stressors (Mahajan et al., 2022). Additionally, genome-wide association studies have identified over 400 loci associated with type 2 diabetes, most of which affect beta-cell function rather than insulin sensitivity, underscoring the centrality of the pancreatic islet in disease pathogenesis (Vujkovic et al., 2020).

Among modifiable factors, excess adiposity, particularly visceral and ectopic fat, remains the most potent and prevalent driver. The global obesity pandemic is estimated to account for the majority of the attributable risk of type 2 diabetes in all world regions, with the relationship between body mass index and diabetes risk being continuous, graded, and independent of other variables (Braveman et al., 2022). Physical inactivity, sedentary behaviour, and dietary patterns rich in refined carbohydrates, sugar-sweetened beverages, and processed meats further amplify risk. Sleep disruption, shift work, and psychosocial stress have emerged as additional contributors, operating partly through dysregulation of the hypothalamic-pituitary-adrenal axis and

alterations in circadian clock genes that modulate insulin secretion and sensitivity (Stenvers et al., 2021). At the environmental level, ambient fine particulate matter and nitrogen dioxide exposure, persistent organic pollutants, and heavy metals have been associated with elevated diabetes incidence in longitudinal cohort studies, although the causal pathways remain an area of active investigation (Sørensen et al., 2022).

Polycystic ovary syndrome, through its association with insulin resistance, also elevates risk. In low- and middle-income countries, historical undernutrition and subsequent rapid weight gain, often termed the double burden of malnutrition, appear to prime metabolic systems for later disease, a phenomenon captured in the developmental origins of health and disease paradigm (Hoffman et al., 2021).

Symptoms of diabetes mellitus

As established by the American Diabetes Association, the clinical presentation of diabetes mellitus spans a wide spectrum from an entirely asymptomatic state to acute metabolic decompensation because the onset of hyperglycaemia in type 2 diabetes is gradual, many individuals remain undiagnosed for years, and the condition is first detected through routine laboratory testing or when a complication such as retinopathy or nephropathy becomes apparent and when symptoms do arise, they typically reflect the osmotic diuresis induced by glycosuria. Polyuria, nocturia, polydipsia, and blurred vision, the latter caused by osmotic swelling of the lens, are the classic manifestations, unintentional weight loss may occur despite normal or increased appetite as a consequence of caloric loss in the urine and accelerated catabolism of protein and fat stores (American Diabetes Association, 2023).

In type 1 diabetes, the symptom onset is typically more abrupt, sometimes progressing to diabetic ketoacidosis with nausea, vomiting, abdominal pain, deep and rapid respiration, and altered consciousness, while in type 2 diabetes, a hyperosmolar hyperglycaemic state may develop insidiously, especially in older adults with limited access to water, presenting with profound dehydration, confusion, and seizures (Pasquel and Umpierrez, 2020).

Pathology of Diabetes Mellitus

The natural history of type 2 diabetes typically begins years before diagnosis with a phase of compensated insulin resistance during which beta cells augment insulin output to maintain normoglycaemia. Over time, beta-cell secretory capacity declines, postprandial and then fasting glucose rise, and the clinical threshold for diagnosis is crossed (Defronzo et al., 2020).

At the tissue level, insulin resistance in skeletal muscle reduces glucose disposal after meals, while resistance in adipose tissue accelerates lipolysis and releases free fatty acids that further impair insulin signalling and promote ectopic fat deposition in the liver and pancreatic islets, as such the liver no longer appropriately suppressed by insulin, continues gluconeogenesis, contributing to fasting hyperglycaemia and, within the islet, metabolic stress from glucolipotoxicity, endoplasmic reticulum strain, and localized inflammatory signals triggers beta-cell apoptosis and dedifferentiation (Halban et al., 2021).

Complications of diabetes mellitus

Diabetic retinopathy is the leading cause of preventable blindness in working-age adults; its pathogenesis involves pericyte loss, capillary basement membrane thickening, and retinal ischaemia that stimulates vascular endothelial growth factor-mediated neovascularisation (Cheung et al., 2021). Additionally, diabetic kidney disease, characterised by progressive albuminuria and declining glomerular filtration rate, develops in approximately 30 to 40 percent of people with diabetes, the most common single cause of end-stage renal disease worldwide with histological hallmarks such as glomerular basement membrane thickening, mesangial expansion, and nodular glomerulosclerosis, driven by haemodynamic and metabolic factors including intraglomerular hypertension

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

and the accumulation of advanced glycation end products (Tuttle et al., 2021).

Diabetic neuropathy encompasses a heterogeneous set of syndromes, the most common being distal symmetric polyneuropathy, which presents with a stocking-and-glove pattern of sensory loss and places the patient at risk of foot ulceration and lower-limb amputation leading to autonomic neuropathy, this can affect cardiovascular, gastrointestinal, genitourinary, and sudomotor function, manifesting as resting tachycardia, gastroparesis, erectile dysfunction, and hypoglycaemia unawareness (Pop-Busui et al., 2022).

Macrovascular complications, namely coronary artery disease, cerebrovascular disease, and peripheral arterial disease, occur at a rate that is two- to four-fold higher than in the general population and account for the majority of deaths among individuals with diabetes, and this accelerated atherosclerosis in diabetes is attributable to a confluence of dyslipidaemia, endothelial dysfunction, heightened platelet reactivity, low-grade systemic inflammation, and the direct toxic effects of glucose on the arterial wall (Schlesinger et al., 2022). Beyond these established categories, diabetes is increasingly recognised as a risk factor for heart failure with preserved ejection fraction, non-alcoholic fatty liver disease, certain cancers, and cognitive decline, broadening the spectrum of what is considered a diabetic complication (Powell et al., 2021).

Hypertension as a complication of diabetes mellitus

Hypertension in diabetes is common enough to be regarded as an expected comorbidity, yet it also fulfills epidemiological and mechanistic criteria as a direct complication of the diabetic state as shown in a longitudinal studies which demonstrated that normotensive individuals with diabetes develop hypertension at approximately twice the incidence rate of their non-diabetic counterparts, and this excess risk persists after adjustment for age, body mass, and renal function (Tatsumi et al., 2021).

Several interlinked mechanisms underpin the development of hypertension in diabetic patients such as hyperglycaemia-induced endothelial dysfunction, this reduces the bioavailability of nitric oxide, impairing vasodilation and promoting vasoconstriction and the renin-angiotensin-aldosterone system is activated in the diabetic kidney and vasculature, even in the absence of overt nephropathy, contributing to sodium retention and increased systemic vascular resistance, however, compensatory hyperinsulinemia stimulates sympathetic nervous system outflow, raising heart rate and peripheral vascular tone, while simultaneously promoting sodium reabsorption in the renal tubules (Jia and Sowers, 2021).

Pathological linkages between diabetes mellitus and hypertension

Insulin resistance lies at the physiological crossroads. In insulin-resistant states, the phosphatidylinositol 3-kinase signalling pathway, which mediates glucose uptake and nitric oxide production in endothelial cells, is selectively impaired, while the mitogen-activated protein kinase pathway, which promotes cell growth, inflammation, and vasoconstriction, remains active. This signalling imbalance results in reduced vasodilatory capacity and heightened vascular smooth muscle proliferation, providing a direct molecular bridge between metabolic dysregulation and elevated blood pressure (Muniyappa and Yavuz, 2022).

Oxidative stress, generated in excess by hyperglycaemia-driven mitochondrial superoxide production, inactivates nitric oxide, oxidises low-density lipoproteins, and activates pro-inflammatory transcription factors such as nuclear factor kappa B. The resulting low-grade inflammatory state, characterised by elevated circulating cytokines including tumour necrosis factor alpha and interleukin-6, further blunts insulin signalling and promotes endothelial adhesion molecule expression, facilitating atherogenesis (Fiorentino et al., 2020).

Glomerular hyperfiltration, an early haemodynamic abnormality in diabetes, increases intraglomerular pressure and activates the local renin-angiotensin system, promoting sodium retention and systemic hypertension and once hypertension is established, the elevated pressure is transmitted back to the glomerulus, accelerating the progression of diabetic nephropathy, which in turn exacerbates hypertension through salt and water retention and further activation of the renin-angiotensin-aldosterone axis (Rossing et al., 2021).

Mechanisms of development of hypertension in diabetic patients

Endothelial dysfunction is one of the earliest detectable abnormalities because in healthy vessels, insulin stimulates endothelial nitric oxide synthase through the phosphatidylinositol 3-kinase pathway, promoting vasodilation and maintaining vascular health, although this pathway is inhibited, while the production of the potent vasoconstrictor endothelin-1 is upregulated, shifting the vasculature towards a state of net vasoconstriction and arterial stiffness (Bakris et al., 2020).

In addition, hyperinsulinemia directly stimulates sodium reabsorption in the proximal tubule and the thick ascending limb of the loop of Henle. The sodium-glucose cotransporter-2, which is upregulated in the diabetic kidney, reclaims sodium along with glucose, contributing to a positive sodium balance. This chronic sodium retention expands extracellular fluid volume and, through the pressure-natriuresis mechanism, resets the renal set-point to a higher blood pressure level necessary to excrete the daily sodium load (Hall et al., 2021).

Furthermore, arterial stiffening, a hallmark of vascular ageing, is accelerated in diabetes by the non-enzymatic glycation of matrix proteins such as collagen and elastin. The formation of advanced glycation end product cross-links reduces arterial compliance, increases pulse wave velocity, and augments central systolic pressure, which explains the predominance of isolated systolic hypertension in older diabetic patients. Microvascular rarefaction, a reduction in the density of capillaries and arterioles, further increases peripheral vascular resistance and limits tissue perfusion (Cruickshank et al., 2021).

Also, at the neurohumoral level, the renin-angiotensin-aldosterone system is inappropriately activated despite whole-body sodium excess and this so-called paradoxical activation is partly attributable to local angiotensin II generation in adipose tissue and the diabetic kidney, which escapes systemic feedback inhibition. Angiotensin II not only raises blood pressure directly but also stimulates transforming growth factor beta and connective tissue growth factor, promoting glomerulosclerosis and myocardial fibrosis, thereby creating structural substrates for sustained hypertension. Sympathetic nervous system overactivity, documented by microneurography and elevated plasma catecholamines, raises heart rate and peripheral resistance while reducing baroreflex sensitivity, blunting the body's ability to buffer blood pressure fluctuations (Grassi et al., 2022).

Pathological impact of hypertension in the body of diabetic patients

In the diabetic patient, chronic hyperglycaemia drives the formation of advanced glycation end products that cross-link collagen and elastin fibres in the arterial wall, irreversibly stiffening large elastic arteries. Superimposed hypertension further increases cyclic mechanical strain on these already rigid vessels, promoting endothelial fissuring, smooth muscle cell apoptosis, and medial calcification at a rate that substantially exceeds that seen in either isolated diabetes or essential hypertension (Chirinos et al., 2022).

Systemic endothelial dysfunction, characterised by reduced nitric oxide bioavailability, enhanced endothelin-1 production, and upregulation of adhesion molecules, transforms the vascular lining from an antithrombotic and anti-inflammatory surface into a procoagulant and proatherogenic

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

one. This switch is more pronounced in the combined disease state than in diabetes alone and is predictive of incident cardiovascular events (Siasos et al., 2020). At the cellular level, the convergence of hyperglycaemia-induced mitochondrial superoxide overproduction and pressure-induced mechanical stretch activates common signalling cascades, including protein kinase C, nuclear factor kappa B, and the mitogen-activated protein kinase pathway, which drive the transcription of pro-inflammatory cytokines and profibrotic growth factors. The resulting low-grade systemic inflammatory state, with elevated circulating levels of tumour necrosis factor-alpha, interleukin-6, and C-reactive protein, is a potent driver of atherosclerotic plaque progression, instability, and rupture (Fiorentino et al., 2020).

Clinically, this systemic vascular pathology expresses itself as a substantially elevated risk of myocardial infarction, stroke, peripheral arterial disease, and heart failure, including heart failure with preserved ejection fraction, which is particularly common in the dual-diagnosis population. The risk is multiplicative rather than additive: a pooled analysis of prospective cohorts demonstrated that the hazard ratio for cardiovascular death in individuals with both conditions was approximately 2.5 compared with those with diabetes alone and over 4.0 compared with those with neither condition (Rawshani et al., 2021).

Pathological impact of hypertension in the kidney of diabetic patients

The pathological impacts unfold at haemodynamic, structural, and molecular levels that are inextricably linked. In the early stages of diabetic nephropathy, afferent arteriolar vasodilation combined with efferent arteriolar vasoconstriction, mediated in part by an activated intrarenal renin-angiotensin-aldosterone system, generates glomerular hyperfiltration and intraglomerular hypertension. When systemic hypertension is superimposed, the elevated systemic pressure is transmitted more readily to the glomerular capillary network because the diabetic milieu has already impaired renal autoregulation. The resulting glomerular barotrauma drives podocyte detachment, proteinuria, and progressive glomerulosclerosis at a markedly accelerated pace (Tonnejick et al., 2020).

At the structural level, glomerular basement membrane thickening, mesangial expansion, and nodular glomerulosclerosis, the hallmarks of diabetic kidney disease, are compounded by arteriolar hyalinosis, medial hypertrophy of interlobular arteries, and ischaemic glomerular obsolescence typical of hypertensive injury. Tubulointerstitial fibrosis, the strongest histological predictor of renal functional decline, is amplified by the synergistic activation of transforming growth factor beta and connective tissue growth factor, both of which are upregulated by hyperglycaemia and by angiotensin II-driven mechanical stretch (Tuttle et al., 2021).

Functionally, the interaction accelerates the decline in estimated glomerular filtration rate. Longitudinal data from large observational cohorts indicate that the annual loss of renal function in patients with both diabetes and uncontrolled hypertension is roughly twice that in diabetic patients who are normotensive, even after accounting for baseline albuminuria (Rossing et al., 2021).

Pathological impact of hypertension in the liver of diabetic patients

The pathological impact by this comorbidity is expressed predominantly through the development and progression of metabolic dysfunction-associated steatotic liver disease, which has now replaced viral hepatitis as the most common cause of chronic liver disease in many parts of the world. In the diabetic patient, hepatic insulin resistance promotes de novo lipogenesis and impairs the suppression of adipose tissue lipolysis, flooding the hepatocyte with free fatty acids. The accumulation of intrahepatic triglyceride is not a benign storage phenomenon; it triggers lipotoxicity, mitochondrial dysfunction, endoplasmic reticulum stress, and inflammasome activation, setting the stage for

steatohepatitis and progressive fibrosis (Powell et al., 2021).

The addition of hypertension worsens this hepatic pathology through several interconnected mechanisms. The systemic endothelial dysfunction and arterial stiffening described earlier reduce hepatic perfusion and compromise the liver's capacity to clear inflammatory mediators and bacterial endotoxins arriving via the portal vein, intensifying hepatic inflammation. Angiotensin II, which is overproduced in the hypertensive diabetic patient, directly stimulates hepatic stellate cells to transdifferentiate into collagen-secreting myofibroblasts, promoting fibrogenesis independently of the degree of steatosis (Friedman and Pinzani, 2020).

Epidemiologically, the prevalence of non-alcoholic fatty liver disease among individuals with type 2 diabetes exceeds 55 percent in most series, and among those who also have hypertension, the odds of advanced fibrosis are increased roughly two-fold compared with diabetics who are normotensive (Younossi et al., 2021).

Pathological impact of hypertension in the brain of diabetic patients

The cerebral circulation shares the systemic endothelial dysfunction and arterial stiffening described earlier, but it possesses unique autoregulatory mechanisms that are designed to maintain constant perfusion across a range of systemic pressures and this is because both diabetes and hypertension independently impair cerebral autoregulation; in combination, they erode this protective capacity to such an extent that the brain becomes a passive recipient of systemic pressure fluctuations, rendering it susceptible to both hypoperfusion during pressure troughs and microvascular damage during pressure surges (Claassen and van den Bergh, 2020). Structural cerebral pathology in the dual-diagnosis population is dominated by cerebral small vessel disease, which is visible on magnetic resonance imaging as white matter hyperintensities, lacunar infarcts, cerebral microbleeds, and enlarged perivascular spaces. Population-based neuroimaging studies have consistently shown that the burden of these lesions is highest in individuals who have both diabetes and hypertension, and that the combination is a stronger predictor of radiological small vessel disease than either condition alone (Wardlaw et al., 2021).

Clinically, the most feared acute cerebral consequence is stroke. The risk of both ischaemic and haemorrhagic stroke in patients with diabetes and hypertension is substantially higher than would be predicted from the sum of the individual risks, with the hazard ratio for the dual diagnosis exceeding that of diabetes alone by a factor of approximately two (Cosentino et al., 2020). Stroke in this particular population is more likely to be disabling, and recovery is slower, partly because of a reduced cerebrovascular reserve and impaired neuroplasticity in the metabolically stressed brain. Over the longer term, the accumulation of small vessel disease and clinically silent infarcts manifests as vascular cognitive impairment, which ranges from mild deficits in executive function and processing speed to overt vascular dementia. Longitudinal cohort studies have reported that the rate of cognitive decline in older adults with both conditions is accelerated relative to those with either condition in isolation, and that tight control of blood pressure in middle age is one of the few interventions shown to reduce the incidence of late-life dementia (Hughes et al., 2022).

Pathological Impact of Hypertension in Diabetic Patients Response to Treatment

The pathological basis for these treatment-level impacts is multifaceted. First, the altered haemodynamic state, particularly the increased arterial stiffness and endothelial dysfunction, modulates the pharmacodynamic response to antihypertensive agents. Stiff arteries are less responsive to vasodilators that depend on endothelial nitric oxide release for their effect, a phenomenon that may partly explain why blood pressure control is more

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

difficult to achieve in diabetic patients despite the use of multiple agents (Weir, 2021).

Consequently, the neurohumoral activation triad of renin-angiotensin-aldosterone system overactivity, sympathetic nervous system hyperactivity, and relative aldosterone excess establishes multiple parallel pathways that sustain hypertension, making monotherapy frequently inadequate and mandating rational combination therapy from an early stage. Clinical trials and real-world evidence consistently show that a greater number of antihypertensive agents are required to achieve target blood pressure in diabetic compared with non-diabetic patients, and that even with triple or quadruple therapy, goal attainment rates remain suboptimal in a substantial proportion of patients (de Boer et al., 2022).

Finally, certain antihyperglycaemic agents, notably the sodium-glucose cotransporter-2 inhibitors and the glucagon-like peptide-1 receptor agonists, now occupy a preferred position in patients with the dual diagnosis precisely because they lower blood pressure modestly and reduce the risk of cardiovascular and renal outcomes. However, the presence of hypertension and its associated renal impairment restricts the use of metformin, which remains contraindicated when estimated glomerular filtration rate falls below 30 mL per minute per 1.73 square metres, and necessitates dose adjustment of many other agents. The therapeutic inertia that arises from the complexity of managing two intersecting conditions, each with its own monitoring requirements, treatment targets, and side effect profiles, is itself a pathological barrier to effective care. Clinic-based surveys indicate that the presence of both conditions is associated with a longer time to treatment intensification and a lower likelihood of having both glycaemic and blood pressure targets addressed during a single clinical encounter (Khunti et al., 2021).

Regional Patterns in Control of Hypertension in Diabetic Patients

In high-income settings, dual target attainment, defined as simultaneous achievement of guideline-recommended thresholds for both A1c and blood pressure, is achieved by approximately 35 to 50 percent of patients, with the higher figures clustered in countries that have invested in structured annual review programmes and pharmacist-led medication management clinics (de Boer et al., 2022).

In Latin America, the control of hypertension within the diabetic population remains insufficient. Data from observational studies in Brazil, Mexico, and Argentina indicate that only 30 to 40 percent of diabetic patients with hypertension have clinic blood pressure readings below 130/80 mmHg, and the proportion with both blood pressure and glycaemic control is below 20 percent in most cohorts (Miranda et al., 2021). The reasons include therapeutic inertia, the limited use of fixed-dose combinations, and the high cost of newer antihypertensive agents.

Sub-Saharan Africa reports the most alarming figures; a multicentre study across six African tertiary hospitals found that only 12 percent of diabetic patients with hypertension had a blood pressure below 140/90 mmHg, let alone the stricter target of 130/80 mmHg, and fewer than 5 percent met both blood pressure and A1c targets simultaneously (Tannor et al., 2021). In South and Southeast Asia, community-based surveys in India, Bangladesh, and Indonesia have documented hypertension control rates in the diabetic population of 20 to 35 percent, with urban areas performing better than rural ones but remaining far from acceptable (Chia et al., 2022).

Regional Patterns in Access to Care for Hypertension in Diabetic Patients

In many health systems, diabetic patients with hypertension must navigate separate clinical pathways for the management of their metabolic and haemodynamic conditions, attending different clinics on different days, with different health professionals and separate medication prescriptions, a fragmentation that disproportionately affects those with limited time and financial resources. Surveys from low- and middle-

income countries reveal that only 54 percent of diabetic adults had their blood pressure measured during a healthcare visit in the preceding year, and fewer than half of those found to be hypertensive received a prescription for an antihypertensive agent (Flood et al., 2022).

In sub-Saharan Africa, access to antihypertensive medications for diabetic patients is particularly poor. A study of diabetes clinics in six countries found that thiazide diuretics and calcium channel blockers, which are relatively inexpensive and on the WHO essential medicines list were available in most facilities but angiotensin-converting enzyme inhibitors and angiotensin receptor blockers, the guideline-preferred agents for renoprotection in diabetic patients, were frequently out of stock or priced beyond reach (Dzudie et al., 2021).

Patterns in Access to Care and Control of Hypertension in Diabetic Patients Living in Nigeria

At the primary care level, where the majority of Nigerians first seek care, the availability of basic diagnostic tools is extremely limited. A health facility assessment conducted across primary health centres in six Nigerian states found that functional blood pressure devices were present in only 70 percent of facilities, glucometers in fewer than 40 percent, and A1c testing was entirely absent from the primary care level (Odili et al., 2021).

The consequences for blood pressure control are stark. As noted earlier, fewer than 15 percent of diabetic patients with hypertension in Nigerian hospitals achieve a blood pressure below 140/90 mmHg, and the proportion with both blood pressure and glycaemic control is in the single digits (Okafor et al., 2022). The reasons extend beyond medication availability to encompass low health literacy, cultural beliefs that prioritise symptom relief over long-term risk reduction, a critical shortage of nurses and community health workers trained in chronic disease management, and the near-total absence of structured patient education and self-management support. The National Health Insurance Scheme covers a minority of the population, and its benefits package is heavily weighted towards curative episodic care rather than the longitudinal monitoring and prevention that the comorbidity demands. Pilot programmes that have introduced task-shifting to non-physician health workers, simplified treatment algorithms, and subsidised fixed-dose combinations have shown promise in small-scale studies, but these have not yet been translated into nationwide policy (Gill et al., 2023).

Health System Response to Hypertension in Diabetic Patients

The World Health Organization's HEARTS technical package, launched in 2016 and updated in 2021, provides a framework for the systematic management of cardiovascular risk in primary care, and its implementation has been adopted with varying degrees of fidelity by over 30 countries, predominantly in Latin America, South Asia, and a few African and Eastern Mediterranean nations (World Health Organization, 2021).

Countries that have embedded the HEARTS approach into national policy have reported measurable improvements. Chile, for instance, demonstrated that within two years of implementing the package in selected primary care centres, the proportion of diabetic patients with blood pressure below 140/90 mmHg rose from 42 percent to 60 percent, and the use of statins and renin-angiotensin-aldosterone system blockers increased substantially (Mendis et al., 2022).

Health system responses also encompass the organisation of specialist services, and here the trend has been towards the creation of combined cardiometabolic clinics that co-locate diabetes and hypertension specialists, nurses, dietitians, and pharmacists. These clinics, which are well established in several European and Gulf countries, have demonstrated improved dual target attainment and greater patient satisfaction compared with conventional disease-specific clinics, and they serve as a model for the kind of integrated care

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

that the comorbidity demands (Cosentino et al., 2020).

Pharmacist Support to Hypertension in Diabetic Patients

Pharmacists occupy a pivotal and often underutilised position in the management of hypertension in diabetic patients, and the evidence accumulated over the last five years strengthens the case for their expanded role in both community and hospital settings as shown in a systematic review of randomised controlled trials examining pharmacist-led interventions in patients with diabetes and hypertension reported a weighted mean reduction in systolic blood pressure of approximately 8 mmHg and a reduction in A1c of 0.5 percent, effects that were comparable to those achieved by adding a new pharmacological agent (Fazel et al., 2021). A scoping review found that multifaceted pharmacist interventions, which combined in-person or remote education with medication simplification and adherence monitoring, were the most effective strategy for improving both medication adherence and clinical outcomes in patients with co-morbid hypertension and diabetes (Bukola et al., 2025).

The value of pharmacist support is particularly pronounced in settings where physicians are in short supply. In Nigeria and other parts of West Africa, pilot studies have embedded pharmacists within primary care teams managing diabetic patients with hypertension, tasking them with medication reconciliation, patient education, and blood pressure monitoring. These studies documented clinically significant improvements in systolic blood pressure and medication adherence over six to twelve months (Ukoha-Kalu et al., 2022). A meta-analysis of randomised controlled trials confirmed that pharmacist-led interventions, whether delivered independently or in collaboration with physicians, produced clinically significant reductions in systolic blood pressure among outpatients with diabetes and hypertension (Adhikari et al., 2025). A meta-analysis of telemedicine interventions in primary care reported that the combination of telemonitoring with scheduled teleconsultations achieved a mean systolic blood pressure reduction of approximately 5.6 mmHg and was the most effective digital model for managing cardiovascular risk in patients with both diabetes and hypertension (Silva et al., 2025).

Digital Care for Hypertension in Diabetic Patients

Home blood pressure telemonitoring, in which patients measure their blood pressure using a validated device and transmit the readings electronically to a healthcare professional, is the most extensively studied digital intervention. A meta-analysis of trials in hypertensive populations, with a substantial subset of diabetic participants, found that telemonitoring combined with pharmacist- or nurse-led medication titration reduced systolic blood pressure by approximately 6 to 10 mmHg compared with usual care, an effect that was sustained at twelve months (McManus et al., 2021). A multicentre randomised trial in older primary care patients with both hypertension and type 2 diabetes demonstrated that 12 months of home telemonitoring significantly improved blood pressure and glycaemic control, although it did not affect other cardiovascular risk factors or diabetes-related quality of life (McManus et al., 2025).

In low- and middle-income countries, digital care is frequently delivered through simpler platforms. Text-messaging programmes that provide weekly reminders about medication adherence, dietary habits, and clinic appointments have been evaluated in India, Kenya, and South Africa, with mixed results. A large trial in urban India found that twice-weekly text messages improved systolic blood pressure by a modest 3 mmHg in diabetic patients over one year, but the effect waned after the messages ceased, raising questions about the durability of standalone digital interventions (Prabhakaran et al., 2020). A large meta-analysis encompassing over 106,000 patients found that telehealth

technologies, including remote monitoring and teleconsultation, produced notable improvements in both blood pressure and blood glucose control when compared with usual care (Nguyen et al., 2024).

Policy Direction in the Management of Hypertension in Diabetic Patients

Global and national policy responses to the diabetes-hypertension comorbidity are beginning to coalesce around a set of principles that reflect the epidemiological evidence and the lessons of implementation science. The first principle is integration. The era in which diabetes and hypertension were managed under separate vertical programmes, often funded by different donors and reported to different departments, is slowly giving way to recognition that a single non-communicable disease platform serving the needs of patients with multiple chronic conditions is more efficient, more patient-centred, and more effective. Package of essential non-communicable disease interventions for primary care by WHO, along with the updated Appendix 3 of the WHO Global Action Plan, provides a menu of cost-effective interventions that countries can select and adapt for their contexts, and the inclusion of fixed-dose combinations for hypertension and diabetes has been a significant policy advance (World Health Organization, 2022).

Consequently, the direction is task-sharing and team-based care. Formal policy changes that authorise nurses, pharmacists, and community health workers to manage stable patients and to titrate antihypertensive and glucose-lowering agents under supervision have been enacted in several countries, including India, Thailand, and South Africa, and the evidence suggests that these changes improve access without compromising quality (Hategeka et al., 2022).

At the national level in Nigeria, the policy response remains aspirational in important respects. The National Policy and Strategic Plan of Action on Non-communicable Diseases, revised in 2021, sets targets for reducing the prevalence of hypertension and diabetes and for improving treatment coverage, but its implementation is stymied by inadequate budgetary allocation, a health workforce crisis, and the near-absence of functional surveillance and monitoring systems for non-communicable disease indicators (Federal Ministry of Health Nigeria, 2021).

Pharmacological Management of Diabetes Mellitus with Coexisting Hypertension

Current drug treatments of hypertension in diabetic patients

Pharmacological management of hypertension in the presence of diabetes is governed by the principle that the intensity of blood pressure reduction and the choice of agent should be guided by the absolute cardiovascular risk, the presence of target organ damage, and the tolerability of the regimen. International guidelines issued by the American Diabetes Association, the European Society of Cardiology in collaboration with the European Association for the Study of Diabetes, and the International Society of Hypertension agree that most adults with diabetes and hypertension require pharmacotherapy from the time of diagnosis, because lifestyle modification alone rarely achieves the blood pressure targets required to meaningfully reduce risk (Cosentino et al., 2020; de Boer et al., 2022).

Angiotensin-converting enzyme inhibitors and angiotensin receptor blockers are the foundation of antihypertensive therapy in diabetic patients, particularly in the presence of albuminuria or chronic kidney disease based on their renoprotective effects which is mediated through the reduction of intraglomerular pressure and the attenuation of transforming growth factor beta-driven fibrosis, are superior to those of other antihypertensive classes at similar levels of blood pressure reduction (Moke et al., 2023a; Natale et al., 2024). Landmark trials established this evidence base, and contemporary real-world analyses continue to confirm that the use of these agents is independently associated with a slower

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

progression of diabetic nephropathy and a lower incidence of end-stage renal disease (Tuttle et al., 2021). The combination approach of both antihypertensive drugs and antidiabetics, have been shown to be improve hypertension-diabetes cormobidity (Ilias et al., 2020; Moke et al., 2023b; Joshi et al., 2026)

Calcium channel blockers, particularly the dihydropyridine subclass, are recommended as the second-line agent in most patients, and they are frequently combined with a renin-angiotensin-aldosterone system blocker in a single-pill combination which is based on their efficacy in lowering systolic blood pressure is robust across all age groups and ethnicities, and they are metabolically neutral, neither worsening nor improving insulin sensitivity. Thiazide-like diuretics, specifically chlorthalidone and indapamide, are preferred over hydrochlorothiazide because of their longer duration of action and more convincing evidence of cardiovascular event reduction (Unger et al., 2020; Moke et al., 2023b).

Mineralocorticoid receptor antagonists, such as spironolactone and eplerenone, are reserved for patients with resistant hypertension, defined as uncontrolled blood pressure despite the use of three agents at optimal doses including a diuretic (Moke et al., 2022). They are particularly effective in the diabetic population because of the prevailing state of relative aldosterone excess, and the addition of spironolactone to a background regimen of three drugs has been shown to reduce systolic blood pressure by 10 to 15 mmHg in resistant cases (Weir, 2021). In the MAGMA randomised trial, the addition of spironolactone to standard therapy in patients with type 2 diabetes and chronic kidney disease significantly reduced aortic plaque progression and left ventricular mass, independent of blood pressure reduction, providing mechanistic evidence for the pleiotropic benefits of mineralocorticoid receptor antagonism (Rajagopalan et al., 2024). A retrospective cohort study reported that finerenone, a non-steroidal mineralocorticoid receptor antagonist, was associated with superior cardiovascular outcomes compared with spironolactone or eplerenone in patients with type 2 diabetes, suggesting a more favourable benefit-risk profile for this newer agent (Park et al., 2025).

Blood pressure goals in diabetic patients

The target blood pressure for adults with diabetes and hypertension has been the subject of intense debate, but a broad consensus has crystallized around a goal below 130/80 mmHg for most patients, provided that the treatment is well tolerated. This target is endorsed by the ADA, the ESC, and the ISH, and it is supported by a meta-analysis of randomised controlled trials which demonstrated that achieving a systolic blood pressure between 120 and 130 mmHg in diabetic patients was associated with a significant reduction in major cardiovascular events, stroke, and all-cause mortality when compared with less intensive targets (de Boer et al., 2022).

The role of newer diabetes drugs with heart and kidney benefits in diabetic patients

The sodium-glucose cotransporter-2 inhibitors, including empagliflozin, dapagliflozin, and canagliflozin, lower blood glucose by blocking glucose reabsorption in the proximal tubule, but their clinical impact extends far beyond glycaemic control. A comprehensive review documented that beyond their glucose-lowering and cardiorenal effects, SGLT2 inhibitors reduce uric acid, blood lipids, body weight, and all-cause mortality, positioning them as agents that address multiple dimensions of the cardiometabolic syndrome simultaneously (Kario et al., 2025). Additionally, review of the antihypertensive properties of SGLT2 inhibitors noted that these agents lower clinic, home, and ambulatory blood pressure, with particularly pronounced effects on nocturnal hypertension in patients with type 2 diabetes (Bilić Ćurčić et al., 2025). These agents reduce systolic blood pressure by approximately 4 to 6 mmHg, an effect that is attributed to their natriuretic action and their ability to reduce arterial stiffness and body weight. More importantly, they have been shown in large

outcome trials to reduce the risk of hospitalisation for heart failure by 30 to 35 percent and to slow the progression of chronic kidney disease in patients with and without diabetes, outcomes that are independent of their glucose-lowering properties (Heerspink et al., 2020; Zannad et al., 2020). A pathophysiological review integrated the mechanisms linking hypertension, type 2 diabetes, chronic kidney disease, ischaemic heart disease, and obesity, and traced the evidence from key SGLT2 inhibitor outcome trials that underpin the current guideline recommendations for these agents in cardiorenal protection (Ivanov et al., 2025).

Glucagon-like peptide-1 receptor agonists, including liraglutide, semaglutide, and dulaglutide, lower blood glucose by stimulating insulin secretion and suppressing glucagon in a glucose-dependent manner, and they also reduce body weight and systolic blood pressure by 2 to 5 mmHg. Their cardiovascular outcome trials demonstrated a reduction in major adverse cardiovascular events, but unlike the sodium-glucose cotransporter-2 inhibitors, their principal effect on heart failure appears to be neutral, while their renal benefit is mediated largely through a reduction in albuminuria. Both drug classes are now recommended as first-line additions to metformin in patients with established atherosclerotic cardiovascular disease, heart failure, or chronic kidney disease, irrespective of A1c, a paradigm shift that directly integrates the management of diabetes and hypertension (Davies et al., 2022).

Regional Strategies in the Management of Hypertension in Diabetic Patients

In sub-Saharan Africa, the Pan-African Society of Cardiology has advocated for a simplified treatment algorithm that begins with a fixed-dose combination of an angiotensin-converting enzyme inhibitor or angiotensin receptor blocker plus a calcium channel blocker, reserving diuretics and spironolactone for subsequent steps, and explicitly integrating screening for diabetes control into hypertension consultations (Dzudie et al., 2021). A Delphi consensus study on integrating diabetes, hypertension, and HIV care in sub-Saharan Africa identified five essential components for a unified chronic care platform: strengthened surveillance, reliable drug procurement, access to laboratory testing, unified health education, and continuity of care across conditions (McCombe et al., 2025). The high cost of the newer glucose-lowering agents precludes their widespread use in most African nations, and efforts are underway to explore the feasibility of biosimilar and generic production. In South and Southeast Asia, the HOPE Asia Network has developed consensus recommendations that prioritise the use of single-pill combinations, home blood pressure monitoring, and the early addition of low-dose spironolactone for resistant cases, while recognising the emerging evidence for sodium-glucose cotransporter-2 inhibitors in patients with heart failure and kidney disease (Chia et al., 2022).

Latin American countries implementing the WHO HEARTS package have standardised hypertension management in diabetic patients around a core set of generic medications and algorithmic titration, with demonstrable improvements in blood pressure control at the primary care level (Mendis et al., 2022). The HEARTS 2.0 initiative identified 45 candidate interventions for integrating cardiovascular-kidney-metabolic care in primary health settings, including a lower diagnostic threshold for hypertension in high-risk individuals, systematic use of single-pill combinations, inclusion of SGLT2 inhibitors, and expanded roles for non-physician health workers (Meghnath et al., 2025). A pilot implementation of the HEARTS model in 11 primary care facilities in Guatemala demonstrated its feasibility and acceptability, with monthly hypertension treatment initiations increasing significantly and a small but growing number of patients with both diabetes and hypertension receiving integrated care (Miller et al., 2025).

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

Lifestyle Changes in the Management of Hypertension in Diabetic Patients

Pharmacotherapy no matter how sophisticated is built upon a foundation of lifestyle modification that remains the first and most essential therapeutic intervention for every patient with diabetes and hypertension. A review of lifestyle management strategies for hypertension and type 2 diabetes reaffirmed the value of the DASH diet, regular aerobic and resistance exercise, weight reduction, smoking cessation, and moderate alcohol intake as cornerstones of non-pharmacological therapy (Kim et al., 2025). The evidence is compelling that sustained changes in diet, physical activity, body weight, and tobacco use can lower blood pressure and blood glucose, reduce the requirement for medication, and improve cardiovascular outcomes, although the effectiveness of lifestyle interventions is mediated by the intensity of the support provided and the patient's social context.

A comprehensive meta-analysis of lifestyle trials in hypertensive diabetic patients reported that a structured programme combining dietary counselling, supervised exercise, and weight loss targets reduced systolic blood pressure by 5 to 8 mmHg and A1c by 0.3 to 0.5 percent over twelve months, effects that are comparable to the addition of a low-dose antihypertensive or glucose-lowering agent (Patel et al., 2021). A systematic synthesis of reviews published between 2019 and 2024 concluded that lifestyle interventions in primary care remain underutilised despite robust evidence of their effectiveness for individuals with hypertension, obesity, and type 2 diabetes, and called for their systematic integration into routine clinical pathways (Busse et al., 2025).

Role of Healthy Diet in the Treatment of Hypertension in Diabetic Patients

Dietary modification for the patient with diabetes and hypertension centres on the DASH (Dietary Approaches to Stop Hypertension) diet and the Mediterranean diet, both of which emphasise high intakes of vegetables, fruits, whole grains, legumes, nuts, and lean protein sources, while restricting saturated fats, refined carbohydrates, and added sugars. The DASH diet, originally developed for hypertension, reduces systolic blood pressure by approximately 6 to 11 mmHg in hypertensive individuals, and its effects are amplified when combined with sodium restriction to less than 2 grams of sodium per day, equivalent to approximately 5 grams of salt (Filippou et al., 2020). An analysis of over 144,000 UK Biobank participants found that the combination of poor diet quality and low physical activity conferred a synergistic increase in the risk of developing both type 2 diabetes and hypertension, with the joint hazard exceeding the sum of the individual risks (Jackson et al., 2024).

Role of Physical Activity in the Treatment of Hypertension in Diabetic Patients

Regular physical activity produces clinically meaningful reductions in blood pressure and improves insulin sensitivity through distinct but complementary mechanisms, including enhanced endothelial function, reduced sympathetic nervous system activity, and increased skeletal muscle glucose uptake. Aerobic exercise, performed at moderate intensity for at least 150 minutes per week and distributed over at least three days, is the bedrock of the exercise prescription, reducing systolic blood pressure by 5 to 8 mmHg in hypertensive adults and lowering A1c by approximately 0.6 percent in patients with type 2 diabetes (Colberg et al., 2022). A pilot randomised trial in elderly patients with both type 2 diabetes and hypertension reported that a novel intervention combining exercise performed under hypoxic conditions with a low-carbohydrate, high-fat diet produced improvements in glycaemic control, blood pressure, and lipid profiles, suggesting that alternative lifestyle strategies merit further investigation (Makris et al., 2025).

Role of Weight Control in the Treatment of Hypertension in Diabetic Patients

Excess adiposity is the single most important modifiable driver of both diabetes and

hypertension, and weight reduction, even in modest amounts, yields substantial cardiovascular benefits. A sustained weight loss of 5 to 10 percent of initial body weight has been shown to reduce systolic blood pressure by approximately 3 to 8 mmHg and to improve all measures of glycaemic control, and a loss of 15 percent or more, which is increasingly achievable with newer pharmacological agents and bariatric surgery, can induce diabetes remission in a substantial proportion of patients (Wadden et al., 2021).

Role of Smoking Avoidance in the Treatment of Hypertension in Diabetic Patients

Tobacco smoking, through its acute sympathomimetic effects and its chronic promotion of endothelial dysfunction, arterial stiffness, and systemic inflammation, is a powerful and independent risk factor for cardiovascular disease in the general population, and its detrimental impact is magnified in the patient with diabetes and hypertension. Each cigarette causes a transient rise in blood pressure of 5 to 10 mmHg that lasts for approximately 30 minutes, and chronic smoking blunts the antihypertensive efficacy of beta-blockers, angiotensin-converting enzyme inhibitors, and other agents (Mancia et al., 2021).

Role of Patient Education in the Management of Hypertension in Diabetic Patients

Patient education is the thread that connects lifestyle modification, medication adherence, self-monitoring, and long-term engagement with the health system. Structured education programmes that combine knowledge about the conditions with practical skills in home blood pressure and glucose monitoring, medication management, and the interpretation of symptoms have been shown to improve blood pressure control and glycaemic outcomes in diverse populations, although the effect size is modest and dependent on sustained reinforcement (Chatterjee et al., 2021; Isibor et al., 2025). An economic analysis from Mexico found that the direct costs of pharmacotherapy for patients managing both type 2 diabetes and hypertension impose a substantial financial strain on households, contributing to treatment interruption and poor control (Figueroa-García et al., 2026). A scoping review of task-shifting practices in low- and middle-income countries found that non-physician health workers can effectively deliver components of diabetes and hypertension care, although consistent training, supportive supervision, and enabling policy are necessary for sustained impact (Odusola et al., 2024).

CONCLUSION

This review has described the global epidemiology and regional heterogeneity of the diabetes-hypertension comorbidity, traced the pathological linkages that render the combination more dangerous than either condition alone, and examined the patterns of control, management, access, and health system response across continents. The evidence is unequivocal: the coexistence of diabetes and hypertension amplifies vascular risk, accelerates organ damage to the kidneys, brain, liver, and systemic vasculature, and creates a pharmacological challenge that demands integrated, evidence-based, and sustained management. In high-income settings, incremental improvements have been achieved through structured monitoring, team-based care, and the introduction of newer cardioprotective glucose-lowering agents, while in the regions that carry the fastest-growing burden, particularly sub-Saharan Africa and South Asia, the gap between knowledge and practice is widening.

Recommendations

The epidemiological trajectory points to an inexorable rise in the absolute number of individuals living with the diabetes-hypertension comorbidity, driven by population, ageing, and the ongoing obesity pandemic. This trend will be most dramatic in sub-Saharan Africa and South Asia, where the health systems are least prepared. Several priority actions will include;

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

1. The global non-communicable disease monitoring framework must move beyond tracking single conditions to routinely reporting integrated indicators of dual and multimorbidity control, so that countries can be held accountable for the outcomes that matter to patients rather than to vertical programmes.
2. Investment in implementation research is urgently needed to identify the most effective and cost-effective methods of delivering integrated diabetes-hypertension care in low-resource settings. This includes comparative evaluations of fixed-dose combination pills that contain antihypertensive and glucose-lowering agents in a single tablet, of nurse-led algorithmic titration protocols, and of community-based peer support models that have shown promise in pilot studies.
3. Thirdly, the digital health revolution must be steered towards equity. Simple, low-cost mobile phone-based interventions that support adherence and blood pressure self-monitoring should be scaled and rigorously evaluated in Africa and South Asia, while high-income nations refine more sophisticated tools and ensure that they do not widen existing health disparities.
4. Fourthly, the training of health professionals must be reformed to equip every doctor, nurse, and pharmacist with the competencies to manage multiple chronic conditions simultaneously, moving away from the specialist silos that characterised twentieth-century medical education.
5. Fifthly, the policy architecture for non-communicable diseases in countries such as Nigeria requires an urgent shift from strategy documents to operational plans with dedicated budget lines, supply chain guarantees, and a human resource strategy that incentivises health workers to serve in underserved areas.

REFERENCES

Abbas, M.A., Al-Khaldi, Y.M. & Gad, R.A. (2025). Mediating effects of hypertension in association between household wealth disparities and diabetes among women of reproductive age: analysis of eight countries in sub-Saharan Africa. *Journal of Public Health*, 47(1): 102–111.

Adediran, O.S., Akintunde, A.A., Fasanmade, O.A., Ohwovoriole, A.E. & Ofoegbu, E.N. (2021). Prevalence and determinants of hypertension among patients with diabetes mellitus in a semi-urban Nigerian community. *West African Journal of Medicine*, 38(4): 312–319.

Adhikari, B., Mishra, S.R., Schwarz, D., Shrestha, R. & Vaidya, R. (2025). Pharmacist interventions to improve hypertension management among patients with diabetes: a systematic review and meta-analysis of randomized controlled trials. *Journal of the American Pharmacists Association*, 65(5): e102352.

Akintunde, A.A., Odili, A.N. & Dzudie, A. (2025). Hypertension treatment and control in a semi-urban community in southern Nigeria: implications for scalable community-based interventions in low-resource settings', *Hypertension*, 82(Suppl 1): Abstract TAC133.

Al-Rubeaan, K., Youssef, A.M., Al-Sharqawi, A.H., Al-Hamidi, H.A., Al-Qumaidi, K. & Al-Naqeb, D. (2022). Prevalence and associated factors of hypertension among adults with diabetes in Saudi Arabia. *Journal of Diabetes and its Complications*, 36(5): 108175.

American Diabetes Association (2023). Standards of medical care in diabetes—2023. *Diabetes Care*, 46(Supplement 1): S1–S291.

Anjana, R.M., Unnikrishnan, R., Deepa, M., Pradeepa, R., Tandon, N., Das, A.K., Joshi, S., Bajaj, S., Jabbar, P.K., Das, H.K., Kumar, A., Dhandhania, V.K., Bhansali, A., Rao, P.V., Desai, A., Kalra, S., Ramachandran, A. & Mohan, V. (2021). Metabolic non-communicable disease health report of India: the ICMR-

INDIAB national cross-sectional study. *The Lancet Diabetes and Endocrinology*, 9(7): 434–445.

Bakris, G.L., Ali, W.K., Parati, G., Weir, M.R., Dalal, J. & Williams, B. (2020). Endothelial dysfunction and hypertension in diabetes. *Journal of Hypertension*, 38(8): 1463–1473.

Bankole, O., Oduntan, O., Olukoya, M., Adeyemi, K. & Wright, O. (2025). Prevalence of hypertension and diabetes mellitus in a health district of Lagos, Nigeria. *Journal of Community Medicine and Primary Health Care*, 37(2): 45–53.

Beck, R.W., Riddlesworth, T.D., Ruedy, K.J., Ahmann, A., Bergenstal, R.M., Bhargava, A., Bode, B.W., Haller, S., Kruger, D.F., McGill, J.B., Polonsky, W.H., Price, D., Toschi, E. & Wolpert, H. (2021). Continuous glucose monitoring versus usual care in patients with type 2 diabetes receiving multiple daily insulin injections. *Annals of Internal Medicine*, 174(3): 302–310.

Bilić Ćurčić, I., Ninčević, V., Canecki Varzic, S., Prpić Križevac, I. & Mihaljević, I. (2025). Changing the landscape of hypertension management with SGLT2i'. *Southeastern European Medical Journal*, 6(1): 47–55. doi: 10.26332/seemedj.v6i1.247.

Braveman, P.A., Gottlieb, L.M., Adler, N.E., Berkowitz, S.A., Banzon, E. & Kindig, D.A. (2022). The social determinants of health and diabetes. *Diabetes Care*, 45(3): 501–512.

Bukola, F., Oduwole, T., Eze, C.A. & Eghan, B.A. (2025). Pharmacist interventions to improve medication adherence in patients with co-morbid hypertension and diabetes: a scoping review and bibliometric analysis. *BMC Health Services Research*, 25: 412.

Chatterjee, S., Davies, M.J., Heller, S., Speight, J., Snoek, F.J. & Khunti, K. (2021). Diabetes structured self-management education programmes: a systematic review of the evidence. *Diabetologia*, 64(9): 1945–1962.

Cheng, Y.J., Kanaya, A.M., Araneta, M.R.G., Saydah, S.H., Kahn, H.S., Gregg, E.W., Fujimoto, W.Y. & Imperatore, G. (2020). Prevalence of diabetes by race and ethnicity in the United States, 2011–2016. *Journal of the American Medical Association*, 322(24): 2389–2398.

Cheung, N., Mitchell, P. & Wong, T.Y. (2021). Diabetic retinopathy, *The Lancet*, 398(10300): 643–656.

Chia, Y.C., Turana, Y., Sukonthasarn, A., Zhang, Y., Shin, J., Park, S., Tan, C.C., Siddique, S., Sison, J., Soenarta, A.A., Azizi, M., Kario, K. & Wang, J.G. (2022). Consensus recommendations for the management of hypertension in Asia: the HOPE Asia Network 2022 update. *Hypertension Research*, 45(3): 331–348.

Chinese Society of Endocrinology and Chinese Hypertension League (2025). Chinese expert consensus on the management of hypertension in adults with type 2 diabetes mellitus. *Chinese Journal of Endocrinology and Metabolism*, 41(6): 453–470.

Chirinos, J.A., Segers, P., Hughes, T. & Townsend, R. (2022). Large artery stiffness in health and disease: JACC state-of-the-art review. *Journal of the American College of Cardiology*, 79(16): 1579–1601.

Claassen, J.A.H.R. & van den Bergh, W.M. (2020). Cerebral autoregulation in diabetes and hypertension. *Journal of Cerebral Blood Flow and Metabolism*, 40(4): 705–717.

Colafella, K.M.M. & Denton, K.M. (2020). Sex-specific differences in hypertension and associated cardiovascular disease. *Nature Reviews Nephrology*, 16(4): 223–234.

Colberg, S.R., Sigal, R.J., Yardley, J.E., Riddell, M.C., Dunstan, D.W., Dempsey, P.C., Horton, E.S., Castorino, K. & Tate, D.F. (2022). Physical activity/exercise and diabetes: a position statement of the American Diabetes Association. *Diabetes Care*, 45(1): 143–157.

Cosentino, F., Grant, P.J., Aboyans, V., Bailey, C.J., Ceriello, A., Delgado, V.,

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

Federici, M., Filippatos, G., Grobbee, D.E., Hansen, T.B., Huikuri, H.V., Johansson, I., Juni, P., Lettino, M., Marx, N., Mellbin, L.G., Ostgren, C.J., Rocca, B., Roffi, M., Sattar, N., Seferovic, P.M., Sousa-Uva, M., Valensi, P. & Wheeler, D.C. (2020). 2019 ESC Guidelines on diabetes, pre-diabetes, and cardiovascular diseases developed in collaboration with the EASD. *European Heart Journal*, 41(2): 255–323.

Cruickshank, J.K., Wright, J.S., Gooding, K.M. & Shore, A.C. (2021). Microvascular structure and function in diabetes and hypertension. *Journal of Hypertension*, 39(5): 870–881.

Davies, M.J., Aroda, V.R., Collins, B.S., Gabbay, R.A., Green, J., Maruthur, N.M., Rosas, S.E., Del Prato, S., Mathieu, C., Mingrone, G., Rossing, P., Tankova, T., Tsapas, A. & Buse, J.B. (2022). Management of hyperglycaemia in type 2 diabetes, 2022. A consensus report by the American Diabetes Association (ADA) and the European Association for the Study of Diabetes (EASD). *Diabetes Care*, 45(11): 2753–2786.

de Boer, I.H., Bangalore, S., Benetos, A., Davis, A.M., Michos, E.D., Muntner, P., Rossing, P., Zoungas, S. & Bakris, G. (2022). Diabetes and hypertension: a position statement by the American Diabetes Association. *Diabetes Care*, 45(9): 1998–2012.

Defronzo, R.A., Ferrannini, E. & Groop, L. (2020). Type 2 diabetes mellitus. *Nature Reviews Disease Primers*, 6(1): 41.

Dzudie, A., Rayner, B., Ojji, D., Schutte, A.E., Twagirumukiza, M., Damasceno, A., Ba, S.A., Kane, A., Kramoh, E., Kacou, J.B.A., Onwubere, B., Cornick, R., Sliwa, K., Anisiuba, B., Mocumbi, A.O., Ogola, E., Awad, M., Nel, G., Otieno, H., Toure, A.I., Kingue, S., Kengne, A.P., Perel, P., Adler, A., Poulter, N. & Mayosi, B. (2021). Roadmap to achieve 25 percent hypertension control in Africa by 2025. *Cardiovascular Journal of Africa*, 32(1): 12–21.

Fazel, M.T., Bagalagel, A., Lee, J.K., Martin, J.R. & Slack, M.K. (2021). Impact of pharmacist-led interventions on blood pressure and glycaemic control in patients with diabetes and hypertension: a systematic review and meta-analysis. *Journal of the American Pharmacists Association*, 61(5): 592–603.

Federal Ministry of Health Nigeria (2021). National Policy and Strategic Plan of Action on Non-communicable Diseases 2021–2025. Abuja: Federal Ministry of Health.

Figueroa-García, J., Granados-García, V.M., Martínez-Barro, D. & Palomo-Piñón, S. (2026). Costs of pharmacological treatment in hypertension and type 2 diabetes mellitus. *Revista Médica del Instituto Mexicano del Seguro Social*, 64(1): e6696.

Filippou, C.D., Tsioufis, C.P., Thomopoulos, C.G., Mihas, C.C., Dimitriadis, K.S., Sotiropoulou, L.I., Chrysochoou, C.A., Nihoyannopoulos, P.I. & Tousoulis, D.M. (2020). Dietary approaches to stop hypertension (DASH) diet and blood pressure reduction: a systematic review and meta-analysis of randomized controlled trials. *Nutrients*, 12(9): 2666.

Fiorentino, T.V., Prioletta, A., Zuo, P. & Folli, F. (2020). Hyperglycemia-induced oxidative stress and its role in diabetes mellitus related cardiovascular diseases. *Current Pharmaceutical Design*, 26(27): 3300–3310.

Flood, D., Hane, J., Jaacks, L.M. & Manne-Goehler, J. (2024). Rural-urban differences in diabetes care and control in 42 low- and middle-income countries: a cross-sectional study of nationally representative individual-level data. *Diabetes Care*, 47(12): 2145–2153.

Flood, D., Marcus, M.E., Theilmann, M., Manne-Goehler, J., Vollmer, S., Bischops, A., Geldsetzer, P. & Davies, J.I. (2022). Diabetes and hypertension care among adults with diabetes in low- and middle-income countries: a cross-sectional study of 45 national surveys. *PLOS Medicine*, 19(11): e1004122.

Friedman, S.L. & Pinzani, M. (2020). Hepatic fibrosis 2020: an update on key pathways and molecular targets. *Journal of Hepatology*, 73(2): 439–459.

GBD 2021 Diabetes Collaborators (2022). Global, regional, and national burden of diabetes from 1990 to 2021, with projections of prevalence to 2050: a systematic analysis for the Global Burden of Disease Study 2021. *The Lancet*, 399(10341): 2299–2334.

Gholami, M., Sharifzadeh, H. & Khalili, S. (2024). Blood pressure control among diabetic patients in the Eastern Mediterranean Region: a systematic review and meta-analysis. *Current Diabetes Reviews*, 21(10): E310724232514.

Gill, G.V., Mbanya, J.C., Ramaiya, K.L. & Tesfaye, S. (2023). Diabetes in Africa: epidemiology, management and healthcare challenges. *Diabetologia*, 66(2): 261–270.

Grassi, G., Biffi, A., Seravalle, G., Brambilla, G., Quarti-Trevano, F. & Mancia, G. (2022). Sympathetic neural mechanisms in hypertension: recent insights. *Hypertension*, 79(2): 308–317.

Gruzdeva, D. & Kokkinos, A. (2025). Editorial: Advances in diabetes and hypertension research. *Frontiers in Endocrinology*, 16: 1711423.

Halban, P.A., Polonsky, K.S., Bowden, D.W., Hawkins, M.A., Ling, C., Mather, K.J., Powers, A.C., Rhodes, C.J., Sussel, L. & Weir, G.C. (2021). Beta-cell failure in type 2 diabetes: postulated mechanisms and prospects for prevention and treatment. *Diabetes Care*, 44(4): 769–777.

Hall, J.E., do Carmo, J.M. & da Silva, A.A. (2021). Obesity, kidney dysfunction and hypertension: mechanistic links. *Nature Reviews Nephrology*, 17(5): 349–362.

Hategeka, C., Ayele, H., Ndizeye, C., Manzi, A., Shio, M.T. & Ruckert, A. (2022). Task shifting and task sharing for non-communicable disease management in low- and middle-income countries: a systematic review of implementation strategies and outcomes. *BMJ Global Health*, 7(10): e009487.

Heerspink, H.J.L., Stefansson, B.V., Correa-Rotter, R., Chertow, G.M., Greene, T., Hou, F.F., Mann, J.F.E., McMurray, J.J.V., Lindberg, M., Rossing, P., Sjostrom, C.D., Toto, R.D., Langkilde, A.M. & Wheeler, D.C. (2020). Dapagliflozin in patients with chronic kidney disease. *New England Journal of Medicine*, 383(15): 1436–1446.

Hoffman, D.J., Powell, T.L., Barrett, A.L. & Pasek, T.A. (2021). Developmental origins of metabolic diseases. *Physiological Reviews*, 101(1): 189–248.

Hughes, T.M., Sink, K.M., Williamson, J.D. & Lockhart, S.N. (2022). Blood pressure, brain health, and cognition: a review of clinical evidence. *Hypertension*, 79(3): 521–532.

Ilias, I., Thomopoulos, C., Michalopoulou, H., Bazoukis, G., Tsioufis, C., & Makris, T. (2020). Antidiabetic drugs and blood pressure changes. *Pharmacological Research*, 161: 105108.

International Diabetes Federation (2021) IDF Diabetes Atlas. 10th edn. Brussels: International Diabetes Federation.

Isibor, N.P., Moke, E.G., Umukoro, E.K., Ben-Azu, B., Anachuna, K.K., Elijah, O.B., Kadiri, M.A., Ekuerhare, B. & Isidahomen, O.F. (2025). Collaborative impact of diabetes education by International Diabetes Federation and national health systems on prevalence of diabetes amongst the indigenous people of Africa. *Emerging Frontiers in Translational Biomedicine and Health Sciences*, 1(1): 26-34.

Isiekwe, G.I., Osadolor, O.O., Akinboboye, B.O. & Onuoha, K.O. (2024). Screening for diabetes and hypertension in adult dental patients: the experience in a Nigerian dental center. *Frontiers in Dental Medicine*, 5: 1468375.

Ivanov, D., Dimova, R. & Tankova, T. (2025). Sodium-glucose cotransporter 2 inhibitors in the context of cardiorenal-metabolic comorbidity. Part 1: Pathophysiology and key clinical studies.

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

Ukrainian Journal of Nephrology and Dialysis, (4): 3–18.

Jackson, S.E., Brown, J. & Aveyard, P. (2024). Joint associations of diet and physical activity with incident type 2 diabetes and hypertension: an analysis of 144,288 UK Biobank participants. *International Journal of Epidemiology*, 53(4): dyae098.

Jia, G. & Sowers, J.R. (2021). Hypertension in diabetes: an update of basic mechanisms and clinical disease. *Hypertension*, 78(5): 1197–1205.

Joshi, P., Rick, G., Mesineni, S., Bohara, S., Atif, S., Poonthottam, N., Azam, A., Mehmood, Y., Ali, R., Raquib, N., Sasikumar, A., Khalid, A., & Anyagwa, O. E. (2026). Antihypertensive therapy in diabetes mellitus: efficacy, safety, and metabolic impacts in type 1 and type 2 diabetes. *Cardiovascular Diabetology. Endocrinology Reports*, 12(1): 4.

Kario, K., Hoshide, S., Chia, Y.C., Park, S., Shin, J., Siddique, S., Turana, Y., Sukonthasarn, A., Chen, C.H., Nailes, J., Tan, C.C., Sison, J., Soenarta, A.A., Sogunuru, G.P., Wang, T.D. & Wang, J.G. (2022). Guidance on ambulatory blood pressure monitoring: a statement from the HOPE Asia Network. *Journal of Clinical Hypertension*, 24(2): 141–152.

Kario, K., Wang, J.G., Chia, Y.C. & Turana, Y. (2025). Multi-dimensional roles of sodium-glucose cotransporter 2 inhibitors: beyond hypoglycemic and cardiorenal protection. *Frontiers in Pharmacology*, 16: 1509878.

Khunti, K., Seidu, S., Kunutsor, S. & Davies, M. (2021). Association between adherence to combined targets for blood pressure and glycaemic control and cardiovascular outcomes in patients with type 2 diabetes. *Diabetes, Obesity and Metabolism*, 23(3): 715–725.

Kim, H.J., Park, S. & Lee, J.H. (2025). Lifestyle management of hypertension and type 2 diabetes. *Korean Journal of Medicine*, 98(5): 241–250.

Mahajan, A., Spracklen, C.N., Zhang, W., Ng, M.C.Y., Petty, L.E., Kitajima, H., Yu, G.Z., Rueger, S., Speidel, L., Kim, Y.J. & others (2022). Multi-ancestry genetic study of type 2 diabetes highlights the power of diverse populations for discovery and translation. *Nature Genetics*, 54(5): 560–572.

Makris, K.C., Papadopoulos, A. & Kourtoglou, G. (2025). Evaluating the therapeutic potential of exercise in hypoxia and low-carbohydrate, high-fat diet in managing hypertension in elderly type 2 diabetes patients: a novel intervention approach. *Nutrients*, 17(3): 450.

Mancia, G., Groppelli, A., Di Rienzo, M., Zanchetti, A. & Parati, G. (2021). Smoking impairs baroreflex sensitivity and blood pressure variability: implications for hypertension management. *Journal of Hypertension*, 39(4): 695–702.

Manne-Goehler, J., Geldsetzer, P., Agoudavi, K., Andall-Brereton, G., Aryal, K.K., Bicaba, B.W., Bovet, P., Brian, G., Dorobantu, M., Gathecha, G., Gurung, M.S., Guwatudde, D., Houehanou, C., Houinato, D., Jorgensen, J.M.A., Kagaruki, G.B., Karki, K.B., Labadarios, D., Martins, J.S., Mayige, M.T., Musinguzi, G., Mutungi, G., Mwalim, O., Mwangi, J.K., Norov, B., Quesnel-Crooks, S., Raynes-Greenow, C., Ramke, J., Sahakyan, S., Sathananthan, V., Sibai, A.M., Sturua, L., Tsabedze, L., Wesseh, C.S., Zaw, A., Barnighausen, T., Vollmer, S., Atun, R. & Jaacks, L.M. (2022). Health system performance for diabetes care in low- and middle-income countries: a pooled analysis of individual-level data from 55 nationally representative surveys. *The Lancet Global Health*, 10(6): e868–e877.

Manne-Goehler, J., Geldsetzer, P., Davies, J.I., Flood, D. & Bischops, A. (2024). Achievement of recommended targets for cardiovascular disease prevention in adults with diabetes in 38 low- and middle-income countries. *The Lancet Global Health*, 12(9): e1124–e1135.

McCombe, G., Murtagh, S., Lazarus, J.V., Van Hout, M.C. & Bachmann, M. (2025).

Integrating diabetes, hypertension and HIV care in sub-Saharan Africa: a Delphi consensus study on international best practice. *BMC Health Services Research*, 25: 1235.

McManus, R.J., Little, P., Stuart, B., Raftery, J. & Hobbs, F.D.R. (2025). Impact of 12-month mHealth home telemonitoring on clinical outcomes in older individuals with hypertension and type 2 diabetes: multicenter randomized controlled trial. *JMIR mHealth and uHealth*, 13: e67412.

McManus, R.J., Little, P., Stuart, B., Raftery, J., Zhang, J., Hinton, L., Mancey, C., Yardley, L., Gray, A., Wight, L., Connell, K.A., Strnk, S., Milner, S., Heawood, L., Lane, S., Wilson, E., Szymanska, A., Little, S., Merriel, A., Hernandez, R., Lacy, P.S., Gladwell, D., Nuttall, J., Thomas, M., Sharp, L., Brooks, E., Ward, A., Brunger, F., Tye, R., Jackson, M., Courtenay, M. & Hobbs, F.D.R. (2021). Home and Online Management and Evaluation of Blood Pressure (HOME BP) using a digital intervention in poorly controlled hypertension: randomised controlled trial. *BMJ*, 372: m4858.

Meghnath, K., Grassani, A.M., Pena, A., Ramirez, M. & Rosende, A. (2025). Candidate interventions for integrating hypertension and cardiovascular-kidney-metabolic care in primary health settings: HEARTS 2.0 Phase 1. *Global Heart*, 20(1): 34.

Mendis, S., Graham, I., Narula, J. & Varghese, C. (2022). Implementing the World Health Organization HEARTS technical package for cardiovascular disease management in primary care: a review of country experiences. *Global Heart*, 17(1): 48.

Miller, A., Moran, A.E., Diez, F., Mazariegos, M. & Flood, D. (2025). Evaluating the World Health Organization's HEARTS Model for hypertension and diabetes management: a pilot implementation study in Guatemala. *Global Heart*, 20(1): 30.

Miranda, J.J., Carrillo-Larco, R.M., Ferreccio, C., Hambleton, I.R., Lotufo, P.A., Nieto-Martinez, R., Ortiz, A., Rubinstein, A. & Werneck, G.L. (2021). Hypertension prevalence, awareness, treatment and control in Latin America: a systematic review and meta-analysis of population-based studies. *Journal of Hypertension*, 39(4): 649–660.

Mishra, S., Gupta, R. & Huffman, M.D. (2025). Multiple cardiovascular risk factor care in 55 low- and middle-income countries: a cross-sectional analysis of nationally-representative, individual-level data from 280,783 adults. *BMJ Global Health*, 10(5): e012347.

Misra, A., Gopalan, H., Jayawardena, R., Hills, A.P., Soares, M., Reza-Albarrán, A.A. and Ramaiya, K.L. (2022). Diabetes in developing countries. Journal of Diabetes, 14(2): 91–102.

Moke, E.G., Demaki, W.E., Daubry, T.M.E., Ataikiru, O.M., Agbonifo-Chijiokwu, E**.**, Ofulue, O.O., Ekuerhare, B., Akpoyovwere, O., Edje, K.E. & Isibor, N.P. (2023c). Coexistence of hypertension with diabetes mellitus and its pharmacotherapy. *Scientia Africana*, 22(2): 135-154

Moke, E.G., Ekuerhare, B., Enaohwo, M.T., Asiwe, J.N., Ofulue, O.O., Umukoro, E.K. & Isibor, N.P. (2022). Resistant hypertension. *Journal of Drug Delivery and Therapeutics*, 12(3-S): 230-235.

Moke, E.G., Omogbai, E.K.I., Osagie-Eweka, S.D.E., Uchendu, A.P., Obayuwana, O.M., Okoro-Akpandu, E., & Ben-Azu, B. (2023b). Antihypertensive and antihyperglycemic effects of combinations of losartan with metformin and/or glibenclamide in desoxycorticosterone acetate and streptozotocin-induced hypertensive diabetic rats. *Laboratory Animal Research*, 39: 7

Moke, E.G., Omogbai, E.K.I., Osagie-Eweka, S.D.E., Uchendu, A.P., Omogbiya, A.I., Ben-Azu, B., Eduviere, A.T., Edje, K.E., Umukoro, E.K., Anachuna, K.K., Asiwe, J.N., Ahante, E. & Oghoghovwe, I.J. (2023a). Co-administration of metformin and/or glibenclamide with losartan reverse *NG*-nitro-L-arginine-methyl

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

ester-streptozotocin-induced hypertensive diabetes and haemodynamic sequelae in rats. *Microvascular Research*, 147: 104497

Muniyappa, R. & Yavuz, S. (2022). Insulin resistance pathways, inflammation, and atherosclerosis. *Endocrinology and Metabolism Clinics of North America*, 51(3): 497–515.

Natale, P., Palmer, S. C., Navaneethan, S. D., Craig, J. C., & Strippoli, G. F. (2024). Angiotensin-converting-enzyme inhibitors and angiotensin receptor blockers for preventing the progression of diabetic kidney disease. *The Cochrane Database of Systematic Reviews*, 4(4): CD006257.

Nguyen, T.M., Pham, T.T., Le, H.T. & Nguyen, H.V. (2024). The effect of telehealth on clinical outcomes in patients with hypertension and diabetes: a meta-analysis of 106,261 patients. *Journal of Medical Internet Research*, 26: e59201.

Odili, A.N., Chori, B.S., Danladi, B., Nwakile, P.C., Okoye, I.K., Abdullahi, U., Nwagbara, K., Ezeala-Adikaibe, B.A., Ogedengbe, J.O. & Dzudie, A. (2021). Prevalence, awareness, treatment and control of hypertension in Nigeria: data from a nationwide survey. *Journal of Hypertension*, 39(7): 1339–1348.

Odusola, A.O., Misra, S., Bhardwaj, A., Srivastava, S. & Nagpal, V. (2024). Task-shifting practices with non-physician health workers in the management of diabetes and hypertension in low-middle income countries: a scoping review. *BMJ Public Health*, 2(1): e000390.

Okafor, U.H., Unachukwu, C.N. & Chinenye, S. (2022) 'Hypertension in patients with diabetes mellitus in a Nigerian tertiary hospital: prevalence, control and associated factors. *Nigerian Journal of Clinical Practice*, 25(6): 790–796.

Park, S., Lee, H.Y. & Kim, J.Y. (2025). Nonsteroidal mineralocorticoid receptor antagonists and cardiovascular events in type 2 diabetes: a retrospective study. *Cardiovascular Diabetology*, 24: 298.

Pasquel, F.J. & Umpierrez, G.E. (2020). Hyperosmolar hyperglycemic state: a historic review of the clinical presentation, diagnosis, and treatment. *Diabetes Care*, 43(9): 1945–1953.

Patel, A., Joshi, R., Peiris, D. & Neal, B. (2021). Lifestyle interventions for blood pressure and glucose control in people with diabetes and hypertension: a systematic review and meta-analysis. *Diabetes, Obesity and Metabolism*, 23(5): 1124–1134.

Pop-Busui, R., Boulton, A.J.M., Feldman, E.L., Bril, V., Freeman, R., Malik, R.A., Sosenko, J.M. & Ziegler, D. (2022). Diabetic neuropathy: a position statement by the American Diabetes Association. *Diabetes Care*, 45(2): 567–589.

Powell, E.E., Wong, V.W.S. & Rinella, M. (2021). Non-alcoholic fatty liver disease. *The Lancet*, 397(10290): 2212–2224.

Prabhakaran, D., Jha, D., Prieto, V., Roy, A., Ajay, V.S., Goenka, S., Tandon, N., Ramakrishnan, L., Reddy, K.S., Ali, M.K. & Narayan, K.M.V. (2020). Effectiveness of a text-messaging intervention for hypertension control among patients with diabetes in India: a randomized clinical trial. *JAMA Internal Medicine*, 180(9): 1196–1205.

Price, A.J., Crampin, A.C., Amberbir, A., Kayuni-Chihana, N. & Musicha, C. (2025). Prevalence of obesity, hypertension, and diabetes, and cascade of care in sub-Saharan Africa: a cross-sectional, population-based study in rural and urban Malawi. *The Lancet Global Health*, 13(5): e789–e801.

Rajagopalan, S., Vergara-Martel, A., Zeman, J., Wells, R. & Dobre, M. (2024). Mineralocorticoid receptor antagonism prevents aortic plaque progression and reduces left ventricular mass and fibrosis in patients with type 2 diabetes and chronic kidney disease: the MAGMA trial. *Circulation*, 150(9): 689–701.

Rawshani, A., Rawshani, A., Franzén, S., Sattar, N., Eliasson, B., Svensson, A.M., Zethelius, B., Miftaraj, M., McGuire, D.K., Rosengren, A. & Gudbjörnsdottir,

S. (2021). Risk factors, mortality, and cardiovascular outcomes in patients with type 2 diabetes. *New England Journal of Medicine*, 379(7): 633–644.

Rossing, P., Persson, F., Hansen, T.W. & Parving, H.H. (2021). The kidney in diabetes: dynamic pathways of injury and repair. *Nature Reviews Nephrology*, 17(2): 89–103.

Schlesinger, S., Neuenschwander, M., Lang, A., Schwedhelm, C., Knuppel, S. & Rohrmann, S. (2022). Cardiovascular risk in diabetes: a systematic review and meta-analysis of prospective studies. *Diabetologia*, 65(5): 812–826.

Selvin, E., Warren, B., He, X., Sacks, D.B. & Rinke, A.T. (2020). Establishment of community-based reference intervals for fructosamine, glycated albumin, and 1,5-anhydroglucitol. *Clinical Chemistry*, 66(6): 832–841.

Siasos, G., Tousoulis, D., Tsigkou, V., Kokkou, E., Oikonomou, E., Vavuranakis, M., Papavassiliou, A.G. & Stefanadis, C. (2020). Endothelial dysfunction in diabetes and hypertension: the role of inflammation and oxidative stress. *Current Vascular Pharmacology*, 18(4): 321–334.

Silva, J.R., Pereira, M. & Ribeiro, F. (2025). Managing cardiovascular risk factors with telemedicine in primary care: a systematic review and meta-analysis of patients with arterial hypertension and type 2 diabetes. *European Journal of Preventive Cardiology*, 32(3): 345–356.

Sørensen, M., Poulsen, A.H., Hvidtfeldt, U.A., Brandt, J., Frohn, L.M., Ketzel, M., Christensen, J.H. & Raaschou-Nielsen, O. (2022). Air pollution, road traffic noise and type 2 diabetes: a multi-cohort study. *Environment International*, 160: 107052.

Stenvers, D.J., Scheer, F.A.J.L., Schrauwen, P., la Fleur, S.E. & Kalsbeek, A. (2021). Circadian clocks and insulin resistance. *Nature Reviews Endocrinology*, 17(2): 75–86.

Stergiou, G.S., Palatini, P., Parati, G., O'Brien, E., Januszewicz, A., Lurbe, E., Persu, A., Mancia, G. & Kreutz, R. (2021). 2021 European Society of Hypertension practice guidelines for office and out-of-office blood pressure measurement. *Journal of Hypertension*, 39(7): 1293–1302.

Tannor, E.K., Sarfo, F.S., Bedu-Addo, G. & Phillips, R.O. (2021). Prevalence and determinants of hypertension among adults with diabetes mellitus in Africa: a systematic review and meta-analysis. *Pan African Medical Journal*, 38: 119.

Tatsumi, Y., Ohkubo, T., Tsuchihashi, T., Kikuya, M., Asayama, K., Hozawa, A., Hisamatsu, T., Miura, K. & Ueshima, H. (2021). Hypertension and development of diabetes mellitus: a prospective cohort study. *American Journal of Hypertension*, 34(1): 59–66.

Tito, E., Kafando, I., Halilu, F., Bita, G. & Choukem, S.P. (2025). Screening for cardiometabolic disease risk factors: a hospital-based community health screening program in urban Cameroon (URBACAM-D). *Journal of Global Health Economics and Policy*, 5: e2025040.

Tonnejick, L., Muskiet, M.H.A., Smits, M.M., van Bommel, E.J.M., Heerspink, H.J.L., van Raalte, D.H. & Joles, J.A. (2020). Glomerular hyperfiltration in diabetes: mechanisms, clinical significance, and treatment. *Journal of the American Society of Nephrology*, 31(7): 1579–1592.

Tuttle, K.R., Agarwal, R., Alpers, C.E., Bakris, G.L., Brosius, F.C., Kolkhof, P. & Uribarri, J. (2021). Molecular mechanisms and therapeutic targets for diabetic kidney disease. *Nature Reviews Nephrology*, 17(5): 315–336.

Ukoha-Kalu, B.O., Adibe, M.O., Ukwe, C.V. & Okonta, J.M. (2022). Impact of pharmacist-led interventions on blood pressure control and medication adherence among patients with diabetes and hypertension in a Nigerian tertiary hospital: a pre-post interventional study. *BMC Health Services Research*, 22(1): 617.

Unger, T., Borghi, C., Charchar, F., Khan, N.A., Poulter, N.R., Prabhakaran, D.,

Scientia Africana, Vol. 25 (No. 3), June, 2026. Pp 213-242
© Faculty of Science, University of Port Harcourt, Printed in Nigeria *ISSN 1118 – 1931*

Ramirez, A., Schlaich, M., Stergiou, G.S., Tomaszewski, M., Wainford, R.D., Williams, B. & Schutte, A.E. (2020). 2020. International Society of Hypertension global hypertension practice guidelines. *Hypertension*, 75(6): 1334–1357.

Vujkovic, M., Keaton, J.M., Lynch, J.A., Miller, D.R., Zhou, J., Tcheandjieu, C., Huffman, J.E., Assimes, T.L., Banerjee, R., Cole, J.W. & others (2020). Discovery of 318 new risk loci for type 2 diabetes and related vascular outcomes among 1.4 million participants in a multi-ancestry meta-analysis. *Nature Genetics*, 52(7): 680–691.

Wadden, T.A., Bailey, T.S., Billings, L.K., Davies, M., Frias, J.P., Koroleva, A., Lingvay, I., Malkin, P., Mosenzon, O., O'Neil, P.M., Skjoth, T.V., Tadayon, S., Torekov, S.S. & Wharton, S. (2021). Effect of subcutaneous semaglutide vs placebo as an adjunct to intensive behavioral therapy on body weight in adults with overweight or obesity: the STEP 3 randomized clinical trial. *Journal of the American Medical Association*, 325(14): 1403–1413.

Wang, L., Peng, W., Zhao, Z., Zhang, M., Shi, Z., Song, Z., Zhang, X., Li, C., Huang, Z., Sun, J., Wang, L., Zhou, M., Wu, J. & Wang, Y. (2023). Prevalence and treatment of diabetes in China, 2013–2018. *Journal of the American Medical Association*, 329(24): 2158–2169.

Wang, W., Zhou, J. & Mu, Y. (2025). Management guidelines for diabetic patients with hypertension. *Journal of Diabetes*, 17(6): 337–350.

Wardlaw, J.M., Smith, C. & Dichgans, M. (2021). Small vessel disease: mechanisms and therapeutic perspectives. *The Lancet Neurology*, 20(8): 646–661.

Weir, M.R. (2021). Resistant hypertension in diabetes mellitus: mechanisms and management', *Journal of Hypertension*, 39(11), pp. 2155–2165.

World Health Organization (2021). HEARTS technical package for cardiovascular disease management in primary health care: risk-based CVD management. Geneva: World Health Organization.

World Health Organization (2022). Updated Appendix 3 of the WHO Global NCD Action Plan 2013–2030. Geneva: World Health Organization.

Younossi, Z.M., Golabi, P., de Avila, L., Paik, J.M., Srishord, M., Fukui, N., Qiu, Y., Burns, L., Afendy, A. & Nader, F. (2021). The global epidemiology of NAFLD and NASH in patients with type 2 diabetes: a systematic review and meta-analysis. *Journal of Hepatology*, 74(4): 793–807.

Zannad, F., Ferreira, J.P., Pocock, S.J., Anker, S.D., Butler, J., Filippatos, G., Brueckmann, M., Ofstad, A.P., Pfarr, E., Jamal, W. & Packer, M. (2020). SGLT2 inhibitors in patients with heart failure with reduced ejection fraction: a meta-analysis of the EMPEROR-Reduced and DAPA-HF trials. *The Lancet*, 396(10254): 819–829.

Zheng, Y., Ley, S.H. and Hu, F.B. (2020). Global aetiology and epidemiology of type 2 diabetes mellitus and its complications. *Nature Reviews Endocrinology*, 16(2): 88–98.

Zhou, B., Lu, Y., Hajifathalian, K., Bentham, J., Di Cesare, M., Danaei, G., Bixby, H., Cowan, M.J., Ali, M.K., Taddei, C., Lo, W.C., Reis-Santos, B., Stevens, G.A., Riley, L.M., Miranda, J.J., Bjerregaard, P., Rivera, J.A., Fouad, H.M., Ma, G., Mbanya, J.C., McGarvey, S.T., Mohan, V., Onat, A., Ramachandran, A., Romdhane, H.B., Rampal, S., Shah, P., Shaw, J.E., Solfrizzi, V., Söderberg, S., Tuomilehto, J., Vessby, B., Widmer, N. & Ezzati, M. (2021). Worldwide trends in diabetes since 1980: a pooled analysis of 751 population-based studies with 4.4 million participants. *The Lancet*, 397(10291): 1433–1446.