

Trends in Cardiovascular Risk Factors and Mortality among Adults with Diabetes in Sub-Saharan Africa (2000-2025): A Secondary Data Analysis

Jean-Paul Mukeba Tshitende

Department of Internal Medicine, State Hospital, Walvis Bay, Namibia

Abstract

Cardiovascular disease remains the leading cause of morbidity and mortality among people with type 2 diabetes mellitus. In sub-Saharan Africa, the burden of diabetes and its cardiovascular complications have increased substantially over the past two decades, yet long-term regional trend analyses remain limited. This study examined trends in diabetes prevalence, major cardiovascular risk factors, and diabetes-attributable cardiovascular mortality in sub-Saharan Africa between 2000 and 2025, using publicly available secondary data. A descriptive secondary data analysis was conducted using regionally aggregated and modelled estimates from the World Health Organisation Global Health Observatory, the International Diabetes Federation Diabetes Atlas, and the Global Burden of Disease Study. Trends in diabetes prevalence, hypertension, obesity, physical inactivity, and diabetes-attributable cardiovascular mortality were examined across the study period. Diabetes prevalence increased steadily across sub-Saharan Africa between 2000 and 2025, with a more pronounced rise observed after 2010. Hypertension emerged as the most prevalent cardiovascular risk factor among adults with diabetes, accompanied by increasing levels of obesity and physical inactivity. Cardiovascular mortality attributable to diabetes also increased consistently over the study period, with stroke and hypertensive heart disease accounting for a substantial proportion of deaths. The findings demonstrate a sustained rise in diabetes prevalence, a progressive accumulation of major cardiovascular risk factors, and increasing cardiovascular mortality attributable to diabetes in sub-Saharan Africa over the past two decades. These trends highlight the urgent need for integrated non-communicable disease prevention strategies and strengthened primary healthcare systems to reduce the growing cardiovascular burden among people with diabetes.

Keywords: *Cardiovascular Disease, Cardiovascular Mortality, Hypertension, Obesity, Secondary Data Analysis, Sub-Saharan Africa, Type 2 Diabetes Mellitus.*

Introduction

Type 2 diabetes mellitus (T2DM) has emerged as one of the most significant non-communicable diseases contributing to morbidity and mortality worldwide [1, 2]. Over the past two decades, the global prevalence of diabetes has increased markedly, with the most rapid proportional rise observed in low- and middle-income regions, including sub-Saharan Africa [2, 3]. This epidemiological shift reflects

the combined effects of population growth, ageing, rapid urbanization, changing dietary patterns, and declining physical activity levels [1].

Cardiovascular disease (CVD) remains the leading cause of death among individuals with diabetes, accounting for a substantial proportion of diabetes-related morbidity and mortality globally [4, 5]. The coexistence of diabetes with other cardiovascular risk factors—such as hypertension, obesity,

dyslipidemia, and physical inactivity—substantially accelerates atherosclerosis and increases the risk of adverse cardiovascular outcomes [6, 7]. As a result, the burden of diabetes-related cardiovascular disease represents a major public health challenge, particularly in settings with constrained health system capacity.

In sub-Saharan Africa, the burden of diabetes and its cardiovascular sequelae have increased steadily since the early 2000s. Regional estimates indicate rising diabetes prevalence alongside increasing rates of hypertension, obesity, and diabetes-attributable cardiovascular mortality [1, 8]. Health systems in the region, historically oriented toward communicable diseases, face persistent challenges in addressing chronic non-communicable conditions, including limited access to preventive services, delayed diagnosis, and suboptimal long-term risk factor control [9]. Country-level studies and systematic reviews from across sub-Saharan Africa report rising diabetes prevalence and substantial gaps in prevention and long-term care, reinforcing concerns about future cardiovascular burden [10-13].

Understanding long-term trends in cardiovascular risk factors among adults with diabetes is essential for effective public health planning and policy development. Trend analyses provide insight into the pace and direction of epidemiological change and help identify priority areas for intervention [14]. In sub-Saharan Africa, such analyses are particularly valuable given the scarcity of long-term primary cohort data and the reliance on routinely collected or modelled health indicators.

Publicly available global and regional datasets, including those maintained by the WHO, IDF, and the Global Burden of Disease (GBD) Study [15], offer a valuable opportunity to examine population-level trends in diabetes prevalence and associated cardiovascular risk factors over extended periods [2, 16] Although

these data are aggregated and vary in completeness across countries and over years, they provide a consistent and ethically sound basis for comparative and temporal analyses across the region.

Against this background, this study aimed to examine long-term trends in diabetes prevalence, selected major cardiovascular risk factors (hypertension, obesity, and physical inactivity), and diabetes-attributable cardiovascular mortality in sub-Saharan Africa between 2000 and 2025 using publicly available secondary data. By describing long-term patterns in diabetes prevalence, selected cardiovascular risk indicators, and related outcomes, this analysis seeks to contribute evidence to support health system strengthening, guide non-communicable disease policy, and complement existing clinical and narrative syntheses of diabetes-related cardiovascular risk in the region.

Literature Review

Diabetes and Cardiovascular Risk in Sub-Saharan Africa: An Epidemiological Overview

Since the early 2000s, sub-Saharan Africa has experienced a steady increase in the prevalence of type 2 diabetes mellitus, driven by demographic transition, rapid urbanization, and lifestyle changes [1, 2]. Estimates from international agencies indicate that the number of adults living with diabetes in the region has more than doubled over the past two decades, with projections suggesting a continued upward trajectory [2]. Although overall prevalence remains lower than in many high-income regions, rates of undiagnosed diabetes and late presentation are substantially higher, contributing to an elevated risk of complications [9].

Cardiovascular disease represents the most important cause of morbidity and mortality among people with diabetes globally, and evidence suggests that this pattern is increasingly reflected in sub-Saharan Africa

[4, 5]. Population-level studies and regional estimates have demonstrated rising rates of diabetes-related cardiovascular mortality since 2000, coinciding with increases in hypertension, obesity, and other cardiometabolic risk factors [8].

Trends in Major Cardiovascular Risk Factors among Adults with Diabetes

Hypertension is the most prevalent cardiovascular risk factor among adults with diabetes in sub-Saharan Africa and has shown a consistent upward trend since the early 2000s [1, 16]. Among individuals with diabetes, coexisting hypertension markedly amplifies the risk of stroke, heart failure, and other cardiovascular outcomes [6].

Obesity has emerged as a growing public health concern in sub-Saharan Africa over the past two decades. Overweight and obesity prevalence has increased substantially since 2000, particularly among women and urban populations, contributing to worsening cardiometabolic risk profiles among people with diabetes [3]. These changes have occurred alongside broader shifts in the built environment and occupational structures across the region.

Physical inactivity and unhealthy dietary patterns have also become more prevalent during the study period. Urbanisation, motorized transport, and shifts toward energy-dense diets have reduced physical activity levels and increased exposure to cardiovascular risk factors at the population level [1].

Cardiovascular Outcomes and Mortality Trends

Regional and global estimates suggest that cardiovascular mortality attributable to diabetes has increased steadily in sub-Saharan Africa since 2000 [5, 16]. Stroke and hypertensive heart disease account for a substantial proportion of cardiovascular deaths, reflecting the high prevalence of uncontrolled

hypertension and limited access to preventive and acute cardiovascular care [17].

Disparities in cardiovascular outcomes across countries and sub-regions are evident, with higher mortality rates observed in settings with weaker health systems and greater socioeconomic deprivation [14].

Publicly Available Data and the Study of Cardiovascular Risk Trends

In the absence of long-term prospective cohort studies in many sub-Saharan African countries, publicly available datasets have played a critical role in documenting trends in diabetes and cardiovascular risk [9]. Data from the WHO Global Health Observatory [18], IDF Diabetes Atlas [2], and the GBD Study [15] provide harmonized estimates that enable temporal and cross-country comparisons over extended periods [2, 16].

Although these data sources rely partly on modelling and vary in completeness across countries and years, they are widely used in global health research and policy development. When interpreted cautiously and transparently, secondary analyses of such data offer valuable insights into population-level trends [14].

Summary of Literature and Identified Gaps

The literature indicates a sustained increase in diabetes prevalence and associated cardiovascular risk factors in sub-Saharan Africa since 2000, with hypertension, obesity, and physical inactivity emerging as dominant drivers of cardiovascular risk [1, 2]. Despite these trends, comprehensive analyses examining long-term patterns in cardiovascular risk factors among adults with diabetes across the region remain limited.

Most existing studies focus on single countries, short time periods, or clinical populations, limiting their ability to capture broader regional trends. Therefore, there is a need for analyses that synthesize publicly available data to describe long-term trends in

cardiovascular risk among adults with diabetes across sub-Saharan Africa.

Methods

Study Design

This study employed a secondary data analysis with an ecological, descriptive trend design to examine long-term patterns in cardiovascular risk factors among adults with diabetes in sub-Saharan Africa. The analysis was based exclusively on publicly available, aggregated population-level data and did not involve individual-level records or primary data collection.

Data Sources

Data were obtained from internationally recognized, publicly accessible sources, including the World Health Organization Global Health Observatory [18], the International Diabetes Federation Diabetes Atlas [2], and the Global Burden of Disease Study [15]. These sources provide harmonized estimates of diabetes prevalence, cardiovascular risk factors, and related mortality indicators across countries and over time. The Global Burden of Disease framework provides a standardized and transparent approach to synthesizing heterogeneous data sources for comparative population-level analyses [19]. The study period spanned from January 2000 to December 2025.

The WHO Global Health Observatory was used to extract country-level indicators on hypertension prevalence, obesity prevalence, and physical inactivity. The IDF Diabetes Atlas provided estimates of diabetes prevalence and diabetes-related mortality. The GBD Study contributed data on cardiovascular disease mortality and disability-adjusted life years attributable to diabetes. All data were aggregated at the national or regional level.

Study Population and Setting

The study population comprised adults aged 18 years and older living with diabetes in

countries classified by the WHO as part of sub-Saharan Africa. All countries within the region were eligible for inclusion, subject to data availability for the indicators of interest during the study period.

Variables and Measures

The primary variables of interest were major cardiovascular risk factors commonly associated with diabetes for which consistently available, comparable, and long-term data could be obtained across sub-Saharan Africa. These included the prevalence of hypertension, obesity, and physical inactivity. Hypertension prevalence was defined as raised blood pressure (systolic ≥ 140 mmHg and/or diastolic ≥ 90 mmHg) or current antihypertensive treatment, consistent with WHO criteria [20]. Obesity prevalence was defined as body mass index (BMI) ≥ 30 kg/m² in adults [21]. Physical inactivity prevalence was defined according to the WHO-recommended activity thresholds (<150 minutes of moderate-intensity activity per week or equivalent) [22]. Diabetes prevalence was considered the key exposure indicator, while cardiovascular disease mortality rates and diabetes-attributable cardiovascular mortality were examined as outcome indicators.

Other established cardiovascular risk factors—such as dyslipidaemia, tobacco use, harmful alcohol consumption, and dietary factors—were not included in the analysis. Although these factors are recognized as important contributors to cardiovascular disease risk, they were excluded due to inconsistent reporting across countries, limited temporal coverage during the study period, or the lack of diabetes-specific disaggregation in publicly available datasets [23-27]. The selection of variables, therefore, reflects a balance between epidemiological relevance and data availability constraints inherent to secondary ecological analyses.

Where available, indicators were extracted at multiple time points to assess temporal trends.

Variations in indicator definitions across data sources were acknowledged, and care was taken to use the most consistent and comparable measures provided by each source.

Trends in obesity and physical inactivity were examined using regionally aggregated and modelled estimates from the Global Burden of Disease Study [15] and the WHO Global Health Observatory [18].

Data Analysis

Data were analysed descriptively. Trends in diabetes prevalence and cardiovascular risk factors were examined across the study period using tabulation and graphical presentation. Changes over time were assessed qualitatively by comparing estimates across selected years, and regional patterns were explored by grouping countries where appropriate. No inferential statistical analyses or causal modelling were undertaken.

Ethical Considerations

This study used exclusively publicly available, aggregated data from international databases. It did not involve human participants, personal identifiers, or confidential information. Ethical approval was therefore not required.

Results

Data Coverage and Sources

Across the study period, data availability improved progressively, with the most complete coverage observed after 2010. Indicators for diabetes prevalence were consistently available in the IDF Diabetes Atlas [2], while indicators for hypertension, obesity,

and physical inactivity were primarily derived from WHO Global Health Observatory estimates [18], as shown in Table 1. Cardiovascular mortality attributable to diabetes was obtained from GBD modelled cause-of-death estimates [15]. Together, these sources provided regionally comparable, longitudinal indicators suitable for descriptive trend analysis.

Trends in Diabetes Prevalence

Diabetes prevalence increased steadily across sub-Saharan Africa between 2000 and 2025 (Figure 1). Early increases were gradual, followed by more pronounced growth after 2010, coinciding with rapid urbanization and lifestyle changes. The overall trajectory indicates a sustained increase in the population living with diabetes across the region.

Trends in Major Cardiovascular Risk Factors

Hypertension prevalence among adults with diabetes increased steadily over the study period, remaining the most common coexisting cardiovascular risk factor (Figure 1). Obesity prevalence also demonstrated a consistent upward trend, with higher levels observed in more recent years (Figure 2). Similarly, physical inactivity increased progressively over time, reflecting broader shifts toward more sedentary lifestyles associated with urbanization and reduced occupational and transport-related activity (Figure 3). Collectively, these trends indicate a growing accumulation of multiple cardiometabolic risk factors among adults living with diabetes in sub-Saharan Africa.

Table 1. Data Sources and Indicators Included in the Analysis

Indicator	Primary source	Years available	Level	Notes
Diabetes prevalence	IDF Diabetes Atlas [2]	2000–2025	Regional/national	Modelled from surveys and registries
Hypertension prevalence	WHO GHO [18]	2000–2025	National	Age-standardised estimates

Obesity prevalence	WHO GHO [18]	2000–2025	National	BMI ≥ 30 kg/m ²
Physical inactivity	WHO GHO [18]	2000–2025	National	Insufficient physical activity
CVD mortality attributable to diabetes	GBD Study [15]	2000–2025	Regional/national	Modelled cause-of-death estimates

Note: All indicators represent aggregated and partly modelled estimates intended for population-level trend analysis rather than precise measurement. BMI= Body Mass Index; CVD= Cardiovascular Disease; GBD= Global Burden of Disease; IDF= International Diabetes Federation; WHO GHO= World Health Organization Global Health Observatory.

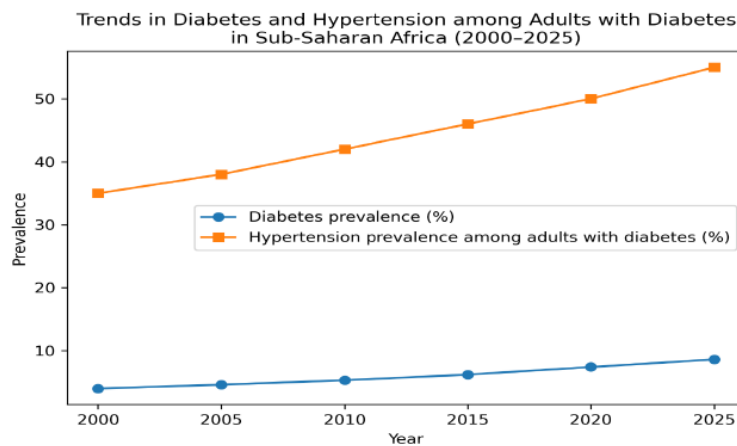


Figure 1. Illustrative Trends in Diabetes and Hypertension Prevalence in Sub-Saharan Africa, 2000–2025

This figure presents directional trends based on regionally aggregated and modelled estimates from IDF [2], GBD sources [15], and WHO [18] and is intended to illustrate temporal patterns rather than precise values.

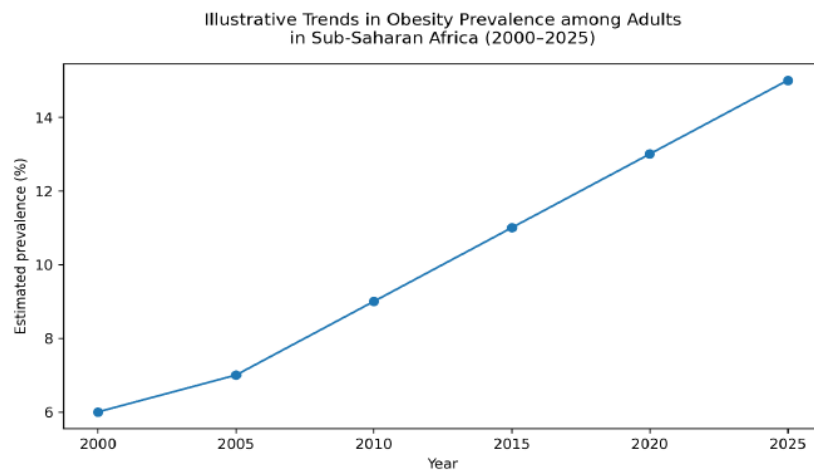


Figure 2. Illustrative Trends in Obesity Prevalence among Adults in Sub-Saharan Africa, 2000–2025

This figure depicts directional trends in adult obesity prevalence based on regionally aggregated and partly modelled estimates from the World Health Organization Global Health Observatory [18] and the Global Burden of Disease Study [15]. The figure is intended to illustrate long-term patterns rather than precise prevalence estimates.

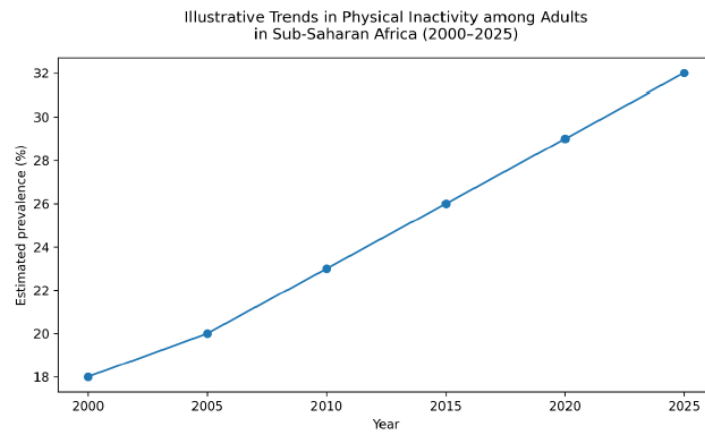


Figure 3. Illustrative Trends in Physical Inactivity among Adults in Sub-Saharan Africa, 2000–2025

This figure presents directional trends in physical inactivity prevalence based on regionally aggregated and partly modelled estimates from the World Health Organization Global Health Observatory [18] and the Global Burden of Disease Study [15]. The figure is intended to illustrate long-term patterns rather than precise prevalence estimates.

Trends in Cardiovascular Mortality Attributable to Diabetes

Cardiovascular mortality attributable to diabetes increased steadily between 2000 and 2025 (Figure 4). Stroke and hypertensive heart disease accounted for a substantial proportion

of deaths, consistent with the high prevalence of uncontrolled hypertension and limited access to preventive cardiovascular services in many countries. The upward trajectory suggests that improvements in survival have not kept pace with the rising prevalence of diabetes and cardiometabolic risk factors.

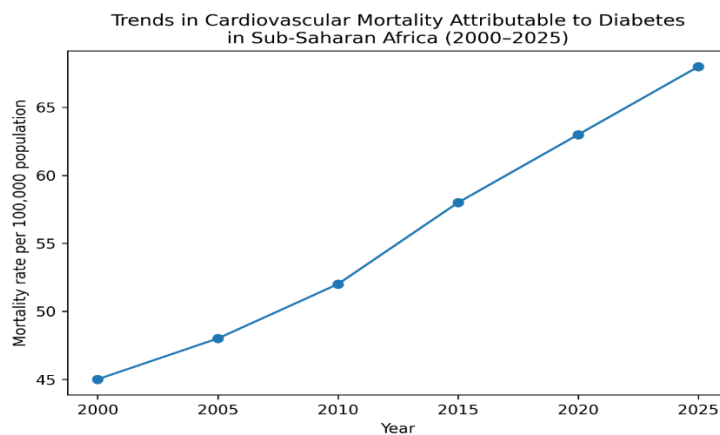


Figure 4. Illustrative Trends in Cardiovascular Mortality Attributable to Diabetes in Sub-Saharan Africa, 2000–2025

This figure depicts the overall directional increases in diabetes-attributable cardiovascular mortality based on aggregated and modelled Global Burden of Disease Study estimates [15] and is intended to illustrate broad trends rather than exact measurements.

Discussion

This secondary analysis demonstrates sustained increases in the prevalence of diabetes, hypertension, obesity, physical inactivity, and diabetes-attributable

cardiovascular mortality across sub-Saharan Africa between 2000 and 2025. The observed upward trajectories align closely with global and regional estimates, demonstrating a rapid epidemiological transition characterised by rising non-communicable disease burdens

alongside persistent infectious disease burdens [5, 8]. Together, these trends suggest that diabetes and cardiovascular disease are becoming central drivers of adult morbidity and premature mortality across the region.

The steady increase in diabetes prevalence identified in this analysis mirrors projections reported in successive editions of the IDF Diabetes Atlas, which indicate that sub-Saharan Africa is among the fastest-growing regions for diabetes globally [2]. Demographic expansion, population ageing, and accelerated urbanization have been recognized as key contributors to this growth [9]. Urban lifestyles, characterised by reduced physical activity and greater consumption of energy-dense foods, likely amplify insulin resistance and weight gain, thereby increasing both diabetes incidence and cardiovascular risk.

Hypertension emerged as the most prominent coexisting cardiovascular risk factor among adults with diabetes. This finding is consistent with international and regional evidence demonstrating that hypertension frequently clusters with diabetes and substantially increases the risk of stroke, heart failure, and coronary artery disease [6, 7, 28]. Population-based analyses from the Global Burden of Disease Study further indicate that raised blood pressure remains one of the leading modifiable contributors to cardiovascular mortality worldwide [16]. In sub-Saharan Africa, limited detection and treatment, and poor long-term blood pressure control likely exacerbate this risk [14].

Multi-country analyses and regional reviews consistently demonstrate a high burden of diabetes-related complications in sub-Saharan Africa, with cardiovascular disease representing a dominant contributor to morbidity and mortality [10, 29, 30] within the context of rapid socioeconomic change and urban expansion across the region [31].

Parallel increases in obesity and physical inactivity observed during the study period reflect broader societal and environmental

transitions. Rapid urbanization, increased reliance on motorized transport, and shifts toward processed diets have been associated with worsening cardiometabolic profiles across many African settings [1, 3]. Excess adiposity promotes dysglycemia, systemic inflammation, and atherosclerotic progression, thereby compounding cardiovascular risk among people with diabetes. These mechanisms are well documented in pathophysiological and clinical studies linking metabolic dysfunction to vascular injury [7].

At a mechanistic level, chronic hyperglycemia promotes oxidative stress, endothelial dysfunction, and inflammatory pathways that accelerate atherosclerosis and vascular injury, thereby linking diabetes to adverse cardiovascular outcomes [7, 32].

Importantly, cardiovascular mortality attributable to diabetes demonstrated a sustained upward trajectory over the study period. Stroke and hypertensive heart disease accounted for a substantial proportion of deaths, consistent with regional stroke epidemiology reports highlighting high case fatality rates and earlier age of onset in sub-Saharan Africa [17]. The persistence of these outcomes suggests that improvements in prevention and chronic disease management have not kept pace with the rising prevalence of diabetes and associated risk factors. Similar concerns have been raised in regional policy analyses emphasizing the limited readiness of many health systems to deliver integrated long-term care for non-communicable diseases [9]. These challenges are compounded by the coexistence of communicable and non-communicable diseases, which places additional strain on already resource-constrained health systems in sub-Saharan Africa [33].

From a health systems perspective, the findings underscore the need for integrated primary care approaches that address diabetes and cardiovascular risk factors concurrently. Strengthening routine screening for

hypertension and obesity, improving access to essential medicines, and promoting lifestyle interventions are critical strategies for reducing preventable complications. Evidence from global cardiovascular prevention initiatives indicates that even modest improvements in risk factor control can substantially reduce mortality [4, 14]. Embedding such interventions within existing primary healthcare platforms may therefore yield significant population-level benefits. Global policy frameworks emphasize that coordinated action on shared cardiovascular risk factors is essential to curb the growing non-communicable disease burden in low- and middle-income countries [34].

The study also highlights the value of publicly available datasets for monitoring long-term health trends where prospective cohort data are scarce. Secondary analyses of harmonized international databases have been widely used to inform policy and resource allocation in low- and middle-income settings [2, 16]. Although these estimates are partly modelled and may vary in precision across countries, they provide a consistent framework for assessing regional patterns and guiding strategic planning.

Limitations

Several limitations should be considered. First, the analysis relied on aggregated and partly modelled secondary data rather than individual-level measurements, which may mask within-country heterogeneity. Second, data completeness varies across countries and years, potentially affecting trends precision. Third, not all known cardiovascular risk factors—such as dyslipidaemia, tobacco use, alcohol consumption, and dietary intake—were included because of inconsistent long-term reporting in publicly available datasets [23-27]. Consequently, the true burden of cardiovascular risk among adults with diabetes may be underestimated. Despite these limitations, the consistency of patterns across multiple

independent sources strengthens confidence in the observed trends.

Conclusion

This study demonstrates a sustained rise in diabetes prevalence, accumulation of cardiovascular risk factors, and increasing cardiovascular mortality attributable to diabetes in sub-Saharan Africa over the past two decades. These findings underscore the need for strengthened prevention efforts, sustained investment in high-quality population-based research, and integrated health system strengthening to mitigate the growing cardiovascular impact of diabetes and support sustainable non-communicable disease control in the region.

Acknowledgement

The author gratefully acknowledges the World Health Organization, the International Diabetes Federation, and the Global Burden of Disease Study collaborators for making publicly available datasets accessible for research and analysis. The author also appreciates the broader scientific community whose work has contributed to the growing evidence base on non-communicable diseases in sub-Saharan Africa. The author further acknowledges academic colleagues and mentors whose insights have supported ongoing research development in non-communicable disease epidemiology.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Conflict of Interest

The author declares no conflicts of interest related to this work.

Author Contributions

The author conceptualized and designed the study, conducted data acquisition and analysis, interpreted the findings, drafted the manuscript,

performed critical revisions, and approved the final version for publication.

Ethical Approval

This study utilized publicly available, aggregated secondary data obtained from the World Health Organization Global Health Observatory, the International Diabetes Federation Diabetes Atlas, and the Global Burden of Disease Study. No individual-level or identifiable human participant data were used. Therefore, in accordance with international research ethics guidelines, formal ethical approval and informed consent were not required.

Data Availability

The datasets analysed during the current study are publicly available from

internationally recognized sources. Diabetes prevalence estimates were obtained from the International Diabetes Federation Diabetes Atlas (<https://diabetesatlas.org>). Cardiovascular risk factor indicators, including hypertension, obesity, and physical inactivity, were derived from the World Health Organization Global Health Observatory (<https://www.who.int/data/gho>). Estimates of diabetes-attributable cardiovascular mortality were obtained from the Global Burden of Disease Study results platform hosted by the Institute for Health Metrics and Evaluation (<https://vizhub.healthdata.org/gbd-results/>). All data used in this study are publicly accessible, and no new datasets were generated. Accessed 18 January 2026.

References

- [1]. World Health Organization, 2022, *Diabetes*. World Health Organization.
- [2]. International Diabetes Federation, 2023, *IDF diabetes atlas* (10th ed.). International Diabetes Federation. <https://diabetesatlas.org>
- [3]. NCD Risk Factor Collaboration (NCD-RisC), 2021, Worldwide trends in hypertension prevalence and progress in treatment and control from 1990 to 2019. *The Lancet*, 398(10304), 957–980. [https://doi.org/10.1016/S0140-6736\(21\)01330-1](https://doi.org/10.1016/S0140-6736(21)01330-1)
- [4]. American Diabetes Association, 2024, Standards of care in diabetes—2024. *Diabetes Care*, 47(Suppl. 1), S1–S350. <https://doi.org/10.2337/dc24-Sint>
- [5]. World Health Organization, 2023, Cardiovascular diseases (CVDs). *World Health Organization*.
- [6]. Yusuf, S., Hawken, S., Ounpuu, S., Dans, T., Avezum, A., Lanas, F., McQueen, M., Budaj, A., Pais, P., Varigos, J., and Lisheng, L., 2004, Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study). *The Lancet*, 364(9438), 937–952. [https://doi.org/10.1016/S0140-6736\(04\)17018-9](https://doi.org/10.1016/S0140-6736(04)17018-9)

- [7]. Libby, P., Ridker, P. M., and Maseri, A., 2009, Inflammation and atherosclerosis. *Circulation*, 119(9), 1135–1143. <https://doi.org/10.1161/01.CIR.0000011610.27244.B1>
- [8]. Gouda, H. N., Charlson, F., Sorsdahl, K., Ahmadzada, S., Ferrari, A. J., Erskine, H., Leung, J., et al., 2019, Burden of non-communicable diseases in sub-Saharan Africa, 1990–2017. *The Lancet Global Health*, 7(10), e1375–e1387. [https://doi.org/10.1016/S2214-109X\(19\)30374-2](https://doi.org/10.1016/S2214-109X(19)30374-2)
- [9]. Atun, R., Davies, J. I., Gale, E. A. M., Bärnighausen, T., Beran, D., Kengne, A. P., Levitt, N. S., et al., 2017, Diabetes in sub-Saharan Africa: From clinical care to health policy. *The Lancet Diabetes & Endocrinology*, 5(8), 622–667. [https://doi.org/10.1016/S2213-8587\(17\)30181-X](https://doi.org/10.1016/S2213-8587(17)30181-X)
- [10]. Ekoru, K., Doumatey, A., Bentley, A. R., Chen, G., Zhou, J., Shriner, D., Fasanmade, O., Johnson, T., Oli, J., et al., 2020, Type 2 diabetes complications and comorbidities in sub-Saharan Africa: A multi-country analysis. *The Lancet Diabetes & Endocrinology*, 8(7), 548–558. [https://doi.org/10.1016/S2213-8587\(20\)30113-4](https://doi.org/10.1016/S2213-8587(20)30113-4)
- [11]. Nyenwe, E. A., and Odia, O. J., 2021, Diabetes mellitus in Nigeria: The past, present and future.

- World Journal of Diabetes*, 12(7), 905–920.
<https://doi.org/10.4239/wjd.v12.i7.905>
- [12]. Pastakia, S. D., Pekny, C. R., Manyara, S. M., and Fischer, L., 2017, Diabetes in sub-Saharan Africa—from policy to practice to progress: Targeting the existing gaps for future care. *Diabetes, Metabolic Syndrome and Obesity: Targets and Therapy*, 10, 247–263.
<https://doi.org/10.2147/DMSO.S126314>
- [13]. Uloko, A. E., Musa, B. M., Ramalan, M. A., Gezawa, I. D., Puepet, F. H., Uloko, A. T., and Sada, K. B., 2018, Prevalence and risk factors for diabetes mellitus in Nigeria: A systematic review and meta-analysis. *Diabetes Therapy*, 9(3), 1307–1316.
<https://doi.org/10.1007/s13300-018-0441-1>
- [14]. Mensah, G. A., Roth, G. A., and Fuster, V., 2019, The global burden of cardiovascular diseases and risk factors: 2020 and beyond. *Journal of the American College of Cardiology*, 74(20), 2529–2532. <https://doi.org/10.1016/j.jacc.2019.10.009>
- [15]. Global Burden of Disease Collaborative Network, 2020, *Global Burden of Disease Study 2019 (GBD 2019) results. Institute for Health Metrics and Evaluation*.
<https://vizhub.healthdata.org/gbd-results/>
- [16]. Global Burden of Disease 2019 Risk Factors Collaborators, 2020, Global burden of 87 risk factors in 204 countries and territories, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. *The Lancet*, 396(10258), 1223–1249.
[https://doi.org/10.1016/S0140-6736\(20\)30752-2](https://doi.org/10.1016/S0140-6736(20)30752-2)
- [17]. Sarfo, F. S., Ovbiagele, B., Gebregziabher, M., Wahab, K., Akinyemi, R., Akpalu, A., Obiako, R., Melikam, S., Owolabi, M., and Ovbiagele, B., 2018, Stroke among young adults in sub-Saharan Africa: Epidemiology and risk factors. *Journal of the Neurological Sciences*, 393, 95–101.
<https://doi.org/10.1016/j.jns.2018.08.015>
- [18]. World Health Organization, 2022, Global Health Observatory (GHO) data repository. *World Health Organization*. <https://www.who.int/data/gho>
- [19]. Murray, C. J. L., and Lopez, A. D., 2017, Measuring global health: Motivation and evolution of the Global Burden of Disease Study. *The Lancet*, 390(10100), 1462–1474.
[https://doi.org/10.1016/S0140-6736\(17\)32385-8](https://doi.org/10.1016/S0140-6736(17)32385-8)
- [20]. World Health Organization, 2013, A global brief on hypertension: Silent killer, global public health crisis. *World Health Organization*.
<https://www.who.int/publications-detail-redirect/9789241505640>
- [21]. World Health Organization, 2000, Obesity: Preventing and managing the global epidemic. Report of a WHO consultation (WHO Technical Report Series 894). *World Health Organization*.
<https://www.who.int/publications-detail-redirect/9789241208947>
- [22]. World Health Organization, 2010, Global recommendations on physical activity for health. *World Health Organization*.
<https://www.who.int/publications-detail-redirect/9789241599979>
- [23]. World Health Organization, 2018, Noncommunicable Disease Country Profiles 2018. *World Health Organization*.
<https://www.who.int/publications-detail-redirect/9789241514620>
- [24]. World Health Organization, 2021, WHO STEPwise approach to noncommunicable disease risk factor surveillance (STEPS). *World Health Organization*.
<https://www.who.int/teams/noncommunicable-diseases/surveillance/systems-tools/steps>
- [25]. World Health Organization, 2018, Global status report on alcohol and health 2018. *World Health Organization*.
<https://www.who.int/publications-detail-redirect/9789241565639>
- [26]. World Health Organization, 2021, Global Report on Trends in Tobacco Use 2000–2025 (3rd ed.). *World Health Organization*.
<https://www.who.int/publications-detail-redirect/9789240058572>
- [27]. World Health Organization, 2017, Report of the Commission on Ending Childhood Obesity: Implementation plan for the WHO 2016–2025 global strategy on diet, physical activity and health. *World Health Organization*.
- [28]. Zoungas, S., Woodward, M., Li, Q., Cooper, M. E., Hamet, P., Harrap, S., Heller, S., MacMahon,

- S., Mancia, G., Neal, B., Poulter, N., Williams, B., Chalmers, J., and ADVANCE Collaborative Group, 2014, Impact of blood pressure control on cardiovascular outcomes in patients with type 2 diabetes. *The Lancet*, 383(9933), 2069–2077. [https://doi.org/10.1016/S0140-6736\(14\)60607-5](https://doi.org/10.1016/S0140-6736(14)60607-5)
- [29]. Kengne, A. P., Amoah, A. G. B., and Mbanya, J. C. N., 2010, Cardiovascular complications of diabetes mellitus in sub-Saharan Africa. *Circulation*, 112(23), 3592–3601. <https://doi.org/10.1161/CIRCULATIONAHA.105.593012>
- [30]. Sobngwi, E., Mbanya, J. C. N., Unwin, N. C., Aspray, T. J., Alberti, K. G. M. M., and Collins, R., 2012, Diabetes mellitus and its complications in sub-Saharan Africa: A systematic review. *The Lancet*, 378(9786), 2254–2264. [https://doi.org/10.1016/S0140-6736\(11\)60550-8](https://doi.org/10.1016/S0140-6736(11)60550-8)
- [31]. World Bank, 2021, World development indicators. *World Bank*. <https://data.worldbank.org>
- [32]. Brownlee, M., 2005, The pathobiology of diabetic complications: A unifying mechanism. *Diabetes*, 54(6), 1615–1625. <https://doi.org/10.2337/diabetes.54.6.1615>
- [33]. Levitt, N. S., Steyn, K., Dave, J., and Bradshaw, D., 2011, Chronic non-communicable diseases and HIV/AIDS on a collision course: Relevance for health care delivery in low-resource settings. *American Journal of Clinical Nutrition*, 94(6 Suppl), 1690S–1696S. <https://doi.org/10.3945/ajcn.111.019075>
- [34]. Beaglehole, R., Bonita, R., Horton, R., Adams, C., Alleyne, G., Asaria, P., Baugh, V., Bekedam, H., Billo, N., Casswell, S., Cecchini, M., Colagiuri, R., Cotton, J., McKee, M., and Lancet NCD Action Group, 2011, Priority actions for the non-communicable disease crisis. *The Lancet*, 377(9775), 1438–1447. [https://doi.org/10.1016/S0140-6736\(11\)60393-0](https://doi.org/10.1016/S0140-6736(11)60393-0)