

**AKENTEN APPIAH-MENKA UNIVERSITY FOR SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT**

**CONCORDANT COMORBIDITIES IN DIABETES: PREVALENCE,
DETERMINANTS, AND DISTRIBUTION PATTERNS AMONG PATIENTS
ATTENDING THE ASHANTI MAMPONG MUNICIPAL GOVERNMENT
HOSPITAL**

DANIEL OBIRI-YEBOAH

2025

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BY

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A thesis to the School of Graduate Studies, Akenten Appiah-Menka University of Skills
Training and Entrepreneurial Development in partial fulfilment of the requirements for the
award of a Master of Philosophy degree in Public Health

NOVEMBER, 2025

DECLARATIONS

Candidate's Declaration

I hereby declare that this thesis, with the exception of quotation and references contained in published works which have been duly acknowledged; is the result of own original work and that no part of it has been presented for another degree in this university or elsewhere.

Daniel Obiri-Yeboah

Signature: Date:

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the Appiah-Menka University of Skills Training and Entrepreneurial Development.

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DEDICATION

This work is dedicated to my beloved mother, whose strength, resilience, and unyielding support have been the foundation of my life and education.

I also dedicate this thesis to all individuals living with diabetes and struggling with its complications especially Low and Middle Income Countries. May this work serve as a small step towards better understanding, management, and care.

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LIST OF ABBREVIATIONS

AGEs	Advanced Glycation End Products
BMI	Body Mass Index
CAD	Coronary Artery Disease
CDC	Center for Disease Control and Prevention
CKD	Chronic Kidney Disease
CVD	Cardiovascular Disease
DCCT	Diabetes Control and Complications Trial
DM	Diabetes Mellitus
EHR	Electronic Health Record
ESRD	End-Stage Renal Disease
FBG	- Fasting Blood Glucose
GHS	Ghana Health Service
GL	Glycaemic Load
HbA1c	Haemoglobin A1C
HBM	Health Belief Model
HDL	High-Density Lipoprotein
IDDM	Insulin-Dependent Diabetes Mellitus
IGT	Impaired Glucose Tolerance
LDL	Low-Density Lipoprotein
LMIC(s)	Low- and Middle-Income Country/Countries
MoH	Ministry of Health
NAFLD	Non-Alcoholic Fatty Liver Disease
NASH	Non-Alcoholic Steatohepatitis
NCD(s)	Non-Communicable Disease(s)

NHANES	National Health and Nutrition Examination Survey
OPD	Outpatient Department
PAD	Peripheral Artery Disease
SES	Socioeconomic Status
SSA	Sub-Saharan Africa
T1DM	Type 1 Diabetes Mellitus
T2DM	Type 2 Diabetes Mellitus
UKPDS	United Kingdom Prospective Diabetes Study
WHO	World Health Organization

ABSTRACT

Nowadays diabetic comorbidities constitute a major public health problem in Ghanaian context. However, there is a dearth of evidence in epidemiology and determinants of diabetic comorbidity in Ghana, particularly in the study setting. Therefore, this study was conducted to estimate the prevalence, examine the determinants associated and assess the socio-demographic predictors of concordant comorbidities among diabetes patients attending the Ashanti Mampong Government Hospital. A hospital-based cross-sectional study was conducted, with a total of 430 diabetic patients were selected using the simple random sampling without replacement (SRSWOR) technique. Bivariable and multivariable logistic regression analysis were carried out using Stata version 19 (StateCorp LLC, College Station, TX, USA). Descriptive and inferential statistics were employed in the data in analysis. To measure the strength of association and Adjusted Odds Ratio (AOR) with 95% Confidence Interval (CI) was used. Moreover, variables with p -value ≤ 0.05 were considered as statistically significant with the outcome variable. In this study, it is found that the overall prevalence of concordant comorbidity among adult diabetic out-patients was 84.0% (95% CI: 80.2 – 87.3). Moreover, more than two-third of patients, 96.9% were diagnosed for type two diabetic mellitus (T2DM). Age ≥ 55 years (AOR = 7.61; 95% CI: 2.14 – 10.71; $p = 0.034$), female (AOR = 3.89; 95% CI: 1.92 – 5.10; $p = 0.028$), T2DM (AOR = 2.38, 95% CI: 1.57–3.59, $p = 0.000$), ≥ 5 years duration of treatments (AOR = 9.04, 95% CI: 2.02–12.88, $p = 0.036$), and poor glycaemic control (AOR = 1.31, 95% CI: 1.02–2.67, $p = 0.000$) were factors significantly associated with concordant diabetic comorbidity. The findings underscore the importance of early detection and timely, appropriate management of diabetic comorbidities to improve patients' quality of life and overall functional status.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Diabetes is a Non-Communicable Diseases (NCDs), reaching epidemic proportions globally (Motala *et al.*, 2022). According to Arokiasamy *et al.* (2021), 60% of all deaths worldwide are caused by NCDs, including diabetes, of which 80% of deaths due to diabetes occur within low- and middle-income countries (LMIC), including Ghana. It is projected that by 2030, type-2-diabetes mellitus (T2DM) would become the leading cause of death on the African continent (Carmen *et al.*, 2021). A study among diabetes mellitus (DM) patients showed that the coexistence of hypertension in diabetes mellitus is attributed to the risk of death and cardiovascular events by 44% and 41%, respectively, compared with 7% and 9% of risks in people with diabetes alone (Akalu & Belsti, 2020).

Diabetes foot problems, peripheral neuropathy, ophthalmic diseases, erectile dysfunction, cardiovascular and cerebrovascular disorders, renal impairment, and other modifiable and non-modifiable factors can all be impacted by hyperglycaemia, which raises the risk of complications in diabetics (Alam, 2021). Symptoms of diabetes include frequent urination (polyuria), excessive thirst (polydipsia), blurred vision, sugar in urine (glycosuria), dehydration, weight loss, and sometimes increased hunger (polyphagia) (Razaq *et al.*, 2020).

Several factors can contribute to diabetes in individuals, including demographic variables such as lifestyle, urbanisation, unhealthy dietary habits, family history, cigarette smoking, and growing consumption of cheap processed food, genes, viruses, age, sex, ethnicity, socioeconomic status, and lifestyle factors such as diet, physical activity, and smoking status (Al-Worafi, 2024; Kidanie *et al.*, 2020; Ndateba, 2020; Struijs *et al.*, 2019).

Additionally, genetic predisposition, duration of diabetes, glycaemic control, and presence of other determinants such as hypertension and dyslipidaemia play significant roles (Goicochea-Rios *et al.*, 2024). Factors associated with type 2 diabetes mellitus comorbidity among adult patients include physical inactivity and overweight or obesity, both of which contribute to insulin resistance and can lead to the development of type 2 diabetes. In contrast, type 1 diabetes occurs when the individual's body immune system attacks and destroys beta cells in the pancreas (Gbadamosi, 2021).

When a patient has two or more chronic illnesses or medical disorders, this is known as comorbidity (Bajgain *et al.*, 2021; Agu, 2019). Patients with diabetes who have one or more chronic diseases are said to have diabetes comorbidities, which can be categorized as either concordant or discordant (Ejeta *et al.*, 2021). Concordant comorbidities are diseases with similar pathophysiological characteristics, such as hypertension, obesity, hyperlipidaemia, Cardiovascular Disease (CVD), and Chronic Kidney Disease (CKD), frequently concentrating on the same illness, while discordant comorbidities are illnesses that are not etiologically related to diabetes mellitus and do not share similar determinants (Ejeta *et al.*, 2020).

Ejeta *et al.* (2021), reported that 40% of diabetic patients have at least three comorbidities, whereas the majority have at least one. However, other studies reported that 88.5% of patients have two conditions and over 97.5% have one, particularly in Sub-Saharan Africa (Kwobah, 2020; Ndateba, 2020). Furthermore, effectively managing diabetes presents significant challenges, particularly in low- and middle-income nations like Ghana (Afaya, 2021). Koduah *et al.* (2021), documented a heightened occurrence of persistent complications, notably a 97.2% prevalence of hypertension among patients with type 2

diabetes mellitus, a trend commonly observed in low- and middle-income countries such as Ghana.

The distribution of concordant comorbidities among patients with diabetes varies across populations and geographic regions. Cardiovascular diseases, including coronary artery disease, stroke, and peripheral arterial disease, are among the most prevalent concordant comorbidities (Allison *et al.*, 2023). Other common comorbidities include hypertension, dyslipidaemia, obesity, and chronic kidney disease (Ruze *et al.*, 2023). Moreover, the prevalence of specific comorbidities may differ according to the type of diabetes. Type 2 diabetes being associated with a higher risk of cardiovascular complications compared with type 1 diabetes (Saeedi *et al.*, 2019).

Comorbidities with diabetes mellitus raise the demand for medical treatment, the expense of hospital stays, and the need for routine checkups. It is simpler to choose the best course of treatment for DM patients when one is better aware of the prevalent comorbidities and associated factors. Early identification and successful management of comorbidity have been shown to increase a patient's lifespan and quality of life (Groenewegen *et al.*, 2020). Nearly 90% had at least two comorbid conditions, and over 98% had at least one, according to a recent study involving over 1.3 million individuals (Erener, 2020). Between 6% and 64% of people in sub-Saharan Africa (SSA) have DM comorbidity (Faijer-Westerink *et al.*, 2019). According to a Ghanaian study, concordant comorbidities were present in 55.8% of persons with diabetes mellitus (Meseret & Wondimagegne, 2025). The development of comorbidities in individuals with diabetes mellitus is influenced by a number of characteristics, including sex, age, location of residence, economic position, and length of DM, family history of DM, type of DM, type of medication, proteinuria, and glycaemic management, according to earlier

research. (Al-Worafi, 2024; Chauke, 2022; Ejeta *et al.*, 2021). Individuals must know about determinants and complications to combat this pandemic and adopt healthy lifestyles. Despite this urgency, limited research has been conducted on diabetes within the study area, hindering efforts to estimate the disease burden (Ganasegeran *et al.*, 2020).

1.2 Statement of the Problem

Diabetes mellitus remains a major public health concern in Ghana, ranked among the top ten causes of outpatient hospital attendance and contributing to 6.8% of adult hospitalizations and 7.5% of all adult deaths (Gbadamosi, 2021). Beyond its direct burden, diabetes is frequently accompanied by concordant comorbidities conditions that share similar pathophysiological mechanisms such as hypertension, dyslipidaemia, cardiovascular diseases, and chronic kidney disease. These comorbidities significantly worsen clinical outcomes, increase healthcare costs, and complicate long-term management of patients (Ejeta *et al.*, 2021).

Despite the growing burden of diabetes in Ghana, there is limited empirical evidence on the prevalence, determinants, and distribution of concordant comorbidities, particularly at the sub-municipal level. Most existing studies are concentrated in large urban centres, leaving peripheral municipalities like Ashanti Mampong poorly represented in national data. The Ashanti Mampong Municipal Government Hospital serves as a major referral point for surrounding communities, yet no documented study has assessed the pattern and distribution of concordant comorbidities among its diabetic population. This gap in evidence constrains the ability of local health managers to plan targeted interventions, allocate resources efficiently, and strengthen integrated chronic care services.

Given the increasing number of diabetic patients reported in the municipality and the potential for undetected or poorly managed comorbidities, it is critical to investigate the magnitude and determinants of concordant comorbidities as well as their distribution patterns within the Ashanti Mampong Municipal Government Hospital. Addressing this gap will provide essential baseline data to inform screening protocols, early intervention strategies, and context-specific chronic care planning within the municipality.

1.3 Justification of the Study

In Sub-Saharan Africa, the burden of concordant comorbidities among patients with diabetes is rising, driven in part by weak health systems in the region. These systemic weaknesses intensify the challenges of managing diabetes and its complications, potentially worsening patient outcomes. However, this escalation is unlikely to be the sole driver of an overall increase in the burden of diabetes-related illness, which is also shaped by broader demographic trends, limited access to care, and socioeconomic factors.(Ejeta *et al.*, 2021;Yau *et al.*, 2021;Kidanie *et al.*, 2020).

In Ghana, the prevalence of diabetes is increasing, with estimates that approximately 1.5% of the population has diabetes (Obeng, 2022a). The Ghana Health Service (GHS) and the Ministry of Health (MOH) are working to improve diabetes management and prevention, particularly in the country's growing burden of non-communicable diseases. However, the distribution of concordant comorbidities among patients with diabetes in Ghana is not well understood, which can hinder the development of effective prevention and management strategies. A study conducted in the Ashanti region of Ghana found that 44.4% of patients with diabetes had hypertension, 23.1% had hyperlipidaemia, and 15.6% had kidney disease,

highlighting the need for a better understanding of the determinants and distribution of comorbidities among patients with diabetes in this region (Gyasi *et al.*, 2023).

In the Ashanti region of Ghana, the prevalence of diabetes is particularly high, with estimates suggesting that approximately 2.5% of the population has diabetes (Ofori *et al.*, 2022). The Ashanti Regional Health Directorate is working to improve diabetes management and prevention in the region, particularly in the region's growing burden of non-communicable diseases (Maina Gatimu *et al.*, 2016). However, the determinants and distribution of concordant comorbidities among patients with diabetes in the region are poorly understood, which can hinder the development of effective prevention and management strategies. A study conducted in the Kumasi Metropolis found that 55.6% of patients with diabetes had hypertension, 31.1% had hyperlipidaemia, and 20.8% had kidney disease, highlighting the need for a better understanding of the determinants and distribution of comorbidities among patients with diabetes in this region (Biah, 2017). Comparing SSA, especially Ghana, to Western nations, disparities have been noted in the prevalence, treatment, and results of diabetes (Motala *et al.*, 2022). Renal impairment, peripheral neuritis, diabetic foot disease, ocular, cerebrovascular, erectile dysfunction, and cardiovascular disorders are caused by inadequate or nonexistent diabetes care (Bereda, 2022). An increased incidence of prolonged complications, including hypertension, was found among type-2 diabetes mellitus patients in various government hospitals in the Ashanti region (Nuamah *et al.*, 2017). This calls for addressing a critical gap in understanding concordant comorbidities and diabetes within the Ghanaian context. While numerous studies have explored this topic in other countries, there remains a significant dearth of research within Ghana, particularly concerning the unrecognised distribution and determinants of concordant comorbidities among patients with diabetes. Ghana's unique cultural, geographical, and genetic makeup necessitates localised

investigations to understand the' prevalence and determinants of these comorbidities comprehensively. The findings of this study provided invaluable insights into the prevalence, distribution, and determinants of concordant comorbidities in patients with diabetes in Ghana. The evidence from this research will serve as a crucial foundation for formulating evidence-based policies and interventions aimed at effectively preventing, diagnosing, and managing diabetes. Ultimately, the knowledge gained from this study paved the way for the enhanced management of patients with diabetes in Ghana.

1.4 Research Questions

1. What is the prevalence of concordant comorbidities among patients with diabetes attending Mampong Government Hospital?
2. What determinants are associated with concordant comorbidities among patients with diabetes attending Mampong Government Hospital?
3. What is the socio-demographic predictors of concordant comorbidities among patients with diabetes attending Mampong Government Hospital?

1.5 Main Objective

The study assessed and evaluated the prevalence of concordant comorbidities among diabetic patients attending the Ashanti Mampong Government Hospital of Ghana.

Specifically, this study sought to:

1.5.1 Specific Objectives

1. To estimate the prevalence of concordant comorbidities among diabetes patients attending the Ashanti Mampong Government Hospital.

2. To examine the determinants associated with concordant comorbidities among diabetes patients attending the Ashanti Mampong Government Hospital.
3. To assess the socio-demographic predictors of concordant comorbidities among diabetes patients attending the Ashanti Mampong Government Hospital.

1.6 Significance of the Study

This study is significant because it addresses the increasing burden of Diabetes Mellitus (DM) and its associated comorbidities, which remain a major public health concern in Ghana, particularly in Mampong and similar districts. The findings from this research provide essential data on the prevalence and predictors of comorbid conditions such as hypertension, cardiovascular disease, and chronic kidney disease among DM patients. The study supports clinical decision-making by helping healthcare providers identify high-risk groups and adopt integrated care models that manage DM alongside its comorbidities. It equips practitioners with knowledge to personalize treatment plans, improve patient outcomes, and promote early screening and preventive measures in diabetes management.

The findings also make a significant contribution to national health policy. They provide evidence to the Ministry of Health (MoH), Ghana Health Service, Christian Health Association of Ghana, and other partners to verbalise targeted interventions and strategies aimed at preventing and managing chronic disease clusters. This includes developing policies that support early detection, resource allocation, and education campaigns to reduce lifestyle-related determinants. Furthermore, the study enriches the scientific literature on chronic disease epidemiology in sub-Saharan Africa by providing localised, context-specific data. It helps fill the knowledge gap on concordant comorbidities and the role of sociodemographic

and behavioural determinants in disease progression among diabetic populations. This contributes to ongoing global discourse on multimorbidity and integrated healthcare.

Additionally, the study informs public health surveillance efforts by identifying priority areas for monitoring and intervention. It lays the foundation for effective collaboration among health institutions, civil society organizations, and policymakers in solving the increasingly prevalent diabetes and chronic disease comorbidities in Ghana. The study has both scientific and practical importance as it contributes to improving diabetes management, guiding policy development, enhancing public health interventions, and strengthening the evidence base for future research.

1.7 Delimitation of the Study

This study focused on patients diagnosed with diabetes and aimed to investigate the factors influencing the occurrence and distribution of concordant comorbidities within this population. The research was limited to adult patients aged 15 years and above diagnosed with either type 1 or type 2 diabetes. This excludes patients with gestational diabetes and other specific types of diabetes. Furthermore, the study only considered comorbidities that commonly co-occur with diabetes, such as hypertension, cardiovascular diseases, neuropathy, retinopathy, and nephropathy. Non-concordant were not included in the analysis. The geographical scope of the study was limited to a specific region or health care setting to ensure feasibility and relevance to the local population. Additionally, the research primarily relies on existing medical records, patient surveys, and clinical data from the selected health care facility.

1.8 Limitations

This study, which was carried out at the Mampong Government Hospital in Mampong Municipal, was limited to examining diabetes determinants, identifying typical sequelae, and figuring out comorbidities among diabetic patients. The amount of time available for the investigation was one of its main limitations. Additionally, the study was limited to examining other topics, such as diabetes awareness. The cross-sectional study design can only help to measure their present experiences, but cannot measure future experiences, unlike a prospective study. The cost of resources and the limited time available for data analysis did not allow the entire study population to be used. The limited sample size of 430 participants may not make the result generalizable to the entire population.

1.9 Organization of the Study

This study was divided into six chapters. Chapter 1 presents the introduction of the study, highlighting the background of the study, the problem statement, objectives of the study, the research questions, and the significance of the study. Chapter 2 reviews relevant background literature related to the study. Chapter 3 presents the research methods to be used for the study, describing the study area, target population, study population, sampling procedure, sample size, data collection methods, data processing and analysis, as well as ethical issues of the study. Chapter 4 presents the findings of the study, and Chapter 5 discusses the results. Chapter 6 presents a summary of the key findings, conclusions, recommendations, and suggestions for future studies.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This section of the research focuses on the conceptual examination of pertinent aspects related to the research topic, namely, Concordant Comorbidities in Diabetes: Prevalence, Determinants, and Distribution Patterns among Patients in the Ashanti Mampong Municipal Government Hospital, Ghana, with the aim of understanding the prevalence, examine the determinants associated and assess the socio-demographic predictors of concordant comorbidities among diabetes patients attending the Ashanti Mampong Government Hospital. It encompasses a chronological arrangement covering the conceptual review of concordant comorbidities among diabetic patients. The section also delved into related theories and the development of hypotheses and concludes the theoretical review.

2.1 Overview

Diabetes mellitus (DM), known as diabetes, is a serious health concern that is gradually emerging as a clinical and public health problem, making it a serious worldwide risk to people's health and well-being as well as that of families and society as a whole (Ejeta *et al.*, 2020). A metabolic disorder in which an absolute or relative deficiency of insulin results in hyperglycaemia, leading to acute and chronic complications (Dilworth, 2021). This disease is complex and multifactorial, characterised by chronic high blood sugar levels caused by defects in insulin action, secretion, or both (Vijay, 2020).

DM manifests primarily as Type 1 and Type 2, with additional rare forms, such as gestational diabetes (Mukerji *et al.*, 2020). Previously, type 1 DM (T1DM) was referred to as insulin-dependent diabetes mellitus (IDDM) by clinicians. T1DM arises from the autoimmune

destruction of pancreatic β -cells responsible for insulin production (Roep *et al.*, 2021, p. 1). Progressive loss of β -cells can lead to complete cessation of insulin production, leading to impaired glucose metabolism and resulting in hyperglycaemia (Roep *et al.*, 2021, p. 1). Excess glucose is excreted in urine (Yau *et al.*, 2021). Although the precise cause of T1DM remains elusive, it is believed to stem from a combination of autoimmune, environmental, and genetic factors (Yau *et al.*, 2021). Traditionally associated with children (hence the term "juvenile diabetes"), T1DM is now recognised as prevalent among adults as well (Dabelea *et al.*, 2021).

Type 2 Diabetes Mellitus (T2DM) is typically characterised by flaws in both insulin secretion and the body's response to insulin, leading to hyperglycaemia (Ojha *et al.*, 2019). In these cases, the ability to produce insulin does not completely vanish but rather diminishes progressively, contributing to insulin deficiency and/or resistance (Clarebeau *et al.*, 2020). The manifestations of this disease can vary from insulin resistance with partial insulin production to reduced insulin secretion with or without insulin resistance (Sakurai *et al.*, 2021). Diagnosis is often only performed when complications arise. Lifestyle and genetic factors primarily underlie the development of T2DM (Peters *et al.*, 2017) and are often correlated with obesity, poor dietary habits, stress, physical inactivity, and urban living (Peters *et al.*, 2017).

In Ghana, where the prevalence of diabetes is steadily increasing, it becomes imperative to understand the distribution and determinants of these concordant comorbidities (Achila *et al.*, 2021). This research focuses on diabetic patients attending the Mampong Government Hospital in the Ashanti Region of Ghana, aiming to shed light on the prevalence and factors contributing to these comorbid conditions. The importance of this study lies in its potential to

inform better clinical management and public health strategies aimed at improving patient outcomes. Despite the urgency of addressing diabetes, limited research in some areas hampers efforts to accurately assess the disease's impact, emphasizing the need for increased public awareness and healthy lifestyle adoption to combat this global health concern. This section reviewed the literature on the subject matter and important published studies by other researchers relevant to this study.

2.2 Conceptual Review

The primary concepts central to this study include Diabetes Mellitus, Concordant Comorbidities, Distribution and Determinants. Diabetes Mellitus is defined as a chronic metabolic disorder characterized by persistent hyperglycaemia resulting from defects in insulin secretion, insulin action, or both (Adeva-Andany *et al.*, 2019). Concordant comorbidities refer to medical conditions that are pathophysiologically related to diabetes, commonly including hypertension, cardiovascular disease, and nephropathy (Negussie, 2023). Determinants are the factors influencing the development and distribution of these comorbidities, such as demographic factors (age, sex), clinical factors (duration of diabetes, glycaemic control), and lifestyle factors (diet, physical activity) (Ejeta *et al.*, 2021).

The relationship between diabetes and its concordant comorbidities is both complex and interdependent (Everett *et al.*, 2023). Diabetes and hypertension, for instance, share common determinants such as obesity, physical inactivity, and an unhealthy diet, leading to their frequent co-occurrence (Motuma *et al.*, 2023). The presence of one condition often exacerbates the other, creating a cycle of worsening health outcomes (Ritchie & Wedzicha, 2020). For instance, uncontrolled diabetes can lead to the development of hypertension, which in turn can worsen diabetic complications like nephropathy. Understanding these

relationships is crucial for developing integrated approaches to patient management that address the full spectrum of a patient's health needs. Over time, the understanding of comorbidities in diabetic patients has evolved from viewing each condition in isolation to recognizing the interrelated nature of these diseases. Initially, the focus was primarily on the management of diabetes as a single entity, with less emphasis on the coexisting conditions. However, as research has advanced, there has been a growing recognition of the need for a more holistic approach that considers the interdependence of multiple chronic conditions (Barbosa *et al.*, 2021). This has led to the development of integrated care models that address both diabetes and its related comorbidities simultaneously, emphasizing the need for comprehensive and coordinated care (Cooper *et al.*, 2024).

Despite the progress made in understanding diabetes and its comorbidities, significant gaps and contradictions remain in the literature, particularly in the context of Sub-Saharan Africa (Abdul-Samed *et al.*, 2024). Most studies on diabetes comorbidities have been conducted in high-income countries, leading to a paucity of data from low- and middle-income countries like Ghana (Asogwa *et al.*, 2022; Kaluvu *et al.*, 2022). Furthermore, there are inconsistencies in reported prevalence rates and determinants for certain comorbidities, likely due to differences in study designs, populations, and diagnostic criteria (Xiao *et al.*, 2022). These gaps highlight the need for more region-specific research that can provide accurate data and guide interventions tailored to the local context.

The relevance of understanding the distribution and determinants of concordant comorbidities in diabetic patients cannot be overstated. In the context of Ghana, where healthcare resources are often limited, identifying the most common comorbidities and their determinants can help prioritize healthcare interventions. By focusing on patients at the Mampong Government

Hospital, this study aims to contribute to the existing body of knowledge, providing data that can inform clinical practice and public health policies aimed at improving the management of diabetes and its associated comorbidities in the Ashanti Region, Ghana, as a whole.

2.3 Empirical Review

A substantial body of empirical research has examined the relationship between diabetes and its concordant comorbidities, with studies conducted across various regions, including Sub-Saharan Africa (Abebe *et al.*, 2020). These studies primarily focus on identifying the prevalence of comorbid conditions such as hypertension and cardiovascular disease among diabetic patients, as well as exploring the factors that contribute to the development of these comorbidities (Bajgain *et al.*, 2021; Gold *et al.*, 2020). The majority of these studies are quantitative, providing valuable data on the burden of comorbidities in diabetic populations (Gregg *et al.*, 2024).

2.3.1 Prevalence of Concordant Comorbidities among Diabetes Patients

Diabetes is a chronic metabolic disorder that affects the body's ability to produce or respond to insulin, resulting in elevated blood glucose levels (Cheng *et al.*, 2021). The prevalence of concordant comorbidities among diabetes patients is alarmingly high, with cardiovascular diseases, hypertension, Dyslipidaemia, chronic kidney disease, and obesity being the most common (K. Nagy *et al.*, 2024). The coexistence of these conditions not only complicates diabetes management but also exacerbates the overall morbidity and mortality associated with diabetes (Kosmalski *et al.*, 2022). Earlier studies in Ghana on the prevalence of diabetes mellitus in the 1960s recorded 0.2 % in a population of men living in Ho (Afaya *et al.*, 2020). Concordant comorbidities refer to coexisting medical conditions that share a similar pathophysiological profile with a primary disease, in this case, diabetes (Guerrero-Fernández

de Alba *et al.*, 2020). Numerous studies have explored the prevalence and impact of concordant comorbidities in diabetic patients (Eilat-Tsanani *et al.*, 2021; Pati *et al.*, 2020). A systematic review by Caton *et al.* (2018), highlights that conditions such as hypertension, Dyslipidaemia, and cardiovascular diseases (CVD) are commonly observed in diabetic patients due to overlapping determinants like obesity, sedentary lifestyle, and poor diet. Other studies by Abbasi-Kangevari *et al.* (2023), and Ford *et al.* (2019), have expanded on this by exploring the longitudinal outcomes of these comorbidities on diabetic patients' health, health-care utilization, and costs.

Henning (2018), analysed 15 studies to establish the correlation between diabetes and cardiovascular diseases, finding that 50-80% of diabetic patients present with one or more cardiovascular conditions. Dalal *et al.* (2024), reviewed electronic medical records of 7,500 diabetic patients and reported a high prevalence of hypertension (64%) and dyslipidaemia (54%) among this population. A cross-sectional study by Ford *et al.* (2019), involving 3,200 participants examined the influence of these comorbidities on the quality of life, concluding that comorbid cardiovascular conditions severely impacted patients' physical and mental well-being. The populations in these studies predominantly consist of adult and elderly diabetic patients. Henning (2018), focused on patients aged 45 and above with Type 2 diabetes.

Koduah *et al.* (2021), included patients from various demographics but maintained a focus on adults (40-65 years) with a mean duration of diabetes of 10 years. Ford *et al.* (2019), examined older adults (60 years and older) diagnosed with diabetes for at least five years, drawing participants from both community health centres and speciality diabetes clinics. The studies employed a combination of electronic health records (EHRs), patient surveys, and

clinical assessments for data collection. Henning (2018), employed meta-analysis methods to examine existing literature and medical records, identifying patterns in comorbidities. J Henning (2018), extracted data from hospital EHR systems, focusing on diagnosis codes related to diabetes and concordant conditions. Ford *et al.* (2019) employed structured interviews, self-reported health questionnaires, and clinical evaluations, including blood pressure and cholesterol tests.

The key variables measured in these studies include the presence of comorbidities such as hypertension, cardiovascular diseases, and dyslipidaemia (independent variables). Outcome variables often focus on diabetes-related complications, mortality rates, quality of life, and healthcare costs. For example, Henning (2018), measured the incidence of hospitalizations and cardiovascular events, while Sema *et al.* (2021), analysed the frequency of medical consultations and prescription drug use. The prevalence of concordant comorbidities among diabetic patients is remarkably high. Henning (2018), found that over 70% of diabetic patients suffer from at least one cardiovascular condition. Sarker *et al.* (2024), identified hypertension and dyslipidaemia as the most common concordant comorbidities, with these conditions increasing the need for more intensive diabetes management and significantly higher healthcare costs.

Gu *et al.* (2023), noted that comorbidities like hypertension and CVD not only increase the likelihood of diabetes complications but also reduce patients' quality of life by limiting physical activity and contributing to depression. The studies are robust in their use of large sample sizes, enhancing the generalizability of findings. The use of EHR data ensures accurate identification of comorbid conditions (Zhao *et al.*, 2023), while longitudinal studies provide insights into how comorbidities develop and impact diabetes over time (Sarker *et al.*,

2024). One limitation is the reliance on EHRs, which may not capture undiagnosed or unreported conditions (Zhao *et al.*, 2023). Cross-sectional designs like those employed by Gu *et al.* (2023), also limit the ability to infer causal relationships between diabetes and comorbidities.

The existing literature consistently highlights the high prevalence of concordant comorbidities, particularly hypertension and cardiovascular diseases, among diabetic patients (Cruz-Ávila *et al.*, 2020). A common theme across studies is the substantial impact these comorbidities have on the management of diabetes, overall health outcomes, and health-care costs. However, there are some gaps in understanding the mechanisms by which diabetes exacerbates the risk of these comorbidities (Biah, 2017). Furthermore, there is a need for more research on how social determinants of health, such as income and education, influence the prevalence and management of comorbidities among diabetic patients (Chan *et al.*, 2024; Arokiasamy *et al.*, 2021b; Bain *et al.*, 2020; Gulsin *et al.*, 2019). Additionally, few studies focus on younger populations with diabetes, which could offer insights into the early onset of concordant conditions (Chan *et al.*, 2024; Trischitta *et al.*, 2020). The prevalence of concordant comorbidities among diabetes patients is a significant concern in healthcare. Over time, uncontrolled diabetes can lead to numerous comorbid conditions, many of which are concordant, meaning they are pathophysiological related to diabetes and share similar management approaches. Understanding these concordant comorbidities is essential for comprehensive diabetes care, as they can increase morbidity, mortality, and healthcare costs.

However, the crude prevalence of diabetes mellitus in the general Accra population in the late 1990s was 6.3%, while the age-adjusted prevalence and impaired glucose tolerance (IGT) were 6.1% and 10.7%, respectively (Biah, 2017). In Ghana, diabetes mellitus continues to

rank among the top 10 reasons for OPD hospital visits (Afaya *et al.*, 2020). 6.8% of all adult hospitalizations and 7.8% of all adult deaths are caused by this (Kwakye *et al.*, 2021). At a teaching hospital in Ghana, similar research found that 97.2% of patients with type 2 diabetes had hypertension, one of the several chronic sequelae that were prevalent (Wireko-Gyebi *et al.*, 2022). Adding to this, though, is the reality that diabetes mellitus care is difficult in Ghana (Motala *et al.*, 2022a). Therefore, in order to make diabetes mellitus easier to control, it is necessary to comprehend the determinants linked to the condition. Among these include chronic kidney disease (CKD), hypertension, dyslipidemia, and cardiovascular diseases (CVD).

2.3.1.1 Cardiovascular Diseases and Diabetes

Cardiovascular disease (CVD) is one of the most prevalent and severe comorbidities among diabetes patients (Kwobah, 2020). Numerous studies indicate that adults with diabetes are at a two to four time's greater risk of developing CVD than those without diabetes (Kwobah, 2020; Schmidt, 2019). According to Aga *et al.* (2019), the incidence of heart failure is significantly higher in diabetic patients, with a prevalence of 22.3% compared to 12.6% in the non-diabetic population. More recent studies have also underscored the high prevalence of CVD among diabetes patients (Usman *et al.*, 2021). A global meta-analysis revealed that the prevalence of CVD among individuals with type 2 diabetes ranges from 32% to 46% (Einarson *et al.*, 2018). Similarly, a study conducted in the United States by the Centres for Disease Control and Prevention (CDC) reported that nearly 68% of adults aged 65 or older with diabetes die from heart disease, while 16% die from stroke (CDC, 2022).

2.3.1.2 Hypertension

Hypertension exacerbates diabetes related complications by increasing the risk of cardiovascular diseases (CVD), nephropathy, and retinopathy (Pearce *et al.*, 2019). Proper management of blood pressure through lifestyle changes and medications like ACE inhibitors or ARBs is essential for diabetes patients. Diabetes significantly increases the risk of cardiovascular diseases, including coronary artery disease (CAD), myocardial infarction (heart attack), stroke, and peripheral artery disease (PAD). Cardiovascular complications are the leading cause of death among diabetes patients (Schmidt, 2019). The hyperglycaemic state in diabetes contributes to atherosclerosis, endothelial dysfunction, and inflammation, all of which accelerate cardiovascular disease progression. Statins, antihypertensives, and antiplatelet therapies are typically prescribed to mitigate this risk.

Hypertension is another common concordant comorbidity in diabetes, affecting up to 70-80% of individuals with type 2 diabetes (Aga *et al.*, 2019). This high prevalence is often linked to the overlapping determinants of insulin resistance, obesity, and atherosclerosis. In a cross-sectional study conducted by Aga *et al.* (2019) and Wang *et al.* (2020), among diabetic patients in China, the prevalence of hypertension was found to be as high as 58%, with significant associations between high blood pressure and poor glycaemic control.

2.3.1.3 Dyslipidaemia

Dyslipidaemia, characterized by abnormal lipid levels, is another common comorbidity in diabetes patients, particularly those with type 2 diabetes (Feingold & Grunfeld, 2023). Insulin resistance contributes to the deregulation of lipid metabolism, leading to elevated triglycerides, low high-density lipoprotein (HDL) cholesterol, and increased low-density lipoprotein (LDL) cholesterol (Feingold & Grunfeld, 2023). This lipid imbalance is a major

contributor to the development of cardiovascular diseases in diabetic patients. Management involves lipid-lowering agents like statins and dietary modifications. Research indicates that approximately 70% to 97% of individuals with type 2 diabetes experience some form of dyslipidaemia (Tomlinson *et al.*, 2021). A study by Warraich & Rana (2017) found that dyslipidaemia not only increases the risk of atherosclerotic cardiovascular disease but also contributes to diabetic complications such as peripheral artery disease and stroke.

2.3.1.4 Chronic Kidney Disease (CKD)

CKD is another prevalent concordant comorbidity, affecting approximately 30% to 40% of patients with diabetes (Edmonston *et al.*, 2024). Diabetes is the leading cause of end-stage renal disease (ESRD), and its presence exacerbates the progression of kidney dysfunction. According to a cohort study conducted by Edmonston *et al.* (2024), over 40% of patients with type 2 diabetes develop CKD, with a significant proportion progressing to ESRD if not correctly managed. Diabetic nephropathy is the leading cause of chronic kidney disease, accounting for approximately 40% of CKD cases. Elevated blood sugar levels damage the blood vessels in the kidneys, reducing their ability to filter waste and leading to kidney failure in severe cases. Early detection and management through glycaemic control, blood pressure management, and the use of medications like ACE inhibitors or ARBs are key to preventing the progression of CKD in diabetes patients.

Diabetic retinopathy is a typical microvascular complication of diabetes, affecting the small blood vessels in the retina (Bosma *et al.*, 2019). It is a leading cause of blindness in adults. Hyperglycaemia leads to the breakdown of the blood-retinal barrier, resulting in microaneurysms, haemorrhages, and, in advanced cases, retinal detachment. Routine eye exams and strict glycaemic control can prevent or delay the progression of diabetic retinopathy.

Diabetic peripheral neuropathy affects the peripheral nerves, especially in the lower extremities. It is characterized by numbness, tingling, pain, and, in severe cases, loss of sensation, increasing the risk of foot ulcers and amputations (Yavuz, 2022).

High blood sugar levels damage nerve fibres, and the condition is more common in those with long-standing or poorly controlled diabetes. Treatment focuses on glycaemic control, pain management, and regular foot care. Related to peripheral neuropathy and vascular complications, diabetic foot syndrome includes ulcers, infections, and gangrene, which may require amputation. Reduced sensation in the feet due to neuropathy, along with poor circulation, makes diabetes patients more susceptible to infections and slow-healing wounds. Foot care, proper footwear, and regular check-ups are crucial preventive measures. Non-alcoholic fatty liver disease (NAFLD) and its more severe form, non-alcoholic steatohepatitis (NASH), are frequently observed in individuals with type 2 diabetes (Vetrano *et al.*, 2023). Insulin resistance and obesity are major contributors to fat accumulation in the liver. NAFLD can progress to cirrhosis and liver failure if not managed. Lifestyle interventions, weight loss, and medications that improve insulin sensitivity are often recommended to manage liver-related complications in diabetes.

2.3.1.5 Obesity

Obesity, especially abdominal obesity, is commonly associated with diabetes and increases the risk for other concordant comorbidities, including hypertension, dyslipidaemia, and CVD (Ejeta *et al.*, 2021). Obesity and diabetes are closely interrelated, with obesity being both a determinant for and a consequence of diabetes (Ejeta *et al.*, 2021). In particular, visceral obesity (fat around internal organs) is strongly associated with insulin resistance, leading to type 2 diabetes. Approximately 80% of individuals with type 2 diabetes are overweight or

obese. Obesity, which is a significant determinant for diabetes mellitus, continues to escalate in both the developed and the developing world. For instance, in 2014, more than 1 in 3 adults aged over 18 years were overweight, and more than one in 10 were obese (Bain *et al.*, 2020). Managing obesity through lifestyle changes such as diet, exercise, and sometimes bariatric surgery is critical in controlling blood sugar levels and reducing the risk of other complications. A study conducted by Cardel *et al.* (2022) indicated that the prevalence of obesity among diabetes patients in the U.S. was about 87%, reinforcing the need for integrated weight management and diabetes care.

Globally, the prevalence of diabetes mellitus is rising (WHO, 2016). Compared to 108 million (4.7%) in 1980, 422 million adults worldwide had diabetes mellitus in 2014, accounting for 8.5% of the global population (WHO, 2016). By raising the risk of cardiovascular and other diseases, this led to 1.5 million deaths in 2012 and an additional 2.2 million indirect deaths. By 2030, it is anticipated that 600 million persons worldwide would have diabetes mellitus of some kind (Arokiasamy *et al.*, 2021b). Nonetheless, low- and middle-income nations are home to around 80% of these diabetes (Obeng, 2022). Conversely, the diabetes mellitus epidemic has a major negative influence on socioeconomic and health outcomes, particularly in developing nations (Arokiasamy *et al.*, 2021a). Along with other non-communicable diseases, the prevalence of diabetes mellitus is rising in Sub-Saharan Africa (Motala *et al.*, 2022b, p. 2). Diabetes mellitus complications can reduce life expectancy by several years and cause functional impairments in day-to-day living (Mezil & Abed, 2021).

2.4.2 Determinants of Concordant Comorbidities among Diabetes Patients

Diabetes mellitus (DM) is a multifactorial disease that significantly increases the risk of various comorbid conditions, particularly concordant comorbidities (Ejeta *et al.*, 2021). These comorbidities, which share pathophysiological mechanisms and management strategies with diabetes, include conditions such as cardiovascular disease (CVD), hypertension, dyslipidaemia, and chronic kidney disease (Ejeta *et al.*, 2021). Understanding the determinants associated with concordant comorbidities is essential for effective disease management, prevention of complications, and improvement of patient outcomes (Ejeta *et al.*, 2021). One of the significant challenges in diabetes management is the presence of comorbidities, particularly concordant comorbidities, which are health conditions that have similar pathophysiologic mechanisms to diabetes (CARE, 2022). The existence of these comorbidities complicates treatment, increases healthcare costs, and contributes to poorer health outcomes (Gold *et al.*, 2020). This review explores the determinants contributing to the development of concordant comorbidities in diabetes patients, supported by relevant research studies (Gold *et al.*, 2020).

Concordant comorbidities are conditions that share overlapping determinants, mechanisms, and management strategies with diabetes. These typically include cardiovascular diseases (CVD), hypertension, hyperlipidaemia, chronic kidney disease (CKD), and neuropathy (Sinclair & Abdelhafiz, 2022). These comorbidities exacerbate the course of diabetes, leading to higher rates of complications and mortality. The burden of concordant comorbidities in patients with diabetes has profound clinical implications. These comorbidities are not only related to the primary disease process but also aggravate the prognosis, leading to increased morbidity and mortality. Determinants associated with concordant comorbidities among diabetic patients can be broadly categorized into non-modifiable and modifiable factors. Non-

modifiable factors include age, sex, and genetic predispositions, while modifiable factors include lifestyle choices such as diet, physical inactivity, smoking, and alcohol consumption. In addition, metabolic and biochemical determinants such as obesity, hypertension, dyslipidaemia, and poor glycaemic control play a pivotal role in the development and progression of these comorbidities.

Concordant comorbidities are conditions that share common determinants or pathophysiological mechanisms with diabetes, exacerbating the complications and prognosis for patients (Nithya *et al.*, 2023). A range of empirical studies has focused on identifying determinants for these comorbidities in diabetes patients, utilizing cohort studies, cross-sectional analyses, and clinical trials. The United Kingdom Prospective Diabetes Study (UKPDS), which investigates the progression of comorbidities in Type 2 diabetes patients (Joseph *et al.*, 2022). The National Health and Nutrition Examination Survey (NHANES) has provided longitudinal data on diabetes patients and their associated comorbidities (Chung *et al.*, 2020). A cohort study by Gyasi *et al.* (2023), examining cardiovascular risk in diabetic patients.

The studies generally emphasize that concordant comorbidities such as hypertension and CVD significantly increase the mortality and morbidity in diabetic patients (Aga, B Dunbar, *et al.*, 2019). Key findings across multiple studies indicate that determinants such as poor glycaemic control, obesity, insulin resistance, age, and smoking contribute to the onset of these conditions (Adeva-Andany *et al.*, 2019). Management of both diabetes and its associated comorbidities is essential for improving patient outcomes. For instance, the UKPDS study demonstrated that the development of hypertension and CVD was accelerated in patients with poor glycaemic control, highlighting the role of hyperglycaemia as a central

determinant (Joseph *et al.*, 2022). Similarly, the NHANES data indicated a high prevalence of dyslipidaemia and hypertension in diabetic patients (Chung *et al.*, 2020).

Most empirical studies focus on middle-aged to older adults, typically aged 40 and above, with both Type 1 and Type 2 diabetes (Vázquez-de Sebastián *et al.*, 2021; Qin *et al.*, 2020). The sample sizes range widely, from several hundred to tens of thousands of participants, depending on the scale of the research. The UKPDS study, for example, followed over 5,000 patients with Type 2 diabetes, while the NHANES survey included a nationally representative sample of more than 30,000 individuals (Chen *et al.*, 2023; Pollock *et al.*, 2022). Studies have generally focused on diverse populations, including various ethnicities, with a particular emphasis on populations that have higher risks of developing diabetes-related complications, such as African Americans and Hispanic Americans (Ying Yu *et al.*, 2024; Haw *et al.*, 2021).

Poor glycaemic control is a major determinant for the development of concordant comorbidities (Agu, 2019). Patients with elevated HbA1c levels are more likely to develop CVD, CKD, and hypertension. Obesity, particularly central adiposity, is a strong predictor of both diabetes and its comorbidities. Insulin resistance, often associated with obesity, contributes to the pathophysiology of hypertension and dyslipidaemia. Longer duration of diabetes and older age significantly increase the risk of developing concordant comorbidities. Age-related decline in cardiovascular and renal function exacerbates these conditions. Smoking has been consistently linked to a higher risk of CVD in diabetes patients. Smokers are more likely to suffer from myocardial infarctions and stroke (Ding *et al.*, 2019).

The empirical studies utilized a combination of primary data collection and secondary data analysis (Alam, 2021). Primary data collection involved patient interviews, clinical evaluations, and laboratory tests (blood glucose levels, cholesterol, and kidney function). Additionally, secondary data included retrospective analysis of medical records and large health surveys such as NHANES and the Framingham Heart Study. In most studies, laboratory measures were critical for assessing key variables like glycaemic control (HbA1c levels), blood pressure, and lipid profiles (Jha *et al.*, 2024; Luo *et al.*, 2024). At the same time, patient interviews provided insights into lifestyle factors (e.g., smoking, diet, exercise). Large sample sizes in studies such as NHANES and UKPDS offer robust statistical power and generalizability. Longitudinal data allows for the examination of the temporal relationship between diabetes and comorbidities (Manzini *et al.*, 2022). Consistent use of objective clinical measures (e.g., HbA1c, lipid profiles) ensures the accuracy of findings. Most studies rely on self-reported data for lifestyle factors such as smoking and diet, which may introduce bias. Limited research on younger populations or people with Type 1 diabetes. Lack of granularity in some studies regarding the specific mechanisms by which diabetes exacerbates comorbidities (Hajishengallis & Chavakis, 2021).

Glycaemic control, obesity, and lifestyle factors such as smoking and physical inactivity are universally acknowledged as key determinants for the development of concordant comorbidities among diabetes patients. Most studies converge on the fact that early intervention, particularly targeting glycaemic control and obesity, can significantly reduce the incidence of these comorbidities (Abdullah *et al.*, 2025; Khunti *et al.*, 2025a). There is limited research on younger adults with diabetes and their risk of developing concordant comorbidities. Additionally, few studies explore the role of socioeconomic factors (e.g., income, education) in the development of these conditions. More research is also needed on

the long-term effects of newer diabetes treatments (e.g., GLP-1 receptor agonists) on comorbidities. However, gaps remain in understanding the interaction of these determinants across different populations and over the long term. Future studies should aim to fill these gaps by exploring underrepresented populations and novel treatments. Research has indicated noteworthy correlations between concordant comorbidities of diabetes mellitus and demographic attributes (Ejeta *et al.*, 2021; Guerrero-Fernández de Alba *et al.*, 2020; Dunbar, *et al.*, 2019). Several determinants contribute to the development of concordant comorbidities among diabetes patients, including:

2.4.2.1 Age

Ageing is a significant non-modifiable determinant for the development of both diabetes and its concordant comorbidities (Johansson *et al.*, 2021). As individuals age, the prevalence of comorbid conditions, such as cardiovascular diseases and hypertension, increases. A study by Strain *et al.* (2018), showed that older adults with type 2 diabetes are more likely to have multiple comorbidities, with cardiovascular diseases and CKD being particularly prevalent. Ageing is a key determinant for both diabetes and its associated concordant comorbidities (Iyengar *et al.*, 2020). The risk of developing cardiovascular diseases, hypertension, and chronic kidney disease increases with age, primarily due to the cumulative burden of metabolic deregulations, oxidative stress, and vascular damage. In elderly patients with diabetes, the risk of CVD and hypertension is particularly high due to age-related changes in arterial stiffness, endothelial function, and renal function.

Studies in *Diabetologia* (2015) demonstrated that the risk of cardiovascular events increases significantly after age 60 in individuals with type 2 diabetes, with older patients having a higher likelihood of experiencing myocardial infarctions and strokes (Salinero-Fort *et al.*,

2021). Studies have shown increasing diabetes mellitus prevalence with age (Arvind *et al.*, 2024; Animaw & Seyoum, 2017; Ogurtsova *et al.*, 2017). Studies by Rett & Gottwald-Hostalek (2019) and Yip *et al.* (2017) showed that the prevalence of pre-diabetes and diabetes mellitus is comparable to those seen globally and changes significantly with an individual's age. The prevalence of diabetes mellitus, however, rose in the 20–40 age range and declined in the 41–60 age range, according to (Sun *et al.*, 2022). However, this runs counter to a research that found that the peak age group in Shanghai's rural districts was 35-44 years old for men and 45-54 and 55-64 years old for women (Wang *et al.*, 2021). Furthermore, new research indicates that as people age, the prevalence of pre-diabetes and diabetes mellitus rises (Akhtar *et al.*, 2020; Al-Rifai *et al.*, 2019, p-2). Furthermore, as people with diabetes mellitus age, their risk of heart failure rises (Seferović *et al.*, 2018).

2.4.2.2 Duration of Diabetes

The duration of diabetes plays a critical role in the development of comorbidities. Longer exposure to hyperglycaemia is associated with vascular damage, which contributes to the onset of conditions like CVD, CKD, and diabetic neuropathy. A meta-analysis by Forbes and Cooper (2013), highlighted that the duration of diabetes is positively correlated with the incidence of macro vascular and micro vascular complications, particularly in patients with poor glycaemic control (Monnier *et al.*, 2021). The longer the duration of diabetes, the higher the likelihood of developing concordant comorbidities. Over time, chronic hyperglycaemia leads to endothelial dysfunction, vascular inflammation, and accelerated atherosclerosis, all of which contribute to the development of cardiovascular disease, hypertension, and kidney dysfunction. Prolonged diabetes also leads to glycation of proteins, which can further exacerbate organ damage. A longitudinal study in the *Journal of Clinical Endocrinology & Metabolism* (2018) reported that patients with diabetes for more than 10 years had a

significantly higher incidence of coronary artery disease and chronic kidney disease compared to those with shorter diabetes duration.

2.4.2.3 Poor Glycaemic Control

Chronic hyperglycaemia is a known contributor to the development of both microvascular and macrovascular complications in diabetes patients (Paul *et al.*, 2020). Poor glycaemic control, typically measured by haemoglobin A1C (HbA1c) levels, has been linked to the increased risk of concordant comorbidities. The Diabetes Control and Complications Trial (DCCT) demonstrated that intensive glycaemic control significantly reduces the risk of complications such as retinopathy and nephropathy, which are common in patients with diabetes (Sun *et al.*, 2022).

Chronic hyperglycaemia is a direct contributor to the development of concordant comorbidities in diabetes patients. Elevated blood glucose levels over time lead to the formation of advanced glycation end-products (AGEs), which cause oxidative stress, inflammation, and vascular damage. Poor glycaemic control increases the risk of cardiovascular diseases, diabetic nephropathy, and retinopathy. A landmark study, the Diabetes Control and Complications Trial (DCCT), demonstrated that intensive glucose control reduced the risk of cardiovascular events by 42% in type 1 diabetic patients, indicating the importance of maintaining optimal glycaemic levels to prevent comorbidities.

2.4.2.4 Obesity

Obesity is a well-established determinant for both diabetes and its concordant comorbidities (Blüher & Stumvoll, 2020). The excess adiposity contributes to insulin resistance, leading to poor glycaemic control and the onset of conditions like hypertension, dyslipidaemia, and

cardiovascular disease. A study by Grant *et al.* (2021), found that obesity increases the likelihood of developing both type 2 diabetes and its associated comorbidities, particularly among younger adults. Obesity is a major modifiable determinant for diabetes and its comorbidities. It is closely linked to insulin resistance, chronic low-grade inflammation, and Dyslipidaemia, all of which contribute to the development of concordant conditions like cardiovascular disease and hypertension. Visceral adiposity, in particular, is associated with increased production of pro-inflammatory cytokines and free fatty acids that promote atherogenesis and endothelial dysfunction. The Framingham Heart Study (2019), found that individuals with both diabetes and obesity had a two-fold increase in the risk of heart failure and hypertension compared to normal-weight individuals with diabetes.

2.4.2.5 Hypertension

Hypertension is a common comorbidity in diabetes patients and a significant determinant for cardiovascular disease and CKD (Edmonston *et al.*, 2024). The coexistence of diabetes and hypertension amplifies the risk of complications due to increased pressure on the vascular system. Research by Lauder *et al.* (2023), showed that effective management of blood pressure in diabetes patients significantly reduces the risk of cardiovascular events, reinforcing the link between these two conditions. Hypertension is a significant determinant for several concordant comorbidities, particularly cardiovascular disease and chronic kidney disease, in patients with diabetes. Diabetes and hypertension often coexist, and their combined effects accelerate the progression of vascular damage, atherosclerosis, and nephropathy. Poorly controlled blood pressure significantly increases the risk of stroke, heart attacks, and end-stage renal disease in these patients. Data from the UK Perspective Diabetes Study showed that intensive blood pressure control in diabetic patients reduced the incidence

of cardiovascular events by 25%, highlighting the critical role of hypertension as a modifiable determinant (Abdullah *et al.*, 2025).

2.4.2.6 Dyslipidaemia

Dyslipidaemia, characterized by elevated triglycerides, low-density lipoprotein cholesterol (LDL-C), and low high-density lipoprotein cholesterol (HDL-C), is prevalent among diabetes patients and is a major determinant for cardiovascular diseases (Warrach & Rana, 2017). The combined effect of diabetes and Dyslipidaemia accelerates atherosclerosis, increasing the risk of heart attacks and strokes. A cohort study by Markandu, (2025), found that lipid abnormalities in diabetes patients contribute significantly to cardiovascular mortality, emphasizing the need for lipid management in this population. Dyslipidaemia, characterized by elevated levels of low-density lipoprotein (LDL) cholesterol, triglycerides, and low levels of high-density lipoprotein (HDL) cholesterol, is another key determinant for concordant comorbidities in diabetes patients. Dyslipidaemia promotes atherosclerosis, leading to coronary artery disease, stroke, and peripheral vascular disease. It is often exacerbated by poor glycaemic control and obesity. A study published in the Journal of the American College of Cardiology (2019) found that diabetic patients with untreated Dyslipidaemia had a 60% higher risk of cardiovascular disease compared to those with controlled lipid levels.

2.4.2.7 Chronic Inflammation

Chronic low-grade inflammation, commonly seen in individuals with diabetes, is another determinant for the development of concordant comorbidities (Domazet *et al.*, 2024). Inflammatory markers such as C-reactive protein (CRP) are elevated in both diabetes and cardiovascular diseases, suggesting shared pathophysiological mechanisms. The study by Goswami *et al.* (2021), demonstrated that inflammation plays a critical role in the progression

of both diabetes and cardiovascular diseases, supporting the notion that controlling inflammation may mitigate the risk of these comorbidities.

2.4.2.8 Socioeconomic Factors

Socioeconomic factors, such as income, education, and access to healthcare, also play a role in the development of concordant comorbidities (Sum *et al.*, 2020). Lower socioeconomic status is associated with higher rates of diabetes and its complications, often due to limited access to healthcare services, poor medication adherence, and unhealthy lifestyle choices. A population-based study by Kivimäki *et al.* (2018), showed that socioeconomic disparities contribute to unequal health outcomes, with disadvantaged individuals experiencing higher rates of both diabetes and cardiovascular diseases. Excessive calorie intake is a crucial factor contributing to the global epidemics of type 2 diabetes mellitus and obesity, according to several studies (Haramati, Eden, 2024; Ruze *et al.*, 2023).

The quality of fats and carbohydrates plays an important role in the development of diabetes mellitus, independent of BMI and other determinants (Sievenpiper, 2020; Mohan *et al.*, 2018). Additionally, higher dietary glycaemic load (GL) and Trans-fat are associated with increased diabetes mellitus risk. In contrast, greater consumption of cereal fibre and polyunsaturated fat is associated with decreased risk (Haider *et al.*, 2024). Likewise, research indicates that increasing wholegrain consumption by two servings per day is linked to a 21% decreased chance of developing diabetes mellitus (Hu *et al.*, 2020).

However, eating more white rice raises your risk of developing diabetes mellitus, but eating brown rice, a whole grain, lowers your risk of developing the condition (Hu *et al.*, 2020). Research suggests that low levels of physical exercise and being overweight or obese may be

determinants for diabetes mellitus (Tran *et al.*, 2020; Zhao *et al.*, 2021). Additionally, people in both urban and rural areas are increasingly avoiding labor-intensive activities, regardless of their financial situation, which results in low levels of physical activity (Vidt *et al.*, 2022; WHO, 2016). Increased physical activity lowers the incidence of diabetes mellitus, while sedentary behaviors raise it, according to several epidemiologic studies (World Health Organization, 2016) and Vidt *et al.* (2022). Over the past century, physical exercise has been replaced by increased mobility and industrialization in industrialized countries (WHO, 2016).

Physical inactivity is a significant modifiable determinant for both diabetes and its concordant comorbidities. Regular physical activity improves insulin sensitivity, promotes weight loss, and reduces blood pressure and cholesterol levels. In contrast, sedentary lifestyles increase the risk of obesity, hypertension, Dyslipidaemia, and cardiovascular disease. A study published in *The Lancet* (2018), found that individuals with diabetes who engaged in regular physical activity had a 30% lower risk of developing cardiovascular disease compared to those who were inactive.

Smoking is a well-established determinant for both diabetes and its comorbidities, particularly cardiovascular disease. Smoking exacerbates insulin resistance, increases inflammation, and accelerates atherosclerosis. Diabetic smokers are at significantly higher risk of heart attacks, strokes, and peripheral arterial disease compared to non-smokers with diabetes. *The New England Journal of Medicine* (2016) reported that diabetic patients who smoked had a 35% increased risk of cardiovascular mortality compared to non-smoking diabetic patients. An independent determinant for type 2 diabetes mellitus is cigarette smoking (Triyaniarta *et al.*, 2022).

According to a meta-analysis, current smokers were 45% more likely than non-smokers to develop diabetes mellitus (Ding *et al.*, 2019). The link between diabetes mellitus and cigarette smoking may be explained by a number of potential biological processes. First, smoking has been linked to an increased risk of central obesity or belly fat, which is a known determinant for insulin resistance and diabetes, even though smokers are often thinner than non-smokers (Domazet *et al.*, 2024; Ding *et al.*, 2019). A lower risk of diabetes mellitus is linked to light-to-moderate alcohol use (Åberg *et al.*, 2023). However, excessive alcohol consumption has a number of detrimental metabolic effects, such as elevated triglyceride levels, pancreatitis, disruption of glucose and carbohydrate metabolism, excess caloric intake and obesity, and liver impairment (Hirano *et al.*, 2022).

There is a correlation between diabetes and sex (Antza *et al.*, 2023). Numerous other researchers have discovered that sex is a determinant that affects how diabetic nephropathy develops. According to similar research, men were more likely than women to have diabetes mellitus (Ciarambino *et al.*, 2022; Zhang *et al.*, 2020). This, however, runs counter to recent research that found a greater incidence in women than in men (Fawcett *et al.*, 2020). Furthermore, a determinant for diabetes mellitus that has been established globally is sex (Zeng *et al.*, 2020). Additionally, a study by Akhtar *et al.* (2020), found that women were more likely than men to have pre-diabetes and diabetes mellitus. Yip *et al.* (2017), found a similar finding. On the other hand, a study by Arabshahi *et al.* (2024) and Mohammadifard *et al.* (2020), found that men were more likely than women to have diabetes mellitus.

Individuals' educational attainment has a major impact on the prevalence of pre-diabetes and diabetes mellitus (Al-Rifai *et al.*, 2019). This association varies internationally (Grundlingh *et al.*, 2022). In contrast, another study in Nigeria found that the prevalence of diabetes mellitus

was generally unaffected by educational level (Nwafor *et al.*, 2024). Furthermore, research from both industrialized and developing nations has shown a negative correlation between diabetes mellitus and educational attainment, possibly as a result of higher levels of health consciousness among those with greater education (Rahman *et al.*, 2022; de Courrèges *et al.*, 2021). Similarly, other studies found an association between illiteracy and diabetes mellitus (Lovrić *et al.*, 2022; Asharani *et al.*, 2021). Multiple determinants contribute to the development of concordant comorbidities in patients with diabetes, ranging from non-modifiable factors like age and sex to modifiable factors such as obesity, smoking, and poor glycaemic control (Chauke, 2022; Cherney *et al.*, 2020). Understanding these determinants is essential for reducing the burden of cardiovascular diseases, hypertension, and kidney disease among diabetic patients. Tailoring interventions to address these determinants can help improve long-term outcomes and reduce healthcare costs associated with diabetes management.

Concordant comorbidities are common in diabetes patients and significantly impact their quality of life and health outcomes. Determinants such as age, duration of diabetes, poor glycaemic control, obesity, hypertension, Dyslipidaemia, chronic inflammation, and socioeconomic factors play a crucial role in the development of these comorbidities. Addressing these determinants through early intervention, lifestyle modification, and optimal medical management is essential for improving outcomes in patients with diabetes. Future research should focus on strategies to manage concordant comorbidities better and mitigate their impact on the health of diabetes patients.

2.4.3 Sociodemographic Predictors of Concordant Comorbidities among Diabetes Patients

Diabetes mellitus (DM) is a chronic condition that is frequently accompanied by comorbidities, which significantly influence disease progression, management, and patient outcomes. Patel *et al.* (2018), examine the relationship between sociodemographic factors and the prevalence of comorbidities in diabetes patients. Kim *et al.* (2019), investigate how age, sex, and socioeconomic status affect diabetes-related comorbidities. Nguyen *et al.* (2020), analyse the impact of ethnicity and education level on the occurrence of comorbidities in diabetic patients. Johnson *et al.* (2021), study the influence of urban versus rural living environments on diabetes comorbidities and management.

Patel *et al.* (2018), conducted a cross-sectional study to explore how various sociodemographic factors, such as income, education, and occupation, influence the prevalence of comorbidities among diabetic patients. The study highlighted that lower income and education levels are associated with a higher prevalence of comorbid conditions. Kim *et al.* (2019), used a cohort design to investigate the effects of age, sex, and socioeconomic status on diabetes-related comorbidities. The research found that older age and lower socioeconomic status are significant predictors of increased risk of comorbidities such as cardiovascular disease and hypertension.

Nguyen *et al.* (2020), focused on ethnicity and education level, using a cross-sectional survey to assess how these factors influence the prevalence of comorbidities in diabetes patients. The study revealed disparities in comorbidity rates among different ethnic groups and those with varying levels of education. Johnson *et al.* (2021), examined the role of living environment (urban vs. rural) in the prevalence and management of diabetes comorbidities. The study

found that urban residents had better access to healthcare but faced higher rates of comorbidities compared to rural residents, who had limited access to healthcare services. Patel *et al.* (2018), sampled 1,500 diabetic patients across various socioeconomic backgrounds from urban and rural areas. Kim *et al.* (2019), included 1,200 participants aged 45 and older, with a balanced representation of sex and socioeconomic status. Nguyen *et al.* (2020), surveyed 1,000 diabetic patients from different ethnic backgrounds, including Asian, African American, and Caucasian groups. Johnson *et al.* (2021), examined 800 diabetic patients from both urban and rural settings, with a focus on accessibility to healthcare services.

Patel *et al.* (2018), utilized electronic health records and patient surveys to gather data on sociodemographic factors and comorbidity prevalence. Kim *et al.* (2019), employed longitudinal health assessments and clinical records to track sociodemographic influences on comorbidity development. Nguyen *et al.* (2020), used a cross-sectional survey with detailed questionnaires on ethnicity, education, and comorbidity status. Johnson *et al.* (2021), conducted surveys and interviews with diabetic patients, supplemented by healthcare access records. Patel *et al.* (2018), shared key variables such as income, education level, occupation, and the prevalence of comorbid conditions such as hypertension and hyperlipidaemia. Kim *et al.* (2019), focused on age, sex, socioeconomic status, and incidence of comorbidities, including cardiovascular disease and diabetes-related kidney disease. Nguyen *et al.* (2020), examined ethnicity, education level, and their correlation with diabetes comorbidities such as heart disease and stroke. Johnson *et al.* (2021), Key variables included living environment (urban vs. rural), healthcare access, and the prevalence of diabetes comorbidities.

Patel *et al.* (2018), found that patients with lower income and education levels had a higher prevalence of diabetes-related comorbidities, indicating socioeconomic disparities in health outcomes. Kim *et al.* (2019), identified that older age and lower socioeconomic status were associated with a greater risk of cardiovascular diseases and hypertension among diabetic patients. Nguyen *et al.* (2020), revealed that ethnic minorities and those with lower education levels experienced higher rates of comorbidities, highlighting the influence of ethnicity and education on diabetes outcomes. Johnson *et al.* (2021), discovered that urban residents had better healthcare access but also higher rates of comorbidities, whereas rural residents faced challenges in managing diabetes due to limited healthcare resources. Maier *et al.* (2023)'s, strength lies in the comprehensive sample across various sociodemographic factors, and the Cross-sectional design limits causal inference.

According to Kim *et al.* (2019), a longitudinal design provides insights into the long-term effects of sociodemographic factors and Limited diversity in geographic locations. Nguyen *et al.* (2020), suggest that focusing on ethnicity provides valuable insights into disparities and argue that the Cross-sectional nature may not capture changes over time. Johnson *et al.* (2021), compare urban and rural settings, offering a clear view of healthcare access issues, with a limited sample size affecting generalizability.

Lower income and education levels consistently correlate with higher comorbidity rates. Older age is a significant predictor of increased comorbidities among diabetic patients. Ethnic disparities and lower education levels are associated with higher rates of comorbidities. More longitudinal studies are needed to understand the long-term impact of sociodemographic factors on comorbidities. Greater diversity in study populations could improve the generalizability of findings. Sociodemographic factors such as age, sex, socioeconomic

status, education, ethnicity, and geographic location play critical roles in predicting the prevalence and severity of concordant comorbidities among diabetes patients. This review synthesizes research findings on the sociodemographic predictors of concordant comorbidities in diabetes patients and explores how these factors influence patient outcomes and management strategies.

2.4.3.1 Age as a Predictor of Concordant Comorbidities

Age is one of the most significant sociodemographic predictors of concordant comorbidities among diabetes patients. Research indicates that older adults with diabetes are more likely to develop multiple chronic conditions, especially concordant ones such as hypertension and cardiovascular diseases (Booth *et al.*, 2017). As the body's physiological resilience decreases with age, the cumulative effect of long-term hyperglycaemia exacerbates the risk of developing comorbid conditions, particularly those related to vascular health. The prevalence of hypertension, Dyslipidaemia, and coronary artery disease increases significantly with age, making older adults more susceptible to concordant comorbidities (Lauder *et al.*, 2023).

2.4.3.2 Sex Differences in Comorbidities

Sex-specific differences exist in the prevalence and severity of concordant comorbidities in diabetes patients. Sex differences also play an essential role in the development and progression of concordant comorbidities in diabetes patients. Men are more likely to experience early-onset cardiovascular disease, while women with diabetes have a disproportionately higher risk of coronary artery disease compared to men without diabetes. Postmenopausal women, in particular, are at increased risk due to the loss of oestrogen's protective effects on the cardiovascular system. Research in Circulation (2016) indicated that women with type 2 diabetes have a 50% higher risk of developing heart disease compared to

men with diabetes, mainly due to hormonal differences and disparities in determinants management.

Research shows that men with diabetes tend to have higher rates of cardiovascular comorbidities, while women are more likely to experience conditions such as hypertension and obesity (Regensteiner & Reusch, 2022). These differences may stem from biological factors (such as hormonal differences) as well as disparities in health-seeking behaviours. For instance, women are often found to access preventive care services more frequently than men, leading to earlier detection and management of certain comorbid conditions (Regensteiner & Reusch, 2022).

2.4.3.3 Socioeconomic Status and Education

Socioeconomic status (SES), often measured through income, occupation, and education levels, has a well-established association with the prevalence of diabetes and its comorbidities. Lower SES is consistently linked to poorer health outcomes and higher rates of concordant comorbidities (Sánchez-Díaz *et al.*, 2025). Individuals with lower income and education levels may have limited access to healthcare resources, healthy foods, and medications needed to manage their diabetes and associated conditions. This disparity often results in poorer glycaemic control and an increased risk of complications, such as cardiovascular diseases and nephropathy (Khunti *et al.*, 2025b).

2.4.3.4 Ethnicity and Concordant Comorbidities

Ethnic background is another critical predictor of concordant comorbidities in diabetes patients (Teagle *et al.*, 2022). Several studies have shown that minority ethnic groups, particularly African Americans, Hispanic populations, and Native Americans, are at higher

risk of developing both diabetes and its associated comorbidities, compared to their Caucasian counterparts (Dibato *et al.*, 2023; Ezzatvar *et al.*, 2021). This increased risk is partly attributed to genetic predispositions and lifestyle factors, such as diet and physical activity that vary across different ethnic groups. Additionally, minority populations often face socioeconomic challenges and healthcare disparities, further exacerbating their risk of developing severe comorbidities (Shour *et al.*, 2025).

2.4.3.5 Geographic Location

Geographic factors, including urban versus rural residency and regional healthcare infrastructure, can also influence the prevalence of concordant comorbidities among diabetes patients (Ejeta *et al.*, 2021). Research indicates that diabetes patients in rural areas often have higher rates of comorbidities due to limited access to healthcare services, fewer specialists, and reduced availability of medications (Reilly, 2021). Additionally, lifestyle factors such as diet and physical activity levels, which vary significantly between rural and urban environments, may contribute to the increased prevalence of hypertension and cardiovascular diseases in rural populations.

The sociodemographic predictors of concordant comorbidities not only influence the prevalence of these conditions but also affect diabetes management strategies and outcomes. For example, lower SES patients may struggle to adhere to prescribed treatments due to cost-related barriers, leading to poorer glycaemic control and an increased likelihood of complications (Haider *et al.*, 2024). Additionally, older adults may face cognitive and functional limitations that hinder their ability to manage their diabetes effectively, further increasing the risk of comorbidities (Bellary *et al.*, 2021). Understanding the sociodemographic factors that contribute to comorbidities in diabetes patients is crucial for

tailoring management strategies to individual patient needs. Sociodemographic factors, including age, sex, socioeconomic status, education, ethnicity, and geographic location, are significant predictors of concordant comorbidities among diabetes patients (Martinez-Harvell *et al.*, 2020). Older adults, men, individuals from lower SES backgrounds, ethnic minorities, and rural residents are particularly vulnerable to developing comorbid conditions such as hypertension and cardiovascular diseases (Khalatbari-Soltani *et al.*, 2020). Identifying these sociodemographic determinants can help healthcare providers design personalized interventions aimed at improving patient outcomes and reducing the burden of comorbidities in diabetes populations.

2.5 Theoretical Review

The Health Belief Model (HBM) is a widely used theoretical framework in health behaviour research, aiming to understand and predict individuals' health-related behaviours (Anuar *et al.*, 2020). The HBM provides a comprehensive framework for understanding the factors influencing health-related behaviours, including those related to diabetes. By addressing the key components of the HBM, health care practitioners and policymakers can develop targeted interventions to promote diabetes prevention, early detection, and effective management, ultimately improving health outcomes for individuals with diabetes.

2.5.1 Perceived Susceptibility

This element relates to a person's perception of their vulnerability or susceptibility to a specific medical condition. Patients can evaluate their susceptibility to diabetes mellitus based on several factors, including lifestyle choices, prior health experiences, and family history. Designing interventions to raise awareness and encourage preventative actions in more vulnerable groups can benefit from an understanding of perceived susceptibility.

2.5.2 Perceived Severity

Perceived severity pertains to an individual's assessment of the gravity and possible ramifications of their medical condition. For patients with diabetes, this could include understanding the long-term complications, such as cardiovascular diseases, neuropathy, retinopathy, and kidney damage, associated with uncontrolled diabetes. Higher perceived severity is likely to motivate individuals to engage in preventive behaviours or adhere to treatment regimens.

2.5.3 Perceived Benefits

This component focuses on people's opinions about how well a specific health activity reduces the likelihood or severity of a health problem. For instance, individuals with diabetes may benefit from adhering to a healthy diet, regular exercise, and medication adherence in controlling blood sugar levels and preventing complications. Highlighting these perceived benefits can encourage individuals to adopt and maintain healthy behaviours.

2.5.4 Perceived Barriers

Perceived barriers are a person's estimation of difficulties or impediments to implementing advised health habits. In the context of diabetes management, barriers may include the cost of medications, dietary restrictions, lack of social support, and fear of adverse effects. Identifying and addressing these perceived barriers are essential in facilitating behaviour change and improving treatment adherence.

2.5.5 Cues to Action

Cues to action are external or internal triggers that prompt individuals to engage in health-promoting behaviours. These cues can be informational (e.g., educational campaigns, advice

from healthcare providers), environmental (e.g., availability of healthy food options, accessibility to exercise facilities), or experiential (e.g., symptoms experienced, witnessing others' health outcomes). Understanding effective cues for action can help design interventions to motivate and support behavioural change among individuals with diabetes.

2.5.6 Self-Efficacy

Self-efficacy is the belief in oneself that one can perform a particular health practice successfully. In the context of diabetes management, self-efficacy plays a crucial role in adherence to treatment regimens, lifestyle modifications, and coping with challenges. Interventions aimed at enhancing self-efficacy through skill-building, goal-setting, and social support can empower individuals to take control of their health and effectively manage their diabetes.

2.6 Conceptual Framework

Figure 2.1 Adapted from Negussie (2023): Factors associated with concordant comorbidities in adult patients with diabetes in Central Ethiopia: a cross-sectional study.

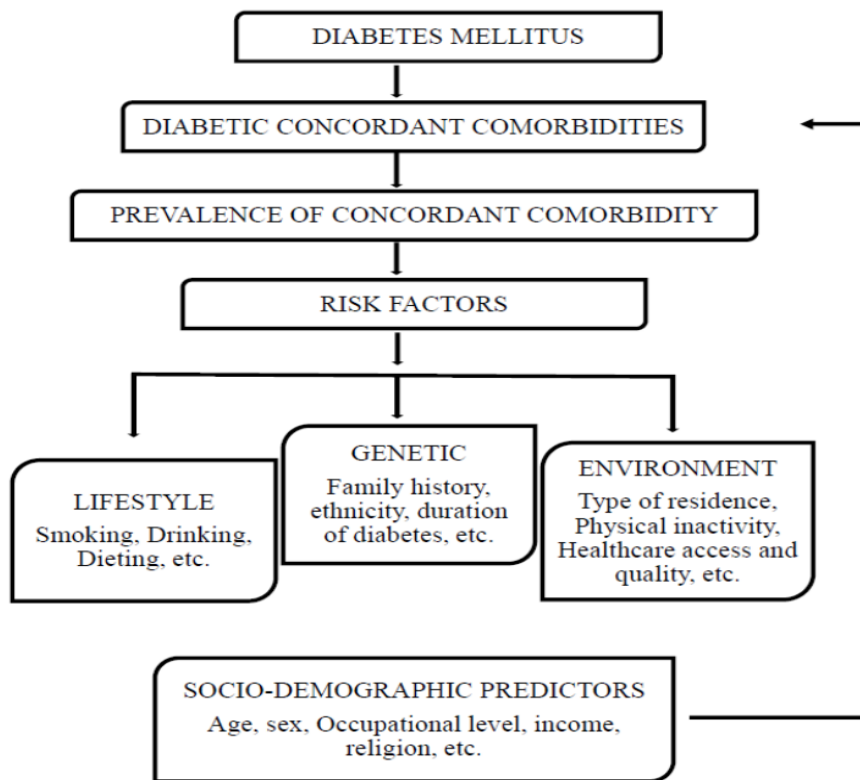


Figure 2.1: Conceptual Framework

At the Mampong Government Hospital in the Ashanti Region of Ghana, concordant comorbidities are present to varying degrees in patients with diabetes. This conceptual framework investigates the factors that influence presence and distribution. Concordant comorbidities include other illnesses or ailments that have similar determinants and treatment modalities, such as diabetes. Patient demographics, such as age, sex, and socioeconomic status, are important parts of the framework. While examining sex disparities might highlight different health concerns that are more common in men and women, understanding the age distribution aids in the identification of specific age-related determinants and prevalence rates. Socioeconomic status, which includes factors like income, education, and occupation, has a significant impact on health literacy and access to health care.

Biological factors are another critical component. Genetic predispositions, such as a family history of diabetes and duration of diabetes, can impact the risk of developing comorbidities. Additionally, glycaemic control levels, as indicated by measures such as HbA1c levels, are closely linked to the incidence and severity of comorbid conditions. Lifestyle and behavioural factors also significantly affect the health outcomes of patients with diabetes. Dietary habits and nutrition influence blood sugar levels and overall health, whereas regular physical activity helps manage diabetes and reduces the risk of comorbidities. Smoking and alcohol consumption can intensify diabetes and cause additional health complications.

Health care access and quality are vital determinants in this framework. The availability and accessibility of medical services, including routine check-ups and specialist care, are essential for effective diabetes management. The quality of care received, including patient education, monitoring, and treatment adherence, directly impacts health outcomes. Psychosocial factors such as mental health and social support further influence the management of diabetes and the development of comorbidities. Conditions like depression and anxiety, which are common among patients with diabetes, can affect disease management, whereas support from family, friends, and health care providers can significantly improve patient outcomes. Environmental factors, including urban versus rural living conditions and healthcare infrastructure quality, also play a role. Differences in lifestyle, health care access, and environmental exposure between urban and rural settings can affect the prevalence of comorbidities. By providing a comprehensive overview of the determinants and distribution of concordant comorbidities among patients with diabetes, this conceptual framework aims to assist healthcare providers and policymakers in developing targeted interventions to improve health outcomes for patients with diabetes at Mampong Government Hospital in the Ashanti Region, Ghana. Integrating the HBM into the conceptual framework for understanding the

determinants and distribution of concordant comorbidities among patients with diabetes can provide a robust tool for developing effective health interventions. By addressing both the practical and psychological aspects of diabetes management, health care providers can enhance patient outcomes and reduce the comorbidity burden.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

This chapter describes the study area, population, sample, and sampling technique used in the study. The methodology also focuses on the instrument used for data collection, pre-testing the instrument, its validity and reliability, and the procedure for data collection.

3.2 Study Design

The study was a hospital-based cross-sectional design employed to assess the associated determinants and complications, and the relationships between determinants and the distribution of these comorbidities in the Mampong Municipal Government Hospital.

3.3 Study Area

Population density is the number of people per square kilometre (km²) of a unit land area. Mampong is in the Ashanti region and is one of the 43 administrative districts. The designation as a municipality was granted in November 2007 through Legislative Instrument (L.I.) 1908. Mampong is the municipal capital, positioned 52 kilometres away from Kumasi, the regional capital. Additionally, Mampong is home to the second most significant stool, the silver stool, within the Ashanti Kingdom. Geographically, Mampong lies between longitudes 0.05° and 1.30° west and latitudes 6.55° and 7.30° north, covering a total land expanse of 449 square kilometres. The municipality comprises 79 settlements, of which approximately 55% are classified as rural and the remaining 45% are classified as urban. The rural areas, predominantly situated in the northern part of the municipality, comprise dispersed communities with fewer than 50 residents each.

This low population density poses challenges to providing essential services and conducting effective monitoring and evaluation of programmes and projects within the district. It is important to recognise the impact on the municipality's food security. Promoting agriculture policies that draw youth into the industry is a good idea. This is why the government's initiative to plant crops for food and jobs has been successful. To accommodate the growing population, municipalities need to implement additional policies. The population density in the municipality is 27.0 people/km² (27 people/km²), which is lower than the regional population density of 45.9 people/km² and the national figure of 49.3 people/km².

According to the 2021 Population and Housing Census, 116,632 people live in the municipality. Of these, 56,965 are men, and 59,667 are women, making up 48.8% and 51.2% (Source: Ghana Statistical Service). With the population growing at a 2.2% annual pace, 119,197 people are expected to live in the city in 2023. The population is represented by a broad base population pyramid that tapers off with an ageing population. A total of 35,001 people was employed; 51%, or 17,867, work in the agriculture sector. Of these, 58.1% are men and 41.9% are women. Among the working population employed in agriculture, 17% are aged 35 or older.

3.3.1 Geographical Locations

Figure 1.1: Map of Mampong Municipal



Source: Ghana Statistical Service, GIS

Figure 3.1: Map of Mampong Municipal

3.4 Study Population

Polit and Beck (2020) stated that a population is the entire collection of phenomena or elements that the researcher is interested in, and that these elements have similar characteristics. Accordingly, a population can be defined to cover a vast collection of cases or may be narrowly defined to include only cases. Researchers, especially quantitative researchers, sample from an accessible population and generalise the findings of the research to a target population after the study. The entire elements that the researcher was interested in became the specific population. In contrast, the elements of the specific population that are

available or accessible to the researcher, such as the study respondents, are called the accessible population.

The participants in the study were patients diagnosed with diabetes mellitus. They were chosen at random from patients presenting for care at the diabetic clinic located on the premises of the Mampong Government Hospital in the Ashanti region of Ghana. This diabetic clinic acts as the community's primary health care institution for the diagnosis, treatment, and management of diabetes mellitus. Patients visiting our clinic come from various backgrounds, including different age groups, sex, socioeconomic statuses, and stages of the disease course. Therefore, the goal of this study was to provide a complete picture of the Mampong community's diabetes mellitus patients who were utilising this speciality clinic's medical services.

3.5 Eligibility Criteria

3.5.1 Inclusion criteria

Participants of adult age as defined by the World Health Organization, who provided assent or informed consent and were currently receiving medical treatment for diabetes, were eligible for inclusion. The Mampong Municipal Government Hospital was selected because it serves as the main referral facility in the municipality, receiving the majority of diabetes cases and maintaining clinical records required for reliable data collection. Its central role in diabetes management within the municipality makes it an appropriate and representative setting for assessing concordant comorbidities.

3.5.2 Exclusion criteria

Individuals with severe cognitive impairments that limited their ability to provide reliable information, as well as pregnant women due to gestational diabetes and pregnancy-related physiological changes that may confound the results were excluded from the study.

3.6 Sample Size Determination

In this study, the sample size was estimated using Cochran's formula, as described by Nanjundeswaraswamy & Dinakar, (2021) using 56% diabetes prevalence (Sosibo *et al.*, 2022).

The formula used for sample size estimation is:

$$n = \frac{(Z_{\alpha/2})^2 p(1-p)}{d^2}$$

Where:

n = desirable sample size

$(Z_{\alpha/2})$ = critical value at a 95% significance level (1.96)

p = proportion of DM (0.56)

d = precision of measurement (acceptable marginal error) (0.05)

Substituting the given values into the formula:

$$\frac{(1.96)^2 \times 0.56 \times (1-0.56)}{0.05^2}$$

$$0.05^2$$

$$n = \frac{3.8416 \times 0.56 \times 0.44}{0.0025}$$

$$0.0025$$

$$n = \frac{0.92928}{0.0025}$$

$$0.0025$$

$$n = 371.71 \approx 372$$

In this study, an attrition rate of 15% of the sample size was assumed. Therefore, 10% of 372 was calculated as 55.8, which was rounded up to 56. This attrition rate was added to the initial sample size estimation to compensate for potential participant dropouts, resulting in a final sample size of 428. To ensure a robust sample size and to accommodate unforeseen circumstances, a slightly larger sample size was recommended. Thus, a minimum of 430 participants were recruited for this study.

3.7 Sampling Technique

A total of 430 patients with diabetes mellitus were selected using the simple random sampling without replacement (SRSWOR) technique, ensuring that once a participant was selected, they could not be selected again (Makwana *et al.*, 2023).

3.8 Data Collection and Tools

3.8.1 Questionnaire Design

To collect pertinent data for the study, structured checklist (questionnaire) was prepared by reviewing relevant literatures and patient's medical card. In doing so, information related to their socio-demographic characteristics (age, sex, residence, and educational level), type of diabetes, duration of diabetes, treatment regimen, glycaemic control and types of concordant comorbidities (hypertension, dyslipidaemia, obesity, CKD and CVD) were obtained. This data was collected based on the patient's medical record chart, and then the team participated to the collection of these relevant data incorporates, two (2) National Service Personnel's supervised by the investigator.

The survey was divided into three parts. Sociodemographic factors (sex, age, religion, and education) are covered in Section A. Types of diabetes mellitus (1 or 2) and

related/associated factors (family history, smoking, amount/frequency, sedentary lifestyle, age at first diagnosis, and duration of the disease) are covered in Section B. The determinants for diabetes mellitus comorbidities are listed in Section C.

3.8.2 Data Collection Procedure

Structured questionnaires were administered to patients attending routine review visits at the clinic. Additionally, diabetes mellitus complications were extracted from participants' medical records, including diabetic neuropathy, erectile dysfunction (in men), cardiovascular conditions, eye problems (e.g., cataracts, retinopathy, etc.), and diabetic foot diseases (such as foot ulcers and amputation). Notably, hypertension was considered a comorbid condition rather than a complication. Diagnosis of these complications was solely based on information documented in the participants' medical records without clinical assessments. Data collection was done during the diabetic clinic day (Wednesday), with an estimated issuance of 33 questionnaires per clinic day.

3.9 Study Variables

The dependent variables were diabetes concordant comorbidities and for the independent variables these include clinic factors (Type of DM, type of treatment, proteinuria, glycaemic control, body mass index (BMI), family history of DM, duration of DM, history of smoking, and follow-up miss and sociodemographic variables (age, religion, education, sex, marital status, and occupational status).

3.10 Data Management

To prevent personal identification, data and information collected from patients were anonymized. The identity of the participants was not revealed in this thesis. Only the lead

investigator and co-investigators had access to the data. Unique code numbers were assigned to each sample collected for this study, and these codes were used in the processing and analysis of the sample data. Additionally, no participants were identified by any means, and all patient data and information were devoid of any identifying names. Questionnaires were kept in a locked file cabinet. A soft copy of the collected data was coded and locked on a computer using a password and was accessible only to the principal researcher.

3.11 Data Processing and Analysis

Data analysis was conducted using Stata version 19 (StateCorp LLC, College Station, TX, USA). Cleaned data were initially imported into Epi-Info version 7.2 for validation before being transferred to Stata version 19 (StateCorp LLC, College Station, TX, USA). for further analyses. Both descriptive and inferential statistical methods were employed. Descriptive statistics, including frequencies, percentages, means and standard deviations, were used to summarised the socio-demographic characteristics of the study participants and to determine the prevalence of concordant comorbidities among individuals with diabetes. Pearson's chi-square tests for homogeneity of proportion were also performed to determine differences in proportions. To assess the association between socio-demographic and clinical factors and the presence of concordant comorbidities, bivariate logistic regression analysis was performed. Variables that demonstrated a p-value of ≤ 0.25 in the bivariate analysis were subsequently included in the multivariate logistic regression model to identify independent predictors of concordant comorbidities. The strength and direction of associations were expressed using Adjusted Odds Ratios (AORs) with their corresponding 95% confidence intervals (CIs). Statistical significance in the multivariate model was set at $p < 0.05$.

3.12 Pretesting/Pilot Study

The questionnaire was designed to reflect the objectives of the study. These were pretested in a pilot study at the Cavalry Hospital with 21 participants to validate the survey tools. The purpose was to establish whether the tool was well-worded, understood, and devoid of significant biases to obtain the intended type of information. Pretesting was carried out to eliminate irrelevant questions and ensure reliability.

3.13 Data Quality Control

- The questionnaire was pre-tested on diabetic patients at another diabetes centre (Cavalry Hospital) to validate the survey instruments and ensure data quality.
- Research assistants were trained to perform surveys accurately.
- Questionnaires were cross-checked by the principal researcher upon interaction.
- Questionnaires were explained to participants before the interaction.
- Before analysis, data are correctly coded and entered.
- Finally, the completeness, the accuracy and the consistency of the collected data was checked on each day of the data collection period critically.

3.14 Ethical Considerations

Official permission was sought from the Mampong Municipal Health Directorate and the Mampong Government Hospital. Ethical approval was obtained from the Committee on Human Research, Publication, and Ethics (CHRPE) of the School of Medical and Dental Sciences (SMDS) at Kwame Nkrumah University of Science and Technology (KNUST) in Kumasi, Ghana (CHRPE/AP/1235/24).

Informed consent was obtained from each participant after reading out and explaining to participants who were not able to read or write, and the consent form was signed or thumb printed by a witness.

CHAPTER FOUR

RESULTS

4.0 Introduction

This chapter presents and describes the results of the current study based on the specific objectives and the literature reviewed during the study. Key results include: sociodemographic and clinical characteristics of the participants, the prevalence of concordant comorbidities, determinants, and sociodemographic predictors of concordant comorbidities. Of the 430 participants estimated for the study 419 consented to participate and were recruited representing a response rate of 97.45%.

4.1 Sociodemographic Characteristics of Participants

Table 4.1 shows that a majority (73.5%) of the participants were female, 57.3% were aged 64 years and above and 26.7% aged 55–64. Most (74%) participants were married, 10.5% employed and 89.5% unemployed. In terms of education, 54.2% had some form of formal education, while 45.8% had none. Monthly income varied, with the largest group (42.5%) earning over 1000 units, followed by 39.6% earning between Gh¢ 101–500. Most (85.4%) participants were Christian, whereas 13.6% and 1% were Muslims and Traditional, respectively. The majority (63.7%) of the participants lived in rural areas while 36.3% resided in urban settings.

Table 4.1: Sociodemographic characteristics of participants

Variable	[n]	[%]
Sex		
Male	111	26.5
Female	308	73.5
Age		
35 – 44	16	3.8
45 – 54	51	12.2
55 – 64	112	26.7
64+	240	57.3
Marital status		
Married	310	74
Not married	109	26
Employment status		
Employed	44	10.5
Unemployed	375	89.5
Educational attainment		
No formal education	192	45.8
Formal education	227	54.2
Monthly income		
≤ Gh¢ 100	10	2.4
Gh¢ 101 – 500	166	39.6
Gh¢ 501 – 1000	65	15.5
> Gh¢ 1000	178	42.5
Religious affiliation		
Christianity	358	85.4
Islam	57	13.6
Traditionalist	4	1
Residence		
Rural	267	63.7
Urban	152	36.3
Total	419	100

n: frequency; %: percentage, SD; Standard Deviation

Source: Field data, 2024

4.2 Clinical characteristics of participants

Table 4.2: Clinical characteristics of participants

Variable	[n]	[%]
Diabetes type		
Type 1	13	3.1
Type 2	406	96.9
Duration		
<1 year	2	0.5
1-4 years	182	43.4
>4 years	235	56.1
Glycaemic Control Level		
Poor	340	81.1
Good	79	18.9
Checking Blood Glucose Level		
Weekly	5	1.2
Monthly	414	98.8
Protein urea		
Negative	325	77.6
Positive	94	22.4
Availability of glucometer at home		
Yes	40	9.5
No	379	90.5
Body Mass Index		
Underweight	73	17.4
Overweight	289	69
Obese	31	7.4
Normal weight	26	6.2
Access to regular healthcare services		
Yes	387	92.4
No	32	7.6
Distance of health facility from residence		
Far	148	35.3
Moderate	87	20.8
Close	184	43.9
Type of Anti-diabetics in use		
OHA (Oral Hypoglycaemic agent)	406	96.9
Insulin	13	3.1
Total	419	100

n: frequency; %: percentage; <: less than; >: greater than

Source: Field data, 2024

Table 4.2 shows that, 96.9% had Type 2 diabetes and had been living with the condition for more than four years (56.1%). Most participants (81.1%) had poor glycaemic control even though 98.8% of them checked their blood glucose levels monthly. Most (77.6%) participants had no protein urea whereas 69% were overweight. Most (90.5%) participants did not have a glucometer at home, although 92.4% had access to regular healthcare services, and 43.9% lived close to a health facility. Most (96.9%) participants are managed using oral hypoglycaemic agents.

4.3 Prevalence of Diabetes Concordant Comorbidity among Participants

Table 4.3 shows that the prevalence of diabetes concordant comorbidities was 84.0% (95% CI: 80.2 – 87.3). The Chi-square test for homogeneity of proportion showed that there was a significant difference between the proportion of participants who had concordant comorbidity and those without concordant comorbidity ($\chi^2 = 172.11$, $df = 1$, $p < 0.001$). Specifically, the proportion of participants who had concordant comorbidity was significantly higher than those without concordant comorbidity. Among those with concordant comorbidity, hypertension was the most common among the reported conditions, affecting 52.0% of participants. Other comorbidities had lower prevalence rates: cardiovascular disease (10.5%), kidney disease (8.8%), neuropathy (11.6%), retinopathy (11.4%), and dyslipidaemia (5.7%), as presented in **Figure 4.1**.

Table 4.3: Prevalence of diabetes concordant comorbidity among participants

Variable	[n]	[%]
Concordant comorbidity		
Present	352	84
Absent	67	16
Total	419	100

n: frequency; %: percentage

Source: Field data, 2024

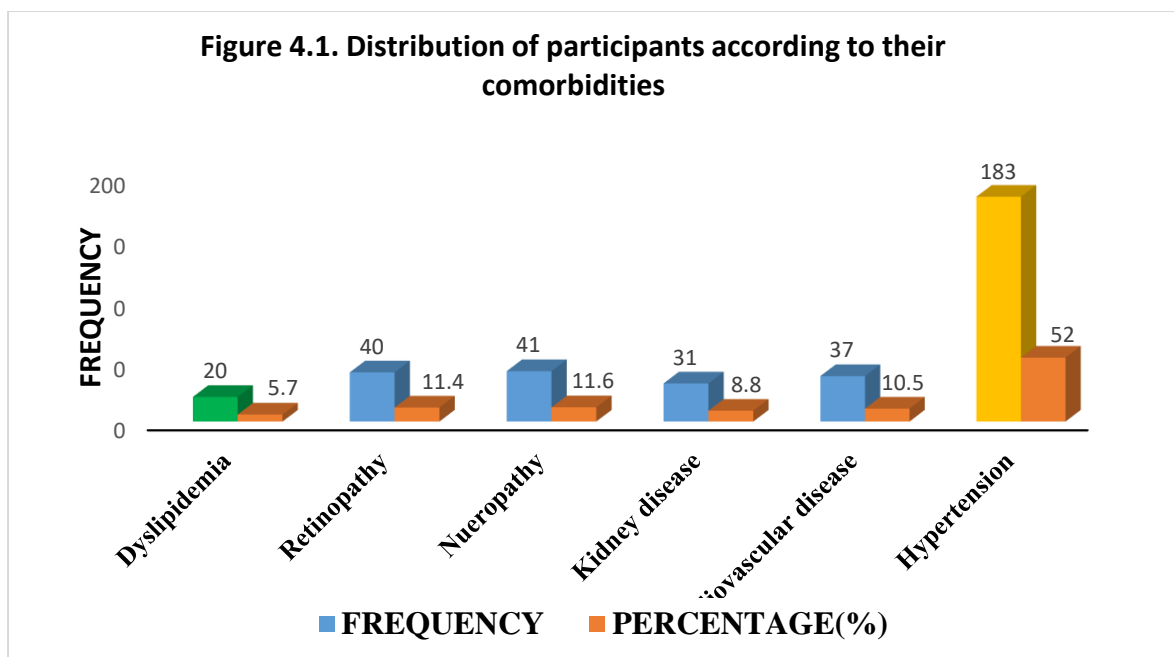


Figure 4.1: Distribution of participant according to their comorbidities

Source: Field data, 2024

4.4 Determinants of Concordant Comorbidity among Participants with Diabetes

Table 4.4 shows the determinants associated with diabetes concordant comorbidity among participants. To avoid prematurely excluding potential confounders and effect modifiers, all variables with a p-value ≤ 0.25 in the bivariate logistic regression (Model I) were included in the multivariate logistic regression (Model II). The adjusted odds ratios (AOR), along with their corresponding 95% confidence intervals (CI) and p-values, are used to determine the independent effect of each factor on the likelihood of developing diabetes concordant comorbidity among the participants.

4.4.1 Behavioural Determinants

Table 4.4.1, indicates that participants who missed follow-up sessions had significantly higher odds of developing diabetes concordant comorbidity compared with those who regularly attend follow-up sessions (AOR = 1.75, 95% CI: 1.28–2.38, p = 0.000). Those who

did not adhere to dietary recommendations were 1.82 times more likely to have concordant comorbidities compared to adherent individuals (AOR = 1.82, 95% CI: 1.25–2.42, $p = 0.000$). Participants who currently smoked had an increased risk of 2.38 (AOR = 2.38, 95% CI: 1.57–3.50, $p = 0.000$), while former smokers had an even higher risk of 3.24 (AOR = 3.24, 95% CI: 2.98–5.71, $p = 0.035$) relative to non-smokers. Similarly, alcohol use was a significant determinant. Participants who had previously consumed alcohol were 3.79 times more likely to develop comorbidities than non-drinkers (AOR = 3.79, 95% CI: 1.16–4.48, $p = 0.016$), and current drinkers had increased odds as well (AOR = 1.31, 95% CI: 1.02–2.67, $p = 0.000$).

4.4.2 Clinical Determinants

As shown in **Table 4.4.2**, participants with poor glycaemic control were at a higher risk compared to those with good control (AOR = 1.31, 95% CI: 1.02–2.67, $p = 0.000$). Body Mass Index (BMI) also showed significant associations. Compared to those with normal weight, underweight individuals had an AOR of 1.46 (95% CI: 1.21–2.50, $p = 0.017$), overweight individuals had an AOR of 1.34 (95% CI: 1.09–1.94, $p = 0.011$), and obese individuals had an AOR of 1.11 (95% CI: 1.07–1.58, $p = 0.016$). Lack of access to regular healthcare services significantly increased the likelihood of comorbidity (AOR = 1.69, 95% CI: 1.21–2.35, $p = 0.002$). The type of diabetes was also a strong predictor. Patients with type 2 diabetes were more than twice as likely to have comorbidities compared to those with type 1 diabetes (AOR = 2.38, 95% CI: 1.57–3.59, $p = 0.000$). Finally, the duration of diabetes had a marked effect. Those who had diabetes for 1-4 years were significantly more likely to have comorbidities (AOR = 8.25, 95% CI: 3.14–12.04, $p = 0.046$) compared to those diagnosed for less than a year. The odds were even higher for individuals with more than four years since diagnosis (AOR = 9.04, 95% CI: 2.02–12.88, $p = 0.036$).

Table 4.4.1: Behavioural determinants of concordant comorbidity among participants with diabetes

Variable	Diabetes concordant comorbidity				COR	[95%CI]	p-value	AOR	[95%CI]	p-value
	[n]	[%]	Present [n = 352]	Absent [n = 67]						
Missed Follow-up sessions										
Yes	218	52	182	36	Ref			Ref		
No	201	48	170	31	1.77	[1.31 - 2.37]	0.000*	1.75	[1.28 - 2.38]	0.000*
Availability of social support										
Yes	219	52.3	181	38	Ref			Ref		
No	200	47.7	171	29	1.23	[0.20 - 2.38]	0.115	1.02	[0.36 - 1.76]	0.136
Diet adherence										
Adhere	289	69	245	44	Ref			Ref		
Do not adhere	130	31	107	23	1.85	[1.28 - 2.43]	0.000*	1.82	[1.25 - 2.42]	0.000*
Smoking status										
Non-smoker	391	93.3	328	63	Ref			Ref		
Current smoker	1	0.2	1	0	2.45	[1.63 - 3.68]	0.000*	2.38	[1.57 - 3.59]	0.000*
Smoked before	27	6.4	23	4	5.37	(2.45 - 7.80)	0.000*	3.24	(2.98 - 5.71)	0.035*
Alcohol Consumption status										
Do not take alcohol	381	90.9	321	60	Ref			Ref		
Currently taking alcohol	1	0.2	1	0	1.26	[1.12 - 3.68]	0.000*	1.31	[1.02 - 2.67]	0.000*
Took alcohol before	37	8.8	30	7	4.99	[1.24 - 6.14]	0.029*	3.79	[1.16 - 4.48]	0.016*
Frequency of engaging in physical activity										
None	43	10.3	39	4	Ref			Ref		
≤60 mins per week	36	8.6	32	4	2.48	[0.20 - 3.16]	0.104	2.16	[0.41 - 3.69]	0.371
61 – 150 mins per week	17	4.1	14	3	0.39	[0.22 - 1.72]	0.232	0.91	[0.76 - 2.78]	0.168
≥151 mins per week	323	77.1	267	56	0.44	[0.27 - 1.33]	0.202	0.59	[0.48 - 1.63]	0.265

AOR, Adjusted odds ratio; COR, Crude odds ratio; n, Frequency; *, p < 0.05; %, Percentage

Source: Field data 2024

Table 4.4.2: Clinical determinants of concordant comorbidity among participants with diabetes

Variable	Diabetes concordant comorbidity				COR	[95%CI]	p-value	AOR	[95%CI]	p-value
	[n]	[%]	Present [n = 352]	Absent [n = 67]						
Body Mass Index										
Normal weight	26	6.2	23	3	Ref			Ref		
Underweight	73	17.4	58	15	1.52	[1.28 - 2.59]	0.022*	1.46	[1.21 - 2.50]	0.017*
Overweight	289	69	246	43	1.44	[1.08 - 1.91]	0.013*	1.34	[1.09 - 1.94]	0.011*
Obese	31	7.4	25	6	1.13	[1.05 - 1.61]	0.021*	1.11	[1.07 - 1.58]	0.016*
Glycaemic Control Level										
Good	79	18.9	64	15	Ref			Ref		
Poor	340	81.1	288	52	1.26	[1.12 - 3.68]	0.000*	1.31	[1.02 - 2.67]	0.000*
Protein urea										
Positive	94	22.4	82	12	Ref			Ref		
Negative	325	77.6	270	55	1.21	[0.56 - 2.57]	0.131	0.77	[0.35 - 1.72]	0.526
Access to regular healthcare services										
Yes	387	92.4	332	55	Ref			Ref		
No	32	7.6	20	12	1.66	[1.19 - 2.29]	0.002*	1.69	[1.21 - 2.35]	0.002*
Health facility Distance from residence										
Close	184	43.9	157	27	Ref			Ref		
Moderate	87	20.8	71	16	0.91	[0.23 - 3.53]	0.189	0.84	[0.20 - 3.35]	0.802
Far	148	35.3	124	24	1.34	[0.68 - 2.66]	0.195	1.37	[0.65 - 2.88]	0.404
Diabetes Type										
Type 1	13	3.1	11	2	Ref			Ref		
Type 2	406	96.9	341	65	2.45	[1.63 - 3.68]	0.000*	2.38	[1.57 - 3.59]	0.000*
Duration										
<1 year	2	0.5	2	0	Ref			Ref		
1-4 years	182	43.4	156	26	6.33	[2.12 - 0.95]	0.033*	8.25	[3.14 - 2.92]	0.046*
>4 years	235	56.1	194	41	3.79	[1.24 - 5.22]	0.041*	9.04	[2.02 - 12.88]	0.036*

AOR, Adjusted odds ratio; COR, Crude odds ratio; n, Frequency; *, p < 0.05; %, Percentage

4.5 Sociodemographic Predictors of Diabetes Concordant Comorbidities among Participants

Table 4.5 presents the sociodemographic predictors of diabetes concordant comorbidity among participants, using both bivariate and multivariate logistic regression analyses. In order to avoid prematurely excluding potential confounders and effect modifiers, all variables with a p -value ≤ 0.25 in the bivariate analysis were included in the multivariate model. The odds of females having diabetes concordant comorbidity were 3.89 times higher (AOR = 3.89; 95% CI: 1.92 – 5.10; $p = 0.028$) than males. Age was another strong predictor of comorbidity. Participants aged 35–44 years, those aged 45–54 had 1.79 times odds (AOR = 1.79; 95% CI: 1.13 – 2.62; $p = 0.002$) compared with 3.65 and 7.61 odds among those aged 55–64 (AOR = 3.65; 95% CI: 1.13 – 5.15; $p = 0.023$) and 64 years and older (AOR = 7.61; 95% CI: 2.14 – 10.71; $p = 0.034$).

Unemployed participants had 5.77 times higher odds of experiencing comorbidity than employed participants (AOR = 5.77; 95% CI: 1.56 – 7.73; $p = 0.026$). Participants with formal education had a significantly lower likelihood of comorbidity than those without formal education (AOR = 0.69; 95% CI: 0.38 – 0.95; $p = 0.031$). Participants living in rural areas had 3.22 times greater odds of experiencing diabetes concordant comorbidity than their urban counterparts (AOR = 3.22; 95% CI: 1.22 – 5.23; $p = 0.041$).

Table 4.5: Sociodemographic predictors of concordant comorbidity among participants with diabetes

Variable	[n]	[%]	Diabetes concordant comorbidity		COR	[95%CI]	p-value	AOR	[95%CI]	p-value
			Present [n = 352]	Absent [n = 67]						
Sex										
Male	111	26.5	93	18	Ref			Ref		
Female	308	73.5	259	49	1.68	[1.14 - 2.73]	0.034*	3.89	[1.92 - 5.10]	0.028*
Age										
35 – 44	16	3.8	13	3	Ref			Ref		
45 – 54	51	12.2	45	6	1.77	[1.28 - 2.08]	0.011*	1.79	[1.13 - 2.62]	0.002*
55 – 64	112	26.7	87	25	3.58	[2.21 - 6.60]	0.026*	3.65	[1.13 - 5.15]	0.023*
64+	240	57.3	207	33	5.67	[2.23 - 7.95]	0.014*	7.61	[2.14 - 10.71]	0.034*
Marital status										
Married	310	74	267	43	Ref			Ref		
Not married	109	26	85	24	2.94	[1.34 - 5.07]	0.032*	1.79	[0.15 - 2.74]	0.642
Employment status										
Employed	44	10.5	40	4	Ref			Ref		
Unemployed	375	89.5	312	63	4.99	[1.24 - 6.14]	0.029*	5.77	[1.56 - 7.73]	0.026*
Educational attainment										
No formal education	192	45.8	168	24	Ref			Ref		
Formal education	227	54.2	184	43	0.61	[0.38 - 0.95]	0.031*	0.69	[0.38 - 0.95]	0.031*
Monthly income										
≤100	10	2.4	9	1	Ref			Ref		
101 – 500	166	39.6	146	20	3.03	[0.34 - 5.62]	0.215	1.72	[0.14 - 2.58]	0.666
501 – 1000	65	15.5	50	15	1.73	[0.17 - 3.07]	0.135	1.43	[0.13 - 2.41]	0.768
≥1001	178	42.5	147	31	2.24	[0.26 - 4.99]	0.159	2.4	[0.25 - 3.03]	0.448
Residence										
Urban	152	36.3	125	27	Ref			Ref		
Rural	267	63.7	227	40	1.22	[1.01 - 2.33]	0.034*	3.22	[1.22 - 5.23]	0.041*

AOR, Adjusted odds ratio; COR, Crude odds ratio; n, Frequency; *, p < 0.05; %, Percentage

CHAPTER FIVE

DISCUSSIONS

5.1 Introduction

This chapter discusses the results of the current study based on the current literature, providing a comprehensive comparison and explanation of findings on sociodemographic and clinical characteristics, and the prevalence of concordant comorbidities among diabetic patients. It further discusses the associated risk and sociodemographic predictors. The implications of these findings are discussed in the context of the healthcare needs of people living with diabetes in Ashanti Mampong Municipal in the Ashanti Region of Ghana and similar settings.

5.2 Prevalence of Concordant Comorbidities

The present study found that 84.0% of diabetes patients attending the Mampong Government Hospital had at least one concordant comorbidity. This prevalence is notably high and highlights the considerable burden of chronic diseases co-occurring with diabetes in clinical practice. Among these patients, hypertension was the most prevalent condition, affecting 52.0%, followed by neuropathy (11.6%), retinopathy (11.4%), cardiovascular disease (10.5%), kidney disease (8.8%), and dyslipidaemia (5.7%). These findings provide important insight into the multiple health challenges diabetes patients face, especially in resource-constrained settings.

The observed 84.0% prevalence of concordant comorbidities in this study is higher than the global average but consistent with findings from similar populations. According to the International Diabetes Federation (IDF) Diabetes Atlas (10th Edition), it is estimated that at least 75% of adults with type 2 diabetes globally have one or more comorbid conditions, and

this figure can rise to over 90% in older adults or those with longstanding diabetes (Tran *et al.*, 2020). The Centres for Disease Control and Prevention (CDC) in the United States reported that nearly 80% of diabetes patients aged 65 years and older have at least one additional chronic disease, typically hypertension or cardiovascular disease (CDC, 2022). In a study by Akın & Bölük (2020) in Turkish, 98.5% of type 2 diabetes patients were reported to have concordant comorbidities, with cardiovascular disease, kidney disease, and retinopathy being the most common. Similarly, a large cross-sectional study by Modjtahedi *et al.* (2021), reported that 40–60% of adults with diabetes had hypertension, 20–30% had cardiovascular disease, and 10–20% experienced neuropathy and retinopathy.

In sub-Saharan Africa, the prevalence rates show significant variation, likely due to differences in healthcare access, diagnostic capacity, and population characteristics. For example, Meme (2017), found that 61% of diabetic patients in Kenya had at least one comorbidity, with hypertension being the most common. In Nigeria, Uloko *et al.* (2018), reported that about 60–70% of people living with diabetes had hypertension, and over 20% had cardiovascular complications. In Ghana, a study by Obeng (2022), found a 55% prevalence of hypertension among urban diabetes patients in Accra.

The high rate can be attributed to several factors observed in the study population, including the advanced age of participants, 57.3% were aged 64 years and above, a group known to be at elevated risk for multimorbidity. Furthermore, the overwhelming majority (96.9%) of participants had type 2 diabetes, which is more frequently associated with other metabolic disorders compared to type 1 diabetes.

5.2.1 Hypertension and Cardiovascular Risk

Hypertension, which affected half (52.0%) of the study population, is the most frequently reported comorbid condition among diabetes patients worldwide (Akalu & Belsti, 2020). According to the American Diabetes Association (ADA, 2023), more than 70% of U.S. adults with diabetes also have hypertension. The somewhat lower prevalence found in this study may be related to underdiagnosis or subclinical presentation in rural populations.

Cardiovascular disease, found in 10.5% of the participants, remains a leading cause of mortality among people with diabetes. In comparison, global studies estimate that 20–30% of people with diabetes will eventually develop overt cardiovascular conditions (Yao *et al.*, 2023). The relatively lower prevalence in this study may again reflect limited diagnostic capabilities or lower awareness of cardiovascular symptoms.

5.2.2 Microvascular Complications: Neuropathy, Retinopathy, and Kidney Disease

Microvascular complications were also reported, with neuropathy and retinopathy affecting over 11% of the population. This aligns with findings by Zhou *et al.* (2020), who found that diabetic neuropathy affects approximately 10–20% of people globally, with increased prevalence among those with longstanding disease and poor glycaemic control. Retinopathy, at 11.6%, is lower than the 20–30% often reported in developed settings, possibly due to a lack of routine eye screening in the studied population.

Kidney disease, reported in 8.8%, is slightly lower than the 15–20% observed in regions with routine screening for albuminuria and estimated glomerular filtration rate (eGFR). Studies such as Afroz *et al.* (2019) noted that chronic kidney disease (CKD) prevalence among diabetics is frequently underestimated in low- and middle-income countries due to limited lab diagnostics.

5.2.3 Dyslipidaemia and Metabolic Risk

The prevalence of dyslipidaemia (5.7%) was significantly lower than what has been reported globally. Studies have estimated the prevalence of diabetic dyslipidaemia to be 30–50%, especially in patients with obesity, poor diet, and limited physical activity (Agyemang, 2022; Feingold & Grunfeld, 2023). The low rate observed in this study may be due to under-testing, limited lipid profiling, or lack of awareness.

The prevalence of concordant comorbidities among diabetes patients in this study is alarmingly high, reflecting a common pattern in both local and international contexts. The high burden underscores the need for an integrated healthcare approach that can simultaneously manage diabetes and its associated chronic conditions. It also points to the importance of early screening, improved access to diagnostics, and sustained lifestyle interventions. Public health efforts should focus on strengthening primary healthcare systems, particularly in rural and resource-limited settings, where undiagnosed and unmanaged comorbidities may further exacerbate the diabetes burden.

This is consistent with global data indicating that hypertension is the most frequent comorbidity in diabetes patients due to overlapping pathophysiology (Ejeta *et al.*, 2021). Local studies, such as Kazibwe *et al.* (2024), found similar hypertension prevalence among diabetics in Northern Ghana. Other comorbidities identified include neuropathy (11.6%), retinopathy (11.4%), cardiovascular disease (10.5%), kidney disease (8.8%), and dyslipidaemia (5.7%). These rates are comparable to the WHO (2016) reports on the burden of diabetes-related complications in sub-Saharan Africa.

5.3 Determinants Associated with Concordant Comorbidities

Key determinants included missing follow-up sessions, poor dietary adherence, smoking, alcohol consumption, poor glycaemic control, BMI, lack of regular healthcare access, and duration/type of diabetes.

5.3.1 Missed Follow-Up Sessions

Patients who did not miss follow-ups had significantly lower odds of having comorbidities (AOR = 1.75; $p = 0.000$). Regular follow-ups likely contribute to early detection and better management of comorbidities. Regular follow-up appointments are crucial for individuals with diabetes mellitus (DM) to effectively manage their condition and prevent the development of concomitant comorbidities. The association between missed follow-up sessions and increased risk of comorbidities can be attributed to several interrelated factors, as supported by existing literature. Consistent medical appointments allow for regular monitoring of blood glucose levels and timely adjustments to treatment plans. Missing these appointments can lead to poor glycemic control, which is a significant determinant for the development of diabetes-related complications.

A study by van den Berg *et al.* (2019), found that patients who missed more than 30% of their scheduled appointments had significantly higher HbA1c levels, indicating poorer glycaemic control, compared to those who attended all appointments. Regular follow-ups provide opportunities for healthcare providers to detect early signs of complications such as neuropathy, retinopathy, and nephropathy. Delayed detection due to missed appointments can result in the progression of these conditions to more severe stages. For instance, a study on diabetic retinopathy screening demonstrated that patients who missed multiple consecutive

appointments were nearly three times more likely to be diagnosed with referable retinopathy at their next screening (Lawrenson *et al.*, 2021).

Regular interactions with healthcare providers reinforce the importance of adherence to medication and lifestyle modifications. Missed appointments can disrupt this reinforcement, leading to decreased adherence. A study published in *Diabetes Care* highlighted that treatment noncompliance, including missed appointments, was independently associated with increased mortality in insulin-treated type 2 diabetes patients (Kalyani *et al.*, 2024). The cumulative effect of poor glycaemic control, delayed detection of complications, and reduced adherence to treatment due to missed appointments can lead to increased hospitalisations and mortality. Patients with insulin-treated type 2 diabetes had higher all-cause mortality rates when they did not take their medications as prescribed and did not attend their clinics, according to the same *Diabetes Care* study (Alharrasi, 2023). Factors such as the cost of treatment, distance to healthcare facilities, and lack of awareness about the importance of follow-up care contribute to missed appointments. A study in Ghana identified that 37% of patients diagnosed with hypertension and diabetes did not return for follow-up visits, with contributing factors including financial constraints and limited understanding of disease management (Achila *et al.*, 2021). Missed follow-up sessions in diabetes care are associated with a cascade of negative outcomes, including poor glycaemic control, delayed detection of complications, reduced adherence to treatment, and increased risk of hospitalisation and mortality (Kwok *et al.*, 2024). Addressing the barriers to regular follow-up and implementing strategies to improve appointment adherence are essential steps in reducing the burden of concordant comorbidities among diabetes patients.

5.3.2 Poor Dietary Adherence

Compared to respondents with university education as their greatest level of education, over half of those with higher non-adherence had no formal education. According to a study by Ali, Alemu, and Sada (2017), adherence to dietary recommendations is significantly correlated with educational attainment. Low levels of education have been associated with higher rates of non-adherence. In other words, Alemu and Sada (2017), claim that it is challenging to comprehend diabetic mellitus dietary recommendations therapy when one is illiterate. This is supported by the idea that patients should understand the suggested treatment plan and take their medications as the complexity of diabetes diet therapy increases. This will make it easier for people with more education to understand.

Non-adherence to dietary recommendations significantly increased the odds of concordant comorbidities among diabetes patients by 82% (AOR = 1.82; $p = 0.000$). This association is well-supported by global evidence linking poor dietary practices with worsened diabetes outcomes. Proper dietary management helps regulate blood glucose levels, maintain a healthy weight, and reduce cardiovascular risk, key to preventing conditions like hypertension, dyslipidaemia, and nephropathy. A study by Evert *et al.* (2019), in *Diabetes Care* confirmed that individualised nutrition therapy improves glycaemic control and lowers the risk of complications. Similarly, a study in Ethiopia found that diabetic patients with poor dietary adherence were more likely to develop hypertension and kidney disease (Arabshahi *et al.*, 2024).

Non-adherence often results in erratic blood sugar levels, leading to vascular damage and increased susceptibility to chronic complications. Contributing factors include lack of nutrition education, food insecurity, and cultural dietary practices, especially in low-resource

settings. Dietary non-adherence undermines diabetes control, heightening the risk of concordant comorbidities. Nutritional counselling and sustained dietary support are essential for long-term diabetes management and complication prevention. Diet plays a critical role in managing blood glucose and cardiovascular health.

5.3.3 Smoking and Alcohol Use

Smoking was identified as a significant determinant and sociodemographic predictor of concordant comorbidities among diabetes patients. The harmful effects of tobacco use, including oxidative stress, endothelial dysfunction, and inflammation, exacerbate the risk of cardiovascular diseases, hypertension, and other diabetes-related complications. Smoking also impairs glycaemic control, thereby increasing the likelihood and severity of multiple chronic conditions occurring concurrently with diabetes.

A study conducted by Zhang *et al.*, (2020), demonstrates that smoking significantly increases the risk of cardiovascular diseases and nephropathy among diabetic patients, highlighting its role in the progression of concordant comorbidities. Again, research found that smoking is associated with poorer diabetes control and increased incidence of hypertension and coronary artery disease in people living with diabetes (Rakisheva *et al.*, 2024). Ding *et al.* (2019), reported that smoking exacerbates insulin resistance and accelerates vascular damage, contributing to higher rates of diabetes-related comorbidities, especially cardiovascular conditions. A meta-analysis showed that smoking cessation reduces the risk of cardiovascular events in diabetic populations, emphasising the strong link between tobacco use and comorbidities (Adeva-Andany *et al.*, 2019). These studies consistently highlight that smoking compounds the physiological burden of diabetes by increasing oxidative stress and vascular injury. This interaction worsens glycaemic control and promotes the development of multiple

concordant chronic diseases, particularly cardiovascular and renal complications. Therefore, smoking status is a critical predictor of comorbidity risk and a key target for intervention in diabetes care.

5.3.4 Alcohol

Alcohol consumption was identified as a significant predictor of concordant comorbidities among diabetes patients. The study found that current and former smokers (AOR = 2.38 and 3.24) and alcohol users (AOR = 1.31 for current, and 3.79 for past use) had significantly higher odds of developing concordant comorbidities. Tobacco and alcohol exacerbate vascular inflammation, oxidative stress, and renal impairment, worsening diabetes outcomes. Excessive or chronic alcohol use can worsen glycaemic control, increase blood pressure, and contribute to liver dysfunction, thereby elevating the risk of developing additional chronic conditions such as hypertension, cardiovascular disease, and diabetic liver complications. Alcohol use may also impair adherence to diabetes management regimens, compounding the risk of multiple comorbidities.

The research found that heavy alcohol consumption is linked to an increased risk of hypertension and cardiovascular diseases in people with diabetes, emphasising alcohol's role in worsening comorbidities (Cruz-Ávila *et al.*, 2020). A study showed that excessive alcohol intake disrupts glucose metabolism and increases the likelihood of diabetic complications, including neuropathy and liver disease (Åberg *et al.*, 2023). (Vetrano *et al.*, 2023) reported that alcohol use is associated with poor diabetes control and a higher incidence of concordant conditions, particularly hypertension and cardiovascular disease. A study conducted by the World Health Organisation (WHO, 2018) identifies alcohol use as a major modifiable determinant that increases the burden of non-communicable diseases, including in diabetic

populations. These studies collectively demonstrate that alcohol use negatively influences metabolic regulation and cardiovascular health, both critical in diabetes management. By impairing glucose control and contributing to organ damage, alcohol consumption elevates the risk of developing multiple concordant comorbidities, making it a significant behavioural and sociodemographic predictor.

A meta-analysis by Triyaniarta *et al.* (2022), found that smoking increases the risk of cardiovascular disease, nephropathy, and mortality in diabetes. Similarly, excessive alcohol use impairs glycaemic control and raises blood pressure, heightening comorbidity risks Ding *et al.*, (2019). Thus, lifestyle modification, including cessation programs, is critical in reducing diabetes-related complications.

5.3.5 Poor Glycaemic Control

Poor glycaemic control was identified as a significant clinical predictor of concordant comorbidities among diabetes patients. Poor glycaemic control (AOR = 1.31; $p = 0.000$) was strongly linked to increased comorbidities. Inadequate blood glucose regulation accelerates the progression of diabetes-related complications such as hypertension, cardiovascular disease, and nephropathy. Chronic hyperglycaemia damages blood vessels, impairs immune response, and promotes inflammation, which increases the risk and severity of comorbid conditions. The landmark UKPDS study (1998) and DCCT trial (1993) demonstrated that improved glycaemic control significantly reduces the risk of microvascular complications. More recent findings reaffirm that HbA1c above target levels correlates with higher odds of multimorbidity in diabetic patients. Effective glucose management remains a cornerstone in preventing and delaying diabetes complications. Poor glycaemic control was associated with a higher incidence of comorbidities such as retinopathy, nephropathy, and cardiovascular

disease. Chauke (2022), found that each 1% increase in HbA1c was associated with a 21% increased risk of any diabetes-related endpoint, including comorbid conditions.

A study by Afaya (2021), highlighted that poor glycaemic control was a strong predictor of hospitalisation due to diabetes-related complications, reflecting its link with multiple concordant comorbidities. Alam (2021), in their review of diabetes complications, emphasised that uncontrolled blood glucose is a critical factor in the development of hypertension and cardiovascular disease, which are the most common concordant comorbidities in diabetic patients. These studies underscore that sustained hyperglycaemia is central to the pathogenesis of most diabetes-related complications. Poor glycaemic control not only reflects inadequate disease management but also actively contributes to the onset and worsening of concordant comorbidities, particularly those affecting the heart, kidneys, and blood vessels. This makes it a vital clinical target for improving overall health outcomes in diabetic populations.

5.3.6 Body Mass Index (BMI)

Body Mass Index (BMI) was found to be a significant predictor of concordant comorbidities among diabetes patients. Individuals with elevated BMI, particularly those classified as overweight or obese, face a greater risk of developing comorbid conditions such as hypertension, cardiovascular disease, and dyslipidaemia. This is due to the metabolic strain imposed by excess adipose tissue, which exacerbates insulin resistance and promotes systemic inflammation, two key mechanisms linking obesity with diabetes-related comorbidities. Both overweight/obesity and underweight status were significantly associated with increased risk of concordant comorbidities, indicating a U-shaped risk pattern. Obesity contributes to insulin resistance, hypertension, and dyslipidaemia, while undernutrition may

reflect poor metabolic reserve and coexisting chronic illness. A study by Adeva-Andany *et al.* (2019) highlighted that excess adiposity promotes chronic inflammation and vascular damage. Meanwhile, research by Agyemang (2022), showed that underweight diabetic patients had higher risks of complications due to frailty and poor immunity. Thus, maintaining a healthy BMI is crucial for reducing diabetes-related comorbidities.

Research conducted found that obesity is a major contributor to the development of type 2 diabetes and its associated comorbidities, particularly hypertension and cardiovascular diseases, due to insulin resistance and endothelial dysfunction. Sun *et al.*, (2022), in their international study on diabetes risk, confirmed that higher BMI significantly correlates with the presence of multiple chronic conditions in people with diabetes, especially in low- and middle-income countries. A study emphasises that obesity is central to the pathophysiology of metabolic syndrome, a cluster of concordant conditions frequently observed in diabetes patients (Ruze *et al.*, 2023). A study conducted in Kenya using DHS data found that higher BMI among diabetic patients, especially women, was significantly associated with increased odds of hypertension and cardiovascular risk, reflecting a common pattern in sub-Saharan Africa (Gatimu *et al.*, 2016). These studies support the idea that BMI is not only a clinical marker of obesity but also a powerful indicator of metabolic stress, which contributes to the development of concordant comorbidities. Higher BMI intensifies insulin resistance, increases blood pressure, and affects lipid metabolism, all of which predispose diabetes patients to additional chronic diseases. Thus, BMI plays a critical role in the burden and progression of comorbidity in diabetes care.

5.3.7 Lack of Access to Healthcare

Access to healthcare services was identified as a significant sociodemographic predictor of concordant comorbidities among diabetes patients. Lack of regular healthcare access significantly increased the odds of developing concordant comorbidities (AOR = 1.69), emphasising the critical role of continuous care in diabetes management. Limited access due to financial constraints, inadequate health insurance coverage, long waiting times, or understaffed facilities can hinder regular monitoring and early management of comorbid conditions such as hypertension and cardiovascular diseases. As a result, poor access contributes to the accumulation of unmanaged conditions that worsen patient outcomes.

A study by Reilly (2021) showed that poor access to care, including transportation barriers and long wait times, was associated with poorer diabetes management and increased risk of comorbidities. Patients who could not regularly see a physician had higher rates of complications. Yedjou *et al.* (2024), in their study explore racial and ethnic disparities in diabetes outcomes in the U.S., finding that limited access to consistent, quality care was directly linked to a higher prevalence of concordant comorbidities among underserved populations. Afaya (2021), conducted in sub-Saharan Africa, this study emphasised that the lack of access to integrated chronic care services resulted in underdiagnosis and poor management of multiple chronic diseases, especially among diabetic patients. A study by Atun *et al.* (2017), in their global analysis, concluded that health system capacity and equitable access to care are essential in controlling non-communicable diseases and preventing concordant comorbidities.

These studies consistently show that limited or inequitable access to healthcare contributes to delayed diagnosis, poor disease monitoring, and lack of preventive care, all of which are

determinants for the development and worsening of concordant comorbidities (e.g., hypertension, cardiovascular disease) in diabetes patients. When patients cannot access routine check-ups, medications, or disease education, their primary condition (diabetes) is poorly managed, increasing the likelihood of developing related chronic conditions.

In a study in sub-Saharan Africa, Abbasi-Kangevari *et al.* (2023), found that limited healthcare access correlates with poorer diabetes outcomes and higher complication rates. Additionally, the World Health Organisation (2020), emphasises that regular primary care visits reduce diabetes-related hospitalisations and mortality. Continuity of care ensures routine monitoring, timely interventions, and better self-management support.

5.3.8 Duration of Diabetes

The findings from the present study revealed a strong association between the duration of diabetes and the prevalence of concordant comorbidities. Specifically, individuals who had lived with diabetes for more than four years were significantly more likely to have one or more comorbid chronic conditions. The adjusted odds ratio (AOR) for participants with diabetes for 1-4 years was 8.25 (95% CI: 3.14–12.92; $p = 0.046$), while for those with more than four years, the AOR increased to 9.04 (95% CI: 2.02–12.88; $p = 0.036$). This demonstrates a steep rise in comorbidity risk with increasing duration of illness. These findings are consistent with existing literature, which consistently identifies a longer duration of diabetes as a major determinant for the development of concordant comorbidities such as hypertension, cardiovascular disease, neuropathy, nephropathy, and retinopathy.

Similarly, Yavuz (2022), using data from the UKPDS, reported that every year increase in diabetes duration was associated with a higher incidence of retinopathy, nephropathy, and

neuropathy. Their analysis also revealed that patients with more than 10 years of diabetes had a significantly higher risk of multiple complications compared to those diagnosed within the past five years. In a large-scale study conducted by Afroz *et al.* (2019), in low- and middle-income countries, patients with over 5 years of diabetes had more than double the odds of developing at least one comorbidity, especially hypertension and cardiovascular diseases. Another cross-sectional study in sub-Saharan Africa by Pastakia *et al.* (2017), similarly found that the duration of diabetes was one of the strongest predictors of both micro- and macrovascular complications, particularly among patients who lacked regular monitoring and access to care. In Ghana, Kazibwe *et al.* (2024), reported that the prevalence of hypertension, dyslipidaemia, and proteinuria increased with a longer duration of diabetes, underscoring the cumulative effect of chronic hyperglycaemia on organ systems. Their study highlighted that patients with over 5 years of diabetes were more likely to present with multiple complications, similar to the patterns observed in the current study.

The pathophysiological basis for this relationship is well-established. Prolonged exposure to hyperglycaemia leads to endothelial damage, oxidative stress, and inflammation, which gradually impairs vascular and neural function. This creates a fertile ground for the development of concordant conditions such as hypertension, cardiovascular disease, chronic kidney disease, and diabetic neuropathy. Furthermore, the longer an individual lives with diabetes, the more time there is for poor glycaemic control, non-adherence, and cumulative metabolic insults to manifest in organ damage. It is also important to note that patients with longer duration of diabetes are more likely to experience “clinical inertia”, a delay in intensifying treatment, which contributes to persistent suboptimal control and a higher risk of complications. This concern is particularly relevant in resource-limited settings such as

Ghana, where lack of access to advanced therapies, diagnostic tests, and specialist care may exacerbate long-term risk.

The evidence from this current study aligns strongly with both regional and global findings that underscore the duration of diabetes as a critical determinant of comorbidity risk. As the duration of the disease increases, so does the likelihood of multiple concordant chronic conditions. This highlights the need for early and aggressive management of diabetes, routine screening for complications, and comprehensive follow-up care to mitigate the long-term burden of comorbidities. Health systems must therefore prioritise continuous care models that support long-term disease monitoring and complication prevention.

5.3.9 Type of Diabetes

Type of diabetes emerged as a significant clinical predictor of concordant comorbidities among diabetes patients. Participants with type 2 diabetes were significantly more likely to develop comorbidities compared to those with type 1 (AOR = 2.38). Patients with type 2 diabetes are particularly at higher risk for developing concordant chronic conditions such as hypertension, dyslipidaemia, and cardiovascular disease due to the strong association with metabolic syndrome, ageing, obesity, and insulin resistance. Studies by Aga *et al.* (2019, p. 1) and Alam (2021) report that type 2 DM patients commonly have multiple comorbidities at diagnosis due to its insidious onset. In contrast, type 1 diabetes, while associated with long-term complications, often manifests earlier in life and may involve different comorbidity patterns. The type of diabetes a patient is diagnosed with plays a crucial role in the risk and pattern of concordant comorbidities. In this study, most of the participants (96.9%, n=406) were diagnosed with Type 2 diabetes, while only 3.1% (n=13) had Type 1 diabetes. This aligns with global trends indicating that Type 2 diabetes is more prevalent, especially among

adults. Type 2 diabetes is strongly associated with lifestyle-related factors such as obesity, sedentary behaviour, and unhealthy dietary patterns, all of which also increase the risk of concordant comorbidities like hypertension, cardiovascular disease, and dyslipidaemia. Moreover, due to its gradual onset, Type 2 diabetes often remains undiagnosed until complications have already developed, compounding the likelihood of multiple coexisting chronic conditions at the point of diagnosis.

A study conducted by Yao *et al.* (2023), found that type 2 diabetes is commonly associated with multiple concordant comorbidities, especially cardiovascular diseases and hypertension, due to overlapping determinants like obesity and ageing. Cojic *et al.* (2024), further reported that patients with type 2 diabetes were more likely to have comorbid conditions such as hypertension and high cholesterol compared to those with type 1 diabetes, emphasising the clustering of risk in type 2. In a comparative study conducted by Li *et al.* (2025), they observed that type 2 diabetes patients had a higher prevalence of multimorbidity than type 1, particularly among older adults. Centres for Disease Control and Prevention (CDC, 2020) has noted that type 2 diabetes is the predominant form associated with concordant conditions, particularly among populations with sedentary lifestyles and high body mass index. These studies consistently support the finding that type 2 diabetes presents a greater risk for concordant comorbidities, largely due to its pathophysiological link with other chronic diseases, especially those within the metabolic syndrome cluster. Therefore, the type of diabetes a patient has is a meaningful predictor of their likelihood of developing multiple chronic conditions concurrently.

Although Type 1 diabetes accounted for a very small proportion of the study population, it is important to note the distinct comorbidity patterns between the two types. Type 1 diabetes,

often diagnosed in childhood or adolescence, is primarily associated with autoimmune mechanisms and presents a higher risk for microvascular complications such as nephropathy, retinopathy, and neuropathy. However, patients with long-standing Type 1 diabetes may still develop concordant comorbidities, especially in the presence of poor glycemic control. The findings of this study, in which the overwhelming burden of concordant comorbidities was observed among Type 2 diabetics, are consistent with existing literature, including studies by Yao *et al.*, (2023) and Achila *et al.*, (2021), which reported a significantly higher prevalence of cardiovascular and metabolic comorbidities among patients with Type 2 diabetes.

5.4 Sociodemographic Predictors of Comorbidity

5.4.1 Sex

Sex emerged as a significant sociodemographic predictor of concordant comorbidities among diabetes patients. Female sex significantly predicted higher comorbidity odds (AOR = 3.89), possibly due to both biological susceptibility and differences in health-seeking behaviour. This observation is supported by findings from Kazeem *et al.*, (2025) and Feyisa *et al.*, (2020). Age was a strong predictor, with older individuals (64 and older) having over 7-fold increased odds. This reflects the age-related vulnerability of organ systems and cumulative exposure to hyperglycaemia (Rakisheva *et al.*, 2024). This may reflect several factors such as age-associated decline in pancreatic β -cell function, which limits the capacity to compensate for insulin resistance (Chang & Halter, 2021). Additionally, older adults often experience a progressive reduction in insulin sensitivity due to sarcopenia and increased visceral adiposity (Cesari *et al.*, 2022). Prolonged exposure to hyperglycaemia leads to cumulative microvascular and macrovascular damage, further increasing susceptibility to complications and comorbidities (American Diabetes Association, 2023). The high prevalence of multiple chronic conditions in this age group, including hypertension, dyslipidaemia, and

cardiovascular disease, amplifies the risk of concordant comorbidities (Yedjou *et al.*, 2024). Polypharmacy common in older adults may also influence disease progression and interaction through drug-disease and drug-drug interactions (Sema *et al.*, 2021). Furthermore, aging is associated with diminished physiological reserve and impaired immune function, which can exacerbate the clinical impact of comorbid conditions (Fulop *et al.*, 2018). Studies suggest women with diabetes often have higher rates of obesity, physical inactivity, and depression, each of which is linked to comorbidities (Berk *et al.*, 2023; Melin *et al.*, 2022). Hormonal changes post-menopause may also exacerbate metabolic and cardiovascular risks. Additionally, women in some contexts face greater barriers to healthcare access, which may delay diagnosis and management.

Biological differences, health-seeking behaviours, hormonal influences, and social roles often lead to varying disease patterns between males and females. For instance, women may experience higher rates of obesity and hypertension due to sociocultural factors, while men may delay seeking care, resulting in late diagnosis and more severe comorbidities. In 2023, a study conducted by Kautzky-Willer *et al.* (2023), found that women with diabetes are at a higher risk of developing cardiovascular diseases than men, partly due to hormonal factors and differences in how diabetes affects vascular function. Using DHS data in Kenya, Gatimu *et al.* (2016), reported that female sex was associated with higher rates of hypertension and obesity among diabetes patients, suggesting a sexed pattern in comorbidities.

The study conducted by Cooper *et al.* (2021), emphasised that sex differences in metabolism, fat distribution, and healthcare utilisation patterns lead to differences in the prevalence and presentation of comorbidities in diabetic patients. A study by Kautzky-Willer *et al.* (2016), found that men are less likely to seek preventive care, often resulting in the detection of

comorbidities at more advanced stages, while women tend to access care more frequently, yet still face higher risks of concordant conditions like hypertension. These studies demonstrate that sex influences not just biological vulnerability, but also access to and use of healthcare services, lifestyle choices, and stress-related factors, all of which contribute to the development of concordant comorbidities. Understanding these differences is crucial for designing sex-sensitive interventions in diabetes care. However, some studies show women are more likely to seek care than men, suggesting a complex interplay of biological and social factors.

5.4.2 Age

Age was identified as a significant sociodemographic predictor of concordant comorbidities among diabetes patients. The odds of comorbidity rose sharply with age, peaking at AOR = 7.61 for participants aged 64 and older. This aligns with the established role of ageing as a non-modifiable determinant. Ageing is associated with declining organ function, cumulative glycaemic exposure, and increased susceptibility to vascular damage (Fountoulakis *et al.*, 2025). Older adults also have longer diabetes duration, more sedentary lifestyles, and may face polypharmacy challenges, all contributing to the development of concordant conditions like hypertension and nephropathy. As individuals grow older, the risk of developing multiple chronic conditions such as hypertension, cardiovascular diseases, and dyslipidaemia increases due to cumulative biological wear, declining organ function, and prolonged exposure to determinants. Older adults also often experience delayed recovery and reduced physiological resilience, making them more susceptible to the coexistence of diabetes-related conditions.

In the Global Burden of Disease Study conducted by Al-Dahshan *et al.* (2025), they found that advancing age is directly associated with an increased burden of non-communicable

diseases, particularly among those with pre-existing conditions like diabetes. Research on multimorbidity showed that the prevalence of multiple chronic conditions increases significantly with age, making older diabetes patients more likely to have concordant comorbidities (Du *et al.*, 2024). Niebuur *et al.* (2023), reported that ageing is a strong predictor of multimorbidity, particularly among those with lifestyle-related chronic diseases such as diabetes, hypertension, and cardiovascular disease. Hashemi *et al.* (2024), in a global study on diabetes complications, found that older adults have a higher prevalence of diabetes-related comorbidities, emphasising the importance of age in risk profiling. These studies collectively support the understanding that age is a natural and cumulative determinant for the development of multiple chronic conditions. Diabetes patients in older age groups often have a longer duration of disease, reduced metabolic adaptability, and more difficulty adhering to treatment regimens, making age a key determinant of concordant comorbidities.

5.4.3 Employment Status

Employment status was observed as a significant sociodemographic predictor of concordant comorbidities among diabetes patients. Berkowitz & Basu, (2021) in their study on socioeconomic determinants of health in low- and middle-income countries, found that unemployment was significantly associated with poor health outcomes, including chronic disease comorbidities, due to lack of access to healthcare and social protection. Unemployed individuals were significantly more likely to have concordant comorbidities (AOR = 5.77), likely due to financial constraints that limit healthcare access, medication adherence, and healthy food choices. Conversely, job-related stress, long work hours, and sedentary occupations among the employed may also contribute to poor lifestyle choices, further exacerbating the risk of comorbidities.

A study by Álvarez-Gálvez *et al.* (2023), concluded that socioeconomic position, including employment, was a strong predictor of multimorbidity, with unemployed individuals more likely to have multiple chronic conditions compared to their employed counterparts. Chatterjee *et al.* (2017), in their assessment of psychosocial determinants for diabetes and comorbidities, reported that work-related stress and lack of job security were significantly associated with poor metabolic control and higher rates of concordant conditions. (Gangaidzo, 2022), findings showed that unemployment and low-income status are correlated with a higher prevalence of diabetes and related complications, emphasising the socioeconomic link to comorbidity. These studies consistently show that employment status influences income stability, access to healthcare, lifestyle behaviours, and psychological well-being, all of which are critical in the development and management of comorbidities in diabetes patients. Whether due to financial hardship among the unemployed or lifestyle-related risks among the employed, employment status plays a multidimensional role in shaping health outcomes.

A study by Gangaidzo (2022), found that unemployment was independently associated with increased odds of type 2 diabetes and its complications, emphasising the link between socioeconomic disadvantage and poor health outcomes. Stress and depression associated with joblessness may also negatively affect self-care behaviours in diabetes patients.

5.4.4 Residence

This study finds that living in rural areas can increase the odds of comorbidities by more than threefold (AOR = 3.22). Rural residents were over three times more likely to have comorbidities (AOR = 3.22), which may be attributed to infrastructural deficits, limited health personnel, and fewer health education campaigns, as noted by Ezeudu & Fadeyi

(2024); Momore (2024). Rural health systems often lack resources, trained personnel, and continuity of care, which delays diagnosis and complicates long-term management. A systematic review by Asmelash & Asmelash (2019) concluded that rurality is strongly associated with worse outcomes in chronic disease management, including diabetes. Moreover, rural populations may have lower health literacy and fewer opportunities for healthy lifestyles, further compounding their risk.

Residence and distance to healthcare facilities emerged as significant sociodemographic predictors of concordant comorbidities among diabetes patients. Individuals residing in rural or peri-urban areas, or those who travel long distances to access healthcare, may experience delayed diagnosis and limited continuity of care, thereby increasing their vulnerability to multiple chronic conditions. This spatial disparity underscores the role of geographical accessibility in shaping health outcomes and highlights the need for targeted interventions to bridge rural-urban healthcare gaps. Several studies support the role of residence and distance as predictors of comorbidities among diabetes patients. The study conducted by Abdul-Samed *et al.* (2025) in global diabetes atlas analysis highlighted that rural populations in low- and middle-income countries face significant barriers to diabetes management, which contributes to complications and comorbidities due to poor access to care.

According to Agyemang *et al.* (2016), a study on diabetes and cardiovascular risk in sub-Saharan Africa reports that rural residents are less likely to receive timely diagnosis and adequate management leading to a higher risk of comorbid conditions. A study conducted by Anarwat *et al.* (2021), found that longer travel distances to healthcare facilities were significantly associated with poorer diabetes outcomes and increased complications, including concordant comorbidities such as hypertension and cardiovascular diseases. This

finding is consistent with studies such as Kazeem *et al.* (2025); Anarwat *et al.* (2021); Spees *et al.* (2019), which found that individuals residing in rural areas or farther from health facilities are more likely to experience delays in diagnosis and treatment, thereby increasing their risk of developing concordant comorbidities. These studies reinforce the argument that geographical and infrastructural barriers are critical determinants of chronic disease outcomes.

CHAPTER SIX

SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS

6.0 Introduction

This final chapter synthesizes the core findings from the study. The study aimed to determine the prevalence, associated determinants, and sociodemographic predictors of concordant comorbidities in diabetic patients. Building on both descriptive and inferential statistical analysis, this chapter offers a consolidated summary of the findings, practical recommendations for improving patient outcomes, directions for future research, and a concluding reflection on the significance of the work.

6.1 Summary of Findings

The study found that diabetes patients in Mampong are burdened by a high prevalence of concordant comorbidities. Specifically, 84.0% of the 419 respondents reported having at least one additional chronic condition alongside diabetes. Hypertension emerged as the most common comorbidity, affecting nearly half (45.3%) of the participants, followed by neuropathy (10.5%), retinopathy (10.3%), cardiovascular disease (9.5%), kidney disease (8.1%), and dyslipidaemia (5.5%). These findings underscore the overwhelming health challenges diabetes patients face, particularly in resource-constrained environments.

Multiple determinants were found to be significantly associated with the development of concordant comorbidities. These included missing follow-up clinic appointments, non-adherence to dietary recommendations, smoking, alcohol use, poor glycaemic control, and abnormal body mass index (BMI). Notably, poor glycaemic control was a consistent predictor, indicating that sustained hyperglycaemia exacerbates vascular and organ damage.

The study also revealed that patients without access to regular healthcare services were significantly more likely to experience comorbid conditions. From a sociodemographic perspective, female sex, older age (especially 64 years and above), rural residency, unemployment, and lack of formal education were strongly predictive of comorbidities. Women had nearly four times the odds of having a comorbid condition compared to men, while the oldest age group had over seven times the odds compared to younger participants. Similarly, unemployed and rural dwellers were disproportionately affected due to limited access to healthcare and socioeconomic resources. These patterns reflect the multifaceted interplay between social determinants and chronic disease burden in vulnerable populations.

6.2 Conclusion

This study examined the prevalence, determinants, and sociodemographic predictors of concordant comorbidities among diabetes patients attending the Ashanti Mampong Municipal Government Hospital. The following conclusions and implications are presented in line with the study's specific objectives.

The study revealed a markedly high prevalence of concordant comorbidities among diabetic patients, with 84% presenting with at least one comorbid condition. Hypertension was the most prevalent, followed by neuropathy, retinopathy, kidney disease, dyslipidaemia, and cardiovascular complications. These findings confirm that the majority of diabetic patients in the municipality experience multiple chronic conditions that complicate clinical management and elevate their risk for severe health outcomes. The high prevalence underscores the urgent need to strengthen integrated chronic care models that simultaneously manage diabetes and related comorbidities. Routine screening for hypertension, cardiovascular disease, renal impairment, and other diabetes-related complications should be incorporated into standard

diabetic review processes. Health facilities should improve diagnostic capacity, ensure consistent monitoring, and allocate resources to support the management of multimorbidity. Public health interventions must prioritize early detection, continuous monitoring, and community education to minimize long-term complications, disability, and premature mortality.

The study identified several clinical and behavioural determinants associated with the presence of concordant comorbidities. These included advanced age (≥ 55 years), female sex, Type 2 diabetes mellitus, long duration of diabetes (≥ 5 years), and poor glycaemic control. These determinants interact to increase metabolic stress, aggravate disease progression, and heighten vulnerability to chronic complications. These findings provide a strong basis for implementing risk-stratified care approaches. Older adults, females, long-standing diabetic patients, and individuals with poor glycaemic control should be considered high-risk groups requiring more intensive monitoring, follow-up, and individualized treatment plans. Clinical care protocols should emphasize strict glycaemic control, adherence support, regular follow-up visits, and targeted health education. At the health system level, these determinants highlight the need for strengthened chronic disease monitoring systems, updated clinical guidelines, and enhanced capacity among healthcare workers to manage complex diabetic cases effectively.

The study found that sociodemographic characteristics such as age, sex, employment status, and residential location significantly predicted the development of concordant comorbidities. Older individuals, females, unemployed patients, and those residing in rural or socioeconomically disadvantaged settings exhibited a higher burden of comorbid conditions.

These findings reflect the influence of social, economic, and geographical factors on health outcomes among diabetic patients.

Recognizing these predictors highlights the need for a holistic diabetes management approach that incorporates social determinants of health. Community-based outreach programs should be tailored to high-risk populations, especially women, older adults, and rural residents. Improving healthcare access through decentralization, mobile clinics, and community health worker engagement will help address disparities in service utilization. Policymakers should prioritize equitable resource distribution and develop interventions that reduce socioeconomic barriers. Addressing these social determinants is essential for enhancing diabetes control and reducing the burden of concordant comorbidities in the municipality.

6.3 Recommendations

In light of the findings, several practical recommendations are proposed to mitigate the burden of concordant comorbidities among diabetes patients.

1. Policy makers

- Develop and implement national guidelines for integrated management of diabetes and its common comorbidities.
- Strengthen resource allocation for screening, diagnostics, and management of hypertension, dyslipidaemia, and chronic kidney disease in diabetic patients.
- Expand continuous professional development programs for healthcare workers on comorbidity prevention and multidisciplinary care models.
- Institutionalize routine, comprehensive screening for concordant comorbidities in all diabetes clinics.

- Establish a coordinated referral and follow-up system for early intervention in high-risk patients.
- Maintain a patient registry to track prevalence patterns and treatment outcomes for policy and clinical decision-making.

2. Practice

- Promote healthy dietary practices through culturally appropriate nutrition education and local food demonstrations.
- Encourage community-led physical activity programs, such as walking clubs and fitness groups, to address obesity and cardiovascular risk.
- Adhere strictly to prescribed treatment regimens, including medications, dietary plans, and scheduled follow-ups.
- Engage actively in self-care practices, such as home blood glucose monitoring, foot care, and participation in support groups.

6.4 Future Research

The current study findings open several avenues for further research.

1. Longitudinal studies are needed to examine the causal relationships between determinants and the progression of concordant comorbidities over time. Such studies would help determine whether interventions implemented early in the disease trajectory can reduce the cumulative burden of complications.
2. Moreover, interventional studies assessing the impact of integrated care models, nutritional programs, and behavioural therapies on health outcomes among diabetic patients would provide evidence for policy reform. There is also a need for qualitative research to explore patients' lived experiences, beliefs, and barriers related to chronic

disease management. Understanding cultural, social, and economic dimensions can inform context-appropriate solutions.

3. Additionally, health systems research is necessary to assess the capacity of rural healthcare infrastructure to manage multimorbidity effectively. This includes evaluating staffing levels, availability of essential medicines, and referral systems. Further exploration into sex-specific and age-specific determinants of health outcomes among diabetes patients will also be valuable. Such research can guide the development of tailored interventions that address disparities in health access and outcomes.

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APPENDIXES

APPENDIX A

**AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND
ENTREPRENEURIAL DEVELOPMENT
FACULTY OF HEALTH AND ENVIRONMENT EDUCATION
DEPARTMENT OF PUBLIC HEALTH EDUCATION**

MPHIL. PUBLIC HEALTH (HEALTH PROMOTION)

Concordant Comorbidities in Diabetes: Prevalence, Determinants, and Distribution Patterns among Patients attending the Ashanti Mampong Municipal Government Hospital.

Research Project Questionnaire

Investigator : Obiri-Yeboah, Daniel (8222030006)
Principal Supervisor : Nana Yaa Awua-Boateng (PhD).
Co-Supervisor : Denis Dekugmen Yar (PhD).

STUDY DESCRIPTION:

This questionnaire is intended to gather your views to better understand the determinants and distribution of concordant comorbidities among diabetic patients attending the Mampong Government Hospital in the Ashanti Region, Ghana.

This survey aims to determine the prevalence of diabetes concordant comorbidities attending the Mampong Government Hospital, identify the determinants of concordant comorbidities and to identify the socio-demographic predictors of concordant comorbidities among Diabetes mellitus (DM) patients attending the Mampong Government Hospital in the Ashanti

region. DM is a serious public health concern that is on the verge of epidemic proportions, making it a major global threat to the health and well-being of individuals, families, and society, including Ghana, and understanding its dynamics in the Mampong Municipality is essential for designing targeted interventions and improving health outcomes. Your participation in this survey will provide valuable insights into the current situation of diabetes concordant comorbidities in your community and contribute to efforts aimed at controlling and preventing this debilitating disease.

Thank you for your participation.

Participant ID:

Date:

Community:

Please tick [] where necessary.

SECTION A: DEMOGRAPHIC AND SOCIO-ECONOMIC CHARACTERISTICS

1. What is your age?

- a. 15 – 24 []
- b. 25 – 34 []
- c. 35 – 44 []
- d. 45 – 54 []
- e. 55 – 64 []
- f. 64 + []

2. What is your sex?

- a. Male []
- b. Female []

3. What is your marital status?

a. Married []

b. Single []

4. What is your current employment status?

a. Self-employed []

b. Unemployed []

5. What is your highest level of education completed?

a. No formal education []

b. Formal education []

6. What is the average monthly income (Ghana Cedi)?

a. \leq 100 []

b. 101 – 500 []

c. 501 – 1000 []

d. \geq 1001 []

7. What religion do you belong to?

a. Christianity []

b. Islam []

c. Traditionalist []

8. How many people live in your household?

a. 0-3 individuals []

b. 4-7 individuals []

c. More than 8 individuals []

SECTION B: DETERMINING THE PREVALENCE OF DIABETES

CONCORDANT COMORBIDITIES

9. What type of diabetes do you have?

- a. Type 1 []
- b. Type 2 []

10. How long have you been diagnosed with diabetes?

- a. Less than one year []
- b. One year ago []
- c. Two years ago []
- d. Three years ago []
- e. Four years ago []
- f. Five years ago []
- g. More than Five years ago []

11. What are your Glycemic Control Levels?

- a. Poor
- b. Good

12. How often do you check your blood glucose levels?

- a. Daily []
- b. Weekly []
- c. Monthly []
- d. Rarely/Never []

13. Are you currently taking medication for your diabetes?

- a. Yes []
- b. No []

14. Which medication?

- a. Metformin []
- b. Glibenclamide []

15. Type of Anti-diabetics in use

- a. OHA (Oral Hypoglycaemic agent) []
- b. Insulin []
- c. OHA + insulin []

16. Family history of DM

- a. Yes []
- b. No []

17. Family Size (immediate)

- a. <1 Family size []
- b. 6-10 Family size []
- c. 1-5 Family size []
- d. 6 – 10 Family size []
- e. >10 Family size []

18. Concordant Comorbidities:

Have you been diagnosed with any of the following conditions? (Tip all that apply)

- a. Hypertension []
- b. Cardiovascular Disease []
- c. Kidney Disease []
- d. Neuropathy []
- e. Retinopathy []
- f. Dyslipidemia []
- g. Other (Please specify)

19. What is your ethnicity and Race?

20. Type of Residence

a. Rural []

b. Urban []

21. Do you have access to healthcare services in your community?

a. Yes []

b. No []

22. Do you have access to regular healthcare services for managing your diabetes?

a. Yes []

b. No []

23. How far is the nearest healthcare facility from your residence?

a. Very far []

b. Far []

c. Moderate distance []

d. Nearby []

e. Very close []

24. Have you or any family member ever been diagnosed with a NCDs?

a. Yes, I have been diagnosed with a NCDs. []

b. Yes, a family member has been diagnosed with a NCDs. []

c. No, neither I nor any family member has been diagnosed with a NCDs. []

d. I prefer not to disclose. []

e. Not applicable. []

25. Have you mixed your Follow-up sessions?

a. Yes []

b. No []

26. What type of housing do you live in?

- a. Apartment/Flat []
- b. House []
- c. Condominium []
- d. Townhouse []
- e. Mobile/Manufactured home []

27. Do you have any Social support?

- a. Yes []
- b. No []

28. Availability of glucometer at home

- a. Yes []
- b. No []

29. Body Mass Index

- a. Underweight []
- b. Normal weight []
- c. Overweight []
- d. Obese []

30. Diet adherence

- a. Adhered []
- b. Not-adhered []

31. Do you attend DM health education?

- a. Yes []
- b. No []

32. You are a member of the Diabetes Association in Ghana?

- a. Yes []

b. No []

33. Medication cost covered by

a. Self []

b. Family []

c. Free []

d. Employer organization []

e. Health Insurance []

f. Others:

**SECTION C: DETERMINANTSS ASSOCIATED WITH THE PRESENCE OF
CONCORDANT COMORBIDITIES**

34. Smoking status

a. Non-smoker []

b. Current smoker []

c. Smoke before []

35. Alcohol Consumption Level

a. Non []

b. Current []

c. Before []

36. Have you ever been hospitalized for a diabetes-related issue?

a. Yes []

b. No []

37. Are you currently experiencing any difficulties managing your diabetes?

a. Yes []

b. No []

38. Have you ever been diagnosed with high blood pressure?

a. Yes []

b. No []

39. How often do you exercise (Physical activity)?

a. None []

b. ≤ 60 mins per week []

c. 61 – 150 mins per week []

d. ≥ 151 mins per week []

40. How often do you take your prescribed diabetes medication as directed?

(Multiple choice)

a. Always []

b. Often []

c. Sometimes []

d. Rarely/Never []

41. Protein urea

a. Negative []

b. Positive []

APPENDIX B



Kwame Nkrumah
University of Science
and Technology, Kumasi

College of Health Sciences
SCHOOL OF MEDICINE AND DENTISTRY

COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS

Our Ref: CHRPE/AP/1235/24

21st November 2024

Mr. Daniel Obiri-Yeboah
Department of Public Health Education
Akenten Appiah-Menka University of Skills
Training and Entrepreneurial Development,
AAMUSTED-KUMASI.

Dear Sir,

LETTER OF APPROVAL

Protocol Title: *"Determinants and Distribution of Concordant Comorbidities among Diabetic Patients Attending the Mampong Government Hospital in the Ashanti Region, Ghana."*

Proposed Site: *Mampong Government Hospital, Ashanti- Mampong Municipal.*

Sponsor: *Self-Sponsored.*

Your submission to the Committee on Human Research, Publications, and Ethics on the protocol named earlier refer.

The Committee reviewed the following documents:

- A notification letter of 10th October, 2024 from the Regional Health Directorate, Ashanti (study site) indicating approval for the conduct of the study in the region.
- A Completed CHRPE Application Form.
- Participant Information Leaflet and Consent Form.
- Research Protocol.
- Questionnaire.

The Committee has considered the ethical merit of your submission and approved the protocol. The approval is for one year, renewable from 21st November 2024 to 20th November 2025. The Committee may, however, suspend or withdraw ethical approval at any time if your study is found to contravene the approved protocol.

Data gathered for the study should be used for the approved purposes only. Permission should be sought from the Committee if any amendment to the protocol or use, other than submitted, is made of your research data.

The Committee should be notified of the actual start date of the project and would expect a report on your study, annually or at the close of the project, whichever one comes first. It should also be informed of any publication arising from the study.

Thank you for your application.

Yours faithfully,

Rev. Prof. John Appiah-Poku.
Honorary Secretary
FOR: CHAIRMAN

Room 7, Block L, School of Medicine and Dentistry, KNUST, University Post Office, Kumasi, Ghana
Tel: +233 (0) 322 063 248 Mobile: +233 (0) 205 453 785 Email: chrpe.knust.kath@gmail.com / chrpe@knust.edu.gh



**GHANA
HEALTH
SERVICE**

REGIONAL HEALTH DIRECTORATE, ASHANTI

P. O. Box 1908 - Kumasi
DIGITAL ADDRESS: AK-037-9113

Quote this number and date on all correspondence

My Ref. No: GHS/ASH/INTRO
Your Ref. No:

Date: 10TH OCTOBER, 2024

THE CHAIRPERSON
COMMITTEE ON HUMAN RESEARCH, PUBLICATION AND ETHICS
ROOM 7, BLOCK L
SCHOOL OF MEDICINE AND DENTISTRY
UNIVERSITY POST OFFICE
KUMASI

LETTER OF SUPPORT

Mr. Daniel Obiri-Yeboah is an M.Phil. Public Health student at the Department of Public Health Education, Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED).

He intends to conduct a study entitled "**Distribution and Determinants of Concordant comorbidities among Diabetic Patients attending the Mampong Government Hospital in the Ashanti Region of Ghana**".

The Regional Health Directorate has given approval for the study on condition that ethical approval is obtained from your office.

Kindly provide him with the necessary support to undertake the study.

Thank you

DR. FRED ADOMAKO-BOATENG
REGIONAL DIRECTOR OF HEALTH SERVICES
ASHANTI REGION

Cc: Daniel Obiri-Yeboah (Principal Investigator)

Email: rdhs.ar@ghs.gov.gh
Tel: 03220-22089/23651
Fax: 03220-26219



M/DPHE/ADM/G/03/24/61

September 2, 2024

The Regional Director
Ghana Health Service Directorate
Ashanti Region, Ghana

Dear Sir/Madam,

PERMISSION TO CONDUCT RESEARCH

Mr. Daniel Obiri-Yeboah (Index Number: 8222030006) is our M.Phil. Public Health student at the Department of Public Health Education, Faculty of Environment and Health Education, AAMUSTED-Mampong Campus.

Mr. Obiri-Yeboah, as part of his academic requirements for the award of Master of Philosophy Degree in Public Health Education, is to undertake a project dissertation on “**Distribution and Determinants of Concordant comorbidities among Diabetic patients attending the Mampong Government Hospital in the Ashanti Region, Ghana**”.

We seek your official consent to permit him to collect data from the Mampong Government Hospital under your jurisdiction. Your approval letter will pave the way for him to apply for ethical clearance before the commencement of the research. The data collected will be used solely for academic purposes.

The outcome of this study would provide empirical data on the determinants of concordant comorbidities among diabetic patients at the Mampong Government Hospital. Relevant recommendations would be made to stakeholders for policy consideration and formulation.

We would be grateful if your outfit would accord him the needed assistance for the successful execution of this proposed study. Therefore, your kind approval is required to conduct this study to fulfill this academic obligation.

Yours faithfully,

DR. DENIS DEKUGMEN YAR
HEAD OF DEPARTMENT
ddyar@aamusted.edu.gh / (0243236810)

cc: The Health Director, Mampong Government Hospital



11th September, 2024

The Chairman
Committee on Human Research, Publication & Ethics
KNUST Kumasi

Dear Sir,

LETTER OF RECOMMENDATION: DANIEL OBIRI-YEBOAH

Mr. Daniel Obiri-Yeboah (Index number: 8222030006) is an MPhil Public Health student at the Department of Public Health Education, Faculty of Environment and Health Education at the Mampong Campus of the Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED).

Mr. Obiri-Yeboah, as part of his academic requirements for the award of a Master of Philosophy Degree in Public Health, is to undertake a project dissertation on “Distribution and Determinants of Concordant Co-morbidities among Diabetic Patients attending the Mampong Government Hospital in the Ashanti Region, Ghana”.

This will be a hospital-based cross-sectional study that aims to determine co-morbidities that have presentations similar to diabetes. The study sites will be the Mampong Government Hospital in the Mampong Municipality where these cases are usually reported. The outcome of this study would provide empirical data to augment diabetes control efforts within this zone of the region. The data collected will be used solely for academic purposes.

We would be grateful if your outfit would accord him the needed assistance for the successful execution of this proposed study. Your kind approval is required to conduct this study in fulfilment of his academic obligation. Thank you for your kind consideration.

Yours faithfully,



Dr. Nana Yaa Awua-Boateng
(Academic Supervisor)

DEPT. OF PUBLIC HEALTH EDUCATION
FACULTY OF ENV. & HEALTH EDUCATION
COLLEGE OF AGRIC. EDUCATION
AKENTEN APPIAH-MENKA
UNIVERSITY OF SKILLS TRAINING & ENTREPRENEURIAL DEVT.
MAMPONG-ASHANTI