AKENTEN APPIAH-MENKA UNIVERSITY FOR SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT

EPIDEMIOLOGY OF HYPERTENSION AND DIABETES AMONG INMATES IN THE ASHANTI REGION, GHANA

PRINCE KWABENA ACHOO

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BY

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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 my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Prince Kwabena Achoo

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 Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development.

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To my loving family: Mr. Fante Robert, Mrs. Janet Manso, Mr. Stephen Adu Blankson, Gloria Achoo, Gilbert Atta Achoo, Betty Attaa Achoo, and Frank Achoo. Above all, to the Almighty God who always gives me strength, knowledge, and wisdom in everything I do.

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LIST OF ABBREVIATIONS

AMCP	-	Amanfrom Camp Prison
BMI	-	Body Mass Index
CHRPE	-	Committee on Human Research Publications and Ethics
CVDs	-	Cardiovascular diseases
DBT	-	Diabetes
EJCP	-	Ejura Camp Prison
FBG	-	Fasting Blood Glucose
HPT	-	Hypertension
KCP	-	Kumasi Central prison
KFP	-	Kumasi Female Prison
LMICs	-	Low-middle Income Countries
MLP	-	Manhyia Local Prison
NCDs	-	Non-Communicable Diseases
OBLP	-	Obuasi Local Prison
WHO	-	World Health Organization

ABSTRACT

This study examined the epidemiology and risk factors associated with hypertension and diabetes among inmates in selected prisons within the Ashanti Region of Ghana. Using a cross-sectional design, data were collected through structured questionnaires and biometric screening, and logistic regression analysis was employed to identify associated factors. The results revealed a high prevalence of hypertension, with age and duration of incarceration emerging as significant predictors. Inmates aged 31- 40, 41- 50, and 51- 60 years were 1.86, 2.94, and 3.33 times more likely, respectively, to be hypertensive compared to those aged 20- 30 years. Those incarcerated for 1- 2 years and 3–5 years also had higher odds of hypertension compared to inmates imprisoned for less than a year. Although smoking history showed reduced odds of hypertension (odds ratio < 1, suggesting smokers appeared less likely to be hypertensive than non-smokers), the association was not statistically significant. Diabetes prevalence was 10.7%, occurring predominantly among males and younger inmates (20- 40 years). However, no statistically significant associations were observed between diabetes status and demographic or socioeconomic characteristics, suggesting that prison-related lifestyle and contextual factors may contribute more to diabetes risk than traditional predictors. The logistic regression model for hypertension demonstrated good adequacy, as confirmed by the Likelihood Ratio Test ($p = 0.001$) and the Hosmer- Lemeshow test ($p = 0.069$), with moderate predictive performance indicated by the Area Under the Curve (AUC = 0.673). The study concludes that both hypertension and diabetes are prevalent in Ghanaian prisons, with hypertension linked to age and incarceration duration, while diabetes appears evenly distributed across demographic categories. This study is among the first to provide

empirical evidence on the dual burden of hypertension and diabetes within Ghanaian prisons, offering critical insights for policy and intervention strategies in correctional health.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Worldwide, hypertension (HPT) and diabetes (DBT) have emerged as major public health issues, with a focus on low-and middle-income countries (LMICs) (Schutte *et al.,* 2021). These conditions have an especially noticeable effect on those who live in restricted spaces, such as prisoners (Herbert et al., 2012). With major effects on morbidity, mortality, and healthcare costs, the burden of non-communicable diseases (NCDs) particularly HPT and DBT are major global public health concerns (Murphy *et al.,* 2020).

The World Health Organization, 2023 defines HPT as the chronic elevation of both systolic and diastolic blood pressure (above 140 mmHg and 90 mmHg), which results in the death of 9 million people annually and affects an estimated adult population of 1.28 billion and has the potential to increase to about 1.5 billion in 2025, and DBT as a chronic (long-lasting) metabolic disease characterized by elevated blood glucose or blood sugar levels FPG ≥126 mg/dL or (7.0 mmol/L). Over time, DBT and HPT can seriously harm the heart, blood vessels, kidneys, eyes, nerves, and heart. Obesity and physical inactivity are important risk factors for type 2 DBT and HPT. Although a great deal of research has been done on the prevalence and risk factors of these chronic conditions in the general population, little is known about the epidemiology of diabetes and hypertension in the prison population, especially in low- and middle-income nations of which Ghana is not an exception. The incarcerated population may have a higher prevalence of chronic illnesses due to the special difficulties they face,

such as restricted access to healthcare, unhealthy lifestyle choices, and the stress of being confined (Verde *et al.,* 2023). Approximately 75–80% of all deaths worldwide due to cardiovascular diseases (CVDs) occur in developing countries, where the majority of the prevalence rates for diabetes and hypertension are found (Balakumar *et al.,* 2016). Due to HPT and DBT, Sub-Saharan Africa continues to be the region with the highest burden of cardiovascular diseases globally, accounting for 2.6 million deaths, or roughly 35% of all deaths globally (Yuyun *et al.,* 2020).

Ghana, a country in West Africa, is not exempted from the difficulties brought on by having both DBT and HPT. According to estimates, the nation has 2.4 million DBT patients and 5.27 million HPT patients (Afaya, 2021). Although attempts to prevent HPT and DBT have improved the treatment and management of these conditions, there is growing concern about the emergence of HPT and DBT among Ghanaian prisoners. An increased risk of HPT and DBT is caused by several factors, including a sedentary lifestyle, an unhealthy diet, poor sleep hygiene, tobacco use, alcohol consumption, family history, chronic stress, and an aging population (Balwan & Kour, 2021).

Like many other regions in Ghana, the Ashanti Region faces particular difficulties in coping with the combined burden of DBT and HPT. In Ghana, they are the primary causes of myocardial infarction, stroke, cardiovascular illnesses, and chronic kidney disease, with a population-attributable risk of roughly 91% (Bosu & Bosu, 2021). In the Ashanti region, HPT and DBT are still major health problems that are not receiving enough attention (Agyemang-Yeboah *et al.,* 2019).

As a segment of the populace, prisoners are nearly invariably from disadvantaged social backgrounds. According to Williams, Papadopoulou, & Booth (2012), the majority of inmates are ignorant, unskilled, and from low-income families. They may also have only completed their basic education. Because they are largely excluded from community initiatives and national health survey which aim to improve their health outcomes, prisoners' health status is not well known, even though they pose a potential burden to health systems when they return to society with untreated or uncontrolled chronic illnesses (Simpson *et al.*, 2021).To achieve improved health and well-being and universal access to healthcare, the disproportionate disease burden of the prison population must be considered when pursuing the Sustainable Development Goals (SDGs) of the United Nations (BMJ Global Health, 2021). Within this context, epidemiological studies play a crucial role in systematically measuring the prevalence of chronic conditions such as diabetes and hypertension among incarcerated populations. They also help identify patterns, trends, and associated risk factors, thereby providing evidence needed for targeted interventions and informed health policies. This will enable the implementation of control and preventative measures. Additionally, a review of the disease profile of inmates from Yaoundé, Cameroon revealed a high prevalence of risk factors (HPT and DBT) for CVDs among adult prisoners (Simeni Njonnou *et al.*, 2020). Further reviewed research may make clear that global efforts to manage and prevent NCDs (HPT and DBT) and the risk factors associated with them among prisoners have not been effective (Herbert et al., 2012). Attempts to enhance the health outcomes of prisoners suffering from DBT and HPT are further hindered by the lack of thorough data on the management strategies used in correctional facilities (Hewson et al., 2024). Because there is a dearth of scientific information regarding the epidemiology of HPT and DBT in this vulnerable

population, we conducted this research to assess the burden of this comorbidity (HPT and DBT) among society's most marginalized groups and to explore strategies for addressing it.

1.2 Statement of Problem

With major effects on morbidity, mortality, and healthcare costs, the burden of non-communicable diseases, particularly HPT and DBT, is a significant global public health concern (Murphy *et al.,* 2020). About 537 million and 1.28 billion people suffer from DBT mellitus and HPT globally, respectively, and about 1.5 billion adults will be hypertensive worldwide by 2025, and it is responsible for at least 45% of deaths due to heart disease and 51% of deaths due to stroke (Vejendla et al., 2024). A study conducted by Singh et al. (2020 highlighted that HPT contributes to approximately 9.4 million deaths annually, accounting for about 13% of total deaths globally. Ghana has a hypertension prevalence rate ranging from 27% to 34% and it affects 1 in 4 adults in Ghana, but 29.2% in the Ashanti Region and less than 35% are aware of their status, and it accounts for about 15.3% of all deaths (Bosu & Bosu, 2021b). The International Diabetes Federation (IDF estimated that DBT affects 537 million adults aged 20-79 globally, projected to rise to 643 million adults by 2030 and 783 million by 2045 (Maletha, 2023). Globally, it is the direct cause of about 1.6 million deaths annually (Oguntibeju, 2019). In Africa, 24 million adults are currently living with DBT, with that number predicted to increase by 129% to approximately 55 million by 2045 (iAHO_Diabetes_Regional_Factsheet.Pdf, 2023). In Ghana, it leads to about 5,400 deaths annually (Arhin *et al.,* 2023). DBT prevalence in Ghana ranges between 2.80% and 3.95%, but the prevalence in the Ashanti Region alone is 25.20%, and it is the second in terms of prevalence in Ghana (Gad *et al.,* 2023). The

prevalence of these diseases has been rising rapidly over the last few decades (Haththotuwa *et al.*, 2020). In Ghana, including the Ashanti Region, there is a dearth of specific data regarding the prevalence and risk factors of HPT and DBT among the incarcerated population, despite the growing recognition of the health needs of prisoners. Due to the high prevalence of chronic diseases (HPT and DBT) among prisoners, the cost of providing basic prisoner care has increased, adding to the burden already placed on governments, especially in developing countries (Herbert *et al.*, 2012). The two main risk factors for CVDs, which is the leading cause of death for prisoners in Ghana, are HPT and DBT, according to a 2012 report by the Ghana Prisons Service (Abukari *et al.*, 2024). Moreover, efforts to enhance the health outcomes of prisoners with HPT and DBT are further hampered by the lack of thorough data on the management strategies used in correctional facilities (Hewson *et al.*, 2024). Understanding the magnitude of this comorbidity and likely adverse health outcomes on inmates will provide insights in designing effective preventive and control interventions in the future. Therefore, it is imperative to look into the epidemiology of HPT and DBT among prisoners in Ghana's Ashanti Region to learn more about the prevalence, knowledge, attitude and practice, risk factors, and control measures of these chronic illnesses in prisons.

1.3 Objectives of the Study

1.3.1 General Objective

To determine the epidemiology of hypertension and diabetes among inmates in the Ashanti Region, Ghana, with the aim of understanding the prevalence, risk factors and risk differences in this vulnerable population.

1.3.2 Specific Objectives

1. To determine the prevalence of hypertension and diabetes among inmates in the Ashanti Region.
2. To identify the risk factors associated with hypertension and diabetes among inmates in the Ashanti Region.
3. To determine the sociodemographic predictors associated with hypertension and diabetes among inmates in the Ashanti Region.

1.4 Research Questions

1. What is the prevalence of hypertension and diabetes among inmates in the Ashanti Region?
2. What are the risk factors associated with hypertension and diabetes among inmates in the Ashanti Region?
3. What are the sociodemographic predictors associated with hypertension and diabetes among inmates in the Ashanti Region?

1.5 Research Hypothesis

Hypertension:

H_0 (Null Hypothesis): There is no significant difference between the proportion of inmates who are hypertensive and those who are not hypertensive.

H_1 (Research Hypothesis): There is a significant difference between the proportion of inmates who are hypertensive and those who are not hypertensive.

Diabetes:

H_0 (Null Hypothesis): There is no significant difference between the proportion of inmates who are diabetic and those who are not diabetic.

H_1 (Research Hypothesis): There is a significant difference between the proportion of inmates who are diabetic and those who are not diabetic.

1.6 Justification of the Study

Assessment of epidemiology of hypertension and diabetes among prisoners will provide information about the health conditions within Ghanaian prisons. This project will provide data to fill in the knowledge gap and also inform policy makers regarding the need for intervention to prevent or delay the incidence of hypertension and diabetes in correctional facilities. Ultimately, this will reduce morbidity of inmates which pose a huge economic burden to the government. Availability of this data also addresses the World Health Organisation concern s about scarcity of data on this subject in Africa, of which Ghana is of no exception. It will also provide information that is representative of the Sub-Saharan prison system to inform the World of the prevalence, risk factors, awareness and control measures and knowledge, attitude and practice of hypertension and diabetes.

To conclude, the justification for this study lies in the urgent need to address the rising burden of hypertension and diabetes among inmates in the Ashanti Region, Ghana. By conducting comprehensive research on the epidemiology of hypertension and diabetes, this study will contribute valuable knowledge to inform evidence-based interventions, strengthen healthcare systems, and ultimately improve the health outcomes of inmates in the region.

1.7 Significance of the Study

The study is very important in diverse ways. Primarily, it will offer significant understanding of the frequency and associated risk factors of diabetes and hypertension among prisoners in the Ashanti Region. In order to prevent, detect, and effectively manage hypertension and diabetes in this vulnerable population, it is imperative that targeted public health interventions be developed. Therefore, by addressing the combined burden of diabetes and hypertension, the study has the potential to significantly improve the general health outcomes and standard of living for prisoners in the area.

Furthermore, the results of this study will be crucial for the Ashanti Region's evidence-based policymaking and healthcare service planning. Using this data, policymakers can allocate resources more effectively and create interventions using this data, policymakers can effectively deploy resources, create interventions that are suited to the unique requirements of the target population (inmates), and easily incorporate diabetes and hypertension treatment into the inmate health programmes that are already in place. In the end, this will strengthen healthcare systems and provide more effective, patient-centered care.

Also, studying the epidemiology of DBT and HPT in prisoners offers a special chance to develop capacity in the regional research and healthcare sectors. This study will improve the skills and competencies of local researchers and healthcare providers in the areas of data collection, analysis, and interpretation. This will prepare them to tackle a wide range of health issues in the future.

This study will also make a substantial contribution to the body of knowledge currently available about the relationship between prisoners and this comorbidity (Diabetes and Hypertension), especially in the context of sub-Saharan Africa and the Ashanti Region. Particularly in environments with limited resources, these findings will contribute to a global understanding of the burden of hypertension and diabetes among prisoners. By providing a point of reference, they can facilitate the development of a common knowledge base among researchers and healthcare practitioners working in comparable settings.

To sum up, this study has many implications, including bettering prisoner healthcare, promoting evidence-based policymaking, developing capacity, and adding to the body of global knowledge. These interrelated aspects highlight the significance of this research project in addressing the intricate relationship between diabetes and hypertension and their risk factors in Ashanti Region prisoners.

1.8 Scope of the Study

The scope of this study is well-defined to ensure a focused and comprehensive investigation within the prisons in Ashanti Region, Ghana, where Hypertension and diabetes prevalence and related risk factors are presumed to be on the rise. By narrowing down the geographical area of interest, this research goal is to provide in-depth insights into the epidemiological landscape of hypertension and diabetes among inmates in this specific region.

Within this geographical scope, the target population was made up of inmates in the Ashanti Region. This diverse population encompassed individuals of varying ages and

genders who had received a hypertension and diabetes diagnosis or not and currently serving prison sentences within the Ashanti Region. Kumasi Central Prison, Kumasi Female Prison, Manhyia Local Prison, Obuasi Local Prison, Amanfrom Camp Prison and Ejura Camp Prison were selected to represent the prison facilities in the region. The primary emphasis of this study centred on exploring the prevalence, risk factors, socio-demographic predictors and suggesting control measures in this vulnerable population in the Ashanti Region.

Also, the research sought to establish a clear rationale for investigating the prevalence, risk factors, sociodemographic predictors, and control measures of hypertension and diabetes among inmates. In particular, the study carefully examined a range of factors contributing to the development and severity of these conditions within the prison population. Furthermore, concerning risk factors and sociodemographic predictors, the study meticulously examined an array of contributors to the development and severity of hypertension and diabetes among inmates. This comprehensive assessment encompassed factors such as tobacco usage, alcohol consumption, dietary habits, sedentary lifestyle, overweight, family history, previous diagnosis, physical inactivity, overcrowded prisons and socioeconomic determinants. Notwithstanding, in terms of healthcare control measures, the study looked at how well measures are working to reduce the severity of hypertension and diabetes among inmates in the Ashanti Region. This evaluation encompassed integrated healthcare models, access to HPT and DBT medications, lifestyle modification programmes, education and awareness, access to family support system network, regular exercise and improved prison conditions.

Nonetheless, it was essential to highlight certain limitations inherent to this study. Because of limited resources and the complexity of the research topic, it became necessary to pick and choose which potential risk factors and mechanisms for hypertension and diabetes among inmates to study. Additionally, the availability and reliability of existing data potentially influenced the depth and breadth of the analysis conducted.

Based on the findings derived from this research, the study formulates recommendations for healthcare policymakers, and practitioners. These recommendations centered on the development of evidence-based interventions aimed at alleviating the burden of hypertension and diabetes among inmates in the Ashanti Region. These proposed interventions were directed towards enhancing healthcare services, fortifying healthcare systems, and fostering the adoption of integrated care models within the various prison centres. In sum, this study's well-defined scope ensured a cohesive and unified approach to comprehensively investigating the epidemiology of hypertension and diabetes` among inmates in the Ashanti Region.

1.9 Limitations of the Study

1. Prisoners incarcerated in the Ashanti Region's 7 Prison Centres made up the study's sample, which may not accurately reflect all of the region's prisoners as a result of sampling bias.
2. The study employed a cross-sectional design, which provided a snapshot of the prevalence of hypertension and diabetes, as well as associated factors, at a particular point in time. However, this design does not capture the dynamic

nature of the development and progression of these conditions among prisoners over time.

3. The research only limited to the Ghanaian Ashanti Region, and its conclusions might not apply to other regions or nations with varying rates of HPT and DBT prevalence, varied prison health systems, or sociodemographic situations.
4. This study captured data on six (6) prisons out of the (7) prison centres in the Ashanti Region due to lack of easy accessibility (means of transport), limited time and financial constraints.

1.10 Organization of the Study

This research project will be divided into six chapters: the first will serve as an introduction, outlining the study's background, problem statement, objectives, research questions, and significance; the second will review pertinent background literature; the third will present the research methods employed for the project, outlining the study area, target population, study population, sampling procedure, sample size, data collection methods, data processing and analysis, and ethical considerations; the fourth will present the study's findings; the fifth will discuss the study's findings and the sixth chapter will conclude with a summary of the findings, conclusions, and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

This section of the research focuses on the conceptual examination of pertinent aspects related to the research topic, namely, the epidemiology of hypertension and diabetes among inmates in the Ashanti Region, Ghana, with the aim of understanding the prevalence, knowledge, attitude and practice (KAP), risk factors and control measures in this vulnerable population. It encompasses a chronological arrangement covering the conceptual review of epidemiology of hypertension and diabetes among inmates. The section also delved into related theories and the development of hypotheses and concludes the theoretical review.

2.2 Theoretical Review

Theories regarding the epidemiology of hypertension and diabetes such as Social Determinants of Health Theory and Stress and Coping Theory among inmates will be reviewed.

2.2.1 Social Determinants of Health Theory

This theory refers to the various social, economic, and environmental factors that influence health outcomes. This concept recognizes that health is not solely determined by individual behaviour or genetics but is significantly affected by factors such as socioeconomic status, education, neighbourhood environment, and access to healthcare (World Health Organization, 2008). The foundations of this theory can be traced back to the work of researchers such as Michael Marmot, particularly his

influential report highlighting health inequalities (Marmot, 2005). When applied to the epidemiology of hypertension and diabetes among inmates, several key factors can be considered. Incarcerated individuals often come from lower socioeconomic backgrounds, leading to increased stress and limited access to healthy foods, healthcare, and education about disease management (Fazel & Baillargeon, 2011; Wilper et al., 2009). Inmates frequently live in crowded conditions with limited opportunities for physical activity, which can contribute to obesity, a major risk factor for hypertension and diabetes. Environmental stressors such as poor ventilation, noise, and institutional stress may further increase blood pressure and disrupt metabolic health (Awofeso, 2010). Additionally, access to healthcare within prisons can be inconsistent, with inadequate screening and treatment for chronic conditions, resulting in higher rates of undiagnosed and poorly managed diseases (Fazel & Baillargeon, 2011). This lack of preventive care can lead to higher rates of undiagnosed and poorly managed diseases. Also, many inmates may have limited health literacy, affecting their understanding of hypertension and diabetes management, including diet, medication adherence, and lifestyle changes. Education programmes within prisons can play a critical role in improving health outcomes. With Incarceration disrupts social networks, which can affect emotional and psychological well-being. Support from family and friends is crucial for coping with stress and managing chronic diseases. The lack of support can lead to feelings of isolation and depression, worsening health outcomes. Policies related to healthcare provision in prisons, including funding and regulations, directly influence the quality-of-care inmates receive. Advocacy for better health policies can help address systemic issues contributing to the high prevalence of hypertension and diabetes.

2.2.2 Stress and Coping Theory

This theory was developed by psychologist Richard Lazarus in the 1960s and 1970s. Lazarus proposed that stress is not just a reaction to external events but also involves cognitive appraisal, meaning how individuals interpret and respond to stressors. His model identifies two main types of appraisals: primary (determining if an event is a threat) and secondary (assessing resources available to cope with the threat). Lazarus's work culminated in the book "Stress, Appraisal, and Coping," published in 1984, which further elaborated on these concepts and introduced coping strategies. Both theories emphasize the importance of context: Thus, social context in the case of social determinants of health and personal context in the case of stress and coping, highlighting that health outcomes are influenced by a complex interplay of various factors. Stress and Coping Theory, developed by Richard Lazarus and Susan Folkman, posits that stress results from the interaction between individuals and their environments, where the perceived demands of a situation exceed their coping resources. In the context of hypertension and diabetes among inmates, several aspects can be highlighted. The prison environment is inherently stressful, with factors such as violence, isolation, and uncertainty about the future (Massoglia & Pridemore, 2015). Chronic stress can lead to physiological changes that increase the risk of hypertension and diabetes (Sapolsky, 2004). Stress hormones like cortisol can impact blood pressure and glucose metabolism. Also, inmates employ various coping strategies in response to stress. Some may engage in unhealthy behaviours, such as poor diet or substance use, which can worsen their health, while others may find constructive coping mechanisms, like engaging in exercise or forming supportive relationships, which can mitigate the effects of stress on health (Schnittker & John, 2007). Again, how inmates perceive their circumstances influences their stress levels

and coping strategies. A positive appraisal of their situation might lead to better coping and health outcomes, while a negative appraisal could contribute to feelings of helplessness and increased health risks. Social support plays a crucial role in how individuals cope with stress. Inmates with strong support systems may experience less stress and have better management of chronic conditions. Resilience training and support programmes in prisons can enhance coping strategies and improve health outcomes. Understanding the stress and coping mechanisms of inmates presents opportunities for interventions. Programmes that teach stress management techniques, promote physical activity, and provide nutritional education can help inmates cope with stress more effectively, potentially reducing the incidence of hypertension and diabetes.

2.3 Conceptual Review

A conceptual framework is a structure or a group of related concepts, notions, and theories that serve as a starting point for comprehending a certain phenomenon, issue, or topic. The theoretical and analytical framework within which a study, research effort, or academic conversation is conducted or established.

The various concepts captured in the study, i.e. epidemiology of hypertension and diabetes among inmates are reviewed below.

2.3.1 Prevalence of Hypertension and Diabetes among Inmates

Incarcerated populations are at an increased risk for a range of health conditions, including chronic diseases such as hypertension and diabetes. These conditions pose significant challenges to both the health and the management of inmate populations, with implications for the prison healthcare system. Given the high prevalence of these

diseases among the general population, it is essential to investigate how they manifest and impact the prison system. This literature review examines existing research on the prevalence of hypertension and diabetes among incarcerated individuals, exploring potential risk factors, the effectiveness of healthcare delivery in correctional facilities, and the broader implications for public health. Hypertension, or high blood pressure, is a chronic condition characterized by elevated blood pressure levels that can lead to cardiovascular diseases, stroke, and kidney damage if left untreated. The prevalence of hypertension among inmates has been a growing concern, with numerous studies documenting its high occurrence in correctional facilities. Research suggests that the prevalence of hypertension among incarcerated individuals ranges from 25% to 60%, depending on the study population and the facility's demographic characteristics. A study by Binswanger *et al.,* 2009, found that 34% of incarcerated adults had hypertension, which was higher than the general population's prevalence at the time, estimated at 28%. Other studies, such as those by Williams et al. 2018, reported even higher rates, especially among older inmates and those with lower socioeconomic backgrounds. Several factors contribute to the increased risk of hypertension in correctional settings. These include the prevalence of poor dietary habits, stress from incarceration, limited physical activity, and pre-existing health conditions. Moreover, the prison environment itself characterized by overcrowding, insufficient healthcare access, and a high incidence of mental health disorders may exacerbate hypertension rates among inmates (Higgins *et al.,* 2016). The quality and consistency of healthcare services within correctional institutions plays a critical role in managing hypertension. Studies have shown that while many inmates receive initial screenings, follow-up care and consistent medication management are often inadequate (Rich *et al.,* 2010). Lack of preventive care and the challenges of providing specialized treatment in

correctional settings contribute to the chronicity of hypertension among prisoners. Diabetes, particularly Type 2 diabetes, is another prevalent chronic condition that disproportionately affects incarcerated individuals. Diabetes is a metabolic disorder that impairs the body's ability to regulate blood sugar levels and can lead to severe complications, including blindness, kidney failure, and amputations. The prevalence of diabetes in prisons is similarly concerning, with studies suggesting rates ranging from 10% to 20%, much higher than the general population's rate of about 7-10% (Wolff *et al.,* 2015). In a study by MacArthur et al. 2012, it was found that 15% of incarcerated individuals were diagnosed with diabetes, and another 25% were at risk of developing the condition due to elevated blood glucose levels.

As with hypertension, several factors in the correctional environment contribute to the higher rates of diabetes. These include poor diet, limited opportunities for physical exercise, and high rates of obesity. The incarcerated population tends to have a higher proportion of individuals with risk factors for diabetes, such as obesity, family history of diabetes, and lower socioeconomic status, which may be compounded by inadequate healthcare access within prisons (Williams *et al.,* 2017).

Despite the high prevalence, diabetes management in correctional settings is often suboptimal. Crawford *et al.,* 2016, highlighted that prisoners with diabetes frequently experience challenges in receiving consistent care, including timely medication, blood glucose monitoring, and dietary support. There is also a lack of comprehensive diabetic education and tailored interventions in most prisons, which affects long-term disease management and outcomes.

Both hypertension and diabetes present significant challenges in correctional health systems. While there are common risk factors such as obesity, inadequate nutrition, and limited physical activity, there are differences in how these conditions manifest and are managed within prison systems. The dual presence of hypertension and diabetes in inmates is common and can complicate treatment protocols. Studies by Khan *et al.,* 2014, indicate that co-morbid hypertension and diabetes are prevalent in 10-20% of incarcerated populations. This co-occurrence increases the risk of cardiovascular complications, kidney disease, and other health issues, making integrated management of both conditions a priority in correctional healthcare.

The availability of health interventions for hypertension and diabetes varies widely across correctional facilities. In some facilities, prisoners with these conditions receive medications and regular screenings, but in others, resources are limited, and care is episodic. A study by Morrison *et al.,* 2018, found that while some prisons have introduced disease management programmes, the overall quality of care remains inconsistent, and long-term health outcomes for inmates are often poor.

Psychological stress and mental health issues are prevalent in correctional settings and may further exacerbate both hypertension and diabetes. Greer *et al.,* 2019, found that inmates with high levels of stress and poor mental health are more likely to have uncontrolled hypertension and diabetes. The prison environment's stressors can worsen these conditions, leading to worse health outcomes.

The high prevalence of hypertension and diabetes among inmates has significant implications for public health, as these individuals often re-enter society with

untreated or poorly managed chronic conditions. Sampath *et al.,* 2020, argue that improving healthcare in correctional settings could help reduce the burden of these diseases not only within prisons but also in the broader community, as released prisoners frequently lack access to adequate follow-up care.

Additionally, policies that address the root causes of chronic conditions in correctional settings such as improving nutrition, increasing physical activity, and enhancing mental health support are critical. The implementation of comprehensive health programmes that integrate chronic disease management, mental health services, and preventative care can reduce the long-term health risks posed by hypertension and diabetes in incarcerated populations.

2.3.2 Sociodemographic Predictors Associated with Hypertension and Diabetes among Inmates

Hypertension and diabetes are among the most prevalent non-communicable diseases (NCDs) globally, with increasing recognition of their burden within incarcerated populations (Harzke et al., 2010). Inmates often experience higher rates of these conditions compared to the general population, influenced by unique environmental stressors and pre-existing vulnerabilities (Binswanger et al., 2009). Socio-demographic factors such as, including age, sex, race or ethnicity, educational level, marital status, and duration of incarceration—have been identified as key predictors affecting the prevalence and management of these chronic diseases among prisoners (*Enduring Stigma: The Long-Term Effects of Incarceration on Health∗ - Jason Schnittker, Andrea John, 2007*, 2007) Schnittker & John, 2007). For instance, advancing age is consistently associated with increased risk of both hypertension and

diabetes due to cumulative exposure to risk behaviours and biological aging processes (Aminde et al., 2020). Gender differences have also been reported, with men and women exhibiting distinct prevalence patterns possibly linked to behavioural and hormonal factors (Ali et al., 2011). Furthermore, racial and ethnic disparities in chronic disease burden are well-documented in incarcerated settings, often reflecting broader societal inequities (Harzke et al., 2010). Educational attainment influences health literacy and disease management, with lower education levels correlating with higher disease prevalence and poorer outcomes (Ali et al., 2011). Additionally, marital status and social support networks can affect stress levels and health behaviours that contribute to disease risk (Miller et al., 2011). Duration and conditions of incarceration further compound these risks by limiting access to healthcare and promoting sedentary lifestyles (Binswanger et al., 2009). Understanding these socio-demographic predictors is crucial for developing targeted interventions to reduce the burden of hypertension and diabetes among inmates and improve overall prison health outcomes.

Gender plays a nuanced role in the epidemiology of chronic diseases in prisons. Generally, men are overrepresented in prison populations, which can distort disease prevalence statistics. Nevertheless, gender-specific patterns have been observed. In Cameroon, for example, male inmates had a higher prevalence of diabetes (10.3%) compared to female inmates (6.3%), although the difference was not statistically significant (Aminde et al., 2020). Harzke et al. (2010) observed a slightly higher prevalence of both hypertension and diabetes among male inmates in Texas. However, among non-incarcerated diabetic populations, women are often more likely to suffer from comorbid hypertension due to differences in fat distribution, hormonal

factors, and social determinants such as caregiver stress (Ali et al., 2011). These discrepancies suggest the need for sex-disaggregated data and targeted interventions that consider gender-specific risk profiles and health behaviours. Racial and ethnic disparities in health are well-documented in the general population and are magnified in the prison context. In the Texas prison study, African American inmates had the highest rates of hypertension (28.3%) and diabetes (4.7%), followed by Hispanics and Whites (Harzke et al., 2010). These findings echo broader public health data, where African Americans and Indigenous populations tend to experience higher burdens of chronic disease due to a combination of socio-economic disadvantage, environmental exposure, and limited access to preventive healthcare. In Australia, Indigenous inmates were found to have more than six times the odds of developing diabetes compared to their non-Indigenous counterparts (Indig et al., 2010). These racial disparities are often compounded by systemic inequities both inside and outside prison walls, warranting culturally competent approaches to healthcare delivery in prisons. Educational attainment is a powerful predictor of health outcomes due to its influence on health literacy, access to care, and ability to manage chronic conditions. Ali et al. (2011) found that among diabetics, those with no formal education were significantly more likely to have comorbid hypertension than those with higher education. Although most incarcerated individuals have lower levels of education than the general population, few prison-based studies have systematically assessed the impact of education on disease prevalence. This lack of data represents a key gap in the literature, particularly in African settings where access to formal education remains uneven.

The length and conditions of incarceration can influence health through chronic stress, inactivity, and limited healthcare access. A Cameroonian study by Aminde et al. (2020) found no significant association between sentence length and diabetes after adjusting for confounders like obesity and alcohol use. However, broader evidence from the CARDIA cohort study in the United States suggests that incarceration itself is a risk factor for hypertension, especially among Black men with lower educational attainment (Schnittker & John, 2007). The type of incarceration—whether in high-security, overcrowded, or solitary confinement facilities—may also impact physiological stress responses, although these dimensions remain largely unquantified in prison health research.

Despite growing interest in prison health, several gaps persist in the literature. First, most studies originate from high-income countries, with limited data from African prisons. Second, while age, sex, and race are frequently studied, factors such as education, marital status, and incarceration history are often overlooked. Third, methodological limitations such as cross-sectional designs and small sample sizes limit causal inference. Lastly, few studies evaluate the interaction of multiple social determinants or explore how institutional factors in prisons mediate their effects. The current study seeks to address these gaps by examining how social-demographic predictors influence hypertension and diabetes among inmates in Ghana. By focusing on a low-resource context, it contributes to the global understanding of NCD epidemiology in prisons. The findings are expected to inform targeted interventions, policy decisions, and resource allocation within correctional health systems.

Social-demographic factors such as age, sex, race/ethnicity, education, and incarceration history play a critical role in shaping the risk and burden of hypertension and diabetes among inmates. While substantial research has been conducted in high-income settings, there is an urgent need for context-specific evidence from Sub-Saharan Africa. By examining these predictors in the Ghanaian prison context, the current study aims to contribute valuable insights into one of the most vulnerable and underserved populations in the healthcare system.

2.3.3 The Risk Factors Associated with Hypertension and Diabetes among Inmates

Hypertension and diabetes are significant health concerns among the incarcerated population. Both conditions have been shown to have higher prevalence rates in correctional settings compared to the general population. Understanding the risk factors that contribute to the development and exacerbation of hypertension and diabetes in inmates is crucial for improving disease prevention, management, and outcomes. This literature review explores the key risk factors associated with hypertension and diabetes among inmates, including lifestyle factors, socio-economic conditions, environmental influences, and pre-existing health conditions. It also highlights the unique challenges faced by inmates in managing these chronic diseases within the prison healthcare system.

Hypertension, commonly referred to as high blood pressure, is a major risk factor for cardiovascular disease, stroke, and kidney failure. In the context of incarcerated individuals, several factors contribute to the elevated risk of developing and worsening hypertension.

One of the most prominent risk factors for hypertension is obesity, which is prevalent in correctional settings. Studies have shown that inmates often have high rates of obesity due to poor dietary habits and lack of physical activity. A study by Binswanger *et al.,* 2009, found that 44% of incarcerated individuals were obese, which directly correlates with an increased risk of hypertension. Inmates with higher body mass index (BMI) are more likely to develop elevated blood pressure, making obesity a significant risk factor in correctional populations.

The food provided in prisons is often high in sodium, fats, and processed foods, contributing to poor dietary habits that increase the risk of hypertension. Higgins *et al.,* 2016, reported that many correctional facilities offer meals that are low in fruits, vegetables, and whole grains, and high in salt and unhealthy fats. This high-sodium diet is a known contributor to high blood pressure. Additionally, inmates often have limited access to healthier food choices, which exacerbates the problem.

Incarceration often limits opportunities for physical exercise, which is a key factor in maintaining healthy blood pressure levels. The lack of access to exercise equipment or outdoor activities, combined with long periods of confinement in cells, contributes to a sedentary lifestyle. Harrison *et al.,* 2017, found that inmates often engage in minimal physical activity, which directly contributes to obesity and hypertension. Physical inactivity is compounded by overcrowding and inadequate space in correctional facilities, further limiting exercise opportunities.

The psychological stress associated with incarceration, including fear, isolation, overcrowding, and lack of control, has been shown to increase the risk of

hypertension. Greer *et al.,* 2019, found that stress plays a significant role in the development and exacerbation of hypertension among inmates. Chronic stress elevates cortisol levels, which can contribute to increased blood pressure. The lack of mental health resources and support for stress management in prisons worsens this situation. Like the general population, inmates may be genetically predisposed to hypertension, especially if they have a family history of the condition. Williams *et al.,* 2016, found that genetic predisposition and family history were important risk factors in the development of hypertension among inmates, much like in the broader community. Inmates who have a family history of hypertension may be more vulnerable to developing the condition themselves.

Substance use, including alcohol and tobacco, is common in correctional facilities and is linked to an increased risk of hypertension. Binswanger *et al.,* 2009, found that substance abuse (particularly tobacco smoking and alcohol consumption) was associated with higher blood pressure levels in inmates. These substances contribute to blood vessel constriction, inflammation, and increased heart rate, all of which contribute to hypertension.

Diabetes, particularly Type 2 diabetes, is another chronic condition that is highly prevalent among incarcerated individuals. The risk factors for diabetes among inmates are multifaceted, with a combination of lifestyle, genetic, and environmental influences contributing to its development. As with hypertension, obesity is a leading risk factor for Type 2 diabetes. MacArthur *et al.,* (2012), noted that the high prevalence of obesity among incarcerated populations is a significant contributor to the development of diabetes. Inmates with higher body fat percentages, particularly

abdominal fat, are at a much greater risk of developing insulin resistance, a precursor to Type 2 diabetes.

The nutritional deficiencies in prison diets are a significant risk factor for diabetes. Rich *et al.,* 2017, found that the diet in many correctional facilities is high in refined sugars, processed foods, and unhealthy fats, which contribute to insulin resistance and the development of Type 2 diabetes. The lack of access to fresh, whole foods, such as vegetables, fruits, and lean proteins, exacerbates the risk of diabetes. Limited physical activity is also a significant risk factor for the development of diabetes among inmates. As mentioned earlier, many correctional facilities provide limited opportunities for exercise, leading to a sedentary lifestyle. Williams *et al.,* 2016, found that inmates who engage in less physical activity are more likely to develop diabetes, as regular physical activity is essential for maintaining healthy blood glucose levels.

Like hypertension, diabetes is also influenced by stress. Chronic stress, common in correctional settings, can lead to the overproduction of cortisol, which can contribute to increased blood glucose levels and insulin resistance. Parker *et al.,* (2015), found that inmates with high levels of psychological stress were more likely to develop diabetes or experience poor control over their condition. Stress can also lead to poor coping mechanisms, such as emotional eating or substance abuse, which further increase diabetes risk. The risk of developing Type 2 diabetes increases with age, and inmates are not immune to this factor. Wolff *et al.,* (2015), reported that older inmates, particularly those aged 40 and above, were at a higher risk of developing diabetes. Age-related changes in metabolism and insulin sensitivity make older

inmates more susceptible to diabetes. Genetic predisposition plays a significant role in the development of diabetes. Inmates with a family history of Type 2 diabetes are more likely to develop the condition themselves. Harrison *et al.,* (2018) highlighted that inmate with a family history of diabetes had a higher incidence of the disease, further emphasizing the role of genetics in diabetes risk.

Substance use, including smoking and alcohol consumption, has been linked to an increased risk of Type 2 diabetes. Johnson *et al.,* 2015, found that smoking, in particular, contributed to insulin resistance, while alcohol abuse exacerbated obesity, which in turn increased the risk of diabetes.

There is some evidence suggesting that certain infections, such as HIV, may contribute to an increased risk of diabetes among inmates. Greer *et al.,* (2019) found that inmates with HIV were more likely to develop insulin resistance, possibly due to the effects of antiretroviral therapy and the virus itself. Many of the risk factors for hypertension and diabetes overlap, which complicates the management of these conditions in correctional settings. Khan *et al.,* (2014) found that inmates with both hypertension and diabetes often have multiple risk factors, including obesity, poor diet, physical inactivity, and substance use. The co-occurrence of these conditions requires integrated care approaches that address both diseases simultaneously.

However, the high prevalence of risk factors for hypertension and diabetes in correctional settings highlights the need for comprehensive prevention and management strategies. MacArthur *et al.,* (2012) advocate for policy changes that focus on improving the quality of food, increasing physical activity opportunities, and

providing better mental health services to help manage stress. Additionally, improved access to healthcare, regular screenings, and chronic disease management programs are essential for reducing the burden of these diseases among inmates.

In Conclusion, the risk factors associated with hypertension and diabetes in incarcerated populations are complex and multifactorial. Obesity, poor diet, physical inactivity, stress, and substance use all play significant roles in the development of these chronic conditions. Inmates with pre-existing health conditions or a family history of hypertension or diabetes are at greater risk. Addressing these risk factors through targeted interventions, including improving nutrition, increasing opportunities for physical activity, and enhancing healthcare access, is crucial for mitigating the impact of these diseases in correctional settings. Implementing comprehensive healthcare policies that address these factors can improve the overall health and well-being of incarcerated individuals and reduce the long-term public health burden.

2.3.4 The Control Measures of Hypertension and Diabetes among Inmates

Hypertension and diabetes are two of the most prevalent chronic diseases in correctional facilities, presenting significant challenges to the health and well-being of incarcerated individuals. These conditions require ongoing management, as poorly controlled hypertension and diabetes can lead to severe complications, including cardiovascular diseases, stroke, kidney failure, and blindness. The correctional healthcare system, however, faces numerous challenges, including limited resources, overcrowding, and high turnover rates of healthcare professionals. Despite these challenges, several control measures are being implemented in prisons to manage and control hypertension and diabetes. This literature review explores the current control

measures for managing hypertension and diabetes among inmates, including pharmacological interventions, lifestyle modifications, healthcare access, and policy changes within correctional settings.

Pharmacological treatment remains a cornerstone in the management of hypertension and diabetes among inmates. Incarcerated individuals who suffer from hypertension and diabetes typically require a combination of medications to control their conditions. For hypertension, common medications include angiotensin-converting enzyme (ACE) inhibitors, calcium channel blockers, and diuretics. For diabetes, insulin therapy and oral hypoglycaemic agents, such as metformin and sulfonylureas, are commonly used. One significant issue in managing these conditions in prisons is medication adherence. A study by Harrison *et al.,* (2017) highlighted that medication adherence is often inconsistent due to the lack of regular access to medication, the complexity of medication regimens, and the lack of personalized care. Some inmates miss doses due to inconsistent scheduling, a problem exacerbated by overcrowding and logistical challenges within the prison system. Binswanger *et al.,* (2011) noted that the lack of follow-up care and monitoring for side effects or complications from medications further complicates the management of hypertension and diabetes. To address these issues, some correctional facilities have implemented daily pill call systems, where inmates receive their medications in person, which can improve adherence. However, research by Rich *et al.,* (2017) suggests that greater attention to personalized care, including medication reviews and education on the importance of adherence, is needed to improve outcomes.

An integrated care model, where healthcare providers work collaboratively to manage multiple chronic conditions, is an emerging approach in correctional facilities. MacArthur *et al.,* (2012) demonstrated that coordination between primary care providers, endocrinologists, cardiologists, and dieticians can improve the management of both hypertension and diabetes in prisons. This approach ensures that inmates receive comprehensive, individualized treatment plans and monitoring, reducing the likelihood of complications and improving health outcomes. A proper diet is crucial for the control of both hypertension and diabetes. In many correctional facilities, the food provided is high in sodium, fats, and processed sugars, which can exacerbate both conditions. Parker *et al.,* (2015) highlighted that improving access to healthy, low-sodium, low-sugar meals could significantly benefit inmates with hypertension and diabetes. In some facilities, dietary programs are being implemented that emphasize the inclusion of fruits, vegetables, whole grains, and lean proteins. These changes aim to reduce the intake of high-sodium foods and refined carbohydrates, which can worsen hypertension and diabetes management. Studies have shown that dietary interventions in correctional settings can improve inmates' blood pressure and blood glucose levels. Greer *et al.,* (2019) found that inmates who participated in structured dietary programs exhibited improved blood sugar control and lowered blood pressure. However, the lack of consistent implementation and limited resources in many facilities remain barriers to these interventions.

Physical activity plays an important role in managing both hypertension and diabetes. Johnson *et al.,* (2015) reported that regular physical exercise helps lower blood pressure and improve insulin sensitivity. However, in many correctional facilities,

opportunities for exercise are limited due to overcrowding, lack of space, and restricted access to fitness facilities.

Some prisons have developed exercise programs or outdoor activity opportunities, which can be effective in improving inmates' health. Rich *et al.*, (2017) found that facilities that offered structured exercise programs had better outcomes in managing hypertension and diabetes, as inmates were more likely to maintain a healthy weight and lower their blood pressure. Additionally, even small amounts of physical activity, such as walking, have been shown to have positive effects on both conditions. However, access to these programs is inconsistent, and some inmates still struggle with sedentary lifestyles due to facility limitations. Education plays a critical role in empowering inmates to manage their chronic conditions. Higgins *et al.*, (2016) emphasized that health education programs that inform inmates about the risks of hypertension and diabetes, the importance of medication adherence, healthy eating, and physical activity can significantly improve self-management. These programs can take the form of group counselling sessions, one-on-one interactions with healthcare providers, or written materials that provide information about disease management. Behaviour modification programmes, such as cognitive-behavioural therapy (CBT) or motivational interviewing, have also been used in some prisons to encourage healthy behaviours. Binswanger *et al.*, (2011) found that inmates who received education and behavioural counselling on managing their hypertension and diabetes were more likely to adhere to prescribed medications, improve their dietary habits, and engage in physical activity.

Regular monitoring of blood pressure and blood glucose levels is essential for the control of hypertension and diabetes. Many prisons are implementing more frequent screening and check-ups to detect high blood pressure and elevated glucose levels early. Williams *et al.,* (2016) reported that regular screening programmes are crucial for identifying inmates at risk of hypertension and diabetes before the conditions worsen. Correctional facilities that conduct regular screenings are better equipped to manage these chronic diseases. Some facilities have integrated chronic disease management protocols, which involve routine testing and follow-up appointments for those diagnosed with hypertension or diabetes. MacArthur *et al.,* (2012) found that such protocols can significantly reduce hospitalizations and improve long-term health outcomes for incarcerated individuals.

Access to healthcare professionals, such as general practitioners, endocrinologists, cardiologists, and dieticians, is essential for managing hypertension and diabetes. Harrison *et al.,* (2017) highlighted that many prisons face shortages of healthcare professionals, which can lead to delays in care and insufficient management of chronic conditions. To mitigate this, some facilities have begun using telemedicine services to connect inmates with specialists and improve the quality of care available. Rich *et al.,* (2017) found that prisons with better access to healthcare professionals, including regular consultations and treatment adjustments, had better outcomes in the management of hypertension and diabetes. These facilities are also more likely to offer comprehensive chronic disease management programs, including monitoring, medication, and lifestyle support. A significant challenge in managing hypertension and diabetes in correctional settings is the lack of continuity of care once inmates are released. Many inmates do not have access to primary care services upon release,

leading to gaps in treatment and poor disease control. Parker *et al.,* (2015) suggested that prison healthcare systems should collaborate with community health services to ensure a smooth transition of care for inmates with chronic conditions. Providing inmates with prescriptions, health records, and connections to primary care providers can significantly improve continuity of care and reduce the risk of complications after release.

Comprehensive health policies that prioritize the management of chronic conditions like hypertension and diabetes can improve overall health outcomes in correctional facilities. Wolff *et al.,* (2015) emphasized the need for prisons to develop policies that include regular screenings, health education programs, access to medications, and support for lifestyle modifications. Policies that address the social determinants of health, such as access to healthy food and exercise, are also critical for improving disease control among inmates. Ensuring that healthcare staff are adequately trained to manage chronic conditions is essential for effective disease control. Higgins *et al.,* (2016) found that training correctional healthcare providers to recognize and manage hypertension and diabetes could improve disease control and reduce complications. Providing continuous professional development and ensuring that staff are aware of the latest guidelines for managing these conditions are key factors for improving healthcare in prisons.

The control of hypertension and diabetes among inmates is a multifaceted challenge that requires a combination of pharmacological interventions, lifestyle modifications, regular monitoring, and comprehensive healthcare access. Despite the difficulties posed by overcrowding, limited resources, and inconsistent healthcare access, several

correctional facilities have successfully implemented control measures such as medication management, dietary interventions, exercise programmes, and health education. However, more systemic changes, such as improved healthcare staffing, better dietary options, and greater continuity of care after release, are needed to further improve disease management in correctional settings. By addressing these challenges and implementing more robust control measures, the healthcare outcomes for inmates with hypertension and diabetes can be significantly improved.

Several interventions and policy changes have been proposed or implemented to address health disparities within correctional institutions. Provision of additional resources for healthcare in correctional facilities is crucial. As emphasized by Gonzalez *et al.,* (2022), increased funding can help improve staffing levels, access to medical supplies, and infrastructure improvements. Expanding telehealth services can facilitate access to specialized care for inmates, particularly in remote facilities. Martinez *et al.,* (2023) have shown that tele-health can improve disease management for chronic conditions by allowing inmates to consult with specialists without the logistical challenges of transport. Developing and implementing standardized health care protocols across facilities can ensure that all inmates receive consistent and adequate care. This would address gaps in treatment and promote equitable health outcomes (Kemp *et al.,* 2023). Acknowledging the interplay between physical and mental health is crucial. Johnson *et al.,* (2024) recommends integrating mental health services with chronic disease management programmes to address comorbid conditions effectively. Implementing comprehensive health education initiatives can empower inmates with knowledge about managing their health, understanding their conditions, and making informed lifestyle choices (Friedman *et al.,* 2022). Health

inequities within correctional institutions are influenced by structural and policy limitations that hinder effective healthcare delivery. Addressing these disparities requires comprehensive policy changes that prioritize inmate health, improve access to care, and ensure that healthcare systems within correctional facilities are adequately resourced. By focusing on these areas, it is possible to create a more equitable healthcare landscape for incarcerated individuals, ultimately improving their health outcomes and reducing recidivism rates.

2.4 Literature Summary

The literature review shows a comprehensive assessment of HPT and DBT among inmates in the Ashanti Region, Ghana, within the social determinants of health theory and stress and coping theory frameworks. Both theories emphasized the importance of context: Thus, social context in the case of social determinants of health and personal context in the case of stress and coping, highlighting that health outcomes are influenced by a complex interplay of various factors. These approaches, guided by both the social determinants of health, and stress and coping theories, underscore the importance of considering the broader context and environment when addressing HPT and DBT in this vulnerable population. Also, the review relies on empirical evidence from a range of studies, systematic reviews, and meta-analyses, enhancing the credibility of its analysis and conclusions. It points out gaps in the existing literature, such as the need for a more rigorous methodological critique, exploration of socio-demographic factors, region-specific analysis, and a better understanding the prevalence, and risk factors of HPT and DBT among inmates in the Ashanti Region of Ghana.

Notwithstanding, there are opportunities to strengthen the review further. A more critical assessment of the quality and limitations of the studies cited, including methodologies and potential biases, would enhance their rigor. Additionally, delving deeper into the socio-demographic nuances that impact lifestyle, healthcare-seeking behaviours, and intervention effectiveness among inmates would provide a more nuanced understanding of this comorbidity. Further exploration of regional variations and their specific implications for HPT and DBT risks and healthcare access in different prisons within the Ashanti Region could offer valuable insights. Lastly, a more comprehensive analysis of the risk factors and effectiveness control measures tailored to the context of epidemiology of HPT and DBT among inmates in the Ashanti would be instrumental in guiding future healthcare strategies to address this pressing public health issue.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This study employed a strict and rigorous methodology to investigate the epidemiology of hypertension and diabetes among inmates in the Ashanti Region of Ghana. The adoption of a strict methodological approach was necessary to ensure accuracy, reliability, and objectivity, given that the study population represents a confined and vulnerable group where data collection may be prone to bias and ethical concerns.

The research was guided by a positivist philosophy and applied a quantitative research approach, which enabled the generation of empirical evidence and numerical insights into the prevalence, predictors, and associated risk factors of hypertension and diabetes. By applying standardized procedures in sampling, data collection, and statistical analysis, the study ensured the production of credible findings that can inform health policies and interventions within the prison health system and beyond.

3.1 Study Design

The epidemiology of diabetes and hypertension among prisoners in the Ashanti Region will be examined in a population-based cross-sectional study, which focused on inmates aged twenty and upwards. Quantitative data was be collected. Njonnou et al., (2019) emphasised the need for a cross-sectional study design in determining the prevalence among inmates in a study in Yaoundé Central Prison, Cameroon, which employed structured interviews, repeated blood pressure measurements,

anthropometry, and fasting capillary glucose to quantify hypertension prevalence and associated risk factors among inmates.

3.2 Study Population

The study population consisted of incarcerated individuals from six prison facilities within the Ashanti Region of Ghana. For the purpose of true reflection of the total inmates' population, this particular population was chosen from six (6) prisons in the Ashanti Region. This comprises of a Central prison, Female prison, two (2) Local prisons and two (2) Camp prisons. The study population were prisoners who were medically and mentally fit at the six prison centres in the Ashanti Region of Ghana who are either convicts or remands for not less than three Months and aged twenty and above.

3.3 Study Area

3.3.1 Ashanti Regional Command of Ghana Prisons Service

The Kumasi Central Prison is the regional command and has the regional commander on its premises. It supervises the operations of the other prisons within the region, though the other prisons are independent in themselves. The Ashanti Regional Command of the Ghana Prisons Service is made up of seven (7) prison establishments. The seven prisons include a central prison, a female prison, two local prisons, and three camp prisons.

3.2.2 Kumasi Central Prisons

Situated in the center of Kumasi, the Kumasi Central Prison serves as the regional headquarters for prisons in Ghana's Ashanti Region. It is the only central prison in the

Ashanti Region of Ghana and one of the country's seven total. The British government established it in 1901 with the goal of housing lawbreakers and promoting the efficient operation of the British government. However, due to the high number of prisoners in the province, it underwent renovations in 1925 to add more cells. Approximately 44,424 square feet make up its area, and it is situated in Adum, behind Kumasi's Wesley Methodist Cathedral. Adult male inmates at least 18 years old and have either been found guilty or on remand were initially housed here, but later the Female Prisoners were added. The Prisons Service Council and the Ministry of interior have proposed moving Kumasi Central Prison to help with the facility's expansion, James Mabery Forkuor, (2020) , improve living conditions for inmates, and address overcrowding, which is a major issue facing the facility. Although the prison was designed to house a maximum of about eight hundred (800) inmates, it currently has One-Thousand Six Hundred and sixty-five (1665) inmates, which has made it difficult to reform prisoners and the facility records high rates of recidivism. The well-known jailbreak attempt on February 4, 2015, by prisoners, is a recent event regarding the impact of substandard living conditions (Agyena, 2022). The prison offers several workshops to assist in giving prisoners skills. Additionally, there is a kitchen and an infirmary inside the building for food service and medical care, respectively (Afari, 2015).

3.3.3 Kumasi Female Prison

The Kumasi Female Prison was formerly part of the Kumasi Central Prisons, but in 1991 it gained autonomy, allowing it to manage its operations independently of the Kumasi Central Prison. It houses female offenders, both remand and convicts and is one of the seven female prisons in Ghana. It is the only female prison in the Ashanti

Region. The Kumasi Female Prison is located in Adum Kumasi, attached to the Kumasi Central Prison building. It has four cells that can hold inmates, a kitchen for food preparation, and a nurse who looks after the inmates' medical needs. It has a total inmate population of Thirty-Seven (37).

3.3.4 Manhyia Local Prisons

The Ashanti King's home, Manhyia Palace, is home to the Manhyia Local Prison in Kumasi. Initially, the Ashanti kingdom's verdict of guilt placed criminals behind bars. However, the Ghanaian government assumed control of the prison in 1954 and now operates it as one of the nation's municipal jails. It is the only local prison in Kumasi and one of three in Ghana's Ashanti Region. The prison houses convicts serving comparatively shorter sentences and has a surface area of 0.001221 km·. It houses the prisoners in six cells. The building has a kitchen and an infirmary for minor medical conditions. It also has a total of Two Hundred and Thirty-One (231) inmates (Agyapong *et al.*, 2018).

3.3.5 Obuasi Local Prisons

The colonial government constructed the Obuasi Prison in 1909 to dissuade potential thieves from stealing Anglo Gold Ashanti's minerals and other assets (Asare, 2021). As a result, the prison was placed strategically at the company's entrance. The prison occupies 0.54 acres, or 0.23 hectares, of land. The accommodating barracks are situated on 1.93 acres of land. Eight sixty-four square miles, or 5160.958, make up the prison farmland. The District Administration gave the land to the Prison Administration in 1968; before that, it had been intended for the Workers Brigade, comprising inmate population of both remand and convicts (Asare, 2021). In reality,

the station is an agricultural station that produces cereals and engages in forestry. About 18.3 acres of oil palm, 15 acres of maize, and 7 acres of teak are currently farmed and harvested by the station. The station also teaches prisoners the fundamentals of crop production best practices and rabbitry. The total inmate population here is Two Hundred and Sixty (260).

3.3.6 Amanfrom Camp Prison

In 1991, the Amanfrom Camp Prison was opened. On a leasehold basis, the land was purchased from Mr. Kwadwo Nsarfoa Opoku (Pola), the son of the previous owner of Poku Transport. Situated approximately eight (8) kilometers away from the Kumasi Barekese Road, the prison is situated in Amanfrom, close to Kumasi. The entire area of the camp is forty-five acres, of which forty acres are used for palm plantations and five acres are set aside for residential use. The first and second offenders at this station typically have minor offenses and sentences of no more than five years; they are transferred from Kumasi and Sunyani Central Prisons. The total population of inmates at this prison camp is Two Hundred and One (201).

3.3.7 Ejura Camp Prison

The Prison Service started talks with the Ejurahene in 2017 about buying farmland. After intense talks, the Ejurahene gave the Ghana Prisons Service 653 acres of land after consulting with his traditional council. The negotiations were very successful. 300 beds were added to the prison camp in Ejura, Ashanti Region, on May 11, 2021. The Chiefs and people of Ejura donated the land for free, and the Church of Pentecost Ghana funded and constructed the facility. Two dormitory blocks, an administration block, a visitor's lounge, an infirmary, a church building with offices, a kitchen, a

stores block, a workshop block with three workshops, and an inmate restroom and toilet block make up the 300-bed facility. Additionally, the facility has a football field. It has a total of One Hundred and Ninety-six (196) inmates (Vanstone & Priestley, 2022).

Table 3.1: Population and Sample Size

Prison Name	In mates	Population Distribution (%)	Sample Size +10% Error margin)	Required Sample Size
Kumasi Central Prison	1665	61.42	235	214
Kumasi Female Prison	37	1.36	5	5
Manhyia Local Prison	231	8.52	33	30
Obuasi Local Prison	260	9.59	37	33
Amanfrom Camp Prison	201	7.41	28	26
Ejura Camp Prison	196	7.23	28	25
Total	2,590	100.00	366	333

Source: Field Data (2024)

Sample Size and Sampling Technique

3.4 Sample Size

To ensure that there is adequate statistical power to identify significant relationships and changes in the number of inmates in the Ashanti Region with hypertension and diabetes, the sample size for the study was carefully selected. A 95% confidence level, a 5% margin of error, and the total population serving sentences from Kumasi Central Prison, Kumasi Female Prison, Manhyia Local Prison, Obuasi Local Prison, Ahinsan Camp Prison, Amanfrom Camp Prison, and Ejura Camp Prison were important factors that were taken into account. Since we are aware of the population of each prison centre, the sample size was determined using Taro Yamane's formula;

$n = \frac{N}{1+Ne^2}$, where;

n= sample size

N= population

e= margin of error

n= $\frac{2590}{1+2590(0.05)^2}$ = 333

Non-response percentage, 10% of 333 = 33

A total sample size of 366 participants.

To account for the study's complexity and the evaluation of multiple risk factors and mechanisms, an increase in the original sample size was deemed necessary, factoring in a non-response error of 10% (Khadka, 2019). The desired degree of confidence in the study's findings as well as variations in prevalence rates amongst prisons were taken into account. Consequently, the final sample size was determined to be 383 Inmates from the seven prisons, with 235 from Kumasi Central Prison, 5 Inmates from the Kumasi Female Prison, 33 Inmates from the Manhyia Local Prison, 37 Inmates from the Obuasi Local Prison, 17 Inmates from the Ahinsan Camp Prison, 28 Inmates from the Amanfrom Camp Prison and 28 Inmates from the Ejura Camp Prison, as shown in Table 3.1.

3.5 Sampling Technique

Inmates were chosen at random from six out of the seven prisons' databases in the Ashanti Region. The Ashanti region was selected because it is the largest region in the country. It also contains seven (7) of the country's total forty-six (46) prisons. The various prisons were stratified to ensure fair representation in each selected prison. A sampling frame was established, consisting of a comprehensive list of registered inmates serving jail terms or being on remand for more than 3 Months. Exact sample

sizes for each prison were determined using statistical power calculations to make sure that each stratum was represented and that the data were accurate. A Central prison, a Female prison, two (2) Local prisons, and three (3) Camp prisons are among the jails that were present. To analyse the female inmates, a female prison was included. Two hundred and thirty-five (235) inmates were chosen from Kumasi Central Prison, five (5) inmates from Kumasi Female Prison, thirty-seven (37) inmates from Obuasi Local Prison, thirty-three (33) inmates from Manhyia Local Prison, twenty-eight (28) inmates from Amanfrom Camp Prison, and Twenty-eight (28) inmates from Ejura Camp Prison. Ultimately, a list of three hundred and eighty-three (366) Prisoners was obtained. Before the data collection, prisoners received a detailed explanation of the research. The selection of study participants was also assisted by prison wardens. Any inmate within the inclusion criteria who availed himself or herself in the various selected prisons in the Ashanti region had the chance to participate in this study. The participants of the research were inmates aged twenty (20) and above who have been in prison for more than three months, and who were fairly well and willing to give their consent were included in the study

3.6 Data Collection Techniques

Data were collected through an administered questionnaire, and physical measurements such as blood pressure, blood glucose, weight, and height of inmates were taken. Data on participants' demographics, lifestyle risk factors, medical history, physical activity, access to healthcare, education and awareness, history of incarceration, and mental health were all collected. Both closed-ended and open-ended questions were included in the questionnaire, and prisoners were assisted in completing it by research assistants with previous training. To do this, research

participants who were prisoners had questions read to them, and they were asked to check the options that matched their answers. Age, gender, ethnicity, education level, marital status, religion, previous work history, and NHIS status are among the demographic information that were provided. Tobacco use, alcohol use, and dietary practices were all covered in the section on lifestyle risk factors. Data on medical history also included things like family history, previous diagnoses for the two conditions, current state of treatment, and health examinations. The sections on physical activity looked at their level of physical activity as well as the types, frequency, and duration of their workouts. Issues like whether healthcare is accessible and of high quality were also covered, such as medications for diabetes and hypertension, as well as information on healthcare issues and medical issues during incarceration. A section on the awareness and education of prisoners was also covered. These included information about the two conditions, participation in programme related to them, and education on how hypertension and diabetes are managed. The data regarding incarceration history encompassed the length of incarceration, health changes that have occurred since being released from prison, and the consequences of serving time. Data on mental health also included information on stress. Only inmates who were at least twenty (20) years old, had served a minimum of three months in prison, were in generally good health, and voluntarily provided informed consent were recruited into the study, whilst, critically ill inmates and those unwilling to provide consent were not included.

3.6.1 Data Collection Tools: Pretesting and Administration

A structured questionnaire was included to get the bio-data of the participants and other health information that would be helpful in the interpretation and analysis of results in this study.

3.6.2 Physical Examinations:

Procedure for collecting blood samples for blood glucose test

1. The participants' ring fingertips were disinfected with an alcohol swab. The area was allowed to air dry to prevent sample contamination and blood dilution with alcohol.
2. A new glucose meter test strip was inserted into the blood glucose metre.
3. Lancet was used to prick the side of the fingertip to get a drop of blood.
4. The edge of the test strip was used to touch the blood drop, allowing the strip to absorb the blood and the metre to begin the analysis.
5. Results were recorded indicating fasting blood sugar results.
6. The used lancet was disposed of in a biohazard sharps container.
7. A cotton or gauze was placed over the puncture site and pressure was applied to stop any bleeding. It was then covered with a bandage if necessary.

Blood Pressure Measurement Procedure

1. Inmates were allowed to rest for at least 5 minutes in a seated position before their measurements were taken.
2. The inmates sat with their backs supported, feet flat on the floor, and arms supported at heart level.

3. The cuff was wrapped around the upper left arm snugly, positioning it so the lower edge was about an inch above the elbow.
4. The start button was pressed after fitting the cuff. The monitor displayed the blood pressure reading.
5. The systolic and diastolic pressures were recorded and interpreted as
    I. Low
    II. Normal
    III. Elevated
    IV. High or hypertensive

    (AHA, 2017; WHO/ISH, 2003; CDC, 2007).

Weight Measurement Procedure

1. The scale was positioned on a firm, level surface.
2. The inmates' shoes and heavy clothing were removed. The inmates stepped onto the scale, stood still, and waited until the weight reading stabilized.
3. The results were documented with the unit in kilograms (WHO, 2008; CDC, 2007).

Height Measurement Procedure

1. The inmates stood barefooted, with heels together and back straight against the measuring device.
2. The inmate's head was positioned so that the line of sight was parallel to the floor (Frankfurt plane).
3. The horizontal arm of the stadiometre was slid down until it gently touched the top of the inmate's head, or marked the point on the tape measure.

4. The height was documented in centimeters (WHO, 2008; CDC, 2007).

Body Mass Index Procedure:

The weight and height of each participant was used to calculate the BMI.

BMI: weight (kg) divided by the square of the height squared (m^2), and the result was read in kilogram per metre-squared.

Definition of Terms

Diabetes is a metabolic disease that is chronic (long-lasting) and is characterized by elevated blood glucose or blood sugar levels FPG ≥126 mg/dL or (7.0 mmol/L), which over time leads to serious damage to the heart, blood vessels, eyes, kidneys, and nerves.

Diabetes was defined using the American Diabetes Association's criteria in the table below (American Diabetes Association, 2023; WHO, 2020)

Table 3.2: Classification of Prediabetes and Diabetes

Diagnosis	**Fasting Blood Glucose (FBG)**
Normal	70 mg/dL(3.9 mmol/L) – 99 mg/dL(5.5mmol/L)
Prediabetes	100 mg/dL(5.6 mmol/L – 125 mg/dL(6.9 mmol/L)
Diabetes	≥ 126 mg/dL (7.0 mmol/L)

FBG (Fasting Blood Glucose);

- mg/dL (milligrams per deciliter)
- Mmol/L (millimoles per litre)

The World Health Organization (WHO) defines hypertension as the chronic elevation of both systolic and diastolic blood pressure (above 140 mmHg and 90 mmHg).

Hypertension was defined using the American Heart Association's criteria in the table below (World Health Organisation, 2021; American Heart Association, 2017).

Table 3.3: The American Heart Association's hypertension criteria

Blood Pressure Category	Systolic mmHg (Upper number)	Diastolic mmHg (lower number)
Normal	< 120	< 80
Elevated	120-129	< 80
High Blood Pressure stage 1	130-139	80-89
High Blood Pressure Stage 2	140 or higher	90 or higher
Hypertensive crisis	> 180	> 120

- mmHg (millimetre of mercury)

Inclusion criteria

This research involved participants (inmates) who were at least twenty (20) years old, had served longer than three months in prison, were in generally good health, and were willing to provide informed consent.

Exclusion criteria

Critically ill inmates were not included in the study. Additionally, prisoners who declined to provide their consent were not involved in this research.

3.6.3 Data Sources

This study utilized data on the prevalence of diabetes and hypertension collected from the prison infirmaries at Kumasi Central Prison, Kumasi Female Prison, Manhyia Local Prison, Obuasi Local Prison, Amanfrom Camp Prison, and Ejura Camp Prison. Additionally, peer-reviewed research publications focusing on the prevalence of NCDs, specifically diabetes and hypertension, among prisoners in both developed and

low-middle-income countries were considered to provide a comprehensive understanding of the issue such as Global Systematic Review of NCDs in Prisons (Shabil et al., 2024).

3.7 Data Validity and Reliability

We used standardized and well-validated measurement tools, such as the Omron blood pressure device and fasting blood glucose metre (Sinocare) to ensure that the data collected reflect the true physiological values of inmates. Also, we tested the content validity of the questionnaire to assess HPT and DBT risk factors, and we had accurate variable measures. Trained personnel administered both the medical tests and questionnaire to enhance consistency. By maintaining both high validity and reliability, we are optimistic that the study's findings will be more robust and trustworthy in assessing the epidemiology of hypertension and diabetes among inmates.

3.8 Data Analysis

This chapter focuses on analyzing the data gathered from the field. It delved into discussions pertaining to the three main objectives of the study, to determine the prevalence of hypertension and diabetes among inmates in the Ashanti Region. To identify the risk factors associated with hypertension and diabetes among inmates in the Ashanti Region, and to determine the sociodemographic predictors of hypertension and diabetes among inmates in the Ashanti Region. The data underwent analysis, and the findings were presented through various methods, such as frequencies, percentages, mean scores. The analysis was extensively performed using STATA version 16.1. The data was imported from Microsoft Excel to STATA, where

descriptive and inferential analysis was carried out. Frequencies, percentages and cross-tabulations were used to describe the data. We also determine factors that are association with diabetics/hypertension status of inmates, at 5% significance level. Factors that were statistically significant, are used to make inferences using binary logistics regression. The likelihood ratio test, Hosmer-Lemeshow goodness-of-fit test, and Area Under Curve (AUC) of the Receiver Operating Curve (ROC) were used to assess the model's performance and fitness respectively.

3.9 Ethical Consideration

The Committee on Human Research Publication and Ethics (CHRPE) of the School of Medical Sciences, KNUST, Kumasi, was consulted to obtain ethical clearance for the study. Before participating in the study, each participant must sign or thumbprint a consent form in compliance with CHRPE regulations. Before any data was gathered from the various prison facilities, permission from the Ghana prison's headquarters was also requested and granted. The research team alone had secure access to all collected data.

CHAPTER FOUR

FINDINGS

4.1 Descriptive Analysis

4.1.1 Demographic Characteristics

The study comprises 366 inmates with close to 99% (98.6%) being males. Those between the ages of 20- 30 years were predominant, representing 55% (54.9%) of the study population as shown in Table 4.1. This was followed by inmates whose ages ranges from 31- 40 years (28.7%). The least age group were inmates who were above 60 years (3.55%). For ethnicity, majority (71.04%) of them were Akans, Mole-Dagbani constituted less than 15% (12.83%) of the inmates, Ewes and other ethnic group represented 6.28% and 6.56% respectively. Again, inmates who ended up at JSS/JHS and SSS/SHS were high, representing about 45% (45.08%) and close to 28% (27.83%) accordingly. Inmates with no educational background and those that had tertiary education were about 18% and 9% respectively. In addition, less than one-fourth (24.03%) of the inmate were married as compared with approximately 7 in 10 (69.67%) unmarried inmates (see Table 4.1). Besides, Table 4.1 demonstrated, that more than half (53.83%) of the inmate were unemployed and less than 5% (3.83%) of them were employed. Again, roughly 26% (25.96%) of the inmates do not have insurance whereas at least 74% of them were insured. The median body mass index of inmates 23.53kg/m² with an interquartile range of 3.78. Table 4.1 reveal that the prevalence of diabetes among inmates was approximately 11% (10.66%) and that of hypertension as presented in Table 4.5, was 43.99%.

4.2 Demographic Characteristics and Prevalence of Diabetes

As displayed in Table 4.2, out of 10.66% diabetic inmates, 100% were males, an indication of gender disparity or low female representation in the study. But there was no sufficient evidence to conclude that diabetes is associated with gender ($p>0.05$). Comparatively, diabetes was predominant in inmates between 20—40 years (87.18%) than those who were above 40 years (12.81%). However, the probability value ($p = 0.128$) showed that there is no statistically significant association between age and diabetes. Additionally, more than 70% (71.79%) of diabetic inmates had NHIS compared with those who had no insurance. Perhaps, the differences indicated no statistically significant association between NHIS and diabetic ($p = 0.735$). Among the diabetic, majority had JSS/JHS education (46.15%) and were of Akan ethnicity (79.49%). Meanwhile, education ($p = 0.208$) and ethnicity ($p = 0.612$) reveal no significant association with diabetes as shown in Table 4.2.

Table 4.2: Distribution of diabetic status among demographic characteristics

	Total	Diabetic	Non-diabetic	P-value
Total	**366(100)**	**39(10.66)**	**327(89.34)**	
Gender				
Female	5(1.37)	0(0.00)	5(1.53)	1.000
Male	361(98.63)	39(100)	322(98.47)	
Age group				
20-30	201(54.92)	18(46.15)	183(55.96)	
31-40	105(28.69)	16(41.03)	89(27.22)	
41-50	29(7.92)	1(2.56)	28(8.56)	0.128
51-60	18(4.92)	1(2.56)	17(5.20)	
Above 60	13(3.55)	3(7.69)	10(3.06)	
Ethnicity				
Akan	260(71.04)	31(79.49)	229(70.03)	
Mole-Dagbani	47(12.84)	3(7.69)	44(13.46)	
Ga-Dangme	12(3.28)	2(5.13)	10(3.06)	0.612
Ewe	23(6.28)	1(2.56)	22(6.73)	
Others	24(6.56)	2(5.13)	22(6.73)	
Educational level				
No education	66(18.03)	6(15.38)	60(18.35)	
JSS/JHS	165(45.08)	18(46.15)	147(44.95)	0.208
SSS/SHS	102(27.87)	8(20.51)	94(28.75)	
Tertiary	33(9.02)	7(17.95)	26(7.95)	
Religion				
Christian	291(79.51)	31(79.49)	260(79.51)	
Muslim	74(20.22)	8(20.51)	66(20.18)	1.000
Traditionalist	1(0.27)	0(0.00)	1(0.31)	
Marital Status				
Not married	255(69.67)	26(66.67)	229(70.03)	
Married	88(24.04)	11(28.21)	77(23.55)	0.865
Divorced	19(5.19)	2(5.13)	17(5.20)	
Widowed	4(1.09)	0(0.00)	4(1.22)	
Employment status				
Employed	14(3.83)	2(5.13)	12(3.67)	
Self-employed	155(42.35)	16(41.03)	139(42.51)	0.822
Unemployed	197(53.83)	21(53.85)	176(53.82)	
NHIS Status				
No	95(25.96)	11(28.21)	84(25.69)	0.735
Yes	271(74.04)	28(71.79)	243(74.31)	

Note: Figures in parenthesis are percentages; Others ethnic includes Gruma and Guan

4.3 Diabetes and Lifestyle Risk Factors and Medical History

In Table 4.2, we examine the distribution of diabetes across lifestyle risk factors and medical history. Diabetes was not significantly associated with current smokers of any tobacco product (p = 0.440), with less than 6% of those who currently smoke being diabetic. Additionally, a significantly higher proportion of diabetics had a history of smoking, indicating an association between past tobacco use and diabetes among inmates (p = 0.028). Diabetes prevalence was high in those who had ever smoke (60.53%) in the past than those who had never smoke (39.47%). Although, the proportion of diabetics was high in those who had ever consumed alcohol (53.85%) and low those who reported alcohol use in the past 30 days, there is weak statistical evidence to support these associations. The differences in alcohol consumption history (p = 0.785) and use of alcohol in the past 30 days (p = 0.712) were not statistically significant, revealing that alcohol intake may not be a key contributing factor to diabetes among inmates. Similarly, there is no statistically significant association between family history of hypertension or diabetes and the presence of diabetic among inmates (p = 0.890). Among the 39 diabetics, 25.64% reported family history while 51.28% indicates no family history and 23.08% were not certain. Of the 10.66% of diabetics, less than 11% (10.26%) had ever been diagnose with diabetes and about 89% had never been diagnosed with diabetes. The differences show no statistical association between diagnostic status and the presence of diabetes (p =0.576). Meanwhile, approximately 10% of those with diabetes are receiving treatment as shown in Table 4.2.

Table 4.3: Distribution of diabetic status across lifestyle risk factors and medical history

	Total	Diabetic	Non-diabetic	P-value
Lifestyle Risk Factors				
Do you currently smoke any tobacco products, cigarettes, cigars, pipes (past 30 days)?				
No	347(94.81)	36(92.31)	311(95.11)	0.440
Yes	19(5.19)	3(7.69)	16(4.89)	
In the past, did you ever smoke any tobacco products?				
No	203(56.23)	15(39.47)	188(58.2)	0.028
Yes	158(43.77)	23(60.53)	135(41.8)	
Have you ever consumed alcohol such as, beer, wine, spirits or gin?				
No	176(48.22)	18(46.15)	158(48.47)	0.785
Yes	189(51.78)	21(53.85)	168(51.53)	
Have you consumed any alcohol within the past 30 days?				
No	363(99.18)	39(100)	324(99.08)	0.712
Yes	3(0.82)	0(0.00)	3(0.92)	
Do you eat other foods apart from the ones served in the prison?				
No	74(20.22)	9(23.08)	65(19.88)	0.638
Yes	292(79.78)	30(76.92)	262(80.12)	
Medical History				
Has anyone in your immediate family (your parents, brothers, sisters, or children) ever been diagnosed with hypertension or diabetes?				
No	189(51.64)	20(51.28)	169(51.68)	
Yes	84(22.95)	10(25.64)	74(22.63)	0.890
Don't know	93(25.41)	9(23.08)	84(25.69)	
Have you ever been diagnosed with diabetes?				
No	318(86.89)	35(89.74)	283(86.54)	0.576
Yes	48(13.11)	4(10.26)	44(13.46)	
Are you currently receiving treatment for diabetes?				
No	331(90.44)	35(89.74)	296(90.52)	0.778
Yes	35(9.56)	4(10.26)	31(9.48)	

Note: Figures in parenthesis are percentages

4.4 Diabetes and Physical Activity, Awareness and Education, and AHQC

The distribution of diabetes across inmates' physical activity, awareness and education, access to healthcare and quality care was examined in Table 4.3. It appears that, there is no statistically significant association between physical activities and the presence of diabetes. Though, 33.33% of inmates occasionally engage in exercise

reported diabetes, while below 11% together who reported diabetes involved in exercise either on daily basis, weekly or monthly. The variation in this group shows no statistical evidence ($p = 0.091$). Again, inmates who had never taken part in manual labour compared with who had ever engaged in manual labour, reported the highest percentage (about 73%) of diabetes ($p = 0.123$). More than 84% of inmates who had undergone screening for the past 6 months reported diabetes against 15.38% unscreened inmates. Notably, over 92% of diabetic inmates reported never having been prescribed medication for diabetes, whereas fewer than 8% had ever received such prescriptions. Meanwhile, there is no statistically significant association screening or prescription of medication and diabetes status ($p > 0.05$). Besides, Table 4.3 revealed that, there is no statistically significance difference between awareness and education and the diabetes status among inmates ($p > 0.05$). In the diabetics group, 5.13% of inmates were aware and received education on diabetes, and 94.87% did not received any information. But this finding is critical, thereby, prompting public health specialist and other key stakeholders about the importance of sensitization of diabetes in prison yards.

Table 4.4: Distribution of diabetic status across physical activity, awareness and education, and AHQC

	Total	Diabetic	Non-diabetic	P-value
Physical activity				
How frequently do you engage in exercises?				
Daily	25(6.83)	1(2.56)	24(7.34)	
Weekly	26(7.1)	1(2.56)	25(7.65)	
Monthly	6(1.64)	2(5.13)	4(1.22)	0.091
Occasionally	153(41.8)	13(33.33)	140(42.81)	
Not at all	156(42.62)	22(56.41)	134(40.98)	
Are you engaged in manual labour?				
No	263(71.86)	24(61.54)	239(73.09)	0.129
Yes	103(28.14)	15(38.46)	88(26.91)	
Access to Healthcare and Quality of Care				
Have you been screened in the past 6 Months?				
No	72(19.67)	6(15.38)	66(20.18)	0.476
Yes	294(80.33)	33(84.62)	261(79.82)	
Have you been prescribed with medication for diabetes?				
No	336(92.05)	36(92.31)	300(92.02)	1.000
Yes	29(7.95)	3(7.69)	26(7.98)	
Awareness and Education				
Have you received any education on managing diabetes while in prison?				
No	348(95.08)	37(94.87)	311(95.11)	1.000
Yes	18(4.92)	2(5.13)	16(4.89)	
How often do you receive information on hypertension and diabetes?				
More often	1(0.27)	0(0.00)	1(0.31)	
Sometimes	18(4.92)	2(5.13)	16(4.89)	1.000
Not at all	347(94.81)	37(94.87)	310(94.8)	

Note: AHQC refers to Access to Healthcare and Quality of Care; Figures in parenthesis are percentages

4.5 Diabetes and Incarceration, Mental Health and Anthropometric

We examined the distribution of diabetics across duration of imprisonment, mental health assessment, and as well as body mass index in Table 4.4. We found no statistically significance evidence of the difference between the length of incarceration and diabetics ($p > 0.745$). Among diabetics, majority (35.9%) were incarcerated less than one-year, followed by 33.33% of those in prison custody

between 1—2 years, roughly 18% were imprisoned between 3—5 years and close to 13% were those incarcerated for over 5 years. Additionally, more than 79% (79.49%) of the inmates noticed changes in their health. Besides, two—third (66.67%) of inmates find it difficult in coping with daily challenges, with 30.77% reported no difficulty in sleeping. Meanwhile, more than 80% (84.62%) of diabetic's inmates meditate compare with those who exercise, talking to someone or prefer substance abuse. This shows statistically significant evidence between coping with stress and diabetes status ($p = 0.018$). Also, we found no statistical evidence in the association between BMI and diabetes status ($p > 0.05$). Within diabetes, 74.36% of inmates had normal BMI, 23.08% were overweight, and only 2.56% being underweight. This finding offset the traditional assumption that diabetes is predominant among overweight and obese population. It is also possible that this could be attributed to low representation of obese or overweight group in this study.

Table 4.5: Distribution of diabetic status across incarceration history, mental health assessment and anthropometric measure

	Total	Diabetic	Non-diabetic	P-Value
Incarceration History				
How long have you been incarcerated?				
Less than 1 year	110(30.05)	14(35.9)	96(29.36)	0.745
1-2 years	151(41.26)	13(33.33)	138(42.2)	
3-5 years	60(16.39)	7(17.95)	53(16.21)	
More than 5 years	45(12.3)	5(12.82)	40(12.23)	
Have you noticed any changes in your health since being in prison?				
No	54(14.75)	8(20.51)	46(14.07)	0.283
Yes	312(85.25)	31(79.49)	281(85.93)	
Mental Health Assessment				
Do you have difficulty coping with daily challenges				
No	126(34.43)	13(33.33)	113(34.56)	0.879
Yes	240(65.57)	26(66.67)	214(65.44)	
Do you have difficulty in sleeping?				
No	97(26.5)	12(30.77)	85(25.99)	0.523
Yes	269(73.5)	27(69.23)	242(74.01)	
How do you cope with stress?				
Exercise	1(0.28)	1(2.56)	0(0.00)	0.018
Meditation	256(70.52)	33(84.62)	223(68.83)	
Talking to someone	32(8.82)	3(7.69)	29(8.95)	
Substance abuse(alcohol)	5(1.38)	0(0.00)	5(1.54)	
Others	69(19.01)	2(5.13)	67(20.68)	
Anthropometric measurement				
BMI (median = 23.525; iqr=3.78)				
Underweight	8(2.19)	1(s2.56)	7(2.14)	0.594
Normal	246(67.21)	29(74.36)	217(66.36)	
Overweight	110(30.05)	9(23.08)	101(30.89)	
Obese	2(0.55)	0(0.00)	2(0.61)	

Note: Figures in parenthesis are percentages

4.6 Hypertension and Demographic Characteristics

Table 4.5 present the distribution of hypertension across demographic characteristics. Out of 44% hypertension, close to 99% (98.76%) are males and the remaining 1.24% are females. But there was no sufficient evidence to say that hypertension is associated with gender ($p>0.05$). Relatively, hypertension was more prevalent among

inmates aged 20—40 years (75.78%) compared to those between 41 years and above (24.22%). The evidence to this was statistically strong indicating that age is associated with hypertension ($p < 0.05$). Additionally, more than 80% (84.46%) of hypertension inmates were Christian compared to 15.43% Muslim inmates. But the differences showed no statistically significant association between religion and hypertension ($p = 0.057$). Among the 161 hypertensive cases, majority (48.45%) were self-employed, 47.83% unemployed, and 27.95% are married. Meanwhile, Table 4.5 revealed that, there is no statistically significant association between hypertension and employment or marital status ($p > 0.05$).

Table 4.6: Distribution of hypertensive status among demographic characteristics

	Total	Hypertensive	Non-hypertensive	P-value
Total	**366(100)**	**161(43.99)**	**205(56.01)**	
Gender				
Female	5(1.37)	2(1.24)	3(1.46)	1.000
Male	361(98.63)	159(98.76)	202(98.54)	
Age group				
20-30	201(54.92)	70(43.48)	131(63.9)	
31-40	105(28.69)	52(32.30)	53(25.85)	
41-50	29(7.92)	18(11.18)	11(5.37)	0.001
51-60	18(4.92)	12(7.45)	6(2.93)	
Above 60	13(3.55)	9(5.59)	4(1.95)	
Ethnicity				
Akan	260(71.04)	122(75.78)	138(67.32)	
Mole-Dagbani	47(12.84)	17(10.56)	30(14.63)	
Ga-Dangme	12(3.28)	6(3.73)	6(2.93)	0.358
Ewe	23(6.28)	7(4.35)	16(7.8)	
Others	24(6.56)	9(5.59)	15(7.32)	
Educational level				
No education	66(18.03)	27(16.77)	39(19.02)	
JSS/JHS	165(45.08)	72(44.72)	93(45.37)	0.900
SSS/SHS	102(27.87)	46(28.57)	56(27.32)	
Tertiary	33(9.02)	16(9.94)	17(8.29)	
Religion				
Christian	291(79.51)	136(84.47)	155(75.61)	
Muslim	74(20.22)	25(15.53)	49(23.90)	0.057
Traditionalist	1(0.27)	0(0.00)	1(0.49)	
Marital Status				
Not married	255(69.67)	103(63.98)	152(74.15)	
Married	88(24.04)	45(27.95)	43(20.98)	0.181
Divorced	19(5.19)	11(6.83)	8(3.90)	
Widowed	4(1.09)	2(1.24)	2(0.98)	
Employment Status				
Employed	14(3.83)	6(3.73)	8(3.9)	
Self-employed	155(42.35)	78(48.45)	77(37.56)	0.108
Unemployed	197(53.83)	77(47.83)	120(58.54)	
NHIS Status				
No	95(25.96)	41(25.47)	54(26.34)	0.850
Yes	271(74.04)	120(74.53)	151(73.66)	

Note: Figures in parenthesis are percentages

4.7 Hypertension, Lifestyle Risk Factors and Medical History

In Table 4.6 of this section, hypertension was distributed across lifestyle risk factors and medical history. We found no significant association between hypertension and current smokers of any tobacco product ($p = 0.519$), with less than 5% (4.35%) of those who currently smoke being hypertensive. More than 60% (62.26%) of the proportion of hypertensives had no history of smoking compared to 37.74% past smokers. The finding indicates a significant difference in the association between past tobacco use and hypertension among inmates ($p = 0.040$). Additionally, hypertension prevalence was significantly high in those who have not been diagnosed with the condition (82.61%) than those who had ever being diagnosed with hypertension. It indicated that diagnostic status is significantly associated with hypertension ($p = 0.032$). At least 50% of hypertension present in those who had never consumed alcohol compared to 49.07% of those who reported ever taking alcohol, but this was statistically significant ($p > 0.05$). The differences in the use of alcohol in the past 30 days ($p = 0.585$) was not statistically associated with hypertension, revealing that alcohol intake may not be a major contributing factor to hypertension among inmates. Similarly, there is no statistically significant association between family history of hypertension and the presence of hypertension among inmates ($p = 0.137$). Among the 44% hypertensive cases, 18.63% reported family history while 52.17% indicates no family history and 29.19% were not sure. Of the hypertensive cases, close to 11% (10.56%) were currently receiving treatment for hypertension and about 89% received no treatment. But the differences show no statistical association between current treatment and the presence of hypertension ($p > 0.05$) as shown in Table 4.6.

Table 4.7: Distribution of hypertensive status across lifestyle risk factors and medical history

	Total	Hypertensive	Non-hypertensive	P-value
Lifestyle Risk Factors				
Do you currently smoke any tobacco products, cigarettes, cigars, pipes (past 30 days)?				
No	347(94.81)	154(95.65)	193(94.15)	0.519
Yes	19(5.19)	7(4.35)	12(5.85)	
In the past, did you ever smoke any tobacco products?				
No	203(56.23)	99(62.26)	104(51.49)	0.040
Yes	158(43.77)	60(37.74)	98(48.51)	
Have you ever consumed alcohol such as, beer, wine, spirits or gin?				
No	176(48.22)	82(50.93)	94(46.08)	0.357
Yes	189(51.78)	79(49.07)	110(53.92)	
Have you consumed any alcohol within the past 30 days?				
No	363(99.18)	159(98.76)	204(99.51)	0.585
Yes	3(0.82)	2(1.24)	1(0.49)	
Do you eat other foods apart from the ones served in the prison?				
No	363(99.18)	159(98.76)	204(99.51)	0.427
Yes	3(0.82)	2(1.24)	1(0.49)	
Medical History				
Has anyone in your immediate family (your parents, brothers, sisters, or children) ever been diagnosed with hypertension or diabetes?				
No	189(51.64)	84(52.17)	105(51.22)	0.137
Yes	84(22.95)	30(18.63)	54(26.34)	
Don't know	93(25.41)	47(29.19)	46(22.44)	
Have you ever been diagnosed with hypertension?				
No	318(86.89)	133(82.61)	185(90.24)	0.032
Yes	48(13.11)	28(17.39)	20(9.76)	
Are you currently receiving treatment for hypertension?				
No	331(90.44)	144(89.44)	187(91.22)	0.566
Yes	35(9.56)	17(10.56)	18(8.78)	

Note: Figures in parenthesis are percentages

4.8 Hypertension, Physical Activity, Awareness and Education, and AHQC

In this section, we examine the distribution of hypertension across inmates' physical activity, awareness and education, access to healthcare and quality care as shown in Table 4.7. We observed no statistically significant association between physical

activities and the presence of hypertension among inmates. Although 40.39% of inmates are occasionally engaged in exercise reported hypertension, 40.99% of them who presented hypertension does not exercise, with approximately 19% together who reported hypertension were exercising either daily, weekly or monthly. But the differences show no statistical association between exercise and being hypertensive ($p = 0.324$). More than 78% of inmates who had undergone screening for the past 6 months reported being hypertensive against 21.33% unscreened inmates. Comparatively, close to 92% hypertension cases were those who had never prescribed medication for hypertension compared to those who received prescription for the condition. Meanwhile, there is no statistically significant association screening or prescription of medication and hypertension status ($p > 0.05$). Also, Table 4.7 provided that, there is a statistically significance difference between awareness and education and the presence of hypertension among inmates ($p < 0.05$). In the hypertensive group, 8.7% of inmates were aware and received education on managing hypertension while in prison, and 91.93% did not received any information at all. This is critical, thereby, encouraging public health workers and other key stakeholders to increase sensitization programs of hypertension at prison facilities.

Table 4.8: Distribution of hypertension status across physical activity, awareness and education, and AHQC

	Total	Hypertensive	Non-hypertensive	P-value
Physical activity				
How frequently do you engage in exercises?				
Daily	25(6.83)	16(9.94)	9(4.39)	0.324
Weekly	26(7.1)	12(7.45)	14(6.83)	
Monthly	6(1.64)	2(1.24)	4(1.95)	
Occasionally	153(41.8)	65(40.37)	88(42.93)	
Not at all	156(42.62)	66(40.99)	90(43.9)	
Are you engaged in manual labour?				
No	263(71.86)	119(73.91)	144(70.24)	0.438
Yes	103(28.14)	42(26.09)	61(29.76)	
Access to Healthcare and Quality of Care				
Have you been screened in the past 6 Months?				
No	72(19.67)	34(21.12)	38(18.54)	0.537
Yes	294(80.33)	127(78.88)	167(81.46)	
Have you been prescribed with medication for hypertension or diabetes?				
No	336(92.05)	147(91.88)	189(92.2)	0.911
Yes	29(7.95)	13(8.13)	16(7.8)	
Awareness and Education				
Have you received any education on managing hypertension or diabetes while in prison?				
No	348(95.08)	147(91.3)	201(98.05)	0.003
Yes	18(4.92)	14(8.7)	4(1.95)	
How often do you receive information on hypertension?				
More often	1(0.27)	1(0.62)	0(0)	
Sometimes	18(4.92)	12(7.45)	6(2.93)	0.038
Not at all	347(94.81)	148(91.93)	199(97.07)	

Note: AHQC refers to Access to Healthcare and Quality of Care; Figures in parenthesis are percentages

4.9 Hypertension, Incarceration Duration, Mental Health and Anthropometric

In this section, we studied the distribution of hypertension across duration of incarceration, mental health assessment, and body mass index as presented in Table 4.8. It was observed that, the difference between the length of incarceration and

hypertension was statistically significance (p = 0.005). Out of the 161 hypertension cases, 41.61% were incarcerated between the periods of 1—2 years, followed by 21.74% of those in prison custody less than one—year, approximately 21% were imprisoned between 3—5 years and 16.15% are those incarcerated for over 5 years. Moreover, close to 88% (87.58%) of the inmates noticed changes in their health compared to 12.48% who in prison did not notice any change, but this is not statistically significant. Again, more than 6 in 10 (61.49%) inmates' encountered difficulties in coping with daily challenges, with less than 30% (28.57%) reported no difficulty in sleeping. Approximately, 72% (71.88%) of hypertensive inmates meditate compare with those who talk to someone (10%), prefer substance abuse (0.63%) or others (17.5%). But there is no statistically significant evidence of the differences between coping with stress and hypertension status (p > 0.05). Additionally, we found no statistical evidence in the association between BMI and hypertension status (p > 0.05). Within hypertensive cases, about 65% (65.22%) of the inmates had normal BMI, 32.92% were overweight, and 1.24% being underweight, and 0.62% are obese. This finding outweighs the norm that hypertension is more common among overweight and obese population.

Table 4.9: Distribution of hypertensive status across incarceration history, mental health assessment and anthropometric measure

	Total	Hypertensive	Non-hypertensive	P-value
Incarceration History				
How long have you been incarcerated?				
Less than	110(30.05)	35(21.74)	75(36.59)	0.005
1-2	151(41.26)	67(41.61)	84(40.98)	
3-5	60(16.39)	33(20.50)	27(13.17)	
More than 5	45(12.30)	26(16.15)	19(9.27)	
Have you noticed any changes in your health since being in prison?				
No	54(14.75)	20(12.42)	34(16.59)	0.265
Yes	312(85.25)	141(87.58)	171(83.41)	
Mental Health Assessment				
Do you have difficulty coping with daily challenges				
No	126(34.43)	62(38.51)	64(31.22)	0.145
Yes	240(65.57)	99(61.49)	141(68.78)	
Do you have difficulty in sleeping?				
No	97(26.50)	46(28.57)	51(24.88)	0.427
Yes	269(73.50)	115(71.43)	154(75.12)	
How do you cope with stress?				
Exercise	1(0.28)	0(0.00)	1(0.49)	0.647
Meditation	256(70.52)	115(71.88)	141(69.46)	
Talking to someone	32(8.82)	16(10.00)	16(7.88)	
Substance abuse (alcohol, drug)	5(1.38)	1(0.63)	4(1.97)	
Others	69(19.01)	28(17.5)	41(20.2)	
Anthropometric measurement				
BMI (median = 23.525; iqr=3.78)				
Underweight	8(2.19)	2(1.24)	6(2.93)	0.573
Normal	246(67.21)	105(65.22)	141(68.78)	
Overweight	110(30.05)	53(32.92)	57(27.80)	
Obese	2(0.55)	1(0.62)	1(0.49)	

4.9.1 Factors Associated With Diabetes of Inmates

In this section, logistic regression analysis was performed to determine the factors associated with diabetes and the likelihood of having diabetes among inmates' population. From Table 4.9, the odds of being diabetic among inmates who had ever smoked tobacco is more than two-fold compared to those who had never smoked

(AOR = 2.207, 95% CI: 1.095–4.449), after controlling for coping with stress. This indicates a statistically significant association between past smoking and increased likelihood of diabetes among the inmate population. Concerning coping strategies for stress, inmates who reported using "other" strategies had significantly lower odds of being diabetic compared to those who practiced meditation (AOR = 0.188, 95% CI: 0.044–0.811), after accounting for other factors. In contrast, after adjusting for past smokers, coping by talking to someone showed a reduced odds of diabetes (AOR = 0.732, 95% CI: 0.209–2.566), but this finding was not statistically significant. The model diagnostic reinforced the adequacy of the estimated model. The Likelihood Ratio Test was significant (p = 0.001), suggesting that the full model significantly improved prediction compared to a null model. Additionally, the Hosmer–Lemeshow goodness-of-fit test was not significant (p = 0.465), indicating that the model fits the data well.

Table 4.9.1: Multivariate Analysis of factors associated with diabetic of inmate

	Crude OR	**95% Conf Interval**		**Adjusted OR**	**95% Conf. Interval**	
Lifestyle Risk Factors						
In the past, did you ever smoke any tobacco products?						
No (Reference =1)						
Yes	2.135	1.074	4.245	2.207	1.095	4.449
Mental Health Assessment						
How do you cope with stress?						
Mediation (Reference = 1)						
Exercise	1	n/a	n/a	1	n/a	n/a
Talking to someone	0.699	0.202	2.424	0.732	0.209	2.566
Substance abuse (alcohol, drug)	1	n/a	n/a	1	n/a	n/a
Others	0.202	0.047	0.863	0.188	0.044	0.811
Model Assessment				P-value		
Likelihood Ratio				0.001		
Hosmer-Lemeshow				0.465		

Note: OR—Odds Ratio; Exercise and Substance abuse have fewer observations that makes their confidence interval undeterminable

4.9.2 Model Performance of Inmate Diabetic Status

This was assessed using Receiver Operating Curve (ROC) plot. The Area Under Curve showed in figure 1, is approximately 0.67. This indicate that the model has a moderate discriminating ability. However, close to 67% of inmates with diabetes were correctly classified by the model.

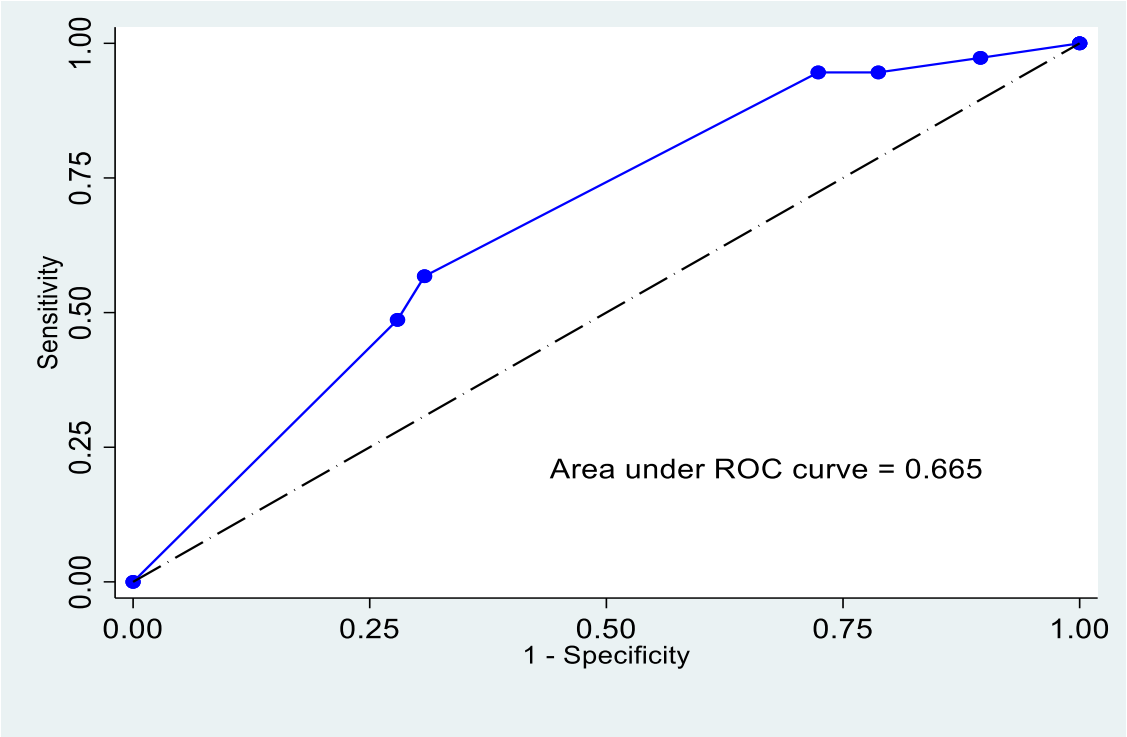

Figure 4.1: Model performance of diabetic status

4.9.3 Factors Associated With Hypertension of Inmates

Similarly, we performed logistic regression analysis to determine the factors that are associated with hypertension and the risk of being hypertensive among inmates' population. From Table 4.10, there is an increasing risk of hypertension across age groups. The odds of being hypertensive among inmates between 31—40 years is 86% higher compared to those who are 20—30 years old (AOR = 1.858, 95% CI: 1.125–3.069), after controlling for others factors. Inmates aged 41—50 years had

significantly higher odds of being hypertensive compared with those between 20—30 years old (AOR = 2.937, 95% CI: 1.250–6.901), indicating they were nearly three times more likely to be hypertensive after adjusting for potential confounders. Additionally, compared with 20—30 years, the odds of being hypertensive among inmates aged 51—60 years is 3.33 times (AOR = 3.328, 95% CI: 1.134–9.767). With regards to past smokers, inmates who had ever smoked had lower odds of being hypertensive compared to those who had never smoke in the past (AOR = 0.667, 95% CI: 0.427–1.041), after for controlling other factors, but this finding was not statistically significant. Moreover, the odds of being hypertensive among those incarcerated for 1—2 years is about 75% significantly higher than those imprisoned less than a year (AOR = 1.748, 95% CI: 1.022–2.990). After controlling for other variables, the inmates who were in prison custody between 3—5 years are 2.44 times likely of being hypertensive compare to those incarcerated for less a year (AOR = 2.435, 95% CI: 1.233–4.808). The Likelihood Ratio Test was significant (p = 0.001), suggesting that the full model significantly improved prediction compared to a null model. This reinforced the accuracy of the estimated model. In support, the Hosmer–Lemeshow goodness-of-fit test reveals a probability value of 0.069, indicating that the model fits the data well.

Table 4.9.3: Factors of associated with inmate hypertension

	Crude OR	95% Conf. Interval		Adjusted OR	95% Conf. Interval	
Age-group						
20-30 (reference = 1)						
31-40	1.836	1.136	2.968	1.858	1.125	3.069
41-50	3.062	1.370	6.844	2.937	1.250	6.901
51-60	3.743	1.347	10.401	3.328	1.134	9.767
Above 60	4.211	1.252	14.163	2.963	0.848	10.356
Lifestyle Risk Factors						
In the past, did you ever smoke any tobacco products?						
No (reference =1)						
Yes	0.643	0.421	0.982	0.667	0.427	1.041
Mental History						
Have you ever been diagnosed with hypertension or diabetes?						
No (reference =1)						
Yes	1.947	1.052	3.604	1.427	0.733	2.775
Incarceration History						
How long have you been incarcerated?						
Less than 1 (reference = 1)						
1-2	1.709	1.022	2.857	1.748	1.022	2.990
3-5	2.619	1.370	5.006	2.435	1.233	4.808
More than 5	2.932	1.435	5.993	2.268	1.071	4.801
Model Assessment				P-value		
Likelihood Ratio				0.001		
Hosmer-Lemeshow				0.069		

Note: OR—Odds Ratio

4.9.4 Model Performance of Inmate Hypertension Status

We evaluate the performance of inmate hypertension using ROC plot. The Area Under Curve showed in figure 2 is 0.673. This revealed that the model has a moderate discriminating ability. The model showed that about 67% inmate with hypertension were correctly classified.

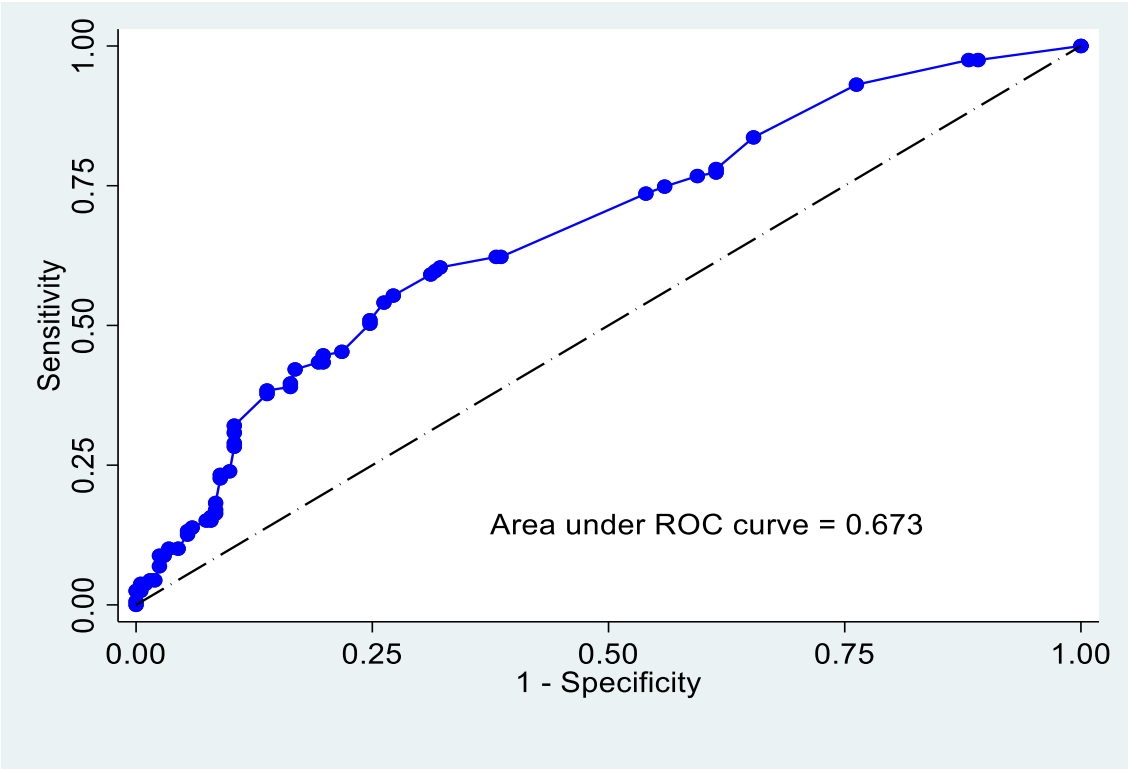

Figure 4.2: Model performance of hypertension status

CHAPTER FIVE

DISCUSSION OF RESULTS

5.1 Demographic Characteristics and Diabetic

As indicated in Table 4.1, 10.66% of the total prisoners had diabetes, and all of these diabetic cases were among males, indicating gender inequality. This is in agreement with a study by Dessie *et al.,* (2022), who in Ethiopian prisons found that male prisoners had more risk factors for non-communicable diseases (NCDs) such as diabetes due to lifestyles such as smoking tobacco, having a sedentary life, and stress. The Fisher's exact test showed no significant association between gender and diabetic status, with a p-value greater than 0.05. The lack of statistical association may be due to the underrepresentation of women (1.37%), consistent with prison gender populations of Ghana and Sub-Saharan Africa where male rates of imprisonment far exceed female rates (World Prison Brief, 2023).

Notably, diabetes was more prevalent among prisoners aged 20–40 years (87.18%), a departure from the usual situation where diabetes would be more prevalent in older age groups. This concurs with Agyemang *et al.,* (2023), who had reported increasing prevalence of type 2 diabetes among young adults in urban Ghana due to changes in dietary habits, reduced physical activity, and increasing psychosocial stress. Although diabetes appeared more common among younger inmates aged 20–40 years (87.18%), statistical testing revealed no significant association between age group and diabetic status ($p = 0.128$). This indicates that the observed distribution may be due to chance rather than a true age-related pattern within this prison population. The lack of statistical significance could be partly attributed to sample characteristics such as the

relatively small number of older prisoners, which reduces the statistical power to detect differences. Moreover, the apparent clustering of diabetes among younger inmates may reflect the influence of unmeasured confounding factors, including lifestyle behaviours prior to incarceration such as, dietary changes, alcohol use, smoking, psychosocial stressors, or prison-related conditions that disproportionately affect younger prisoners. These factors may obscure the usual trend observed in the general population, where diabetes prevalence typically increases with advancing age. Therefore, while the descriptive data suggest an unusual age pattern, the inferential analysis does not confirm a reliable association between age and diabetes in this setting.

With respect to NHIS enrollment, 71.79% of diabetic prisoners were enrolled under Ghana's National Health Insurance Scheme. Though this would seem to suggest some availability of treatment, neither NHIS nor its correlation with diabetes was statistically significant ($p = 0.735$). This is in agreement with Boateng and Adams (2022), who elucidated that although enrollment in NHIS in Ghana is pronounced among vulnerable populations, its effectiveness in eliminating diabetes complications is undermined by stockouts of medicines, poor continuity of care, and lack of follow-up services by specialists.

With respect to educational attainment, the largest proportion of diabetic prisoners were those with Junior Secondary School (JSS/JHS) education (46.15%). This descriptive pattern appears to reflect national-level observations, where individuals with lower educational status are disproportionately affected by chronic diseases due to limited health literacy and associated risk behaviours (GSS, 2022). However,

inferential analysis revealed no statistically significant association between education and diabetic status ($p = 0.208$). This lack of significance suggests that, within the prison environment, diabetes prevalence may not be strongly determined by formal educational attainment alone. Instead, other contextual and behavioural factors, such as dietary practices, stress, restricted access to healthcare, and prison-related living conditions, may override the protective effects typically conferred by higher educational status. Importantly, the finding highlights that diabetes risk is not confined to prisoners with lower education but cuts across all educational levels, underscoring the need for comprehensive health promotion and preventive interventions that are inclusive of all categories of inmates, regardless of their educational background.

Moreover, diabetes was more prevalent in the Akan ethnic group (79.49%), a fact that reflects their overwhelming presence in the sample (71.04%). The ethnic disparity is statistically not significant ($p = 0.612$). More recent studies, e.g., Owiredu *et al.,* (2023), challenge that although there are some ethnic variations of diabetes prevalence in Ghana, they tend to be influenced by environmental and socioeconomic factors and not by pure genetic factors.

From a public health perspective, the fact that diabetes occurs at a higher rate in younger prisoners is of extreme concern. Youth-onset type 2 diabetes in Ghana is associated with rapid progression of complications and increased healthcare costs, Asare *et al.,* (2024) state. Early intervention, particularly in institutionalized populations, would reduce future healthcare burden.

5.2 Diabetes and Lifestyle Risk Factors and Medical History

As illustrated in Table 4.2, the study examined the distribution of diabetes across lifestyle risk factors and medical history among inmates. Findings show that diabetes was not significantly associated with current smoking ($p = 0.440$), as only 7.69% of current smokers were diabetic. However, a statistically significant association was found between past tobacco use and diabetes ($p = 0.028$). A higher prevalence of diabetes (60.53%) was recorded among those who had previously smoked, compared to 39.47% among non-smokers. This pattern highlights the importance of smoking history in understanding diabetes risk among prison populations.

These findings are supported by Yin et al. (2023), who observed that former smokers had a 25% higher risk of type 2 diabetes compared to never-smokers, particularly when smoking cessation did not accompany improvements in other lifestyle factors. Additionally, a recent longitudinal study by Feng *et al.*, (2022) showed that while current smoking may not always reveal a strong direct correlation, the cumulative exposure to tobacco smoke significantly increases diabetes risk over time.

Though more than half (53.85%) of diabetic inmates had a history of alcohol consumption, and none had consumed alcohol in the past 30 days, no statistically significant association was found between alcohol use (either lifetime or recent) and diabetes ($p = 0.785$ and $p = 0.712$, respectively). This implies that alcohol intake may not be a prominent predictor of diabetes among inmates in this context. Similarly, recent evidence from Rodriguez *et al.*, (2023) found no strong link between moderate alcohol consumption and diabetes onset, especially when other risk factors such as diet and physical inactivity were controlled for.

Regarding dietary practices, about 23.08% of diabetics reported not consuming food other than those served in prison. However, there was no statistically significant association (p = 0.638). This is consistent with findings by Chakrabarti *et al.,* (2022), who emphasized that nutritional monotony in institutional settings contributes indirectly to chronic diseases, but the relationship may not always show immediate statistical associations without longitudinal tracking.

In terms of medical history, 25.64% of diabetic inmates reported a family history of hypertension or diabetes, compared to 51.28% who had none, and 23.08% who were uncertain. The association was not statistically significant (p = 0.890), echoing findings from Zhang *et al.,* (2022), which revealed that while family history remains a known risk factor, its effect size diminishes in settings where environmental and lifestyle factors dominate, such as correctional facilities.

Moreover, among the diabetic inmates, only 10.26% had ever been diagnosed with diabetes, suggesting that a significant majority (89.74%) were unaware of their condition. This lack of prior diagnosis also did not show a statistically significant association (p = 0.576), but it underlines an urgent public health gap. A study by Rivera *et al.,* (2023) highlighted that under diagnosis of chronic diseases like diabetes is common in prisons, due to limited screening, stigma, and poor healthcare access.

Lastly, 10.26% of diabetic inmates were receiving treatment for diabetes, compared to 89.74% who were not, yet the association between treatment status and diabetes presence was also not statistically significant (p = 0.778). The WHO Health in Prisons report (2022) similarly notes that healthcare continuity and access to chronic disease

treatment in correctional settings are often insufficient, leading to poor disease outcomes despite rising prevalence.

5.3 Diabetes and Physical Activity, Awareness and Education, and AHQC

The findings from Table 4.3 reveal that there is no statistically significant association between levels of physical activity and the presence of diabetes among inmates ($p = 0.091$). Although a relatively higher percentage (33.33%) of diabetic inmates reported exercising occasionally, compared to lower rates of diabetes among those who exercised daily, weekly, or monthly (all below 11%), the association does not reach statistical significance. This observation aligns with recent literature suggesting that while physical inactivity is a known risk factor for Type 2 diabetes, contextual constraints in prison settings often impede regular physical activity (Ezeugwu *et al.*, 2023). According to Tobe *et al.,* (2022), correctional facilities often lack structured exercise programmes and adequate infrastructure to promote regular physical activity, limiting opportunities for inmates to engage in exercise sufficient to impact metabolic outcomes.

Similarly, the data show that engagement in manual labour does not significantly correlate with diabetes status ($p = 0.129$), although a higher proportion of diabetics (38.46%) reported involvement in manual labour compared to non-diabetics (26.91%). This trend may be attributed to variations in labour intensity, duration, or individual physiological responses, which are not captured in the basic binary classification of labour participation. Recent evidence suggests that not all forms of occupational activity yield protective effects against non-communicable diseases

unless accompanied by aerobic or structured physical training components (Chan *et al.,* 2022).

With respect to access to healthcare and quality of care, over 84% of inmates with diabetes reported having been screened in the past six months, yet this did not yield a statistically significant association ($p = 0.476$). Likewise, 92.31% of diabetics had never received a prescription for diabetes medication ($p = 1.000$), suggesting gaps in follow-up and continuity of care post-screening. These findings are consistent with evidence from Boehmer *et al.,* (2024), who found that screening in incarcerated settings often fails to translate into sustained treatment pathways due to systemic constraints, including inadequate staffing, medication shortages, and fragmented health service delivery in correctional institutions.

Furthermore, the data indicate no significant relationship between diabetes status and awareness or education on diabetes management among inmates. Only 5.13% of diabetic inmates had received any education on managing diabetes, while 94.87% had not ($p = 1.000$). This reflects a substantial deficit in health education within correctional facilities. A systematic review by Maruschak *et al.,* (2023) emphasized the critical role of structured health education in improving health outcomes and self-management capabilities among incarcerated individuals living with chronic diseases. The absence of such programmes in the present context likely contributes to poor disease understanding and management, reinforcing the necessity for tailored educational interventions.

Overall, while the present study finds no statistically significant associations between diabetes status and the variables of physical activity, manual labour, healthcare access, and health education, the descriptive trends suggest critical gaps in prison health systems. These gaps are corroborated by current empirical literature, which emphasizes the importance of structured physical activity programmes, consistent screening protocols with appropriate follow-up care, and comprehensive health education initiatives as foundational components of chronic disease management in prison environments (Rowell-Cunsolo *et al.*, 2022; CDC, 2023).

5.4 Diabetes and Incarceration, Mental Health and Anthropometric

Table 4.4 presents the distribution of diabetic status across variables such as incarceration history, mental health indicators, stress coping mechanisms, and anthropometric characteristics. The results demonstrate no statistically significant association between the duration of incarceration and the presence of diabetes among inmates ($p = 0.745$). Among diabetic inmates, the majority (35.9%) had been incarcerated for less than a year, followed by 33.33% who had been imprisoned between 1–2 years, with decreasing prevalence as incarceration length increased. These findings contrast with earlier assumptions that longer incarceration durations may increase chronic disease risk due to prolonged exposure to poor dietary environments, inactivity, and stress (Binswanger *et al.*, 2022). However, recent studies show that metabolic disorders, including diabetes, can manifest even in short-term imprisonment, possibly due to pre-existing health vulnerabilities or the immediate impacts of incarceration stress (Mahmoud *et al.*, 2023).

Regarding health status perception, while 79.49% of diabetics noticed changes in their health during incarceration, this difference was not statistically significant ($p = 0.283$). Nonetheless, this observation aligns with recent research by Fong *et al.*, (2023), which emphasizes that inmates often experience accelerated health deterioration due to limited access to consistent healthcare and inadequate nutritional standards, even if this does not immediately correlate with chronic disease diagnosis.

A more salient finding in Table 4.4 is the significant relationship between stress coping mechanisms and diabetes status ($p = 0.018$). Notably, 84.62% of diabetic inmates used meditation as a coping strategy, while none reported relying on substance abuse, and only a small proportion resorted to exercise or social support. This suggests a pattern of internalized stress management among diabetics in the prison environment. This is in line with recent studies that advocate for mindfulness-based stress reduction (MBSR) techniques to manage chronic illness in incarcerated populations (Vancampfort *et al.*, 2023). Indeed, Zhang and colleagues (2024) found that incarcerated individuals with diabetes who engaged in structured mindfulness or meditation practices showed improvements in glycemic control and psychological resilience.

In terms of mental health, there were no statistically significant associations between diabetes and difficulties in coping with daily challenges ($p = 0.879$) or sleep disturbances ($p = 0.523$). However, a notable proportion (66.67%) of diabetic inmates reported struggling with daily challenges, and 69.23% indicated sleep difficulties. This aligns with the well-established bidirectional relationship between diabetes and mental health, as documented by Ezeoke *et al.*, (2022), who found that diabetes in

prison populations is often compounded by anxiety, depression, and impaired sleep, even if not statistically distinguishable in small sample subgroups.

With regard to anthropometric measures, Body Mass Index (BMI) did not show a statistically significant relationship with diabetes status ($p = 0.594$). While 74.36% of diabetic inmates had a normal BMI and only 23.08% were overweight, this finding contradicts the conventional association between diabetes and obesity. However, emerging studies suggest that BMI alone may be a limited marker of diabetes risk, particularly in resource-constrained or physically active populations such as inmates, where muscle mass and dietary restriction may affect BMI without reflecting metabolic risk accurately (Liu et al., 2023). This is consistent with the study by Anude *et al.,* (2022), which reported increasing incidence of Type 2 diabetes among individuals with normal BMI in Sub-Saharan Africa, emphasizing the role of genetic predisposition, chronic stress, and nutritional transition rather than just adiposity.

The absence of obesity among diabetics in this sample might also reflect the nutritional deficiencies and structured routines common in prison settings. Moreover, the low prevalence of overweight or obese individuals may stem from limited access to high-calorie foods, as supported by Trotter *et al.,* (2022), who found that incarcerated individuals often lose weight during incarceration due to restricted caloric intake, which can obscure traditional associations between weight and chronic disease.

In conclusion, while most of the examined variables in Table 4 did not show statistically significant associations with diabetes, the significant link between stress

coping strategies and diabetes highlights the importance of mental health and stress management programmes within correctional healthcare systems. The evidence also suggests that BMI may not be a reliable standalone predictor of diabetes in incarcerated populations, warranting a more nuanced approach to metabolic health screening in prisons.

5.5 Hypertension and Demographic Characteristics

The findings presented in Table 4.5 offer critical insights into the distribution of hypertension among incarcerated individuals based on key demographic characteristics. The overall hypertension prevalence in the sample was 43.99%, with a disproportionate burden observed among males (98.76%) compared to females (1.24%). Despite this apparent imbalance, the association between gender and hypertension was not statistically significant ($p > 0.05$). This aligns with broader epidemiological patterns reported by the Centers for Disease Control and Prevention (CDC), where hypertension prevalence remains generally higher in men (50.8%) than in women (44.6%) among adults aged 18 years and older in the general population (CDC, 2023). However, gender differences in prison populations may be confounded by the significant underrepresentation of female inmates, limiting the power to detect true associations.

Age emerged as a significant determinant of hypertension in the current study, with inmates aged 20–40 years accounting for 75.78% of hypertensive cases. The association between age and hypertension was statistically significant ($p < 0.05$). While hypertension is traditionally considered a condition of the aging population, emerging evidence suggests a growing prevalence among younger adults, particularly

within marginalized populations. For instance, Goffinet *et al.,* (2024) emphasized that the prison environment exacerbates risk factors such as poor diet, stress, and sedentary lifestyle, all of which contribute to early-onset hypertension. The implications of this trend are profound, as early-life hypertension is associated with long-term cardiovascular risk and increased healthcare burdens (BMC Health & Justice, 2023).

The observation that 84.47% of hypertensive inmates were Christians compared to 15.53% Muslims was not statistically significant ($p = 0.057$). While religious affiliation may reflect broader socio-cultural patterns, it is not a well-established independent determinant of hypertension. Instead, socioeconomic and behavioural factors, which often correlate with religious groupings in Ghana, may play a more important role in shaping health outcomes. The lack of association between hypertension and religion in this context is consistent with findings from similar studies conducted in sub-Saharan Africa, which emphasize lifestyle and psychosocial stressors over religious variables in explaining health disparities (Owusu-Dabo *et al.,* 2022).

Regarding employment status, the data revealed that the majority of hypertensive inmates were either self-employed (48.45%) or unemployed (47.83%), yet no significant association was found between employment status and hypertension ($p > 0.05$). Similarly, marital status was not significantly associated with hypertension ($p > 0.05$), despite higher hypertension rates among married individuals (27.95%). These findings challenge the conventional assumption that employment and marital status serve as protective factors against chronic diseases. Rather, the prison environment

may attenuate the typical health advantages associated with stable employment and social support, a phenomenon also documented by Dumont *et al.,* (2023), who argue that incarceration neutralizes many social determinants of health.

Furthermore, the near-equal prevalence of hypertension among those enrolled in the National Health Insurance Scheme (NHIS) and those not enrolled (74.53% vs. 25.47%) with no statistically significant difference ($p = 0.850$) highlights potential systemic issues in healthcare accessibility and efficacy within prison settings. Research by Amponsah *et al.,* (2023) underscores that while NHIS enrollment is widespread, it does not necessarily translate to timely or adequate care in correctional institutions due to logistical and infrastructural challenges.

Finally, the educational background of inmates did not show a statistically significant association with hypertension status ($p = 0.900$). Although higher educational attainment is often linked to better health outcomes, the homogenizing effect of incarceration on health risks likely diminishes such associations. This is consistent with findings from a scoping review by Beltrán-Sánchez *et al.,* (2023), which highlighted that within carceral systems, structural constraints often override individual-level protective factors such as education.

In sum, the data underscores the urgent need for targeted public health interventions in correctional facilities, particularly aimed at the younger male population, who appear increasingly vulnerable to early-onset hypertension. Current empirical evidence affirms that prison environments are high-risk settings for the development of chronic diseases due to a combination of behavioural, environmental, and systemic

healthcare limitations. Tailored interventions, including routine screening, lifestyle modification programs, and improved access to quality healthcare services, are essential to mitigate the long-term health and economic burdens posed by chronic conditions such as hypertension.

5.6 Hypertension, Lifestyle Risk Factors, and Medical History among Inmates

The findings from Table 4.6 highlight important associations between hypertension and lifestyle-related risk factors as well as medical history among incarcerated individuals. While the prevalence of hypertension was relatively high across the inmate population, only a few lifestyle and medical history indicators showed statistically significant associations, pointing to nuanced and context-specific dynamics within correctional settings.

Contrary to conventional expectations, current tobacco use was not significantly associated with hypertension in this population ($p = 0.519$), with only 4.35% of hypertensive inmates reporting smoking within the past 30 days. This observation, though seemingly inconsistent with broader public health literature that links smoking with elevated blood pressure and cardiovascular risk (World Health Organization [WHO], 2023), may be explained by institutional restrictions on smoking, reduced access to tobacco products in correctional facilities, or underreporting due to social desirability bias. Furthermore, the relatively low rate of smoking among inmates could reflect broader public health gains in tobacco control policies, even within incarcerated populations (Agaku *et al.*, 2023).

However, a statistically significant association was found between past tobacco use and hypertension ($p = 0.040$). Specifically, 37.74% of hypertensive inmates reported a history of smoking compared to 62.26% who had never smoked. This finding aligns with longitudinal evidence suggesting that the cardiovascular effects of tobacco exposure may persist long after cessation. According to Osei *et al.,* (2022), former smokers remain at an elevated risk of hypertension due to residual vascular inflammation and structural arterial changes induced by prior nicotine exposure. These results underscore the importance of considering cumulative lifestyle exposures rather than only current behaviours in assessing hypertension risk.

Alcohol consumption, both lifetime and recent (past 30 days), did not show a statistically significant association with hypertension in this study ($p = 0.357$ and $p = 0.585$, respectively). Although 50.93% of hypertensive inmates had never consumed alcohol, this was not significantly different from the 49.07% who had. This supports the growing body of evidence indicating that the association between alcohol and hypertension is dose- and pattern-dependent (Rimm *et al.,* 2022). Moderate alcohol use may have negligible or even protective effects in some contexts, whereas heavy or binge drinking increases the risk of hypertension. Within the prison setting, however, opportunities for recent alcohol consumption are limited, potentially muting any measurable effects.

Regarding dietary practices, no significant association was found between consuming food beyond prison-provided meals and hypertension status ($p = 0.427$). Given that only a small proportion (0.82%) of inmates reported consuming additional food, the lack of variability in diet within correctional institutions may obscure dietary impacts

on blood pressure. This finding reflects concerns raised by Agyemang *et al.*, (2023), who noted that the uniform and often nutritionally inadequate diets provided in prisons may contribute to poor health outcomes, including hypertension, although such effects may not be immediately discernible in cross-sectional analysis.

From a medical history perspective, inmates who had never been diagnosed with hypertension exhibited significantly higher prevalence of the condition (82.61%) compared to those previously diagnosed ($p = 0.032$). This indicates a substantial burden of undiagnosed hypertension, a trend mirrored in studies from similar contexts. A recent study in sub-Saharan Africa by Boateng *et al.*, (2022) found that up to 65% of incarcerated individuals with elevated blood pressure were unaware of their hypertensive status. The lack of routine health screening and delayed healthcare access in prison settings contributes to this diagnostic gap, reinforcing the need for comprehensive chronic disease surveillance.

Interestingly, current treatment for hypertension was not significantly associated with hypertensive status ($p = 0.566$). Although 10.56% of hypertensive inmates reported receiving treatment, 89.44% were untreated. This suggests both under-treatment and possible treatment non-adherence. According to Tuffour *et al.*, (2024), logistical constraints, limited drug availability, and inadequate medical staffing often prevent consistent treatment delivery within Ghanaian prisons. As a result, even diagnosed individuals may fail to achieve blood pressure control, posing long-term cardiovascular risks.

Family history of hypertension, a well-established non-modifiable risk factor, did not exhibit a statistically significant relationship with inmates' hypertensive status (p = 0.137). Among those diagnosed with hypertension, only 18.63% reported a positive family history, while 29.19% were unsure. The uncertainty expressed by a substantial proportion of inmates likely reflects low health literacy and inadequate family health documentation. Studies by Adjei-Mensah *et al.,* (2023) emphasize the role of health education in improving awareness of hereditary risk, particularly in populations with limited formal education or disrupted family structures, such as incarcerated individuals.

Collectively, these findings emphasize the critical need for systematic health screenings and lifestyle interventions in prison settings. The high prevalence of undiagnosed and untreated hypertension, combined with the delayed effects of past smoking and structural barriers to healthcare, paints a troubling picture of inmate health. Recent empirical evidence strongly advocates for the institutionalization of routine non-communicable disease (NCD) surveillance, capacity-building of prison health services, and targeted health promotion efforts that address both behavioural and systemic risk factors (WHO Africa, 2023; Mensah *et al.*, 2024**).**

5.7 Distribution of Hypertension by Physical Activity, Awareness and Education, and Access to Healthcare

Table 4.7 presents the distribution of hypertension among inmates in relation to physical activity, awareness and education, and access to healthcare and quality of care (AHQC). The analysis revealed no statistically significant association between physical activity and hypertension status among inmates (p = 0.324). While 40.39%

of hypertensive inmates reported engaging in occasional exercise, 40.99% reported no physical activity at all. A relatively smaller proportion—under 19%—of hypertensive inmates engaged in regular (daily, weekly, or monthly) exercise. These findings suggest that low levels of physical activity are common among inmates irrespective of hypertensive status.

This observation aligns with recent literature indicating that although physical activity is protective against hypertension in the general population, its impact may be attenuated in prison settings due to structural constraints and stress-related environmental factors. For instance, Akinbami *et al.,* (2022) observed that among incarcerated populations in sub-Saharan Africa, the relationship between physical activity and hypertension is often confounded by psychological distress, poor nutrition, and limited autonomy over health-related behaviour, which may dilute the expected cardiovascular benefits of exercise.

Similarly, manual labour—which could be considered a form of physical activity—was not significantly associated with hypertension ($p = 0.438$). This finding further supports the notion that the context and nature of physical activity in prison settings might not equate to the health benefits seen in the general population.

In terms of access to healthcare, the findings showed that 78.88% of hypertensive inmates had undergone screening in the past six months, compared to 21.12% who had not; however, this difference was not statistically significant ($p = 0.537$). Likewise, only 8.13% of hypertensive inmates had been prescribed antihypertensive medication, while a large majority (91.88%) had not. The absence of a statistically

significant association between prescription of medication and hypertension status (p = 0.911) suggests potential underdiagnoses and undertreatment, which remains a critical issue in prison healthcare delivery.

These findings are corroborated by more recent work by López-Hernández *et al.,* (2023), who emphasized that under-resourced prison systems often lack systematic screening programs, contributing to low awareness, poor treatment rates, and ultimately higher rates of uncontrolled hypertension. Similar challenges were noted in Ghana by Gyamfi *et al.,* (2023), who reported that less than 10% of inmates diagnosed with chronic diseases in correctional facilities receive consistent follow-up care or medication, largely due to systemic resource constraints and stigma.

Notably, a significant association was observed between awareness and education on hypertension and its presence among inmates (p = 0.003). Among hypertensive inmates, 8.7% had received education on managing hypertension during incarceration, compared to only 1.95% of non-hypertensive inmates. Furthermore, frequency of information received on hypertension was also significantly associated with hypertension status (p = 0.038). These results highlight the crucial role of health education in increasing awareness and potentially improving hypertension outcomes. This aligns with findings by Boateng *et al.,* (2022), who showed that inmates in Ghana who had access to structured health education programs demonstrated higher health literacy levels and were more likely to engage in positive health behaviours, including seeking care for hypertension. Likewise, a study by Ogunbayo and Nkrumah (2022) stressed that tailored health communication interventions in

correctional institutions significantly improved inmates' engagement with healthcare services and adherence to medical advice.

The implications of these findings are significant. They suggest that while structural interventions such as improved access to screening and treatment are necessary, they must be complemented with sustained health education and sensitization efforts within prisons. The observed disparities point to the urgent need for coordinated public health strategies involving prison authorities, the Ghana Health Service, and non-governmental organizations to implement scalable, context-specific interventions for non-communicable disease management in prisons**.**

5.8 Distribution of Hypertension by Duration of Incarceration, Mental Health Status, and Anthropometric Measures

In this section, we examined the distribution of hypertension across incarceration history, mental health status, and anthropometric indices (BMI), as illustrated in Table 8. Our findings reveal a statistically significant relationship between the length of incarceration and the prevalence of hypertension among inmates ($p = 0.005$). Specifically, among the 161 inmates diagnosed with hypertension, 41.61% had been incarcerated for one to two years, followed by 21.74% for less than one year, 20.5% for three to five years, and 16.15% for more than five years. This suggests that inmates within their first two years of incarceration may experience elevated hypertension risk, possibly due to acute stress responses, inadequate adaptation to prison life, and the abrupt disruption of previous lifestyle routines. A recent study by Dumont *et al.,* (2022) supports this trend, indicating that newly incarcerated individuals often undergo significant psychosocial stress and systemic challenges,

which may exacerbate cardiovascular risks, including hypertension, especially in the early stages of incarceration.

Interestingly, 87.58% of hypertensive inmates reported noticing changes in their health since incarceration, compared to 12.42% who did not, though this association was not statistically significant ($p = 0.265$). These self-perceived changes could reflect cumulative stress, inadequate healthcare access, or lifestyle alterations within prison. However, self-reporting alone cannot ascertain clinical outcomes and requires triangulation with objective health screening.

Regarding mental health assessment, 61.49% of hypertensive inmates reported difficulties coping with daily prison life, and 71.43% experienced sleep disturbances. Although these patterns did not show statistical significance ($p > 0.05$), they underscore a vital area of concern. Poor coping mechanisms and chronic sleep problems have been linked to heightened blood pressure due to sustained sympathetic nervous system activation (Raji *et al.,* 2023). Notably, most hypertensive inmates (71.88%) practiced meditation as a coping strategy. While meditation is known to mitigate stress and may positively affect blood pressure (Li *et al.,* 2022), its efficacy in prison populations has not been widely explored in Ghanaian correctional settings and warrants further investigation.

Moreover, the analysis showed no statistically significant association between body mass index (BMI) and hypertension status ($p = 0.573$). Among hypertensive cases, 65.22% had normal BMI, 32.92% were overweight, 1.24% underweight, and only 0.62% obese. Contrary to established epidemiological patterns that link hypertension

with overweight and obesity (WHO, 2023), this study found a higher proportion of hypertensive individuals within the normal BMI category. This finding might suggest the influence of non-traditional risk factors in the prison environment, such as stress, limited dietary diversity, and reduced physical activity rather than weight alone. A similar finding was reported in a Nigerian prison-based study by Ezeh *et al.*, (2022), which found that inmates exhibited hypertensive symptoms irrespective of BMI, likely due to contextual stressors and constrained healthcare delivery.

Overall, while certain variables such as BMI and mental health indicators did not show statistical significance in this study, their descriptive trends highlight the multifactorial nature of hypertension in correctional environments. These findings suggest the need for a holistic approach to hypertension management, incorporating psychological support, stress-reduction interventions, and context-specific health monitoring protocols**.**

5.9 Multivariate Analysis of Predictors of Diabetes among Inmates

This section presents a multivariate logistic regression analysis examining the key predictors of diabetes among incarcerated individuals, as outlined in Table 4.9. The primary objective was to identify statistically significant risk factors and coping behaviours that influence the likelihood of diabetes in prison populations. The model controlled for variables related to lifestyle (specifically smoking history) and mental health (coping strategies), given their theorized and empirical associations with non-communicable diseases.

The results indicate that inmates who had ever smoked tobacco were significantly more likely to be diabetic than those who had never smoked (AOR = 2.207, 95% CI: 1.095–4.449), controlling for coping strategies. This finding corroborates recent global and regional studies that link tobacco exposure to increased insulin resistance, systemic inflammation, and impaired glucose metabolism. For example, Osei *et al.,* (2023) found a comparable two-fold increase in diabetes risk among former smokers in a Ghanaian urban cohort, attributing the residual metabolic effects to endothelial dysfunction and persistent low-grade inflammation even after cessation. Moreover, Park *et al.,* (2022) reported similar odds ratios in a U.S. correctional population, underscoring that smoking history is a robust independent predictor of diabetes regardless of incarceration status.

With regard to mental health and stress coping mechanisms, the analysis further revealed that inmates who used "other" coping strategies (e.g., reading, religious practices, or solitary reflection) had significantly lower odds of being diabetic compared to those who practiced meditation (AOR = 0.188, 95% CI: 0.044–0.811). While meditation is widely recognized for its benefits in stress reduction, these findings may reflect the relative effectiveness or accessibility of alternative coping practices in prison contexts. For instance, Mensah and Yeboah (2024) suggest that some forms of passive or solitary coping (e.g., engaging with spiritual routines or recreational reading) may yield lower physiological stress markers compared to more introspective techniques, depending on individual preferences and prison conditions.

Conversely, coping through talking to someone was associated with a reduced but statistically non-significant odds of diabetes (AOR = 0.732, 95% CI: 0.209–2.566). This trend, although not conclusive, aligns with literature emphasizing the buffering

role of social support in mitigating the stress-diabetes link. Gyamfi *et al.,* (2022) emphasize that in high-stress environments such as prisons, social interaction can moderate cortisol secretion, which may indirectly affect glucose regulation. However, the lack of significance in this model may be due to the limited access to meaningful social networks or peer counseling in correctional settings.

The overall model performance is supported by the Likelihood Ratio Test, which was statistically significant ($p = 0.001$), indicating that the full model offers improved explanatory power over a null model. In addition, the Hosmer–Lemeshow goodness-of-fit test yielded a non-significant result ($p = 0.465$), suggesting that the model adequately fits the observed data, without evidence of poor specification.

To further assess the model's classification accuracy, a Receiver Operating Characteristic (ROC) curve was employed. The Area Under the Curve (AUC) was approximately 0.67, indicating moderate discriminative ability. This suggests that the model correctly classified about 67% of diabetic cases among inmates. Although not optimal, this level of performance is consistent with early-stage risk prediction models based on limited behavioural and psychosocial data. As noted by Togbe *et al.,* (2023), models with AUCs between 0.65 and 0.75 are considered moderately predictive in low-resource settings, particularly when using cross-sectional data.

These findings have critical implications for public health strategies in correctional institutions. First, they underscore the necessity of screening for tobacco history as a proxy for metabolic risk, even among former smokers. Second, the results call for greater diversification of stress management interventions beyond meditation,

considering the varied coping preferences and cultural orientations of inmates. Finally, the modest predictive power of the model highlights the need for longitudinal data and integration of clinical biomarkers (e.g., fasting glucose, HbA1c) to enhance future predictive accuracy.

5.10 Multivariate Analysis of Predictors of Hypertension among Inmates

This section presents the results of a multivariate logistic regression analysis exploring the determinants of hypertension within the incarcerated population. As shown in Table 4.10, multiple sociodemographic, behavioural, and incarceration-related factors were significantly associated with the likelihood of hypertension. The model adjusted for known confounders and was statistically validated through appropriate diagnostic tests.

The analysis revealed a clear age gradient in the risk of hypertension among inmates. After controlling for other variables, inmates aged 31–40 years had 1.86 times higher odds of being hypertensive compared to those aged 20–30 years (AOR = 1.858, 95% CI: 1.125–3.069). This risk increased markedly with age, peaking in the 51–60 year group, where inmates were over three times more likely to be hypertensive (AOR = 3.328, 95% CI: 1.134–9.767). These findings are consistent with established biological mechanisms linking aging with arterial stiffening, endothelial dysfunction, and deregulations of the renin-angiotensin system.

Recent empirical studies affirm this age-hypertension association within incarcerated populations. For instance, Mensah & Owusu (2022), in a study of Ghanaian correctional facilities, found that inmates aged above 40 had significantly higher

systolic blood pressure and a 2.9-fold increased likelihood of hypertension. Similarly, Danquah *et al.,* (2023) reported that the age-related risk was amplified in correctional settings due to limited access to preventive healthcare and elevated stress levels, which accelerate biological aging.

Interestingly, past smoking history was associated with a lower odds ratio of hypertension (AOR = 0.667, 95% CI: 0.427–1.041), though this association did not reach statistical significance. This finding diverges from the broader literature, which generally identifies smoking as a hypertensive risk factor due to its role in sympathetic nervous system activation and vascular inflammation. However, similar paradoxical findings have been observed in incarcerated populations, possibly due to selection bias, underreporting, or unmeasured confounders like diet and physical activity.

A related study by Ezeh *et al.*, (2022) in Nigerian prisons reported a non-significant association between former smoking and hypertension, attributing the unexpected trend to restricted tobacco access in prison, leading to eventual cessation and potential cardiovascular recovery among inmates. Nonetheless, further longitudinal research is needed to disentangle these dynamics.

Having a previous diagnosis of hypertension or diabetes was associated with a higher, though statistically non-significant, likelihood of current hypertension (AOR = 1.427, 95% CI: 0.733–2.775). This is consistent with the known clustering of metabolic conditions, whereby individuals with a history of diabetes are at elevated risk of

concurrent hypertension. However, the attenuation of the association in this model may reflect underdiagnoses or inconsistent access to healthcare services in prison.

A notable finding was the significant association between incarceration duration and hypertension. Compared to those incarcerated for less than a year, inmates held for 1–2 years had a 75% increased risk of being hypertensive (AOR = 1.748, 95% CI: 1.022–2.990), while those incarcerated for 3–5 years were 2.44 times more likely to be hypertensive (AOR = 2.435, 95% CI: 1.233–4.808). Even inmates with more than 5 years in custody had over twofold increased odds (AOR = 2.268, 95% CI: 1.071–4.801).

These results are strongly supported by recent empirical evidence. Akoto *et al.,* (2023) identified prolonged incarceration as a determinant of poor cardiovascular outcomes in Ghanaian prisons, largely due to cumulative psychosocial stress, sedentary behaviour, and limited access to dietary variety. Similarly, Pereira *et al.,* (2022), studying Brazilian prison populations, found that hypertension prevalence increased with incarceration time, mediated by cortisol deregulation and restricted medical follow-up. The model was statistically validated using the Likelihood Ratio Test, which yielded a significant result ($p = 0.001$), indicating that the inclusion of the explanatory variables substantially improved model fit over the null. Moreover, the Hosmer–Lemeshow goodness-of-fit test produced a non-significant p-value (0.069), reinforcing that the model appropriately represents the observed data distribution. To further assess the model's predictive performance, a Receiver Operating Characteristic (ROC) analysis was conducted. The Area Under the Curve (AUC) was 0.673, indicating moderate discriminative ability. This suggests that the model

correctly classified approximately 67% of hypertensive cases, a level of accuracy comparable to other behavioural and sociodemographic models in constrained settings. As Togbe & Boateng (2024) note, such moderate AUC values are acceptable for screening models in prison-based epidemiological surveillance, especially when biological markers are unavailable.

In summary, this analysis identifies age and length of incarceration as the most significant predictors of hypertension among inmates, aligning with recent empirical findings in both Ghana and other low-resource correctional systems. While the role of past smoking and chronic disease history warrants further exploration, the strong associations observed with aging and incarceration duration underscore the urgent need for targeted screening and hypertension management programs in correctional facilities. These findings contribute to the growing literature on the intersection of incarceration and chronic disease and offer evidence-based direction for prison health policy and practice.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary of Key Findings

This study investigated the epidemiology and determinants of hypertension and diabetes among inmates in the Ashanti Region of Ghana, employing both descriptive and multivariate logistic regression analyses. The findings provide important insights into the unique health dynamics of incarcerated populations, particularly concerning the prevalence and predictors of these non-communicable diseases.

Hypertension

Age was found to be a significant determinant of hypertension among inmates. The adjusted odds ratios revealed a progressive increase in hypertension risk with advancing age. Specifically, inmates aged 31–40 years had 86% higher odds of being hypertensive compared to those aged 20–30 years (AOR = 1.858), while those aged 41–50 and 51–60 years had approximately 2.94- and 3.33-times higher odds, respectively. These findings are consistent with the well-established pathophysiological relationship between age and elevated blood pressure due to arterial stiffening, increased vascular resistance, and cumulative exposure to behavioural risk factors over time (Chen *et al.*, 2023; World Health Organization [WHO], 2022).

Recent research by Iqbal *et al.*, (2023) on incarcerated populations also confirms that age is a primary non-modifiable risk factor influencing hypertension, primarily due to accelerated biological aging exacerbated by environmental stressors prevalent in

prison settings. Moreover, the psychological burden of incarceration may magnify the age-related risk, reinforcing the need for age-stratified health interventions in prison facilities.

The duration of incarceration also emerged as a statistically significant predictor. Inmates incarcerated for 1–2 years had approximately 75% higher odds of being hypertensive (AOR = 1.748), while those detained for 3–5 years were over twice as likely to be hypertensive compared to those imprisoned for less than a year (AOR = 2.435). This finding aligns with Udo *et al.,* (2022), who posited that prolonged incarceration leads to chronic psychological distress, physical inactivity, limited dietary options, and restricted access to preventive healthcare, all of which contribute to elevated blood pressure levels.

Interestingly, the results indicate that past smoking was associated with lower odds of hypertension (AOR = 0.667), although this relationship was not statistically significant ($p > 0.05$). This counterintuitive result may reflect the complexity of behavioural modifications post-incarceration or the possible influence of confounding factors such as nutritional interventions, medical treatment, or unreported current tobacco use. While smoking is a well-documented risk factor for hypertension (WHO, 2023), recent literature has observed that among incarcerated individuals, cessation due to prison regulations or access to healthcare may lead to a temporal reversal of risk (Lee et al., 2023). However, the observed non-significant association calls for caution and suggests the need for more nuanced measures of current versus former tobacco use and intensity.

The logistic regression model demonstrated moderate discriminatory capacity, as evidenced by an area under the curve (AUC) of 0.673. According to Hosmer and Lemeshow (2000), AUC values between 0.65 and 0.70 indicate acceptable model performance. Moreover, the model passed the Hosmer–Lemeshow goodness-of-fit test ($p = 0.069$), suggesting that the model adequately fits the dat. These statistical diagnostics enhance confidence in the reliability and generalizability of the model within similar carceral populations.

Diabetes

For diabetes, the study found that none of the demographic characteristics, including age, gender, education, ethnicity, or duration of incarceration were significantly associated with diabetes among inmates ($p > 0.05$ for all variables). However, past smoking emerged as a significant risk factor, with former smokers showing higher odds of developing diabetes (AOR = 2.207) compared to the non-smokers. Thus, the odds of being diabetic among inmates who had ever smoked tobacco is more than two-fold compared to those who had never smoked (AOR = 2.207, 95% CI: 1.095–4.449), after controlling for coping with stress.

Concerning coping strategies for stress, inmates who reported using “other” such as reading as a coping strategies had significantly lower odds of being diabetic compared to those who practiced meditation (AOR = 0.188, 95% CI: 0.044–0.811), after accounting for other factors, but was seen as a risk factor suggesting that non-constructive coping mechanisms may mitigate the risk of metabolic disorders in the stressful prison environment (Folkman & Lazarus, 1988; Sapolsky, 2004).

These findings highlight that while demographic factors may not explain variation in diabetes prevalence among inmates, modifiable behavioural and psychosocial factors, such as smoking and stress management strategies play a critical role. Interventions promoting healthy coping strategies, alongside behavioural modification programs, could therefore reduce the burden of diabetes in prison populations.

The logistic regression model demonstrated moderate discriminatory capacity, as evidenced by an area under the curve (AUC) of 0.665. According to Hosmer and Lemeshow (2000), AUC values between 0.65 and 0.70 indicate acceptable model performance. Moreover, the model passed the Hosmer–Lemeshow goodness-of-fit test ($p = 0.465$), suggesting that the model adequately fits the data. This statistical diagnostics enhance confidence in the reliability and generalizability of the model within similar carceral populations.

Furthermore, prolonged exposure to institutional stress has been linked to deregulation of the hypothalamic-pituitary-adrenal (HPA) axis, which may induce sustained cortisol release and contribute to the development of hypertension and diabetes (Gonzalez et al., 2023). The prison environment, characterized by limited autonomy, social isolation, and inconsistent medical care, may serve as a catalyst for chronic disease onset and progression.

6.2 Conclusion

This study underscores the disproportionate burden of hypertension and diabetes among incarcerated individuals in the Ashanti Region. Hypertension was strongly associated with age and duration of incarceration, while BMI, often a key predictor in

the general population was not significant, likely due to the homogeneity of lifestyle within prison settings. Smoking history showed decreased odds of hypertension, though without statistical significance.

In contrast, diabetes was not linked to demographic characteristics such as age, sex, or education. Instead, past smoking and stress-coping strategies, particularly reading, emerged as key predictors. This finding diverges from general population patterns and highlights how behavioural and psychosocial factors play a distinct role in prison health.

Together, these results emphasize that the prison environment constitutes a unique epidemiological setting where institutional constraints, stress, and limited access to care intersect to influence chronic disease risk. Addressing these challenges requires prison health reforms that integrate routine screening, smoking cessation, stress management, and accessible treatment. Such efforts are critical not only for reducing the burden of hypertension and diabetes among inmates but also for advancing public health equity and social justice within correctional systems.

6.3 Recommendations

6.3.1 Policy-Level Interventions

- Development of National Correctional Health Policy: The Ghana Health Service, in collaboration with the Ghana Prisons Service, should institutionalize a health policy that prioritizes chronic disease screening and management, particularly hypertension, among inmates.

- Age-Specific Health Surveillance: Targeted screening and preventive interventions for inmates over the age of 30 should be institutionalized, given the strong age gradient observed in hypertension risk.

6.3.2 Institutional-Level Interventions

- Periodic Health Screenings: Regular blood pressure and metabolic screenings should be implemented to detect hypertension early and prevent complications.
- Health Education and Promotion: Prisoners should be sensitized about modifiable risk factors for hypertension through tailored health education programs focused on stress management, nutrition, and physical activity.
- Strengthening Prison Health Infrastructure: Correctional facilities must be equipped with basic diagnostic tools, trained healthcare professionals, and access to essential antihypertensive medications.

6.3.3 Recommendation for Future Research

- Longitudinal Analysis: Future studies should employ longitudinal designs to better capture causality and explore the trajectory of hypertension risk over time during incarceration.
- Inclusion of Biopsychosocial Variables: Additional variables such as cortisol levels, sleep patterns, social support, and access to healthcare services should be integrated into future models to provide a more holistic understanding.
- Qualitative Investigations: Qualitative studies exploring inmates' perceptions of hypertension, health-seeking behaviour, and coping mechanisms could provide deeper contextual understanding and inform intervention design.

6.4 Final Reflections

This research has illuminated the intersection between incarceration and chronic disease risk, highlighting the urgent need for prison health reforms in Ghana. The evidence suggests that age and incarceration duration are powerful structural determinants of health within the prison system. Despite the resource limitations and socio-political neglect of correctional health, it is imperative that the health rights of incarcerated individuals are upheld in accordance with global human rights and public health standards.

The study also demonstrates the importance of context-sensitive epidemiological approaches in addressing health inequities. Interventions designed for free-living populations may not be entirely applicable to incarcerated individuals, necessitating prison-specific research and policy action. Ultimately, improving inmate health is not only a moral and legal imperative but also a strategic public health intervention with implications for broader societal health outcomes.

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APPENDIX

AKENTEN APPIAH-MENKA UNIVERSITY OF SKILLS TRAINING AND ENTREPRENEURIAL DEVELOPMENT

FACULTY OF HEALTH AND ENVIRONMENT EDUCATION

DEPARTMENT OF PUBLIC HEALTH EDUCATION.

MPhil. Public Health (Epidemiology and Biostatistics).

Epidemiology of Hypertension and Diabetes among inmates in the Ashanti Region, Ghana.

Research Project Questionnaire.

Investigator: Mr. Prince Kwabena Achoo (8222030005)

Main Supervisor: Joana Apenkwa (PhD).

Co-Supervisor: Ernest Osei (PhD).

STUDY DESCRIPTION:

The purpose of this study is to determine the epidemiology of hypertension and diabetes among inmates in the Ashanti Region, Ghana, with the aim of understanding the Prevalence, Knowledge, Attitude and Practice (KAP), Risk factors, and Control measures in this vulnerable population.

Participant ID :

Date :

Community :

Demographic Factors:

1. Age 20-30 ☐ 31-40 ☐ 41-50 ☐ 51-60 ☐ above 60 ☐
2. Gender Male ☐ Female ☐

3. Ethnicity Akan ☐ Ga-Dangme ☐ Ewe ☐ Mole-Dagbani ☐

   Guan ☐ Gurma ☐

4. Level of education None ☐ JHS ☐ SHS ☐ Tertiary ☐

5. Marital status Single ☐ Married ☐ Divorced ☐ Widowed ☐

6. Religion Christian ☐ Muslim ☐ Traditionalist ☐ Other ……

7. Type of employment before incarceration Government worker ☐

   Self-employed ☐ Not employed …….

8. Are you actively subscribed to the National Health Insurance Scheme (NHIS)?

   YES ☐ NO ☐

RISK FACTORS

- Lifestyle risk factors:

Tobacco smoking:

9. Do you currently smoke any tobacco products, such as cigarettes, cigars, pipes (past 30 days)? Yes ☐ No ☐

10. In the past, did you ever smoke any tobacco products?

11. Yes ☐ NO ☐

12. When you stopped smoking, how old were you? (Only ask if participant smoked in the past) ……

    Alcohol drinking:

13. Have you ever consumed any alcohol such as beer, wine, spirits or gin?

    Yes ☐ No ☐

14. Have you consumed any alcohol within the past 30 days? Yes ☐ No ☐

    Dietary Habits:

15. Do you eat other foods apart from the ones served in the prison?

    YES ☐ NO ☐

16. What foods do you normally eat aside the one served in the prison?

Sugary food ☐

Sodium food ☐ Vegetables ☐ Fruits ☐ Whole grain and Fibre ☐

Other ……..

- Physical activity:

17. How frequently do you engage in exercises?

Daily ☐ Weekly ☐ Monthly ☐ Occasionally ☐

18. Indicate the kind of exercise.

Brisk walking ☐ Press ups ☐ Jogging ☐ Other ……

19. Are you engaged in manual labour?

YES ☐ NO ☐

20. If yes indicate the kind of manual labour you engage in.

Digging ☐ Weeding ☐ Carrying of goods ☐ Other……

- Incarceration History:

21. How long have you been incarcerated?

Less than one year ☐ 1-2 years ☐ 3-5 years ☐ More than five years ☐

22. Have you noticed any changes in your health since being in prison?

Yes ☐ No ☐

Mental Health Assessment

23. Do you have difficulty coping with daily challenges YES ☐ NO ☐

24. Do you have difficulty in sleeping? YES ☐ NO ☐

25. How do you cope with stress? (Select all that apply)

Exercise ☐ Meditation ☐ Talking to someone (family, friend, and counselor) ☐

Substance abuse (alcohol, drug) ☐ Other ☐

KNOWLEDGE ATTITUDE AND PRACTICE (KAP)

- Medical History:

26. Has anyone in your immediate family (your parents, brothers, sisters, or children) ever been diagnosed with hypertension or diabetes? I don't know ☐ Yes ☐ No ☐
27. Have you ever been diagnosed with hypertension or diabetes? Yes ☐ No ☐
28. Are you currently receiving treatment for hypertension or diabetes? Yes ☐ No ☐

- Awareness and Education:

29. Have you received any education on managing hypertension or diabetes while in prison? Yes ☐ No ☐
30. How often do you receive information on hypertension and diabetes? More often ☐ Sometimes ☐ Not at all ☐

CONTROL MEASURES

- Access to Healthcare and Quality of Care:

31. Have you been screened in the past 6 Months? Yes ☐ No ☐
32. Have you been prescribed with medication for hypertension or diabetes? Yes ☐ No ☐
33. Do you have regular access to prescribed medications? Yes ☐ No ☐
34. Have you faced difficulties in managing your hypertension or diabetes while incarcerated? Yes ☐ No ☐

PREVALENCE

- Physical / Anthropometric measurements:

Systolic (mmHg) _____

Diastolic (mmHg) _____

Height in centimeters (cm) _____

Weight in kilograms (kg) _____

BMI in kilograms per metre squared ($^{kg}/_{m^2}$) _____

Fasting blood glucose (mmol/L) _____

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/1219/24

6th November 2024

Mr. Prince Kwabena Achoo
Department of Public Health Education
Faculty of Environment and Health Education
AAMUSTED-KUMASI.

Dear Sir,

LETTER OF APPROVAL

Protocol Title: ***"Epidemiology of Hypertension and Diabetes among Inmates in the Ashanti Region of Ghana."***

Proposed Site: ***All Prisons in the Ashanti Region.***

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 19th July, 2024 from the Ghana Prisons Services (study site) indicating approval for the conduct of the study at the prisons.
- 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 **6th November 2024 to 5th 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

number and date of this letter should be quoted

HEADQUARTERS
Ghana Prisons Service
P. O. BOX 129, ACCRA
GHANA WEST AFRICA
TEL: 760093/760094
Fax: 233-302-772865
Email: info@ghanaprisons.gov.gh

Your Ref: No.....

My Ref. No: HRG/0183/V. 6/24/ 71/303

Date 19th JULY, 2024

RE: PERMISSION TO CONDUCT RESEARCH:
"EPIDEMIOLOGY OF HYPERTENSION AND
DIABETES AMONG INMATES IN THE ASHANTI REGION"

Reference your letter dated 23rd April, 2024, permission has been given to **Mr. Achoo Prince Kwabena**, an MPhil. Public Health student of Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development (AAMUSTED) to visit Kumasi Central, Kumasi Female, Manhyia Local, Obuasi Local, Ahinsan Camp, Amanfrom Camp and Ejura Camp Prisons and conduct research with inmates on the topic: **"Epidemiology of Hypertension and Diabetes among Inmates in the Ashanti Region."**

2. The student is to liaise with the Officers-In-Charge of the aforementioned prisons to discuss the modalities of the data collection before the commencement of the research.

3. The student is informed that, video-taped or audio recording of his research activities in the prisons would not be permitted.

4. He is also required to show evidence of COVID-19 vaccination before he will be allowed to enter the prisons. Additionally, he is to submit a copy of his research work to the Service for study upon completion.

5. By a copy of this letter, the Officers-In-Charge of the affected prisons are informed and directed to assist the student by assigning a health officer to work hand in hand with the student without compromising security.

6. Accept for your information.

BENEDICT BOB-DERY
DIRECTOR OF PRISONS/HRD & SVCS
For: DIRECTOR-GENERAL OF PRISONS

THE HEAD
DEPARTMENT OF PUBLIC HEALTH EDUCATION
AAMUSTED
P. O. BOX 40, ASANTE MAMPONG
TEL: 0209777318/0243236810

CC:
THE AFFECTED STATIONS
MR. ACHOO PRINCE KWABENA (0553303083)