

ENSIGN GLOBAL COLLEGE
KPONG, EASTERN REGION, GHANA

DEPARTMENT OF COMMUNITY HEALTH

**PROGRESSION OF TYPE TWO DIABETES AMONG THE AGED IN AGINCOURT
MPUMALANGA PROVINCE, SOUTH AFRICA**

BY

GRACIA HELARIE FRAIKUE

JUNE, 2024

**ENSIGN GLOBAL COLLEGE
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(237100245)

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DECLARATION

I, GRACIA HELARIE FRAIKUE hereby declare that with the exception of the references made to other people’s work which I duly acknowledged, this research submitted to the Department of Community Health, Ensign Global College is my original work and has neither in whole nor in part been presented to the University or elsewhere for another degree.

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DEDICATION

I dedicate this work to my parents, Ing. Mr. and Dr. Mrs. Fraikue, my brother Kwow Nyan Fraikue and Grandmother and Betty Biney for their immense support throughout the period of my studies. I am forever grateful.

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I would like to express my profound gratitude to the Almighty God for granting me the grace and strength to successfully complete this dissertation. I am genuinely thankful for the guidance and support provided by my supervisor, Dr. Sandra Boatemaa Kushitor, in completing this thesis. Furthermore, I want to extend my appreciation to my parents, Ing. Mr. and Dr. Mrs. Fraikue, my brother Kwow Nyan Fraikue, and my Grandmother, Betty Biney, for their unwavering support throughout my studies. I am forever grateful for their encouragement.

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ABBREVIATION/ACRONYMS

ABBREVIATION	MEANING
ADA	American Diabetic Association
BMI	Body Mass Index
CAPI	Computer-Assisted Personal Interview
DM	Diabetes Mellitus
GDM	Gestational Diabetes Mellitus
HAALSI	Health and Aging in Africa
HDSS	Health and Demographic Surveillance System
HIV	Human Immunodeficiency Virus
HTN	Hypertension
IDF	International Diabetes Federation
NCDs	Non-communicable Diseases
SA	South Africa
SSA	Sub-Saharan Africa
T2DM	Type two Diabetes Mellitus
TB	Tuberculosis
WHO	World Health Organisation

ABSTRACT

BACKGROUND

Diabetes Mellitus, including Type 2, is of global concern, particularly among aging populations in rural South Africa. T2DM is prevalent among the elderly, yet research on its progression in Agincourt. This study aimed to assess T2DM progression among South Africa's elderly over eight years, using data from the Health and Aging in Africa: A Longitudinal study of INDEPTH (HAALSI).

METHODS

The study utilized a quantitative, cross-sectional design within the HAALSI study, a retrospective longitudinal cohort study, to assess type two diabetes progression among the elderly in rural Agincourt, Mpumalanga Province, South Africa. It employed surveys and structured questionnaires to collect data on demographics, health conditions, lifestyle, and healthcare utilization.

RESULTS

The prevalence of diabetes increased from 8.02% in Wave 1 to 11.49% in Wave 2. In Wave 1, the majority of participants were in the 50-69 age groups, with significant representation from those aged 70 and above. Also, about 90% of the people who did not have Diabetes at baseline progressed to have it at the end of the follow up stage.

CONCLUSION

This study reveals a concerning escalation in diabetes prevalence among the elderly in rural Agincourt, Mpumalanga Province, South Africa, over eight years. Factors such as age, marital status, and employment correlate with diabetes prevalence, alongside health indicators like waist circumference and body mass index. Lifestyle factors including diet, smoking, and alcohol intake also influence prevalence, necessitating targeted interventions to address these contributors.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the study

Diabetes Mellitus is a metabolic disorder marked by high blood sugar levels and related health issues (WHO, 2021). It is a significant global health concern, classified into Type 1 and Type 2 diabetes (Mansoori, 2023). The prevalence of type 2 diabetes (T2DM) is rising, primarily as a result of aging populations, urbanization, and lifestyle modifications. T2DM is especially rising in the over-65 age group. This metabolic disorder is often characterized by polydipsia, polyuria, and polyphagia (Nigro et al., 2018). The World Health Organization (WHO) links T2DM with serious health issues like kidney failure, heart attacks, stroke, and blindness, which resulted in 1.6 million deaths in 2016 (WHO, 2020). T2DM is more common among older adults and individuals with risk factors including insufficient physical activity, unhealthy eating habits, high body mass index (BMI), excess weight, and smoking (Aschner, 2016).

In the year 2021, it was estimated that around 10.5% of individuals aged 20 to 79 years worldwide had diabetes, which amounts to about 536.6 million people. This percentage is projected to increase to 12.2% by the year 2045, encompassing approximately 783.2 million individuals (Sun, 2022). Diabetes is a significant challenge, particularly in low and middle-income countries like Ethiopia, where about 77% of people with diabetes lack proper care (Manne-Goehler, 2016). In Africa, nearly half of diabetes-related deaths occur in individuals under 60 years, with the African Region facing the highest proportion. Additionally, diabetes in Africa is compounded by the coexistence of infectious and chronic diseases. While manageable, untreated high blood sugar can lead to severe complications and even death (Wang, 2018). Poor blood sugar control is linked to shorter lifespans, significant health issues, and a reduced quality of life (Haung et al., 2017). Effective diabetes management and prevention are crucial to address these issues.

Scientists have shown that there is a strong link between obesity and Type 2 diabetes, often called 'diabesity' (Toplak, 2019). Being very overweight, especially around the belly, makes the body less responsive to insulin, a key problem in Type 2 diabetes (Chadt, 2018). In other words, obesity increases the risk of getting Type 2 diabetes. According to International Diabetes Federation (2021), T2DM is a big problem in sub-Saharan Africa (SSA) and is getting worse quickly. The number of people with diabetes in SSA is predicted to go up from 24 million in 2021 to 55 million by 2045. Among SSA countries, South Africa (SA) has the second highest number of people with diabetes. In 2017, there were 1,826,100 adults in SA with diabetes, and the issue is most serious in poorer areas where resources are limited.

This study focuses on T2DM's rise in the elderly, aiming to understand its progression and its implications over a period of eight years.

1.2 Problem statement

The escalating prevalence of Type 2 Diabetes Mellitus (T2DM) in Sub-Saharan Africa (SSA), especially South Africa poses a significant and growing public health concern. Recent data from WHO reveals a worrisome increase in T2DM cases in South Africa (WHO, 2021). This rise is not confined to a single nation, as SSA as a whole experiences a rising tide of T2DM, as documented by the International Diabetes Federation (IDF, 2021). In 2019, IDF estimated a global prevalence of 463 million adults living with diabetes, projected to rise to 700 million by 2045 (International Diabetes Federation, 2019). In SSA, diabetes prevalence is increasing due to urbanization, lifestyle changes, and dietary shifts. While SSA traditionally had lower rates, countries like South Africa and Mauritius report prevalence comparable to developed nations (Atun et al., 2017; Peer et al., 2020). However, accurate assessment faces challenges like limited healthcare infrastructure and under reporting (Mayige et al., 2019). Despite this, consensus exists among experts that diabetes burden is rising in SSA. Urgent attention from

policymakers and healthcare providers is needed to implement preventive measures and enhance access to care.

In South Africa, the prevalence of diabetes mellitus (DM) has been increasing, as indicated by findings from the Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa (HAALSI). The HAALSI study, conducted in the Agincourt sub-district of Mpumalanga Province, demonstrated a concerning trend of rising DM prevalence over time among adults aged 40 years and older (Gómez-Olivé et al., 2017). Data from the study's baseline survey in 2015-2016 revealed a DM prevalence of 14.2%, with projections indicating a notable upward trend in subsequent years. Factors contributing to this trend include lifestyle changes, urbanization, and an aging population (Gómez-Olivé et al., 2017). The HAALSI study serves as a valuable resource for monitoring DM prevalence trends in SA and underscores the importance of targeted interventions to address this growing public health concern.

Diabetes imposes significant implications on healthcare systems and individuals. Managing diabetes requires regular medical check-ups, medication, and lifestyle adjustments, leading to increased healthcare costs and resource allocation (American Diabetes Association, 2022). Individuals with diabetes often face complications like heart disease, kidney failure, and vision problems, reducing their quality of life and life expectancy (Center for Disease Control and Prevention, 2021). Moreover, diabetes can hinder productivity due to frequent hospital visits and sick days, impacting economic stability for both individuals and society (Sloan et al., 2018). Effective management through education, early detection, and access to affordable healthcare services is crucial to mitigate these burdens. The progression of Type 2 Diabetes Mellitus (T2DM) among the elderly population in South Africa over an eight-year period, as documented in the HAALSI study's successive waves, represents a critical health concern that demands investigation and intervention.

1.3 Rationale of the study

This research sought to understand the rapid progression of Type 2 Diabetes Mellitus (T2DM) among the elderly, which is crucial in addressing the growing burden of this condition, particularly in countries like South Africa where the elderly population is increasing. This research aims to shed light on how T2DM progresses over time in older individuals in South Africa. Such insights are vital for tailoring healthcare strategies to effectively manage and prevent T2DM complications in this demographic group. One intervention that can be implemented based on this study is the promotion of healthy aging through lifestyle modifications. Encouraging older adults to adopt healthier dietary habits, engage in regular physical activity, and maintain a healthy weight can help prevent the onset of T2DM or slow its progression. This can be achieved through community-based programs, education campaigns, and support groups targeting the elderly population. Additionally, improving access to diabetes screening and early detection services is essential. Mobile clinics, community health screenings, and outreach programs can be organized to reach elderly individuals in underserved areas. Regular health check-ups and screenings can help identify individuals at risk of developing T2DM or those who may need additional support in managing their condition. Furthermore, enhancing diabetes management and care services for older adults is crucial. This includes ensuring access to affordable medications, regular monitoring, and specialized care for complications associated with T2DM. Collaborative care models involving healthcare professionals, community health workers, and caregivers can provide comprehensive support to elderly individuals living with T2DM.

Education and awareness programs targeting both older adults and healthcare providers are also essential. Older individuals need to be educated about the importance of managing T2DM and adhering to treatment plans, while healthcare providers should receive training on geriatric diabetes care and treatment guidelines. Also addressing social determinants of health such as

poverty, inequality, and access to healthcare is fundamental in tackling T2DM among the elderly. Implementing policies aimed at improving socioeconomic conditions, providing financial assistance for healthcare expenses, and strengthening healthcare infrastructure in underserved areas can help reduce disparities in diabetes care and outcomes among older adults. Understanding the progression of T2DM among the elderly in South Africa is essential for developing targeted interventions and policies to address this growing public health challenge. By implementing interventions such as promoting healthy aging, improving access to screening and care services, enhancing diabetes management, and addressing social determinants of health, we can effectively manage and prevent T2DM complications in older individuals, not only in South Africa but also in other countries facing similar demographic changes and diabetes challenges globally.

1.4 Conceptual framework

This study adapts the conceptual framework of Grundlingh et al. Diabetes prevalence has been explained by this framework (Figure1). They proposed three main factors that influence the prevalence of diabetes and pre-diabetes in South Africa. The following demographic, lifestyle and health factors derived from the framework will be examined in this study. Among the demographic factors include age, marital status, educational level and employment status. Health-related variables comprise of some anthropometric measures including; height, weight, hip and waist measurements, waist-to-hip ratio and body mass index, as well as measurements of blood pressure, haemoglobin, blood glucose. Lifestyle factors include daily consumption of fruits and vegetables, history of smoking or alcohol consumption.

As individuals age, the risk of developing T2DM increases due to physiological changes and cumulative exposure to risk factors.

Variations in T2DM prevalence exist between males and females, influenced by hormonal differences and health-seeking behaviours. Disparities in income, education, and access to healthcare contribute to variations in T2DM prevalence among different socioeconomic groups. This study adapts the conceptual framework of Grundlingh et al. The following demographic, lifestyle and health factors will be examined.

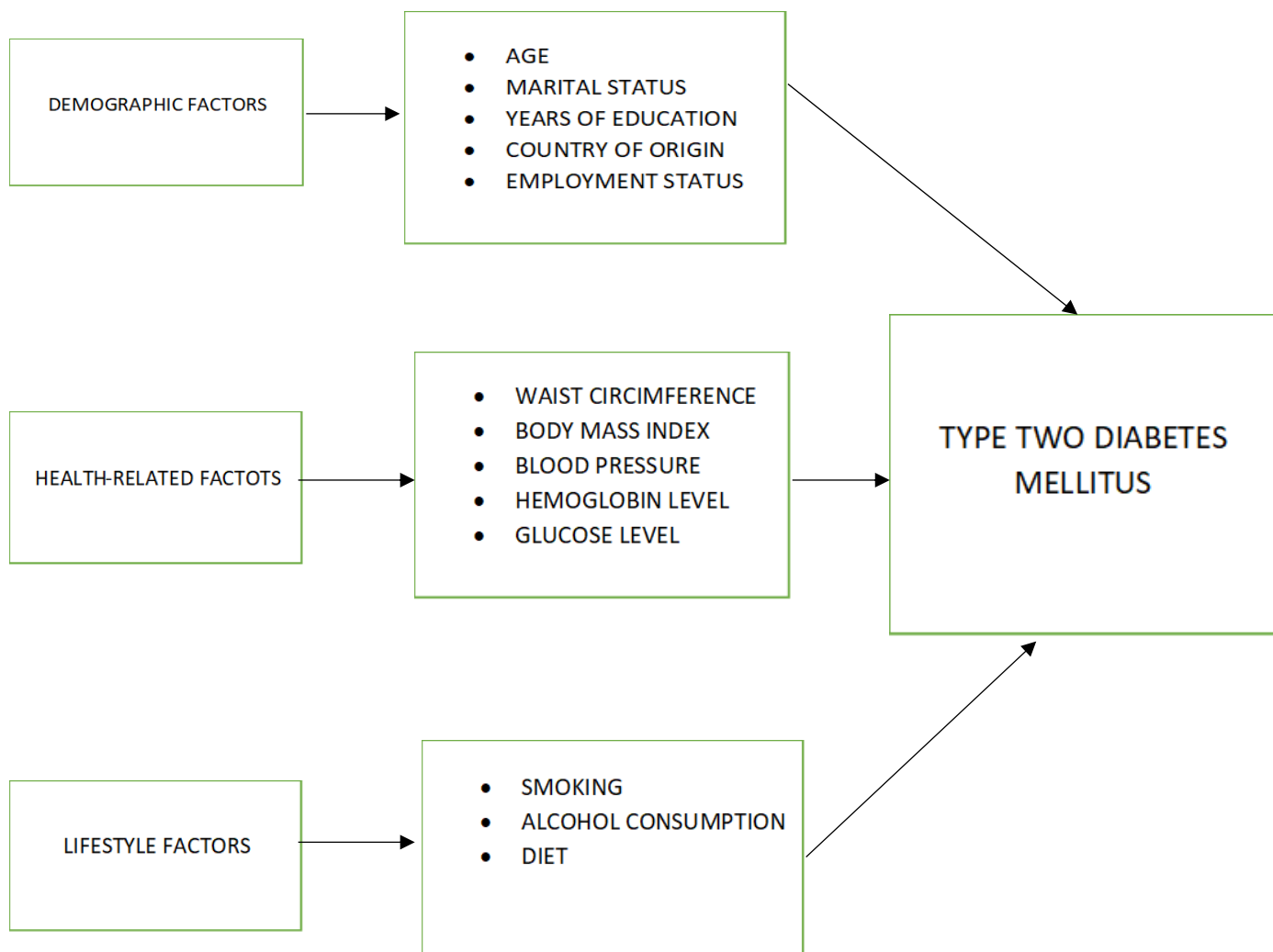


Figure 1.1: Conceptual Framework

Source: Authors Own Construct

1.5 Research questions

1. What are the risk factors of T2DM among the aged in South Africa at each wave?
2. What is the progression of T2DM among the aged over a period of 8 years?
3. What is the relationship between the risk factors of T2DM and it's progression?

1.6 Objectives

1.6.1 General objective

This study aimed to assess the progression of T2DM among the aged in South Africa.

1.6.2 Specific objectives

1. To describe the proportion of adults living with T2DM in Wave 1
2. To monitor and document the development and progression of T2DM among the elderly over an 8-year period.
3. To examine the correlation between identified risk factors and the progression of T2DM among the elderly population.

1.7 Profile of the study area

This study used data from the HAALSI research project. HAALSI was conducted by the Harvard Center for Population and Development Studies in collaboration with the Public Health and Health Transitions Research Unit (Agincourt) of the University of the Witwatersrand. The aim of HAALSI is to examine and characterize the population of older men and women in rural South Africa, specifically in the Mpumalanga province. The study area is located in the Mpumalanga province, South Africa. Mpumalanga is one of the country's provinces, known for its diverse landscapes, including mountains, valleys, and wildlife.

The study area encompasses Agincourt, a community within rural Mpumalanga, and it includes a diverse population of older individuals, both men and women, aged 40 years and older. Mpumalanga, located in eastern South Africa, is a province known for its natural beauty and cultural heritage. Often referred to as the "Place Where the Sun Rises," Mpumalanga offers a unique blend of breath-taking landscapes, rich biodiversity, and a diverse cultural tapestry. Yet, amid its many attractions, the province faces a pressing health concern – the increased prevalence of type 2 diabetes mellitus (T2DM) among its aging population.

Geographically, it is characterized by its diverse topography, featuring towering mountains, deep valleys, and lush Lowveld plains. Biodiversity thrives in this province, providing refuge to a wide array of flora and fauna. Mpumalanga is home to remarkable wildlife, including the celebrated Big Five and numerous bird species. Each group contributes its unique traditions, music, dance, and art to the cultural fabric of the province, offering visitors a chance to immerse themselves in local customs. Mpumalanga thrives through agriculture, mining, forestry, and tourism. It plays a pivotal role in South Africa's agricultural sector, notably in citrus and subtropical fruit production. Additionally, the province is a significant coal producer, which is essential for the country's energy sector. Tourism is a key driver of the province's economy, with attractions like the Kruger National Park, known for its remarkable wildlife, and the Panorama Route, offering travellers an opportunity to explore sites like God's Window and Bourke's Luck Potholes. Nonetheless, the province faces typical challenges seen in many South African regions, including unemployment, poverty, and disparities in healthcare and education access.

However, the high prevalence of T2DM among the elderly population poses a notable health challenge, with potential economic repercussions for the healthcare system. Notably, the prevalence of T2DM among the elderly population is a significant health concern, driving initiatives for healthcare improvements and public awareness campaigns. Mpumalanga, with its natural beauty, cultural diversity, and economic significance, serves as a microcosm of South Africa's marvels and challenges. While it continues to captivate with its splendours, the province also highlights the need to address pressing health issues, particularly the prevalence of T2DM among the aging population. The study is conducted within the framework of the Agincourt health and socio-demographic surveillance system (AHDSS). This system provides a foundation for tracking and monitoring health and demographic trends within the study area.

MAP 1.1: MAP OF MPUMALANGA



MAP OF MPUMALANGA (assessed from Global Africa Network)

1.8 Scope of the Study

This study used HAALSI (Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa) datasets to investigate the progression of type two diabetes among the aged in Agincourt Mpumalanga province, South Africa. The dataset was used to identify the risk factors associated with type two Diabetes Mellitus within the elderly population in South Africa during each survey wave and explore the relationship between the risk factors identified and the progression of type two Diabetes Mellitus among the elderly population. The study's target population included individuals who were aged 40 and older as of July 1, 2014 and individuals who were permanent residents of the study area for the 12 months preceding the 2013 Health and Demographic Surveillance System (HDSS) census. The use of the

HAALSI, a reliable and well-known data source, to support the conclusions made from this study is a strength of this study.

1.9 Organization of thesis

The study is organized into six chapters. Chapter One, the introduction, covers the background of the study, problem statement, justification for the investigation, conceptual framework, research questions, study objectives, profile of the study area, scope of the study, and the study's organization. The second chapter discusses literature relating to the study. The assessment of this chapter also considers the application of theories and factual research pertinent to the topic under consideration. The study's methodology is covered in the third chapter. In particular, the research design, research instrument, data collection process, and data analysis are covered. The analysis of the data and the presentation of the findings are the key topics of Chapter 4. This chapter will be presented in a manuscript style. Chapter Five contains a discussion of the results. Chapter Six presents the key findings and recommendations for the progression of type two diabetes among the aged in Agincourt Mpumalanga province, South Africa.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

This chapter offers evidence on the progression of type two diabetes among the aged in Agincourt Mpumalanga province, South Africa. The global prevalence of T2DM, prevalence of T2DM In Sub-Saharan Africa, prevalence of T2DM In South Africa, risk factors of diabetes, implications of diabetes, progression of T2DM in South Africa, varied theories that have been used to study diabetes as well as the relationship between the Progression and risk factors of T2DM will be discussed in this section and the conceptual framework that has been used to study diabetes

2.2 Global Prevalence of Type two Diabetes Mellitus.

Globally, there are 415 million individuals coping with diabetes mellitus, and approximately 193 million people are believed to have diabetes that has not yet been diagnosed (Chatterjee, 2017). Type 2 diabetes is the primary form of diabetes, encompassing over 90% of all diabetes cases. It results in significant emotional and physical suffering for both patients and their caregivers while also placing a substantial strain on healthcare systems. Although there has been a growing understanding of the risk factors for type 2 diabetes and the effectiveness of preventive measures, the occurrence and spread of this disease continue to escalate on a global scale (Chatterjee, 2017). The prevalence and occurrence of type 2 diabetes mellitus (T2DM) have surged significantly in recent decades and have reached epidemic levels worldwide. The global prevalence of type 2 diabetes has risen dramatically over the past few decades, becoming a pressing global health concern.

In 2019, the International Diabetes Federation (IDF) reported that approximately 463 million adults aged 20 to 79 were living with diabetes worldwide. This figure, however, represents only a snapshot of a larger and more concerning picture. Projections indicate that by 2045, the

number of people with diabetes could surge to nearly 700 million, signifying a substantial 51% increase in just over two and a half decades (International Diabetes Federation, 2019). This alarming upward trajectory can be attributed to a complex interplay of various factors. Urbanization has led to more sedentary lifestyles and the consumption of unhealthy, calorie-rich diets, has contributed to the higher incidence of obesity, which is a primary risk factor for type 2 diabetes. Additionally, the aging global population has introduced a significant demographic shift. Older individuals are more susceptible to type 2 diabetes, making it a condition closely tied to the process of aging (Chen, 2012).

The surge in global diabetes prevalence has placed an enormous burden on healthcare systems worldwide. Managing diabetes necessitates a significant financial commitment, as individuals living with the condition require ongoing medical care, a variety of medications, and frequent monitoring. This financial strain is particularly conspicuous in low- and middle-income countries where healthcare resources are often limited, and budget constraints have a more profound impact (Bommer, 2017). Moreover, the cost of addressing diabetes-related complications, such as cardiovascular disease, kidney failure, and lower limb amputations, contributes substantially to the economic load borne by healthcare systems. These complications demand specialized care and recurrent medical visits, increasing the overall demand for healthcare services and the strain on healthcare infrastructure (IDF, 2017). The burden is not solely economic.

The morbidity and mortality associated with diabetes have a substantial impact on healthcare delivery and outcomes. Patients with diabetes often require specialized care, sometimes in multidisciplinary teams. Additionally, chronic diseases, including diabetes, can drain healthcare resources and hinder the delivery of comprehensive healthcare to individuals with other health concerns, adding a layer of complexity to healthcare systems worldwide (Ogurtsova, 2017). The elderly population faces a unique set of challenges in managing type 2

diabetes on a global scale. As age is one of the predominant risk factors for developing type 2 diabetes, the aging global population contributes to the increasing prevalence of the condition among older individuals.

Beyond age itself, elderly individuals often have multiple comorbidities, making the management of diabetes more complex, as it must be integrated with the care for other health conditions (Sinclair, 2017). Elderly individuals may experience physical limitations and cognitive decline, further complicating their ability to adhere to treatment regimens and self-manage their diabetes effectively. Access to healthcare can be problematic, especially in regions with limited healthcare infrastructure, and elderly patients may find it challenging to consistently adhere to prescribed medications and monitoring schedules (American Diabetes Association, 2019).

In addition to these issues, the elderly is more susceptible to the complications of diabetes, such as neuropathy and retinopathy, which can significantly impact their quality of life. The risk of falls and fractures due to neuropathy, coupled with visual impairment from retinopathy, can make daily living more challenging for older individuals with diabetes (Luo, 2018). Cultural and socio-economic factors also play a vital role in diabetes management among the elderly. Dietary preferences, which are often deeply rooted in cultural traditions, can affect the ability of elderly individuals to adhere to recommended dietary modifications. Financial constraints and limited access to healthcare services further complicate the management of diabetes in this population.

2.3 Prevalence of Type two Diabetes Mellitus in Sub-Saharan Africa

Sub-Saharan Africa (SSA) has witnessed a significant shift in the epidemiology of diseases in recent decades, with the increasing prevalence of non-communicable diseases (NCDs) like type 2 diabetes taking centre stage (WHO, 2020). The region comprises diverse countries with

varying levels of economic development, urbanization, and healthcare infrastructure, which contributes to disparities in diabetes prevalence. According to the World Health Organization (WHO), by 2019, the prevalence of diabetes in the SSA region had reached approximately 3.1% of the adult population, representing a noteworthy increase from previous years (WHO, 2020). In SSA Countries, about 98% of adults with T2DM carry at least one or two comorbidities.

In SSA, the prevalence of T2DM in older persons 55 years of age and older is approximately 13% greater in urban than in rural areas (Losso et al., 2021). Numerous studies have identified prevailing dietary patterns in US, European and Asian populations, and investigated their association with the risk of diabetes (Odegaard et al., 2011). The trends in diabetes prevalence across Sub-Saharan Africa are far from uniform. Some countries have experienced a more rapid increase in diabetes rates than others. This variability can be attributed to multiple factors, including differences in lifestyle, urbanization rates, and genetic predisposition (Hall, 2011).

Urbanization has led to significant shifts in dietary habits and physical activity levels. As rural populations migrate to urban centres, traditional diets rich in whole grains, vegetables, and fruits are often replaced by high-calorie, low-nutrient diets. These dietary changes, coupled with increasingly sedentary lifestyles, have contributed to rising obesity rates, a well-established risk factor for type 2 diabetes (Hall, 2011). Furthermore, genetic factors play a role in diabetes prevalence in SSA. The region has a diverse genetic landscape, with various ethnic groups exhibiting different susceptibilities to diabetes. Genetic predisposition interacts with lifestyle factors, contributing to the variability in prevalence. The impact of lifestyle changes and urbanization on diabetes prevalence is substantial.

As mentioned, urbanization is often accompanied by shifts in dietary patterns, with an increased consumption of processed and high-sugar foods, reduced physical activity, and an

elevated risk of obesity. The transition from physically demanding rural work to more sedentary urban jobs has further exacerbated the problem (Agyeman, 2016). These shifts in lifestyle have, in turn, played a key role in the increasing prevalence of type 2 diabetes. SSA faces numerous challenges in its efforts to address the growing burden of diabetes. Healthcare infrastructure in many countries in the region is often inadequate, with limited resources and healthcare personnel.

Diabetes management requires consistent access to medical care, laboratory tests, and medications, which may be unavailable or unaffordable for many individuals, particularly those living in rural areas (Atun, 2010). Access to care is further hampered by economic disparities and transportation difficulties. The cost of healthcare, including medications, can be prohibitive for many individuals in SSA, leading to poor adherence to treatment regimens. Moreover, there are issues of awareness and education, as many individuals may not be aware of the importance of early diabetes detection and management.

2.4 Prevalence of Type two Diabetes Mellitus in South Africa

In South Africa (SA), the elderly population is particularly susceptible to type 2 diabetes, and this susceptibility remains a critical health concern. While specific data on diabetes prevalence among the elderly in SA post-2013 is limited, it is widely recognized that age constitutes a significant risk factor for the development of type 2 diabetes. With the ongoing increase in life expectancy, the elderly population in SA is on the rise, and this demographic shift plays a pivotal role in the heightened prevalence of diabetes among the aged (IDF, 2019). According to the International Diabetes Federation (IDF), the 2019 statistics for SA indicate an overall diabetes prevalence rate of 4.6%. These figures encompass both urban and rural areas, signifying a nation grappling with the diabetes challenge on multiple fronts (IDF, 2019).

Unfortunately, precise figures specifically targeting the elderly population are not readily available in recent data. Nevertheless, it is well-established that the prevalence of diabetes among the elderly exceeds that among younger age groups, emphasizing the pronounced impact on this demographic. This increase in life expectancy coupled with lifestyle changes has resulted in a substantial number of elderly South Africans living with type 2 diabetes (Peer, 2012). Recent trends in SA's diabetes landscape have unveiled a troubling upward trajectory in prevalence, driven by a multitude of factors. The shift towards more sedentary lifestyles and the transformation of dietary habits, characterized by the consumption of high-calorie, low-nutrient diets, have disproportionately affected the elderly.

The process of urbanization, which often leads to alterations in diet and physical activity patterns, has significantly contributed to these trends. While regional variations may exist due to disparities in lifestyle, genetics, and healthcare access, the overarching trend in SA indicates a surge in diabetes prevalence, particularly among the elderly (Levett, 2011). SA's healthcare system confronts considerable challenges in addressing the growing burden of type 2 diabetes among the elderly. The healthcare infrastructure faces mounting pressure due to the surging demand for diabetes care and management. Elderly individuals often necessitate more extensive and specialized care to effectively manage their diabetes. Given the intricate healthcare needs of the elderly population, which may encompass comorbidities and age-related complications, the healthcare system must be adaptable and expand its capacity (Levett, 2011).

The elderly in SA encounter formidable challenges in accessing healthcare, medications, and regular monitoring, particularly those residing in rural areas. Socioeconomic disparities further compound the issues related to accessing healthcare services, resulting in disparities in diabetes management within the elderly population. SA is witnessing an escalating prevalence of type 2 diabetes among the elderly, a trend that mirrors the global situation. The aging population,

combined with evolving lifestyles, underscores the gravity of this issue. While precise statistics focusing on the elderly segment may be somewhat elusive, the overall burden of diabetes in SA remains substantial. The prevalence of DM in South Africa varies across communities, impacting healthcare and individuals differently. Urban areas, such as Johannesburg and Cape Town, often exhibit higher DM prevalence due to factors like sedentary lifestyles and poor dietary habits (Mutymbizi et al., 2020). These communities face increased healthcare costs and strain on healthcare systems in managing DM and its complications (Mutymbizi et al., 2020). Conversely, rural communities, such as those in the Eastern Cape or Limpopo provinces, may encounter challenges in accessing healthcare services, leading to undiagnosed and untreated DM cases (Mayosi et al., 2012). Additionally, socio-economic disparities contribute to differential impacts, with marginalized communities experiencing greater barriers to diabetes care and management (Mayosi et al., 2012). Addressing these disparities requires tailored interventions focused on improving access to healthcare, promoting healthy lifestyles, and addressing social determinants of health. In South Africa, the expanding prevalence of T2DM goes beyond immediate health implications, placing substantial pressure on healthcare systems and adversely affecting patient outcomes. Recent research by Saeedi et al. (2020) underscores that mortality linked to diabetes is a significant concern in South Africa, necessitating effective intervention strategies.

Furthermore, healthcare disparities within South Africa compounds the T2DM challenge, disproportionately affecting underserved communities. The healthcare system in South Africa reflects many issues common to other Southern African countries, such as disease burden, lack of infrastructure, and societal inequalities (Padarath et al., 2020). However, ongoing reforms in South Africa, particularly in preparation for a National Healthcare Insurance, offer opportunities to learn from effective care models in other African contexts. Kenya's innovative approach to primary healthcare, including significant private sector involvement, is worth

studying (Chuma et al., 2018). Collaboration between the government and non-state actors is crucial for integrated and effective care delivery (Bhatia & Rifkin, 2014). Grassroots social innovation should be supported and connected to policymakers (Shah et al., 2020). South Africa, despite facing significant challenges like inequality and poverty, possesses strong infrastructure, media freedom, civil society engagement, and economic stability (Economist Intelligence Unit, 2021). With these assets, it can make significant progress in addressing healthcare and other societal challenges, contributing to African solutions for African problems. Understanding these dynamics and identifying regional commonalities and differences among South Africa, SSA, and Ghana is essential for devising targeted interventions to mitigate T2DM progression and enhance health outcomes across these regions. Effectively addressing this challenge necessitates a healthcare system that can adapt and expand to meet the distinctive healthcare needs of the elderly diabetic population.

2.5 Risk factors of Type two Diabetes Mellitus

Type two Diabetes Mellitus poses a substantial global health challenge, marked by insulin resistance and impaired insulin secretion. Recognizing the risk factors linked to T2DM is imperative for prevention, timely detection, and efficient management of the disease. Obesity and sedentary behaviour stand out as prominent risk factors for T2DM. Excessive adiposity, especially abdominal obesity, contributes to insulin resistance—a pivotal precursor to T2DM (Abdul-Ghani et al., 2015). Sedentary lifestyles exacerbate this risk by fostering weight gain and diminishing insulin sensitivity (Hu et al., 2018). Genetic predisposition also significantly influences T2DM susceptibility. Family history serves as a robust predictor of the disease, with specific genetic variants affecting insulin signalling pathways or beta-cell function (Khera et al., 2019; Zeggini et al., 2017). Unhealthy dietary habits play a substantial role in T2DM risk. High consumption of processed foods, sugary beverages, and saturated fats elevates the likelihood of T2DM development. Diets deficient in fibre and rich in refined carbohydrates

further exacerbate insulin resistance and T2DM risk (Schulze et al., 2016). Advancing age is a well-established risk factor for T2DM, with prevalence escalating notably in older populations (International Diabetes Federation, 2019). Ethnicity also contributes, with specific ethnic groups—such as African Americans, Hispanics, and Indigenous populations—having a higher risk of T2DM compared to Caucasians (Narayan et al., 2016). Early-life factors, including low birth weight and exposure to gestational diabetes, contribute to T2DM risk later in life (Harder et al., 2017). Individuals born with low birth weight or those exposed to gestational diabetes during fetal development are more prone to developing T2DM due to programmed metabolic abnormalities.

Understanding these risk factors is imperative for implementing preventive strategies and targeted interventions to alleviate the burden of T2DM on individuals and healthcare systems. Addressing these risk factors through lifestyle modifications, genetic screening, and early intervention programs can effectively mitigate the impact of T2DM and enhance health outcomes globally.

2.6. Implications of type two Diabetes Mellitus

Type two Diabetes Mellitus exerts significant implications on both individuals and healthcare systems globally. Firstly, T2DM significantly increases the risk of various comorbidities and complications, including cardiovascular diseases, neuropathy, nephropathy, and retinopathy (ADA, 2019). These complications not only reduce the quality of life but also pose substantial economic burdens on healthcare systems due to increased hospitalizations and long-term care requirements (Kovacs et al., 2020). Moreover, T2DM is associated with higher mortality rates compared to the general population, primarily due to its cardiovascular complications (Mata-Cases et al., 2016). Individuals with T2DM face a shortened life expectancy, highlighting the severity of the disease and the importance of effective management strategies.

T2DM also impacts mental health, leading to increased rates of depression and anxiety among affected individuals (Nouwen et al., 2019). The psychological burden of managing a chronic condition coupled with the fear of complications can significantly diminish overall well-being. Furthermore, T2DM imposes considerable economic consequences on both individuals and society. Direct medical costs associated with T2DM management, including medications, hospitalizations, and physician visits, are substantial (Zhou et al., 2018). Additionally, indirect costs, such as loss of productivity and disability, further exacerbate the economic burden of the disease (Bommer et al., 2018). The implications of T2DM extend beyond the individual level to societal and healthcare system levels. The increasing prevalence of T2DM strains healthcare resources, leading to overwhelmed healthcare facilities and longer wait times for essential services (Khunti et al., 2019). Moreover, disparities in access to healthcare exacerbate existing inequalities, particularly among marginalized populations.

Addressing the implications of T2DM requires a multifaceted approach. Effective management strategies, including lifestyle interventions, pharmacotherapy, and regular monitoring, are essential for preventing complications and improving outcomes (Cosentino et al., 2020). Moreover, public health initiatives aimed at promoting healthy behaviours, early detection, and access to affordable healthcare are crucial for reducing the burden of T2DM on individuals and society (Boyle et al., 2017). T2DM poses significant implications on individuals, healthcare systems, and society as a whole. Addressing the multifaceted consequences of T2DM requires comprehensive strategies that encompass prevention, early detection, and effective management. By prioritizing public health initiatives and ensuring equitable access to healthcare, we can mitigate the impact of T2DM and improve outcomes for affected individuals.

2.7 The progression of Type two Diabetes Mellitus in South Africa

T2DM has emerged as a critical public health concern globally, and SA is no exception to this alarming trend. SA has witnessed a substantial increase in the prevalence of T2DM over the past few decades (Levitt et al.,2016), highlighting the escalating burden of the disease across both urban and rural areas and attributing this rise to the shift from traditional to more westernized lifestyles. This transition is characterized by sedentary behaviours and unhealthy dietary patterns, contributing significantly to the increasing prevalence of T2DM (Mutymbizi et al., 2019). According to Mayosi et al. (2012), there is an emphasis on the disproportionate impact on individuals with lower socioeconomic status, limited access to healthcare, and inadequate health literacy.

Economic disparities exacerbate the prevalence, diagnosis, and management of T2DM, posing challenges to public health initiatives. Genetic predisposition interacts intricately with environmental factors in the development of T2DM. Matsha et al. (2017) underscore the complex interplay of genetic susceptibility, including polymorphisms in genes related to insulin resistance and beta-cell function. Meanwhile, urbanization, dietary choices, and physical inactivity further compound genetic risks, contributing to the surging rates of T2DM in SA. The progression of T2DM in South Africa is hampered by significant healthcare challenges.

Hall et al. (2011) point out that limited resources, inadequate infrastructure, and workforce shortages impede effective prevention and management strategies. Access to diabetes care, particularly in rural areas, is a critical issue that necessitates urgent attention to ensure equitable healthcare provision. However, cultural and behavioural factors contribute significantly to T2DM progression in SA. Raubenheimer et al. (2018) emphasize the impact of traditional beliefs about health, cultural norms regarding food choices, and lifestyle behaviours on diabetes prevalence. Understanding and addressing these cultural influences are crucial for the

development of effective and culturally sensitive interventions. Efforts to mitigate the progression of T2DM in SA involve implementing preventive strategies and interventions.

Oosthuizen et al. (2020) discuss community-based education, lifestyle modification programs, and policy changes as essential components of a comprehensive approach. Early detection through screening and effective management strategies are imperative in addressing the growing challenge of T2DM in the country. The progression of T2DM in SA is a multifaceted issue influenced by epidemiological trends, socioeconomic disparities, genetic and environmental factors, healthcare challenges, and cultural dimensions. Addressing this escalating public health concern requires a holistic approach that integrates preventive strategies, healthcare improvements, and culturally sensitive interventions. Future research and policy measures should focus on evaluating the effectiveness of targeted interventions to alleviate the impact of T2DM on the SA population.

2.8 Relationship Between the Progression and Risk Factors of Type two Diabetes Mellitus

T2DM represents a significant and growing global health challenge, characterized by a complex interplay of genetic, lifestyle, and environmental factors. The progression of T2DM is a dynamic continuum, encompassing a series of metabolic alterations that culminate in impaired glucose metabolism and the manifestation of clinical symptoms (ADA, 2022). This progression typically involves the initial development of insulin resistance, where cells become less responsive to insulin, and the subsequent failure of *pancreatic* beta cells to produce adequate insulin to compensate for this resistance.

Genetic factors play a pivotal role in T2DM susceptibility, with heritability estimated to be around 40-70% (Fuchsberger et al., 2016). Family history, coupled with specific genetic variants, significantly influences an individual's likelihood of developing T2DM. Obesity, particularly abdominal or visceral adiposity, is a prominent modifiable risk factor for T2DM.

Adipose tissue, especially in the abdominal region, secretes adipokines, contributing to insulin resistance and metabolic dysfunction. Sedentary lifestyles and lack of regular physical activity contribute significantly to the progression of T2DM. Exercise improves insulin sensitivity and plays a crucial role in weight management (Colberg et al., 2016).

Dietary habits, especially those high in refined carbohydrates, sugars, and saturated fats, are linked to insulin resistance and contribute to the development of obesity and T2DM (Ley et al., 2014). Advancing age is a non-modifiable risk factor, with T2DM prevalence increasing with age (Gregg et al., 2014). Additionally, ethnicity influences susceptibility, with certain populations, such as African Americans and Hispanics, having a higher risk. Women with a history of gestational diabetes mellitus (GDM) face an elevated risk of developing T2DM later in life. GDM serves as an early indicator, highlighting both genetic and environmental influences. Hypertension and cardiovascular disease are closely intertwined with T2DM, forming a complex relationship where each condition exacerbates the progression of the others (Gregg et al., 2014).

The relationship between T2DM progression and its risk factors is intricate, with each factor contributing to the development and exacerbation of the disorder. Genetic predisposition interacts with environmental factors, influencing an individual's susceptibility to insulin resistance and beta-cell dysfunction (Colberg et al., 2016; Ley et al., 2014). Lifestyle factors, such as obesity, physical inactivity, and poor dietary choices, directly impact insulin sensitivity and contribute to the metabolic dysfunction observed in T2DM. Age and ethnicity further shape the risk profile, emphasizing the importance of considering demographic factors in preventive and management strategies. Gestational diabetes not only poses immediate risks during pregnancy but also serves as a predictive factor for future T2DM risk.

The association between T2DM and cardiovascular complications underlines the systemic nature of the disease and the need for comprehensive management strategies. Given the multifactorial nature of T2DM, preventive strategies must address the various risk factors involved. Implementing lifestyle modifications, including promoting regular physical activity and encouraging healthy dietary patterns, is crucial (Colberg et al., 2016; Ley et al., 2014). Early identification of individuals with a genetic predisposition or a history of gestational diabetes allows for targeted interventions and close monitoring. Public health initiatives should focus on raising awareness about the impact of obesity, emphasizing the importance of maintaining a healthy body weight. Additionally, healthcare professionals play a vital role in promoting regular screening, particularly in high-risk populations, to facilitate early diagnosis and intervention.

The relationship between the progression of T2DM and its risk factors is intricate, involving a dynamic interplay of genetic, lifestyle, and environmental influences. Recognizing the role of genetic predisposition, obesity, physical inactivity, unhealthy dietary patterns, age, ethnicity, gestational diabetes, and cardiovascular complications is essential for developing effective preventive and management strategies. By understanding these relationships, healthcare professionals can tailor interventions to address individualized risk profiles, emphasizing the importance of early identification and comprehensive lifestyle modifications. Further research into the interactions between these factors and their cumulative impact on T2DM progression will contribute to refining preventive measures and therapeutic interventions, ultimately alleviating the global burden of this pervasive metabolic disorder.

2.9 Varied theories used for the study of type two Diabetes Mellitus

Understanding Type two Diabetes Mellitus (T2DM) requires a multifaceted approach that integrates various theoretical frameworks. One prominent theoretical framework used in studying T2DM is the biopsychosocial model. This model considers biological, psychological,

and social factors in understanding the development and progression of T2DM (Adler et al., 2016). It acknowledges the complex interplay between genetic predisposition, psychosocial stressors, and environmental influences on T2DM risk and outcomes. Another theoretical lens commonly employed is the social determinants of health (SDH) framework. This framework emphasizes how social, economic, and environmental factors shape health outcomes, including T2DM prevalence and disparities (Berkowitz et al., 2017). By examining factors such as socioeconomic status, access to healthcare, and neighbourhood characteristics, researchers can better understand the social determinants driving T2DM disparities.

In addition, the health behaviour change theory is integral to understanding T2DM prevention and management. The transtheoretical model (TTM), for example, delineates stages of behaviour change, such as precontemplation, contemplation, preparation, action, and maintenance (Prochaska et al., 2016). Applying TTM helps elucidate individual readiness to adopt and maintain health-promoting behaviours, such as dietary changes and physical activity, crucial for T2DM prevention and control. The ecological systems theory provides a comprehensive framework for examining T2DM within the context of broader environmental influences. This theory considers the interaction between individuals and their microsystems (e.g., family, peers), mesosystems (e.g., community, healthcare settings), ecosystems (e.g., policies, societal norms), and macrosystems (e.g., cultural values, economic structures) (Bronfenbrenner, 2017). By analysing these multiple levels of influence, researchers can identify strategies for promoting health at various ecological levels and mitigating T2DM risk factors. The precision medicine approach has gained traction in T2DM research, emphasizing personalized interventions based on individual genetic, clinical, and lifestyle factors (Kolb et al., 2017). By integrating genomic data, biomarkers, and patient characteristics, researchers aim to tailor interventions to the specific needs of individuals with T2DM, optimizing treatment outcomes and reducing adverse effects. The study of T2DM encompasses diverse theoretical

frameworks that illuminate different aspects of the disease. From the biopsychosocial model to the social determinants of health framework, and from health behaviour change theories to ecological systems theory and precision medicine approaches, researchers utilize a wide array of theoretical perspectives to advance our understanding of T2DM. By integrating these theories, researchers can develop comprehensive strategies for preventing, managing, and mitigating the impact of T2DM on individuals and populations.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Introduction

The strategies, techniques, and analyses employed to accomplish the objectives of the study are described in this chapter.

3.2 Study design and source of data

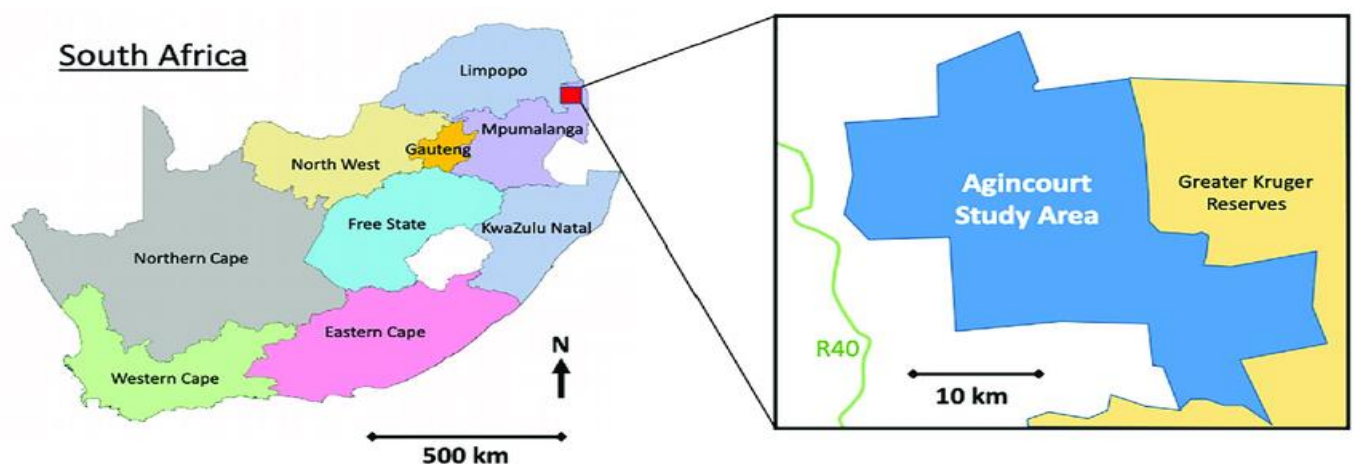
This was a quantitative study with a longitudinal design to identify the progression of type two diabetes among the aged in Agincourt Mpumalanga Province, South Africa. The HAALSI (Health and Aging in Africa: A Longitudinal Study of an INDEPTH Community in South Africa) study was designed as a retrospective longitudinal cohort study. This study was quantitative and was done through surveys and structured questionnaires.

The HAALSI study in South Africa explores the correlation between health and aging by scrutinizing various factors, including demographics, health conditions, lifestyle choices, healthcare utilization, social dynamics, cognitive function, mortality, and biological markers. Details such as age, education, chronic diseases, and mental health are considered, alongside lifestyle aspects like diet and physical activity. The study provides a comprehensive understanding of participants' well-being. but its evolving nature requires continuous updates for the latest insights into the dynamic relationship between health and aging in the studied population.

The HAALSI research took place in the Agincourt sub-district, which is located in rural South Africa's Mpumalanga Province (Figure 3.2). Mpumalanga, South Africa, grapples with various health conditions beyond diabetes mellitus (DM), including tuberculosis (TB), HIV/AIDS,

hypertension, respiratory diseases, maternal and child health issues, malnutrition, non-communicable diseases (NCDs), and mental health disorders. These challenges stem from factors such as poverty, limited access to healthcare services, environmental conditions, and lifestyle factors. Addressing these health conditions requires comprehensive strategies that focus on prevention, early detection, and access to quality healthcare services tailored to the unique needs of the population in Mpumalanga.

MAP 3.1: MAP OF AGINCOURT STUDY AREA, MPUMLANGA, SOUTH AFRICA



MAP OF AGINCOURT STUDY AREA, MPUMLANGA, SOUTH AFRICA

Data from the HAALSI study was used in this investigation. Data were drawn from the baseline and second wave of HAALSI (“Health and Aging in Africa: A Longitudinal study of an INDEPTH community”) cohort study. In order to estimate the prevalence and incidence of major chronic illnesses in persons 50 years of age and older, HAALSI set out to create longitudinal surveys of health, aging, and wellbeing. The eligibility criteria was individuals aged 40 and older as of July 1, 2014, and to have lived in the study site continuously for the 12

months preceding the 2013 Health and Demographic Surveillance System (HDSS) census. This sample size was determined through a random selection process from those who met the study's eligibility criteria. A total of 6,281 persons were selected for recruitment. To maximize the linkages with previous HIV and NCD studies in Agincourt, those who participated in earlier studies and met the eligibility criteria were selected with 100 percent probability. The remainder of the sample was selected randomly from the 2013 census HDSS database, stratifying on sex in order to achieve equal numbers of women and men.

In 2014–2015, the HAALSI baseline round was carried out. A baseline response rate of 87% was used to randomly sample about 40% of all residents in 27 villages who were 40 years of age or older. In particular, 5,059 out of 6,281 men and women who were sampled from these villages completed house interviews; the remaining individuals were either unable to participate or refused (478), could not be located (353), or were disqualified because of death or out-migration (391) (Gómez-Olivé et al., 2018). The study included blood draws, anthropometric and psychological testing. The interviews were administered using a structured Computer-Assisted Personal Interview (CAPI) during a roughly three-hour home visit. In 2018 and 2021, the second and third waves were carried out in succession. The study population for the HAALSI research included 12,875 men and women.

3.3 Data collection method and instruments

The HAALSI study employed a multifaceted approach to collect data. It used various tools and methods to comprehensively capture information related to health, aging, and other relevant factors. Here is a breakdown of the data collection components:

Surveys and Questionnaires: The researchers assessed information from structured surveys and questionnaires. These were carefully designed to collect self-reported data on a wide range

of topics, such as health status, lifestyle, socioeconomic factors, and more. The questions were tailored to the study's specific research goals, allowing participants to share their experiences and insights.

Clinical Assessments: The researcher assessed information from the study which included physical health assessments. Instruments like blood pressure cuffs, scales for measuring weight and height, and devices for calculating body mass index (BMI) were used for the assessment. These assessments provided objective and quantitative data on participants' physical well-being, offering insights into their health status.

The study was divided into three sections: (i) gathering data on households, socioeconomic status, and individual participants; (ii) performing assessments of physical, clinical, and cognitive functioning; and (iii) collecting blood samples in the form of dried blood spots (DBSs) for point-of-care testing. Participants were asked to take off all outer layers of clothes and sit for a minimum of five minutes before having their blood pressure measured. Next, using an Omron M6W automated cuff, the field worker took three blood pressure readings every two minutes. The second and third blood pressure values were used to compute the mean blood pressure. Field personnel obtained droplets of blood, which were then examined for HIV infection status (one to three drops) and preserved DBS on Whatman 903 paper.

HTN was identified as self-reported current antihypertensive medication use or a mean systolic blood pressure (SBP) of ≥ 140 mm Hg or mean diastolic blood pressure (DBP) of ≥ 90 mm Hg. We sought to include all individuals who fit the criteria for HTN at either the baseline or follow-up, thus 12 contradictory responses for self-reported use of anti-HTN medication were recorded as positive at follow-up if the respondent claimed use at baseline but denied use at follow-up (n = 51).

Diabetes was a glucose measurement that met the threshold (≥ 7 mmol/l [126 mg/dL] in fasting group [defined as > 8 hours], and ≥ 11.1 mmol/l [200 mg/dL] in non-fasting [“random or casual”] group. Criteria used to define overweight for the HAALSI study were the ones of the WHO, which considers overweight when BMI ≥ 25 to 29,9 kg/m² and obesity when BMI ≥ 30 kg/m.

Bio specimen Collection: The researchers assessed biological samples, such as blood and urine, that was collected from participants. Specialized instruments and tools, including needles, vials, and containers for specimen storage, was used to ensure the safe and effective collection of these samples. These bio specimens were essential for analysing biomarkers and genetic factors related to health and aging.

3.4 Data handling

The HAALSI study demonstrated a strong commitment to responsible data management, security, and participant confidentiality. It employed a wide array of data collection methods, ensure data accuracy through rigorous quality control, and conducted meaningful data analysis using appropriate statistical techniques. Robust data security measures were put in place, including encryption, restricted access, and safeguards against cyber threats. Participant confidentiality was upheld through anonymization, ethical reviews, and data sharing agreements. Research findings was presented in aggregate or anonymized form to prevent individual identification. Informed consent was obtained from participants, in accordance with ethical standards. Data access was restricted to authorized personnel who adhered to strict confidentiality agreements. The study's practices served as a model for ethical and responsible research, emphasizing the importance of safeguarding participant privacy and data integrity while pursuing valuable insights into health and aging dynamics. The data was cleaned thoroughly with Stata 18 software which helped achieved all statistics for T2DM in SA.

3.5 Statistical analysis

The data collected was organised and cleaned using Stata 18 software. Starting with descriptive statistics to summarize data, regression analysis explored the relationships between variables, allowing for the identification of key predictors of health and aging. Frequency distribution tables was done for all variables of interest such as age, gender and so on. Chi square analysis was used to determine if there are associations between the progression of T2DM and the factors (health, demographics and lifestyle) over the 8-year period. Again, logistic regression was used to determine the strength of significant associations between the progression of T2DM among the aged and the several factors affecting them.

3.6 Ethical issues

Ethics are simply principles of right conduct that must guide researchers in all phases of a research. Before the study began, ethical clearance was obtained from the Ethical Review Committee of Ensign Global College(SN-245). Also, administrative permission was sought from the National Institute on Aging conducted by the Harvard Centre for Population and Development Studies in partnership with Witwatersrand University. Throughout the research process, ethical principles were observed to ensure that the outcomes of the study meet set standards.

3.7 Limitations of the study

Wave 1

1.Measurement Methods

- Reliance on single measurements of fasting glucose levels and HbA1c to diagnose T2DM, which might not capture temporal variations or provide a comprehensive assessment.

- Self-reported data on medication use and medical history might have introduced recall bias.

2. Population and Sampling

- The study focused on an older, rural population, which might limit the generalizability of the findings to other demographics, such as urban or younger populations.

3. Incomplete Data

- Missing data due to non-response or inability to measure fasting glucose in some participants could bias results.
- Lack of detailed dietary and physical activity data which are crucial in understanding T2DM risk factors.

Wave 2

1. Follow-up Issues

- Attrition over time, as some participants were lost to follow-up, moved away, or died, potentially leading to bias in longitudinal analysis.
- Potential for survivor bias, as those who remained in the study might differ significantly in health status compared to those who did not.

2. Measurement Consistency

- Variability in measurement techniques or tools used between waves could affect comparability of data over time.
- Continued reliance on self-reported data, which might still introduce bias.

3. Environmental and Social Factors

- Limited data on environmental and social determinants of health, such as detailed socioeconomic status, cultural practices, and local healthcare infrastructure, which could impact T2DM risk and management.

3.8 Assumptions

- The HAALSI study assumed that the prevalence of T2DM in rural South Africa would be influenced by traditional risk factors such as age, obesity, and physical inactivity. It also assumed that cultural and lifestyle differences in rural populations would affect T2DM incidence and management differently compared to urban areas.
- The study assumed that self-reported data on medication use and medical history would be reliable indicators for assessing T2DM prevalence and management among participants. It also presumed that the methods used to measure fasting glucose levels and HbA1c were sufficient for diagnosing T2DM accurately in this population.
- HAALSI assumed that the demographic and health data collected from older, rural South Africans would provide meaningful insights into the broader patterns of T2DM prevalence and risk factors. The study also assumed that longitudinal follow-up data would help identify trends and causal relationships in T2DM development over time.

CHAPTER 4

4.0 RESULTS

4.1. Progression of type two diabetes among the aged in Agincourt Mpumalanga province, South Africa

The study's results, which were formulated in accordance with the specified objectives, are presented in this chapter. It comprises lifestyle, health, and sociodemographic aspects of the respondents. The chapter also lists the risk factors for both waves 1 and 2 as well as the prevalence of type 2 diabetes. This section also looks at the relationship between diabetes and some selected risk factors.

4.2 Socio-demographic characteristics of the HAALSI population

According to Table 4.1, the socio demographic factors of the HAALSI population in Wave 1 for age distribution, the majority of participants fall within the age groups of 50-59 (27.85%) and 60-69 (26.56%). There is a notable proportion of participants aged 70 and above, with 18.6% falling into the 70-79 age group and 7.43% aged 80 and above. The largest marital status category is currently married/partnered, comprising 55.05% of participants. A significant portion of the sample is widowed, representing 27.74% of participants. Separated/divorced individuals make up 12.29% of the sample, while never-married individuals constitute only 4.92%.

The majority of participants have received no formal education (42.44%) or have completed some primary education (36.66%). A smaller percentage have attained some secondary education (13.15%), while only 7.75% have completed secondary education or more. The majority of participants are from South Africa, accounting for 69.43% of the sample. Participants from Mozambique or other countries constitute 30.57% of the sample.

The largest employment status category is "Retired," with 71.08% of participants falling into this group. Employed individuals make up 17.42% of the sample, while homemakers represent 11.49%. The socio-demographic analysis of participants at follow-up in the HAALSI study wave 2 reveals distinctive trends in marital and employment statuses.

A significant proportion, comprising 47.51% of participants, were currently married, indicating prevalent stable relationships within the community. Additionally, 33.62% of participants are widowed, reflecting experiences of spousal loss among a substantial segment of the population. Separated/divorced individuals constitute 12.03% of participants, underscoring instances of relationship dissolution or disruption. A smaller fraction, representing 6.84% of participants, have never married, highlighting a segment of the population yet to enter into marital unions.

The majority of participants, accounting for 83.43%, are retired, signalling prevalent economic challenges and disengagement from the labour market within the community. Conversely, 14.97% of participants are employed, indicating a subset of individuals actively engaged in remunerative work or occupations. A smaller yet notable proportion, constituting 1.6% of participants, are categorized as homemakers, primarily involved in domestic duties and household management. Demographic variables don't change between the Waves, it is only the permanent variables that were used and according to the study, the report is on only those that changed between the surveys which are marital status and employment status for Wave 2.

Table 4.1 Socio-Demographic factors of the HAALSI population

VARIABLE	Wave 1 n (%)	Wave 2 n (%)
AGE		
40-49	366(19.56%)	
50-59	521(27.85%)	
60-69	497(26.56%)	
70-79	348(18.6%)	
80+	139(7.43%)	
MARITAL STATUS		
Never married	92(4.92%)	128(6.84%)
Separated/Divorced	230(12.92%)	225(12.03%)
Widowed	519(27.74%)	625(33.62%)
Currently married	1030(55.05%)	889(47.51%)
YEARS OF EDUCATION		
No formal education	794(42.44%)	
Some primary (1-7)	686(36.66%)	
Some Secondary (8-11)	246(13.15%)	
Secondary/more (12+)	149(7.75%)	
COUNTRY OF ORIGIN		
South Africa	1299(69.43%)	
Mozambique/others	572(30.57%)	
EMPLOYMENT STATUS		
Employed	326(17.42%)	280(14.97%)
Retired	1330(71.08%)	1561(83.43%)
Homemaker	215(11.49%)	30(1.6%)

4.3 Prevalence of health risk factors of diabetes

In Wave 1, the prevalence of obesity, as indicated by the BMI category, shows that 11.99% of participants fell into the obese category. This translates to 70 individuals out of the total. In Wave 2, the prevalence of obesity remains similar, with 14.31% of participants falling into the obese category, representing 80 individuals. Hypertension is explained in two folds, systolic and diastolic blood pressure. For systolic blood pressure in Wave 1, 8.62% of participants had values ≥ 140 whereas in Wave 2, this proportion increased to 17.11%. For diastolic blood pressure in Wave 1, 7.46% of participants had diastolic blood pressure of ≥ 90 . While in Wave 2, this proportion remained relatively stable at 11.90%. The prevalence of obesity remains high and relatively stable between the two waves, with a slight increase in Wave 2. However, concerning trends observed in hypertension, both systolic and diastolic blood pressure levels indicate an increase in the prevalence of hypertension in both Waves. According to Table 4.2 the diabetes prevalence and associated risk factors at Wave 1 and follow-up in the HAALSI study for Wave 2, for all participants, the prevalence of diabetes at follow-up is 11.49%, with 215 individuals affected and 1656 unaffected.

Individuals who are widowed have the highest prevalence of diabetes (11.92%), followed closely by those who are currently married/partnered (12.04%). Retired individuals have a higher prevalence of diabetes (12.36%) compared to employed individuals (7.86%). Participants with high-risk waist circumference and obesity have higher prevalence rates of diabetes. Individuals with systolic blood pressure ≥ 140 mmHg and diastolic blood pressure ≥ 90 mmHg exhibit elevated prevalence rates of diabetes. Participants with glucose levels ≥ 11 mmol/L have a prevalence rate of 100%, indicating that all individuals with elevated glucose levels have been diagnosed with diabetes. Participants with lower daily fruit and vegetable

intake tend to have higher prevalence rates of diabetes, especially those consuming 0 servings per day.

Table 4.2 Prevalence of health and lifestyle risk factors of Diabetes

VARIABLE	Wave 1(%)	Wave 2(%)
BODY MASS INDEX		
Underweight	0	2.41
Normal weight	5.40	7.63
Overweight	8.14	14.98
Obese	11.99	14.31
ALCOHOL INTAKE		
Yes	6.35	9.98
No	9.27	12.41
SMOKING STATUS		
Yes	5.41	7.67
No	8.70	12.18
HEMOGLOBIN		
<8	15.00	6.76
<11 _≥ 8	12.73	11.37
≥11	7.01	11.79
GLUCOSE LEVELS		
< 11	2.55	2.53
≥ 11	100	100

BLOOD PRESSURE LEVELS		
<i>Systole</i>		
<140	7.60	9.98
≥140	8.62	17.11
<i>Diastol</i>		
<90	8.20	11.40
≥90	7.46	11.90
WAIST CIRCUMFERENCE		
Low risk	2.39	3.99
High risk	9.24	12.93

Table 4.3. Fruits and vegetables intake among the HAALSI population

VARIABLES	Wave 1(%)	Wave 2(%)
FRUITS INTAKE		
0	6.79	12.29
1-2	15.71	25.39
3-4	16.76	17.87
5-6	25.52	27.59
7	7.75	13.04
VEGETABLES INTAKE		
0	6.10	6.10
1-2	17,75	17.75
3-4	13.19	13.19

5-6	21.23	21.23
7	8.33	8.33

4.4 Diabetes prevalence Wave 1 and 2

According to Figure 4.1, the diabetes prevalence of participants at baseline in the HAALSI study (Wave 1) indicates that that 8.02% (150 participants) were diagnosed with diabetes, while the majority 91.98% (1721 participants) did not have the condition. Also, Wave 2 indicates that 11.49% (215 participants) were diagnosed with diabetes, while 88.51% did not have the condition. A notable trend was indicated by the fact that the overall prevalence of diabetes rose from 8.02% in Wave 1 to 11.49% in Wave 2. From the analysis the difference in diabetes prevalence in both waves is 3.47.

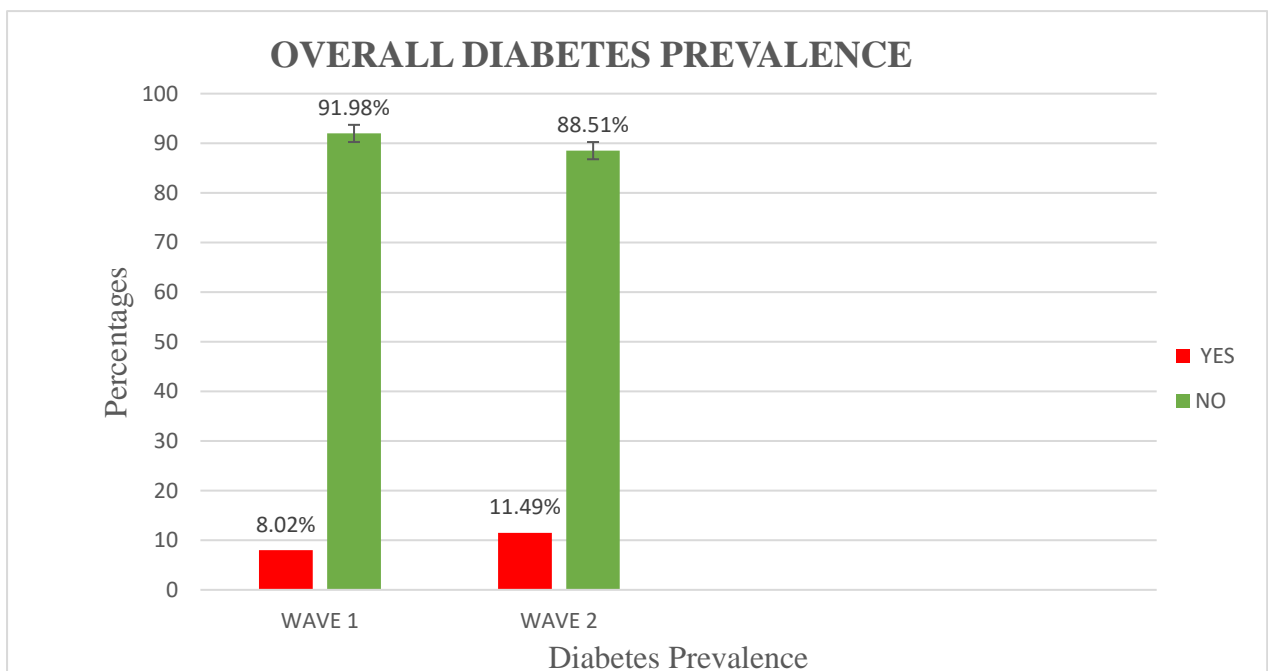
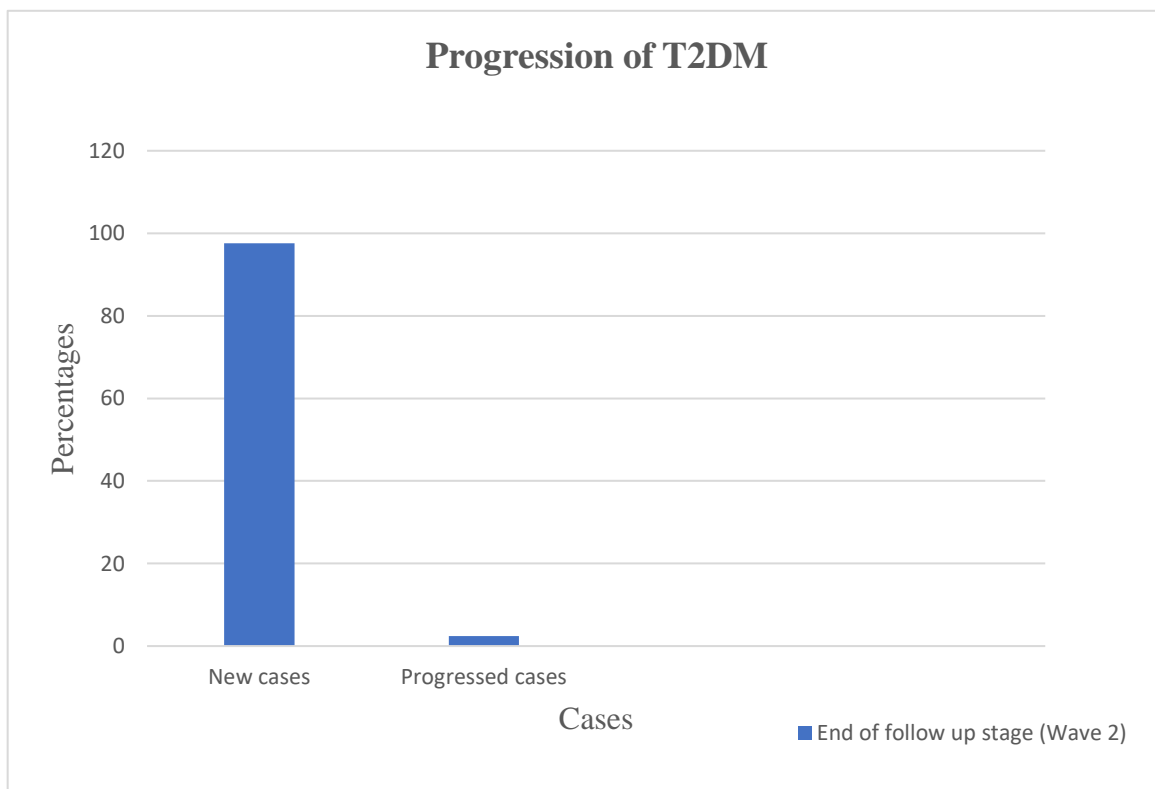


Figure 4.1 Diabetes Prevalence in Wave 1 & 2 of the HAALSI study

4.5 Progression of T2DM in Wave 1 and 2

According to figure 4.2 of the HAALSI study, the progression of type 2 diabetes mellitus (T2DM) among participants reveals notable trends. Out of the 1,871 individuals studied, 97.59% were newly diagnosed with T2DM at baseline (wave 1), indicating a significant incidence rate. Notably, 97% of those initially without diabetes in wave 1 developed T2DM by wave 2, highlighting the rapid progression within the HAALSI cohort. Moreover, during the follow-up period, 2.41% of the initially identified cases advanced, totalling 45 individuals.

Figure 4.2: Progression of T2DM in Wave 1 and 2 from the HAALSI study



4.6 Multivariate logistic regression

In this study, the factors that predicted the presence of diabetes in older adults were body mass index, waist circumference, and participant age. From the multivariate analysis run, participants aged 40-49 years were 0.6 (AOR=0.35; CI=0.14-0.90) times less likely to be diabetic when compared to those who were less than the age of 40 adjusting for all the other variables. Those aged 70-79 years were 1.47 times more likely to be diabetic (AOR=1.47; CI=0.71-3.05).

Compared to participants with a waist circumference below 80cm, high-risk persons or those with a waist circumference >80cm had a 2.39 (AOR=2.39; CI=1.09-5.23) times higher likelihood of having diabetes. Furthermore, compared to their underweight counterparts, those with normal and overweight body mass indices were 0.47 (AOR=0.53; CI=0.33-0.85) and 0.34 (AOR=0.66; CI=0.44-0.99) times less likely to have diabetes, respectively.

According to Table 4.4 below, this is the multivariate logistic regression analysis conducted at Wave 1 of the HAALSI study.

Individuals aged 40-49 years have significantly lower odds of diabetes compared to those under 40 years (AOR: 0.35, p-value: 0.030). There are no significant differences in diabetes odds among other age groups compared to those under 40 years. No significant associations are observed between marital status categories and diabetes odds. There are no significant associations between different levels of education and diabetes odds. Participants from Mozambique/Others have lower odds of diabetes compared to those from South Africa, but the difference is not statistically significant. There are no significant associations between employment status categories and diabetes odds. Participants with high-risk waist circumference have significantly higher odds of diabetes compared to those with low-risk waist circumference (AOR: 2.39, p-value: 0.030). Normal BMI is associated with significantly lower

odds of diabetes compared to being underweight (AOR: 0.53, p-value: 0.009). Being overweight also shows lower odds of diabetes, but the association is marginally significant (p-value: 0.050). No significant associations are observed between blood pressure, hemoglobin levels, smoking, alcohol consumption, daily fruit intake, and daily vegetable intake, and diabetes odds. These findings highlight the significant associations between health-related characteristics, such as waist circumference and BMI, and diabetes odds, while other factors like age, education, marital status, country of origin, employment status, and lifestyle characteristics show no significant associations with diabetes odds at Wave 1 of the HAALSI study.

Table 4.4 Multivariate logistic regression (wave 1)

Multivariate logistic regression			
Variables	Categories	AOR (CI)	P-value
Age group	< 40	Ref	
	40-49	0.35(0.14-0.90)	0.030*
	50-59	0.71(0.33-1.55)	0.389
	60-69	1.16(0.56-2.41)	0.683
	70-79	1.47(0.71-3.05)	0.55
	80+		
Marital status	Never married	Ref	
	Separated/divorced	0.88(0.26-2.90)	0.829
	Widowed	0.83(0.27-2.54)	0.741

	Currently married/ partnered	1.17(0.40-3.45)	0.776
Years of education	No formal education	Ref	
	Some primary (1-7)	0.92(0.61-1.40)	0.713
	Some secondary (8-11)	0.89(0.46-1.69)	0.713
	Secondary or more (12+)	1.39(0.63-3.04)	0.415
Country of origin	South Africa	Ref	
	Mozambique/Others	0.73(0.46-1.48)	0.172
Employment status	Employed	Ref	
	Retired	1.31(0.73-2.36)	0.361
	Homemaker	1.36(0.65-2.85)	0.411
Health-related characteristics			
Waist circumference	Low risk	Ref	
	High risk	2.39(1.09-5.23)	0.030*
Body mass index	Underweight	Ref	
	Normal	0.53(0.33-0.85)	0.009*
	Overweight	0.66(0.44-0.99)	0.050*
	Obese		

Blood pressure (mean			
systolic)	<140	Ref	
	≥140	0.95(0.63-1.45)	0.839
Blood pressure (mean			
diastolic)	<90	Ref	
	≥90	0.93(0.58-1.51)	0.782
Hemoglobin			
	<8	Ref	
	< 8 ≥ 11	0.83(0.31-2.23)	0.76
	≥11	0.41(0.16-1.06)	0.782
Lifestyle			
characteristics			
Smoking (ever			
smoked)	Yes	Ref	
	No	1.18(0.66-2.11)	0.57
Alcohol (ever			
consumed alcohol)	Yes	Ref	
	No	1.25(0.81-1.91)	0.311
Diet (daily fruit			
intake)	0	Ref	
	1-2	0.99(0.54-1.84)	0.982

2	1.16(0.68-1.98)	0.596
3	1.26((0.71-2.21)	0.431
4	0.90(0.43-1.89)	0.787
5	1.17(0.56-2.61)	0.698
6	1.94(0.57-6.58)	0.285
7	0.83(0.39-1.78)	0.632

Diet (daily vegetable

intake)

0	Ref	
1	1.12(0.37-3.36)	0.837
2	1.27(0.46-3.49)	0.645
3	0.82(0.30-2.28)	0.704
4	0.77(0.26-2.26)	0.637
5	1.37(0.46-4.09)	0.571
6	1.53(0.42-5.55)	0.52
7	1.11(0.33-3.73)	0.869

CHAPTER 5

5.0 DISCUSSION

5.1 Discussion of results

The study aimed to assess the progression of type 2 diabetes mellitus (T2DM) among the elderly population in South Africa, specifically in Mpumalanga, utilizing data from the HAALSI study spanning from 2014 to 2022. Here's a breakdown of the objectives and methods outlined in the study:

- Describe the proportion of adults living with diabetes during the initial phase (Wave 1).
- Monitor and document the development and progression of T2DM among the elderly over an 8-year period.
- Examine the correlation between identified risk factors and the progression of T2DM within the elderly population.

A descriptive method was used and secondary HAALSI was used and cleaned using Stata 18. A descriptive analysis provided an overview of the data while multivariate analysis was likely used to explore the relationship between identified risk factors and the progression of T2DM among the elderly. It appears the study aimed to provide insights into the prevalence, progression, and associated risk factors of T2DM among the elderly population in South Africa over an extended period. The forthcoming chapter will likely present a detailed interpretation and summary of the results obtained from the analysis.

5.2 Socio Demographic factors of the HAALSI population

The socio-demographic characteristics of participants at baseline (Wave 1) of the HAALSI shed light on the diverse composition of the study population. The distribution of participants across different age groups revealed a significant representation of older adults in the HAALSI cohort. Notably, those aged 50-59 years represented the largest segment (27.85%) (Gómez-

Olivé et al., 2018), followed closely by individuals aged 60-69 years (26.56%) and 70-79 years (18.6%). This age distribution underscored the relevance of studying health issues, such as T2DM, among older age groups in South Africa. Participants' marital status reflected varied relationship statuses within the HAALSI cohort. A substantial proportion of individuals were currently married or partnered (55.05%), indicating stable unions. However, significant percentages were widowed (27.74%) or separated/divorced (12.29%) (Gómez-Olivé et al., 2018), reflecting experiences of marital dissolution or loss. These marital status categories may have influenced health outcomes, including T2DM progression, through factors such as social support and lifestyle changes.

Education levels among HAALSI participants demonstrated considerable diversity, with implications for health literacy and access to resources. A portion of participants had received no formal education (42.44%) or only completed primary education (36.66%) (Gómez-Olivé et al., 2018). Relatively fewer individuals had attained some secondary education (13.15%), while the smallest proportion had completed secondary education or higher (7.75%). Education played a crucial role in understanding and managing T2DM, influencing factors such as self-care practices and healthcare utilization. The majority of HAALSI participants originated from South Africa (69.43%), reflecting the study's focus on the Agincourt Health and Socio-Demographic Surveillance System (HDSS) site. However, a significant minority (30.57%) hailed from Mozambique or other countries, highlighting the international diversity within the cohort (Gómez-Olivé et al., 2018).

This diversity may have influenced T2DM progression through cultural factors, healthcare access, and migration-related stressors. Participants' employment status provided insights into their economic circumstances and potential barriers to healthcare access. A considerable proportion were unemployed (71.08%), indicating socioeconomic challenges. Additionally, a smaller fraction was employed (17.42%), while a notable percentage identified as homemakers

(11.49%) (Gómez-Olivé et al., 2018). Unemployment and financial strain may have impacted T2DM management through limitations in accessing medications, healthy foods, and healthcare services. The HAALSI research underscored disparities in T2DM burden across socio-demographic groups. Individuals with lower education levels, limited access to healthcare, and socioeconomic disadvantages were at higher risk of developing and experiencing complications from T2DM.

These findings highlighted the importance of addressing social determinants of health in T2DM prevention and management strategies. Furthermore, HAALSI emphasized the need for early detection and intervention to mitigate the impact of T2DM on older adults' health and well-being. Integrated healthcare approaches, community-based interventions, and health promotion initiatives were essential for supporting T2DM management among the elderly in South Africa. By addressing socio-demographic factors and health disparities, HAALSI aimed to contribute to more effective T2DM prevention and control efforts in the region.

The HAALSI study's follow-up (Wave 2) reveals shifts in socio-demographic characteristics among elderly participants in South Africa, shedding light on the evolving dynamics and implications for T2DM progression (Gómez-Olivé et al., 2018). Marital status changes notably, with a decrease in currently married/partnered individuals (from 55.05% to 47.51%) and an increase in widowed participants (from 27.74% to 33.62%) (Gómez-Olivé et al., 2018). Additionally, slight increases are observed in the percentages of never married and separated/divorced individuals. These changes impact social support networks crucial for managing chronic conditions like T2DM (Gómez-Olivé et al., 2018).

Similarly, employment status experiences shifts, with a decrease in unemployment (from 71.08% to 83.43%) but a slight rise in employment rates (from 17.42% to 14.97%) (Gómez-

Olivé et al., 2018). These alterations may influence access to resources and healthcare, affecting T2DM management among the elderly (Gómez-Olivé et al., 2018). Persistent high unemployment underscores socioeconomic challenges faced by South Africa's elderly, exacerbating T2DM outcome disparities (Gómez-Olivé et al., 2018).

In summary, findings from Wave 2 of the HAALSI study underscore the dynamic socio-demographic characteristics' implications for T2DM progression among South Africa's elderly population (Gómez-Olivé et al., 2018). Addressing these factors is essential in developing effective strategies for T2DM prevention and management (Gómez-Olivé et al., 2018).

5.3 Progression of Diabetes prevalence and risk factors

The baseline findings from the HAALSI study shed light on the prevalence of diabetes and its associated risk factors among the elderly population. At baseline, the overall prevalence of diabetes among participants was 8.02%, indicating a significant presence of this chronic condition within the HAALSI cohort. This finding underscores the importance of addressing diabetes as a public health concern in South Africa. According to Indigo Wellness Index in 2019, South Africa is one of the unhealthiest countries with a high surge in glucose levels, high BMI and obesity among its inhabitants. There was a notable increase in diabetes prevalence with advancing age. Participants aged 70-79 years and 80+ exhibited the highest prevalence rates at 11.78% and 7.91%, respectively, compared to younger age groups (Gómez-Olivé et al., 2018).

Concurrently, other papers indicate that women of child bearing age between 15-24 and 45-54 are susceptible to T2DM (Chivese, 2019). The chi-square statistic for age groups shows a significant association with diabetes prevalence ($X^2 = 20.61, p < 0.001$). This indicates that there is a significant relationship between age groups and diabetes prevalence, suggesting that older age groups are more likely to have diabetes compared to younger age groups. While no

significant association was found between marital status and diabetes prevalence, widowed individuals showed a slightly higher prevalence (8.09%) compared to other marital status categories.

The chi-square statistic for marital status indicates no significant association with diabetes prevalence ($X^2 = 3.57$, $p = 0.312$). This suggests that marital status may not be strongly related to diabetes prevalence among the participants. There was no significant association between education levels and diabetes prevalence, indicating that diabetes affects individuals across various educational backgrounds. The chi-square statistic for years of education also shows no significant association with diabetes prevalence ($X^2 = 0.89$, $p = 0.828$). This suggests that the level of education may not be strongly related to diabetes prevalence in this population. Participants from Mozambique/Others exhibited a lower diabetes prevalence (6.12%) compared to those from South Africa (8.85%), suggesting potential differences in diabetes risk factors between populations according to a study from Indigo Wellness Index, 2019).

It also states that South Africa is noted to be the unhealthiest country with a high prevalence rate of T2DM. The chi-square statistic for country of origin indicates a significant association with diabetes prevalence ($X^2 = 4.03$, $p = 0.045$). This suggests that there may be differences in diabetes prevalence between participants from South Africa and those from Mozambique or other countries. T2DM is more prevalent in urban African areas than the rural areas (Motala, 2022).

Although not statistically significant, employed individuals showed a lower diabetes prevalence (5.52%) compared to the unemployed and homemakers. The chi-square statistic for employment status indicates no significant association with diabetes prevalence ($X^2 = 3.36$, $p = 0.186$). This suggests that employment status may not be strongly related to diabetes prevalence among the participants. Participants categorized as high-risk based on waist

circumference showed a significantly higher diabetes prevalence (9.24%) compared to those at low risk. Participants classified as overweight (8.14%) and obese (11.99%) exhibited higher diabetes prevalence compared to those with normal BMI. Participants with hemoglobin levels below 11 g/dL had a higher diabetes prevalence compared to those with higher levels. Notably, all participants with glucose levels ≥ 11 mmol/L were diagnosed with diabetes, highlighting the importance of glucose monitoring for diabetes detection. Participants who ever smoked showed a slightly lower diabetes prevalence (5.41%) compared to non-smokers.

These results indicated that individuals who had not smoked in the previous 24 hours were more likely to be diabetic than non-diabetic compared to those that had smoked. This finding contradicts that of Pan et al. (2015), who found that smoking cigarettes was one of the most important modifiable risk factors for diabetes. Those who ever consumed alcohol exhibited a lower diabetes prevalence (6.35%) compared to non-drinkers. There was no clear association between daily fruit or vegetable intake and diabetes prevalence. These findings align with previous research indicating that advancing age, obesity, and certain health conditions such as hypertension and dyslipidaemia are significant risk factors for diabetes (Gómez-Olivé et al., 2018).

Chi-square tests were performed for various health-related and lifestyle characteristics, such as waist circumference, body mass index, blood pressure, hemoglobin levels, smoking, alcohol consumption, and daily fruit and vegetable intake. The p-values associated with each test help determine whether these factors are significantly associated with diabetes prevalence in the study population. Overall, the chi-square tests and associated p-values provide valuable insights into the factors associated with diabetes prevalence among the participants in the HAALSI study at baseline. The association between lifestyle factors such as smoking and alcohol consumption with diabetes prevalence is consistent with existing literature (Bloomfield et al., 2014). Overall, the baseline findings from the HAALSI study provide valuable insights

into the prevalence and socio-demographic determinants of diabetes among the elderly population in South Africa.

In Wave 2 of the HAALSI study, several socio-demographic, health-related, and lifestyle characteristics were examined in relation to the prevalence and risk factors of Type 2 Diabetes Mellitus (T2DM) among the aged population. According to the findings of the HAALSI study's second wave, the overall prevalence of T2DM among the participants was 11.49%. The South African government implemented a sugar tax in 2018 and this was done to curb the overconsumption of sugar which was being linked to the growing burden of Non-communicable diseases like DM (South African National Treasury, 2016). This indicated a substantial burden of diabetes within the studied population. Socio-demographic characteristics such as marital status and employment status did not show significant associations with T2DM prevalence, as evidenced by non-significant chi-square values and p-values ($p > 0.05$).

However, certain health-related characteristics demonstrated notable associations with T2DM prevalence. For instance, individuals with high waist circumference and elevated body mass index (BMI) were at significantly higher risk of T2DM ($p < 0.001$). This aligns with established literature indicating the strong correlation between obesity and T2DM development. Additionally, participants with elevated mean systolic blood pressure (≥ 140) were more likely to have T2DM compared to those with lower systolic blood pressure levels ($p < 0.001$). Interestingly, there was no significant association between mean diastolic blood pressure and T2DM prevalence ($p = 0.790$).

Furthermore, hemoglobin levels did not exhibit a significant association with T2DM prevalence ($p > 0.05$). However, glucose levels ≥ 11 were strongly associated with T2DM prevalence, as expected ($p < 0.001$). In terms of lifestyle characteristics, ever smoking was associated with a higher prevalence of T2DM ($p = 0.027$), while alcohol consumption did not

show a significant association ($p > 0.05$). Daily fruit intake did not demonstrate a significant association with T2DM prevalence ($p = 0.493$), but daily vegetable intake showed a significant association ($p = 0.034$), with lower vegetable intake correlating with higher T2DM prevalence. These findings from the HAALSI study's second wave highlight the multifaceted nature of T2DM risk factors among the aged population in South Africa. Factors such as obesity, elevated blood pressure, glucose levels, and smoking status play significant roles in T2DM prevalence according to Grundlingh et al., 2022. Additionally, dietary habits, particularly vegetable intake, emerge as potential modifiable risk factors for T2DM prevention and management.

5.4 Association between socio-demographic and health risk factors and diabetes

The analysis of diabetes prevalence according to table 4.2 and 4.3 and its associated risk factors at baseline in the HAALSI study in wave 1 provides significant insights into the socio-demographic, health-related, and lifestyle characteristics of the participants. Diabetes prevalence increases with age, with the highest prevalence observed in the 70-79 age group (11.78%). Currently married/partnered individuals have a lower prevalence of diabetes compared to other marital status categories. Participants with some secondary education (8-11 years) have the lowest prevalence of diabetes (6.50%).

Participants from Mozambique/Others have a slightly lower prevalence of diabetes compared to those from South Africa. Employed individuals have a lower prevalence of diabetes compared to unemployed individuals. Participants with high-risk waist circumference and obesity have higher diabetes prevalence. Participants with systolic blood pressure ≥ 140 mmHg and diastolic blood pressure ≥ 90 mmHg have higher diabetes prevalence. Participants with hemoglobin < 8 g/dL and glucose level ≥ 11 mmol/L have higher diabetes prevalence. Participants who have ever smoked or consumed alcohol have lower diabetes prevalence

compared to those who have never smoked or consumed alcohol. Participants with higher daily fruit and vegetable intake tend to have lower diabetes prevalence.

The prevalence of diabetes mellitus was used as a measure to ascertain its progression by comparing findings of prevalence for Wave 1 and Wave 2. A notable trend was indicated by the fact that the overall prevalence of diabetes rose from 8.02% in wave 1 to 11.49% in wave 2. A comparable pattern in the course of the disease was also observed in the prevalence of diabetes for the different risk factors. The prevalence of diabetes among participants who were married saw a progression from 8.74% in wave 1 to 12.04% in wave 2. Similarly, the prevalence of diabetes in participants who were retired rose from 8.5% in wave 1 to 12.36% in wave 2.

For health-related characteristics, diabetes prevalence among overweight participants rose from 8.14% in wave 1 to 14.98% in wave 2. Participants who had systolic and diastolic blood pressures of >140/90mmhg also had increased prevalence of diabetes mellitus in wave 2 (17.11% and 11.90% respectively) as compared to wave 1 (8.62% and 7.46% respectively). Remarkably, the prevalence of diabetes decreased in wave 2 for participants with low hemoglobin (<8g/dl), going from 15% in wave 1 to 6.76%.

In terms of lifestyle factors, the prevalence of diabetes rose from 4.81% in wave 1 to 7.67% in wave 2 among individuals with a history of smoking. Similarly, for consumers of alcohol, there was a progression in diabetes prevalence from 6.35% in wave 1 to 9.68% in wave 2. For respondents who did not consume fruits and vegetables every day, the prevalence of diabetes increased from 7.75% and 8.33% in Wave 1 to 13.04% and 7.26% in Wave 2. Their counterparts who consumed fruits and vegetables experienced an increase in diabetes prevalence from 6.79% and 6.10% in Wave 1 to 12.29% and 16.52% in Wave 2. Table 4.3 and 4.4 below demonstrate the progression of type 2 diabetes among the elderly. (Masilela, C.,

Adeniyi, O.V. & Benjeddou, M, 2022). The HAALSI study provided crucial insights into the relationship between T2DM, obesity, and hypertension. Research from HAALSI confirmed that obesity and hypertension are prevalent among individuals with T2DM in South Africa, mirroring global trends (Gómez-Olivé et al., 2017). The study revealed that a significant proportion of individuals with T2DM in South Africa were overweight or obese, aligning with the estimated 80% prevalence globally (Bray, 2017). Additionally, HAALSI highlighted a substantial prevalence of hypertension among T2DM patients within the South African population (Gupta et al., 2017). These findings underscored the interplay between obesity, hypertension, and T2DM, emphasizing the challenges in managing diabetes effectively in the presence of these comorbidities. Consequently, HAALSI reinforced the importance of lifestyle modifications, blood pressure control, and adherence to medical advice in optimizing diabetes management and reducing associated health risks.

5.5 Multivariate logistic regression (wave 1)

The multivariate logistic regression analysis, as part of the HAALSI study, offers valuable insights into the nuanced relationship between various socio-demographic, health-related, and lifestyle factors and the progression of Type 2 Diabetes Mellitus (T2DM) among the elderly populace. Notably, individuals aged 40-49 exhibit significantly lower adjusted odds ratios (AOR) for T2DM compared to those under 40 (AOR=0.35, $p=0.030$), emphasizing the potential influence of age on T2DM risk (Gómez-Olivé et al., 2018). However, no significant disparities in T2DM prevalence emerge among older age groups. Additionally, high waist circumference emerges as a significant risk factor for T2DM (AOR=2.39, $p=0.030$), underscoring the critical role of central obesity in T2DM susceptibility (Gómez-Olivé et al., 2018). According to Chivese (2019), African women of childbearing ages between 15-24 and 45-54 are significantly prone to T2DM and pre-diabetes, indicating gender-specific vulnerabilities to metabolic disorders. Moreover, maintaining a normal BMI appears protective

against T2DM development, as it is associated with lower odds of T2DM compared to being underweight (AOR=0.53, p=0.009), highlighting the adverse effects of both low and high BMI on T2DM risk (Gómez-Olivé et al., 2018).

Interestingly, the study does not find significant associations between T2DM prevalence and various socio-demographic factors such as marital status, education level, country of origin, or employment status, nor with health indicators like blood pressure levels, hemoglobin levels, smoking, alcohol consumption, or daily fruit and vegetable intake (Gómez-Olivé et al., 2018). These findings underscore the complexity of T2DM etiology and suggest that lifestyle factors such as obesity may play a more significant role in disease progression among the elderly in South Africa. The HAALSI study's first wave sheds light on the intricate interplay between diverse factors and the progression of T2DM in South Africa's elderly population. Central obesity emerges as a crucial risk factor, emphasizing the importance of targeted lifestyle interventions aimed at weight management and reducing abdominal adiposity. Understanding these associations is pivotal for guiding tailored interventions to prevent and manage T2DM among the elderly in South Africa, thereby alleviating the burden of this chronic condition and improving overall health outcomes (Gómez-Olivé et al., 2018; Chivese, 2019).

CHAPTER SIX

6.0 Conclusions and Recommendations

6.1 Conclusion

The HAALSI study meticulously tracked diabetes prevalence and associated risk factors among elderly rural South Africans from 2014 to 2022. Diabetes prevalence increased significantly from 8.02% in Wave 1 to 11.49% in Wave 2, indicating a concerning 3.47% rise over the study period. Socio-demographic factors like age, marital status, and unemployment remained prevalent, with slight variations between waves. Health-related characteristics such as high-risk waist circumference and obesity surged over time, alongside lifestyle factors like smoking and alcohol consumption. Dietary habits also played a crucial role, impacting diabetes progression. Overall, the study underscores the urgent need for targeted interventions addressing socio-demographic, health-related, and lifestyle factors contributing to the escalating burden of diabetes in rural elderly populations in South Africa.

6.2 Recommendations

Based on the findings of the HAALSI study, several recommendations emerge to address the rising burden of diabetes among elderly populations in rural South Africa:

1. Targeted Health Education: Health officials, community leaders, NGOs should raise awareness about diabetes risk factors, symptoms, and prevention through culturally sensitive programs accessible to all age groups in Mpumalanga. Also, they should promote healthy weight, blood pressure control, and lifestyle modifications emphasizing diet and exercise for older adults in Mpumalanga.

2. Social Support Interventions: Community leaders and Stakeholders should develop community-based initiatives to support older adults, particularly those who are widowed or divorced, in managing chronic conditions like T2DM.

3. Access to Healthcare Services: The National Department of Health should improve healthcare access for economically disadvantaged older adults in Mpumalanga through subsidies and community-based healthcare initiatives. Strengthen T2DM screening, especially among high-risk groups, with regular health check-ups and screenings.

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APPENDIX ONE: ETHICAL CLEARANCE LETTER



OUR REF: ENSIGN/IRB/EL/SN-245
YOUR REF:

January 2, 2024.

INSTITUTIONAL REVIEW BOARD SECRETARIAT

**Gracia Helarie Fraikue
Ensign Global College
Kpong.**

Dear Gracia,

ETHICAL CLEARANCE TO UNDERTAKE POSTGRADUATE RESEARCH

At the General Research Proposals Review Meeting of the *INSTITUTIONAL REVIEW BOARD (IRB)* of Ensign Global College held on Thursday, December 21, 2023, your research proposal entitled **“Progression of Type Two Diabetes among the Aged in Agincourt Mpumalanga Province, South Africa”** was considered.

You have been granted Ethical Clearance to collect data for the said research under academic supervision within the IRB's specified frameworks and guidelines.

We wish you all the best.

Sincerely,

A handwritten signature in blue ink, appearing to read "Rebecca Acquah-Arhin", with a flourish at the end.

Dr. (Mrs.) Rebecca Acquah-Arhin
IRB Chairperson