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RISKS AND CAUSES OF DEATH AMONG YOUNG PEOPLE IN GHANA: A STUDY OF KINTAMPO HEALTH AND DEMOGRAPHIC SURVEILLANCE SYSTEM

BY

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ACCEPTANCE

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DECLARATION

I, MARIAN W. A. KPAKPAH, hereby declare that except for references to other people's work, which have been duly acknowledged, this is the result of my own research and it has neither in part nor in whole been presented for another degree.

20TH NOVEMBER 2023

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DEDICATION

This thesis is dedicated to my family for their understanding and support during the time I had to undertake this study. I thank you all.

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ABSTRACT

Although young people constitute an important human resource, they experience complex challenges during their transition to adulthood leading to increased mortality. This preventable loss of life not only affects the quality of life they experience, but also hinders their ability to contribute to national development. This study examines the factors affecting youth mortality and its impact on Youth Life Expectancy (YLE), using data from the Kintampo Health and Demographic Surveillance System (KHDSS) in Ghana from 2005 to 2015. The study identifies the broad causes of death, namely, infectious diseases, non-communicable diseases (NCDs), maternal causes and injuries/trauma. It further employs life table analysis to quantify potential gains in YLE when these broad causes of death are either eliminated or reduced in line with the Sustainable Development Goals (SDGs). Distinct sex and age-related mortality patterns emerge from the analysis, underscoring the need for targeted interventions. The research identifies significant gender disparities in YLE and mortality causes, revealing that females generally have a higher life expectancy than males. Additionally, both males and females experience different patterns of mortality risk by age group and cause of death. For example, among the 10 to 14 year age groups, males stand to gain more in YLE by reducing NCDs, whereas for females of the same age group, the elimination of infectious diseases provides the most benefit. Between ages 15 and 24 however, reducing injuries and trauma, yields the highest gains in YLE for both sexes. These findings have crucial policy implications, particularly as they align with SDG 3, which aims to achieve well-being and healthy lives for all. The thesis situates these findings within the broader national context, highlighting the urgency to address youth mortality, especially where the burden is heaviest among the different age groups. Policy recommendations take into account the Ghana's epidemiological transition and the triple burden of disease. The recommendations call for gender and age-specific interventions,

increased healthcare access and public awareness campaigns targeting young people. The thesis concludes that, addressing the specific causes of death among young people can significantly enhance YLE and contribute to meeting SDG 3 targets. The study also identifies a number of gaps for future research, including the need for longitudinal studies to track the long-term impacts of targeted interventions, as well as research into behavioural and socio-economic factors influencing youth mortality.

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
AU	African Union
CDR	Crude Death Rate
DALY	Disability Adjusted Life Years
DSA	Demographic Surveillance Area
DSS	Demographic Surveillance System
ESPAD	European School Survey on Alcohol and Substance Abuse
ETT	Epidemiological Transition Theory
GBD	Global Burden of Disease
GDP	Gross Domestic Product
HBSC	Health Behaviour in School Aged Children
HICs	High Income Countries
HIV	Human Immunodeficiency Virus
ICD	International Classification of Disease
KA-HDSS	Kilite-Awlealo Health and Demographic Surveillance System
KHDSS	Kintampo Health and Demographic Surveillance System
KHRC	Kintampo Health Research Centre
LMIC	Low- and Middle-Income Countries
MTTD	Motor Traffic and Transport Department
NCDs	Non-Communicable Diseases
NHDSS	Navrongo Health and Demographic Surveillance System
PHC	Population and Housing Census
SDGs	Sustainable Development Goals
STIs	Sexually Transmitted Infections
TB	Tuberculosis
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICEF	United Nations Children's Fund
UNFPA	United Nations Population Fund
VA	Verbal Autopsy
WHO	World Health Organisation
YLE	Youth Life Expectancy
YRBS	Youth Risk Behaviour Survey

CHAPTER ONE

INTRODUCTION

1.1 Background of the study

Young people are a vital human resource within every nation, playing pivotal roles in both economic development and societal progress (Chandra-Mouli *et al.*, 2017; United Nations, 2019a). Ensuring their health and wellbeing, therefore, guarantees long-term results beneficial to all nations. Nonetheless, their transition from childhood to adulthood, presents them with a myriad of complex and challenging experiences along the pathway to adulthood. These events, which result from a number of factors, including globalisation, socio-economic and technological advancements, cultural transformations and health transitions, ultimately affect their lifespan and the quality of their lives (Patton *et al*., 2018; Sawyer *et al*., 2018).

Contrary to views that mortality is principally associated with infancy and old age, data in recent times have revealed a worrying trend with increasing rates of mortality among young people 10 to 34 years. Masquelier *et al* (2021) have reported high rates of mortality both in countries with high levels of poverty and armed conflicts, as well as in high income countries (Masquelier *et al*., 2021; Werdecker & Mueller, 2021). This is due to the homogeneous nature of young people across all societies, often as a result of risky and unhealthy behaviours. Young people are disproportionately affected by external factors such as violence, accidents and self-harm, with males being more vulnerable to these external causes than females[1] (Patton *et al*., 2009b). This contributes to a lower quality of life and premature mortality among this age group. More importantly, this burden of mortality is preventable, given the fact that this

[1] https://www.who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death

demographic group constitutes, close to a third of the global population, such preventable deaths contribute to a loss in years of potential lives of a population, as well as loss in productivity for nations (United Nations, 2019b).

In recent years, transformative changes have been observed, reshaping the patterns of health and disease across the global landscape. Consequently, young people, who constitute a significant proportion of the world's population, navigate a unique set of challenges and opportunities during this pivotal phase of life. The concept of the "epidemiological transition," as articulated by Omran (1971), underscores the shifting dynamics of disease patterns across different stages of development. According to the theory, societies transition from high mortality rates resulting from infectious diseases to a predominance of non-communicable diseases and other social determinants of health (Omran, 1971). This places young people at the crossroads of shifting health paradigms distinct from both children and older adults. Despite the distinctive characteristics and challenges, the health concerns of young individuals, especially the factors contributing to their mortality, receives minimal focus in comparison to other age groups.

This challenge arises, in part, from the perception that young people generally exhibit lower mortality rates compared to infants and children. Consequently, data specific to the causes of death and the demographic attributes of deceased young individuals remain scarce. This discrepancy in focus, has resulted in a dearth of data on cause-specific mortality of deceased young individuals as well as of their demographics. There is also insufficient examination of the potential impact of eliminating causes of death within this age group (Chisumpa *et al.*, 2019b; Kebede *et al.*, 2017; Ohene *et al.*, 2011; Okoroiwu *et al.*, 2020). Moreover, as the majority of fatalities occur in older age cohorts, existing studies tend to lump information on

causes of death among adults within the broad age range of 15 to 59 years. This practice obscures the distinct mortality patterns experienced by young individuals. (Werdecker & Mueller, 2021).

In the last half-century, global patterns of health and disease have been influenced by social, economic, environmental and political changes with causal mortality shifting from primarily infectious to social factors over the past decades. The impact of these changes on the health of young people differs from that of older age-groups (Chisumpa *et al*., 2019a; Masquelier *et al.,* 2021*;* Patton *et al.,* 2016*;* Singh *et al.,* 2013*)*. Mortality within the age group 10 to 34 years, varies by sex and across ages and location, with mortality rates lowest among people aged 10 to 14 years, compared to those 20 years and older. Additionally, females experience lower mortality than their male counterparts. A global analysis of deaths among young people from 1950 to 2019, showed that, despite overall reductions in mortality as a result of improvements in child survival, little progress has been made in reducing mortality in youth aged 15 to 24 years (Masquelier *et al.*, 2021; Werdecker & Mueller, 2021).

Ghana, like other developing countries generally has a challenge with regards to vital registration, which has led to inefficient and unreliable death registration records (Ohene *et al*., 2011). Consequently, there is inadequate literature on age-specific death mortality at national and sub-national levels. Moreover, the few studies available on causes of death in Ghana, have focused on certain categories of the population, in particular, infants, children under five, women and the elderly. Nevertheless, since 1995, data at the sub-national level has been accessible through three Health and Demographic Surveillance System (HDSS) sites. These sites were established to facilitate research on the factors influencing morbidity, mortality and fertility in Ghana. The sites collect longitudinal health and demographic information on a

dynamic cohort representing the entire population within a designated geographic area. The purpose of this study, therefore, is to examine the causes of death among young people between the ages of 10 and 34 years in the Kintampo North Municipality and Kintampo South District in the Bono East Region, over a ten-year period. It is expected that, the findings of this study will help guide policy and decision-making as well designing of interventions to facilitate progress towards achievement of national development goals as well as regional and global development commitments, such as the Africa Union Agenda 2063 (AU Agenda 2063) and the 2030 United Nations Sustainable Development Goals (SDGs).

1.2 Statement of the problem

The 2030 United Nations Sustainable Development Goals (SDGs) have become an establishing context for evaluating advancements in global health and growth (Sachs, 2012). The SDGs serve as a worldwide blueprint for promoting peace and prosperity for both humanity and the planet, both in the present and the future. In 2015, a total of one hundred and ninety-three countries pledged to undertake essential measures and work towards achieving 17 interconnected goals. These objectives aim to eradicate poverty, hunger, HIV and AIDS, and discrimination against women and girls by the year 2030. (World Health Organization, 2015). Each SDG goal has a number of targets and related indicators that each member state is expected to work towards. Particularly noteworthy is the scope of SDG 3, which is dedicated to "ensuring healthy lives and promoting well-being for all at all ages." This goal is measured by 13 targets and 28 indicators that are designed to tackle a wide range of health issues – from infectious diseases such as HIV and AIDS to the rising crisis of non-communicable diseases (NCDs) and external causes of morbidity and mortality.

Mortality statistics are a mirror of the situation of health prevalent in a population as well as the level of development. Thus, an explicable understanding of cause specific mortality is imperative to enable countries enhance the survival and longevity of their citizens (Lundquist *et al*., 2015). In countries like Ghana with huge youthful populations, the health of young people should not be merely seen as a health concern, but more importantly from the contribution of this demographic cohort to national development (Kyu *et al.*, 2018; Masquelier *et al*., 2021). Despite this factor, young Ghanaians are at risk as a result of various social and environmental factors, including migration, conflicts and climate change. Furthermore, young people in Ghana, just like their peers in other parts of Sub-Saharan Africa, face a myriad of challenges including poverty, unemployment, high disease burdens and inequalities, that compound their health and longevity. However, national development and the public health policies to address these issues remain largely inadequate (Sawyer *et al*., 2012; Streatfield *et al*., 2014). A study by Masquelier *et al*. (2021) presents a gloomy picture of mortality statistics in Sub-Saharan Africa. According to them, despite consistent declines in global youth mortality, the Sub-Saharan Africa region has seen a significant 20.8 percent increase in mortality among individuals aged 15 to 24 years (Masquelier *et al*., 2021). Concomitantly, existing research on cause-specific mortality in Ghana is conspicuously limited and often does not focus on the important age group of individuals between 10 and 34 years (S Abubakari *et al*., 2022; Awini *et al*., 2014; A Bawah *et al*., 2014). The unavailability of cause specific mortality data is likely to contribute to ineffective public health policies and interventions, which may result in the rise in youth mortality rates that are being observed.

Thus, utilising longitudinal data from the Kintampo North Municipality and Kintampo South District, this study seeks to examine the sociodemographic and behavioural factors contributing to youth mortality. The findings from this study are anticipated not only to enrich the existing

body of literature but also to inform public health strategies aimed at reversing the current mortality trends among the youth. It is expected to offer insights that could guide future public health initiatives in a direction that safeguards the health and well-being of Ghana's youth — thereby ensuring they are not just a demographic statistic, but a prioritised group whose health and well-being is entwined with of the nation's future.

1.3 Research questions

To address the research gaps identified, this study aims to answer the following investigatory questions:

1. What specific causes are most frequently associated with mortality among young people aged 10 to 34 years in the Kintampo North Municipality and Kintampo South District?
2. How have the primary causes of mortality evolved over a decade within this demographic group?
3. What demographic and socio-economic variables act as risk determinants that exacerbate mortality among individuals aged 10 to 34 years?
4. What is the projected impact on life expectancy within the 10 to 34 years, if specific causes of mortality are mitigated or eradicated, in line with the Sustainable Development Goals?

1.4 Rationale of the study

Mortality and morbidity have always been topics of interest to public health. Economic and social changes following the post-colonial era have brought about numerous opportunities and challenges. Certain transformations have positively impacted population health, including economic growth and improved accessibility to health interventions. On the flip side, some of

these changes have been linked to heightened exposure to risk factors, resulting in increased rates of morbidity and mortality. These include exposure to risks associated with non-communicable diseases (NCDs) or the resurgence of communicable diseases, both new and those previously known (Agyei-Mensah & De-Graft Aikins, 2010; WHO, 2009). Changing lifestyles have played a role in elevating risk factors and causes of mortality across different population groups.

While young people aged 10 to 34 generally enjoy good health, persons in this age group still encounter a considerable number of premature deaths due to illnesses and injuries, impacting their overall growth and development. The consumption of alcohol, tobacco, and other substances, coupled with insufficient physical activity, unsafe sexual practices, and violent behaviour, not only pose threats to the immediate health of individuals but also has implications for their well-being as adults and the health of their future offsprings. It is therefore important to promote healthy behaviour among young people and protect them from risks that expose them to premature deaths. This is even more important, since the contribution of young people impacts the welfare of their household as well as the socio-economic development of their countries as a whole.

The critical and overarching reason for considering mortality among adolescents and young people, stems from the need to optimise the impact of the contribution of the youth towards the socio-economic development of their countries. Despite this need, very few countries have high quality cause of death data, with majority of deaths that occur in Sub-Saharan Africa unrecorded (Jamison *et. al*, 2006). Knowledge on incidence rates, trends and causes of death among the different age groups is important. Keeping track of deaths occurring is critical to addressing premature mortality, as evidenced in the reduction of cardiovascular diseases in

Central Europe, as well as the decrease in the incidence of malaria in eastern Sub-Saharan Africa (Wang *et al*., 2016). The importance of understanding the causes of death by sex and age in public health delivery cannot be underestimated. This empowers public health practitioners and policymakers to identify the causes of premature deaths and formulate interventions to mitigate their occurrences (Byass *et al*., 2010). Therefore, to understand the causes of death among young people in Ghana, the study seeks to examine the cause-specific mortality among young people in Ghana using data from the Kintampo Health and Demographic Surveillance System (KHDSS). It is expected that the information contained in this study will shed light on cause-specific mortality among adolescents and young people in the KHDSS area. The estimates derived from this study may be extrapolated to represent cause-specific mortality of this age cohort in Ghana and would serve as evidence to guide policy and programme interventions targeted at the youth in the country. This would ultimately ameliorate the preventable loss of the energetic workforce which should be provided by the teeming youth of the country. This study will also contribute to knowledge by highlighting the causes of mortality among young people 10 to 34 years, examine the variations in specific and all-causes of deaths among adolescents and young people using longitudinal data and describe the patterns and trends in causal mortality among young people in Ghana. The findings of this study will further inform interventions towards Ghana's attainment of national development targets as well as targets under the SDGs on preventable deaths. By using longitudinal data from the Kintampo Health Research Centre (KHRC), the study benefits from a wealth of causal mortality data on the target population at both the group and individual level over a ten-year period.

1.5 Objectives

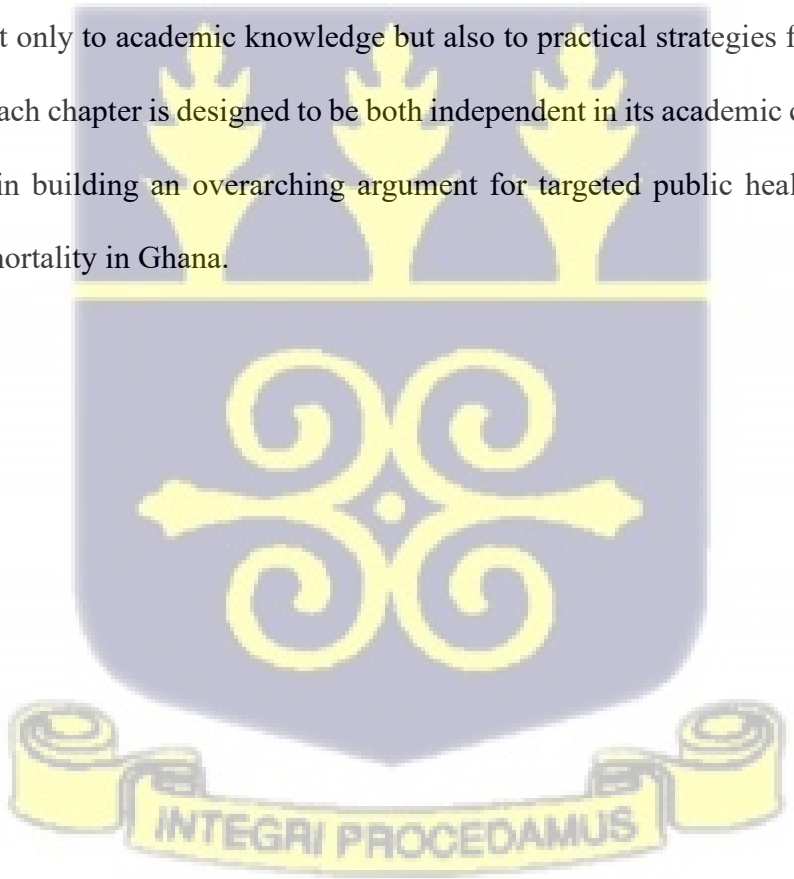
In alignment with the overarching aim of analysing the complexity of youth mortality in Ghana, the study posits the following specific objectives:

1. To identify the primary causes of mortality of individuals between the ages of 10 and 34 years by sex, over a ten-year period.
2. To conduct an in-depth analysis of mortality trends among young people aged 10 to 34 years.
3. To employ multivariate statistical methods for identifying and quantifying demographic and socio-economic variables that serve as significant risk factors for mortality for individuals within the specified age bracket.
4. To evaluate the potential impact on life expectancy for young people between the ages of 10 and 34 years, should specific mortality causes be reduced or eliminated, in line with the broader SDG targets on mortality.

1.6 Organisation of the study

The study is organised into seven chapters. Chapter One provides an introductory framework for the study. It includes the contextual background, problem statement, research questions, objectives and the rationale for the study. Additionally, it outlines the organisation of the subsequent chapters. Chapter Two offers a comprehensive review of existing literature on youth mortality. This chapter situates the research within the broader academic discussions, identifies gaps in current knowledge and explains the theoretical and conceptual frameworks that guide the study. Chapter Three focuses on the research methodology, detailing the study area, the methods for data collection and analytical techniques to be employed. The chapter aims to establish the scientific rigour and validity of the research design. Chapter Four analyses socio-demographic and economic determinants that influence causes of death among the youth.

The chapter employs statistical methods to evaluate how variables such as age, sex, socioeconomic status and educational level contribute to mortality risks. Chapter Five examines the relative risks of various broad categories of causes of death, including infectious diseases, non-communicable diseases and external factors like injuries or trauma. The analysis is specific to the age group 10 to 34 years and utilises data from the KHDSS from 2005 to 2015. Chapter Six evaluates the impact of different causes of death on life expectancy within the study population, contextualised within the Sustainable Development Goals (SDGs). The chapter employs life table analysis to estimate the potential changes in life expectancy under various scenarios of cause-specific mortality reduction. Chapter Seven synthesises the primary findings, conclusions and policy recommendations emanating from the study. The study aims to contribute not only to academic knowledge but also to practical strategies for public health interventions. Each chapter is designed to be both independent in its academic contribution and interconnected in building an overarching argument for targeted public health initiatives to address youth mortality in Ghana.



CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

This chapter presents a comprehensive review of literature relevant to the causes of death among young people. The chapter reviews studies on the prevalent trends in mortality, the different causes of death and patterns of mortality as well as the risk factors associated with dying from the different causes. The final part of this chapter presents the underpinning theoretical framework and the emerging conceptual frameworks that guide the study.

2.2. Operational definition of young people

The terms "young people" and "youth" are frequently employed interchangeably, conveying the same idea. Generally, these terms encompass the notions of "adolescence" and "youth," encapsulating the transition from the dependency of childhood to the autonomy of adulthood. This concept holds both biological and social significance, representing a biological stage in the life cycle marked by the progression from childhood to adulthood. Given the diversity of societies, a young person's experiences and the meaning attributed to the term are influenced by their social and economic positions within a specific social context (Spence, 2005). Nevertheless, despite variations in societal norms, the universal usage and perception of the term "youth" reflect a shared understanding of young individuals. Consequently, the youth phase is fluid and lacks a universally agreed-upon age classification compared to other age groups.

The United Nations, for statistical purposes, defines ‘youth’ as persons between the ages of 15 and 24 years. For operational reasons, the United Nations Population Fund, (UNFPA), the

United Nations Children's Fund (UNICEF) and the World Health Organisation (WHO) further classify adolescents to be those between the ages of 10 to 19 years, (young adolescents being those 10 – 14 years and older adolescents, those aged 15 – 19 years) and young people as persons aged 10 to 24 years (Youth, 2014). Ghana's National Youth Policy (2022 – 2032), defines the youth as an individual aged 15 to 35, in accordance with the National Youth Authority Act of 2016, (Act 939). The fundamental objective for this age range is to respond to the diverse definitions, enabling a responsive approach to the social and cultural context that facilitates holistic development opportunities for young people (Kwankye & Ansah, 2013). This is in line with the African Youth Charter which provides a strategic framework for the development of the youth in the continent (African Union, 2006). Bearing in mind the relevance of this study and considering the overlaps in the definition and classification of young people, this study defines young people to comprise those persons aged 10 to 34 years. The study also uses the term "youth" and "young people" interchangeably.

2.3. Causes of deaths

Studies on causal mortality have categorised the different causes of death based on the International Classification of Diseases and Related Health Problems (ICD). The ICD provides a standardised system of codes for recording and categorising causes of death, to enable countries collect, analyse, interpret, and compare cause-of-death data. The Global Burden of Disease (GBD) Studies further refines these classifications, as it assesses the epidemiology situation of selected countries across all global regions using available data on illnesses and injuries (Abbafati *et al*., 2020a) and classifies causes of death, based on the ICD. The GBD Studies was initiated in 1992 by the World Bank and the World Health Organisation (WHO), to primarily measure the causes of disability and death globally. The studies examine demographic and epidemiological indicators in different age-groups. These include mortality

related indicators such as prevalence rates, life expectancy, probabilities of death, disability-adjusted life expectancy, years of life lost because of premature death and years of life lived with disability as well as disability adjusted life years (DALYs).

The 2017 GBD study, classified causes of death into three groups as shown in Table 2.1 below (Collaborators, 2018; Viner *et al*., 2014). The first group consisted of communicable diseases, maternal, perinatal and nutritional disorders. The second group comprised non-communicable diseases such as diabetes, cancer, stroke, hypertension, and other cardiovascular diseases. Whilst the third group consisted of all intentional and unintentional injuries. Some studies, mainly in Sub-Saharan Africa, further separate maternal causes from the first group of causes, because of their impact on mortality rates in the region (S. Abubakari *et al*., 2019). It is noted that the cause of death in some cases may be undetermined due to lack of adequate information to detect the cause. This study relied on the classifications provided below but with maternal causes of death separated from the first group.

Table 2.1 Classification of broad causes of death

Communicable, maternal, neonatal and nutritional diseases	Non-communicable diseases (NCDs)	Injuries
Diarrhoea, lower respiratory & other common infectious diseases	Cardiovascular diseases (inc. stroke, heart diseases and heart failure)	Road injuries
Neonatal disorders	Cancers	Other transport injuries
Maternal disorders	Respiratory diseases	Falls
Malaria & neglected tropical diseases	Diabetes, blood and endocrine diseases	Drowning
Nutritional deficiencies	Mental and substance use disorders	Fire, heat and hot substances

HIV/AIDS	Liver diseases	Poisonings
Tuberculosis	Digestive diseases	Self-harm
Other communicable diseases	Musculoskeletal disorders	Interpersonal violence
	Neurological disorders (including dementia)	Conflict & terrorism
	Other NCDs	Natural disasters

Source: The GBD study (2017)

2.3.1. Communicable causes of mortality

Communicable diseases encompass illnesses resulting from viruses or bacteria transmitted via contact with contaminated surfaces, bodily fluids, blood products, insect bites, or through the air (Moein *et al*., 2019; Wang *et al*., 2019). The GBD Study, 2017 classifies communicable causes of mortality to include HIV and AIDS and sexually transmitted infections (STIs), respiratory infections and tuberculosis, enteric infections, malaria, neglected tropical diseases and other infections, grouped together with nutritional deficiencies (Roth *et al.*, 2018). Communicable diseases tend to contribute significantly to the burden of mortality across all age groups, particularly in Sub-Saharan Africa and South Asia (Ward *et al*., 2021). However, for adolescents and young people, the cause-specific mortality attributed to communicable diseases tends to be lower compared to the mortalities attributed to communicable diseases amongst infants and older adults and therefore, their specific impact on young people has been less studied. Nevertheless, young people are susceptible to respiratory infections, sexually transmitted diseases and malaria among others due to both biological and social factors. With increases in infections and new variants of existing microbes with drug resistant features, adolescents and young people are at an increased risk of dying from infections. For instance, an assessment of cause of mortality due to communicable diseases amongst the youth living in Montreal, Canada, revealed HIV and AIDS as a strong predictor of mortality amongst homeless youth (Roy *et al*., 2004). Study participants were individuals residing on the streets,

prone to engaging in risky behaviours like unprotected sex, thereby elevating the prevalence of HIV and AIDS amongst them. Again, another study using data from rural adult population aged 15 to 49 years from Butajira, Ethiopia noted that the cause of death due to infectious diseases in poor socioeconomic conditions accounted for about 60 percent of the total causes of death (Lulu & Berhane, 2005).

In Sub-Saharan Africa communicable diseases accounted for 76 percent of total deaths in 2010 (Lozano *et al.*, 2012). Young people in Sub-Saharan African countries are particularly at higher risk of contracting communicable diseases especially HIV and AIDS, tuberculosis and malaria. For example, while the region makes up just about 12 percent of the global population, it accounts for over 60 percent of the global HIV & AIDS infections. Chisumpa *et al*. (2019b) also observed that, young persons between the ages of 15 and 20 years are more susceptible to malaria related deaths (Chisumpa *et al*., 2019a). These are as a result of the triple challenges of poor healthcare, inadequate healthcare infrastructure, socio-cultural barriers and high exposure which make communicable diseases a critical public health issue in the region.

The situation in Ghana reflects the challenges of Sub-Saharan Africa with respect to deaths resulting from infectious diseases. For instance, *Ohene et al.* (2011) observed that infectious diseases contribute to a large proportion of deaths among young people below 30 years in the country. The Ghana Health Service has also reported that most of the malaria cases in the country are found among young people below 35 years (MoH, 2022) . Additionally, Quaye *et al*. (2015), have indicated that sexually transmitted infection rates including HIV and AIDS are increasing among young people in the country. It is clear from the above that while the types of communicable diseases may be similar across all regions, their scale and effect differ. Generally, in Sub-Saharan African countries including Ghana, the risk factors are more intense and multifaceted due to the peculiar challenges in the region compared to the global level. This

requires targeted interventions to facilitate effective prevention and treatment. However, the paucity of data on mortality rates among young people due to communicable diseases increases the tendency to underestimate the national burden of this cause-specific mortality, thereby impacting negatively on the development of youth-specific interventions.

2.3.2. Non-communicable diseases

The term non-communicable diseases (NCDs) encompass a category of illnesses distinguished by their non-infectious nature, arising from a combination of behavioural, environmental, physiological, and genetic factors. These conditions often result in long-term health implications, necessitating extended treatment and care. Non-communicable diseases persist as the primary cause of mortality across all age groups globally, constituting approximately two-thirds of the global mortality rate (Bennett *et al*., 2018). This group includes neoplasms and cancers, cardiovascular diseases, chronic respiratory diseases, digestive diseases, neurological and mental disorders, substance use disorders, diabetes and kidney diseases, skin and subcutaneous diseases, musculoskeletal disorders, and other NCDs (Gouda *et al*., 2019; Roth *et al*., 2018).

There appears to be a scarcity of data regarding the worldwide impact of non-communicable diseases as a cause of mortality among adolescents and young individuals (Mercer, 2018). This is because the overall burden of non-communicable cause-specific mortality is high among the elderly compared to the youth. However, NCDs presents an increasingly relevant issue among young people (Gore *et al*., 2011). It is estimated that amongst the population aged less than 30 years, NCDs contributed four percent (1.7 million mortality cases) of the global burden of all mortality in 2016 (Bennett *et al*., 2018). This proportion includes the burden of mortality

attributed to non-communicable diseases amongst neonates, infants and children. The disparity in focus could be attributed to the higher burden of NCDs in older populations (Mercer, 2018).

A cause-specific assessment of the cases of mortality attributed to NCDs reveals that congenital heart anomalies were the leading causes of mortality, accounting for 13.3 percent of all NCD mortalities in persons under 30 years of age. Additionally, sickle-cell disease was the second leading cause of NCD related mortality accounting for 4.1 percent of mortalities in persons under 30 years (Bennett *et al*., 2018). Compared to communicable diseases, the prevalence of mortality amongst the youth attributed to NCDs is higher than mortality attributed to communicable diseases. For youth aged 10 to 24 years it has been found in the Global Disease Burden study that the disability adjusted life years (DALY) for NCDs has increased by 13.1 percent (Mathers *et al*., 2009). According to available studies, the leading non-communicable disease burden among the youth is mental health disorders. However, there is limited information on the impact of mental health disorders on the mortality burden amongst the youth (Chesney *et al.*, 2014). Most mortalities attributed to mental health disorders are often homicide and suicide and are thus estimated under external causes of death rather than non-communicable diseases cause of death (Colton & Manderscheid, 2006; Whiteford *et al.*, 2013). Another non-communicable disease mortality of interest is cardiovascular related mortalities amongst the youth. The prevalence of strokes in young adults aged 20 to 64 has risen over the past thirty years (Krishnamurthi *et al.*, 2015). Cardiovascular diseases are usually associated with persons in the older age groups and increasingly, evidence have shown that the onset of risk factors for these conditions are often visible during the youthful ages. Of particular concern are issues such as substance abuse, mental health disorders, depression and anxiety as well as obesity (Patton *et al.* 2016). Thus, a better understanding of the age-specific distribution of this burden and how it influences mortality among the youth is imperative, since studies have

established that they share a substantial proportion of the global non-communicable disease burden (Gore *et al.*, 2011).

In Sub-Saharan Africa, the prevalence of communicable diseases has overshadowed the NCD burden in the region. Nevertheless, there is a rising trend of NCDs among young individuals, contributing to a dual burden of both communicable and non-communicable diseases. This situation is negatively impacting the already fragile health systems in the region, as well as efforts in prevention and treatment (Agyei-Mensah & De-Graft Aikins, 2010). Rapid urbanisation of Africa's population and the changing lifestyles which accompanied economic development in the region are key contributory factors to increases in NCDs among young people (Atun *et al.*, 2017). There is, however, scarcity of data on this subject, particularly in low- and middle-income contexts. That notwithstanding, Bawah *et al.* (2016) have identified the different rates of shift towards non-communicable causes of death in developing contexts in Africa and Asia using data from demographic surveillance sites in Ghana, South Africa, Vietnam and Bangladesh (Ayaga Bawah *et al.*, 2016).

Autopsy-determined cause-specific mortalities in Ghana revealed that amongst adolescent mortalities, non-communicable diseases accounted for about 41 percent of the cases (Ohene *et al.*, 2011). Contemporary lifestyles have, particularly among young individuals, heightened exposure to the increased use of tobacco and the consumption of alcohol, fats, red meat and sugar. These factors are crucial risk contributors to non-communicable diseases such as hypertension, diabetes, obesity and various cancers, which may ultimately lead to fatalities (Jamison *et al.*, 2006). In low and middle income contexts, socioeconomic status is closely linked with dietary behaviour and lifestyle risk factors, including consumption of fats and processed foods, harmful substance use, as well as alcohol intake, tobacco use and inadequate

physical activity, all of which underlie non-communicable disease mortality (Allen *et al.*, 2017).

The rising prevalence of risk factors for NCDs in Ghana such as obesity and hypertension especially in the urban areas of the country has been observed. These are early signs of cardiovascular diseases among the youth which has significant public health implications for the future (Juliet Addo *et al*., 2007). The rise of NCDs in Sub-Saharan Africa including Ghana is of major concern due to the already existing burden of communicable diseases and the inadequate healthcare infrastructure. This brings to the fore the need to adapt healthcare systems and strategies in the region to address the current healthcare needs of the population including young people.

2.3.3. External Causes of Mortality

External causes of mortality refers to all injuries including road and other transport injuries, unintentional injuries such as falls, drownings and animal contact, self-harm and interpersonal violence (Roth *et al.*, 2018). In 2012, the documented cases of mortality attributed to external causes were estimate to be 73 per 100,000 population globally (Abio *et al.*, 2020). There were regional disparities in the impact of external causes on overall mortality. Europe reported a rate of 49 per 100,000 population, while America and Southeast Asia witnessed rates of 62 and 99 per 100,000 population, respectively. The estimated external cause mortality in Africa was the highest in 2012, at 116 per 100,000 population. A major contributor to these deaths were road accidents. According to the Centre for Disease Control, the leading causes of deaths among young individuals aged 15 to 29 years in the United States were found to be accidents, unintentional injuries, suicide and homicide (CDC, 2020). In India, between 2010 and 2013, the top five external causes of death among the same group 15 to 29 years were suicide, motor accidents, other unintentional injuries, cardiovascular diseases and digestive system diseases

(Mehta, 2016). Thus, while there exist some similarities in external causes of death among young people, there are regional and country differences. Even in the same region or country, rates of external causes of death differ. A gender comparison of external cause related mortalities amongst the youth reveals that males recorded higher external cause-related mortalities than females (Bacopoulou *et al.*, 2015).

a. Road accident mortality

The burden of external causes of mortality worldwide attributed to road accidents, stood at about a quarter of the total burden of external causes of mortality (Abio *et al.*, 2020). Road accidents accounts for about 1.25 million deaths in 2013. Globally, road accident is the eighth leading cause of mortality across all age groups and the highest cause of mortality amongst young people (James *et al.*, 2020). Motor accidents are a major cause of unintended injuries that leads to mortality amongst adolescents and youth (Patton *et al.*, 2009). However, road accidents are preventable and therefore losing many people in the working age population, through motor accidents is of grave concern. According to the Global Road Safety Status Report (2018) it is estimated that over 1.35 million individuals lose their lives each year in road accidents worldwide, with numbers on the rise in certain nations. This is a major public health concern that urgently needs to be addressed. The increase in road accidents is attributed to the ever-increasing traffic density, despite technical improvements in automobiles and roads (WHO, 2018).

A regional analysis of road accident mortality indicates that the Africa Region has the highest rate of road traffic deaths with a rate of 0.24 per 1,000 people. Despite having only 2 percent of vehicles globally, Africa accounts for about 20 percent of global road traffic deaths. This is due mainly to the poor condition of roads, inadequate law enforcement and the limited pedestrian walkways within the region. Africa is followed closely by the South-East Asia

Region with a rate of 0.18 per 100,000 population (Konlan *et al.*, 2020). On the other hand, high income countries have well-developed infrastructure, but they also experience road traffic deaths due to high-speed driving, driving under the influence of alcohol and non-adherence to safety measures such as the use of seat belts. Moreover, contemporary concerns like the use of mobile phones while driving are adding to the occurrence of road traffic accidents, primarily among the youth in developed nations, but increasingly so in developing countries. Socio-cultural and economic issues also contribute to road traffic accidents as unemployed youth are more likely to engage in speeding and drunk driving. In addition, socio-economic factors also impact on access to safe vehicles and good health service delivery in the event of an accident.

Driving at high speed and motorcycle accidents are the most common causes of road traffic accidents that young people in Ghana experience. A report of the Police Motor Transport and Traffic Department (MTTD) of the Ghana Police Service, indicates that about six people die every day from road accidents (Konlan *et al.*, 2020). This translates into more than 2,000 deaths in a year. It is further estimated that out of 100,000 people, 72 may have been involved in road accidents and have suffered body injuries, while eight may have died from road accidents within the last decade (Coleman, 2014). Evidence from the Navrongo Health and Demographic Surveillance System (NHDSS) showed an increase in the proportion of road traffic fatalities from 6 percent to 18 percent between 1995 and 2010, thus becoming a major cause of mortality in Ghana (Bawah *et al.*, 2014). The economic cost of these fatalities is also high. For instance, in 2007, annual motor accidents cost the country nearly 1.6 percent of Gross Domestic Product (GDP), amounting to about US$ 165 million (Konlan *et al.*, 2020). Bawah *et al* (2014) also found that mortalities due to road traffic injuries increased significantly over a decade with a high proportion of these deaths occurring among persons aged 15 to 39 years of age (A Bawah et al., 2014). Road accident is therefore a real threat to longevity and the economic and social

development of any nation, as many young lives are lost through road accidents. Addressing this issue requires a sustained comprehensive approach which includes improved road designs, enforcement of traffic regulations, awareness creation targeted especially at the youth as well as improved healthcare services[2].

b. Mortality from unintended injuries

Unintended injuries result from falls, drowning, contact with fire and hot substances, poisoning, animal contact, exposure to heat, cold, forces of nature and mechanical forces such as firearms among others (Roth *et al.*, 2018). It has been established that, unintentional injuries are the highest source of adolescent and young adult mortality worldwide (Sleet *et al.*, 2010). The high level of mortality from unintended injuries among young people globally has been attributed largely to their risky behaviours (Burt, 2002; Ssewanyana *et al.*, 2018). In a survey conducted in the United States of America, it was realised that deaths from unintended injuries constituted nearly half (45.9%) of all mortalities amongst adolescents (Kassebaum *et al.*, 2019). In 2006, it was estimated that, in the United States, 22 adolescents aged 10 to 19 years died every day as a result of injuries.

A critical gender-specific analysis of the mortalities caused by unintended injuries reveals that male youth are twice more likely to die from unintended injuries compared to female youth, with males accounting for over 60 percent of the mortalities caused by unintended injuries (Patton *et al.*, 2009b). This increased risk of mortality attributed to unintended injuries among males is due to the risk-taking behaviour of males compared to females. Studies have reported significant gender, ethnic and racial disparities with regard to unintended injuries among people (Irizarry *et al.*, 2017). Mortality caused by unintended injuries is higher in blacks and other

[2] https://www.who.int/news-room/fact-sheets/detail/adolescents-health-risks-and-solutions

racial minorities compared to whites in America. In a study conducted by Brown (2010) in the United States of America, it was discovered that African American children faced a risk over seven times higher for burns or gunshot injuries and over three times higher for preventable injury-related fatalities. The research also established an elevated susceptibility to injuries from falls and vehicular incidents among individuals of Hispanic origin when compared to both white and black populations (Irizarry *et al.*, 2017).

Similar to other Sub-Saharan African countries, the proportion of adolescents in Ghana who die from unintended injuries is relatively lower compared to other causes of death (Blum & Nelson-Mmari, 2004). In a study of autopsy data of 882 adolescent deaths in Ghana, Ohene *et al* (2011) found that deaths from injuries accounted for under twenty percent of the deaths compared to a range of 30 percent to 80 percent in high income countries.

c. Drowning

The burden of mortality as a result of drowning has not received much attention despite its grave impact on young people. However, it has become an issue of concern (Cash & Bridge, 2009). This is because gradually it has become the third cause of unintended deaths globally and is responsible for 7 percent of all injury–related mortalities. Statistics from the World Health Organisation (WHO) indicates that about 320,000 people die from drowning annually. Yet, WHO projects an underestimation of this value which is due to the frequent overlooking of this cause of mortality (Stallman *et al*., 2017). More than 50 percent of the global burden of drowning-related mortality cases occur amongst children and young adults (Ma *et al.*, 2010). For unintended causes of death, drowning is the leading cause of mortality for adolescents and young people besides road accidents (Wallis *et al.*, 2015). Over the decade, from 2006 to 2016, the age standardised mortality rate for drowning is seen to have decreased by about 27 percent (Lin *et al.*, 2019). Data on drowning-related mortality indicates that males have double the

likelihood of drowning compared to females (Franklin *et al.*, 2020). Majority of drowning associated mortalities are reported in low and middle income countries (Franklin *et al.*, 2020). Risk factors linked to drowning fatalities, include factors such as, inadequate barriers to control access to water, insufficient supervision for infants and young children, limited swimming proficiency, travel on water bodies, floods, lack of awareness and risky behaviours like alcohol consumption during swimming (Franklin *et al.*, 2020). Other risk factors established are lower socioeconomic status, some medical conditions such as epilepsy and tourists unfamiliarity with local water risks (Davey *et al.*, 2019).

Drowning is one of the main causes of unintentional injury and fatal trauma in Sub-Saharan Africa (Koné *et al.*, 2015) and yet it is significantly underreported. Inaccurate data collection and surveillance mechanisms have led to underestimation of drowning-related issues among young people in the region. This impacts negatively on the development of targeted interventions and prevention strategies that would contribute to reduction in fatalities.

In Ghana, drowning particularly among children and adolescents in the coastal regions of the country is prevalent. Yet, there are limited public health initiatives and awareness campaigns focused on drowning prevention in the high-risk areas. Unavailability of intervention strategies as well as inadequate data on drowning, exacerbates the problem as the lives of young people continue to be at risk. Drowning poses a worldwide challenge, particularly among young people. Addressing this issue necessitates the accurate gathering and analysis of data to inform prevention and intervention strategies — a significant hurdle for numerous Sub-Saharan African nations, Ghana included.

d. Suicide

Suicide is "the physical act by which a person deliberately procures death" (Perrotta, 2020). It is considered the highest form of self-harm, induced by some pathological or psychological distress or due to an unfortunate personal event. While suicide rates vary by age and sex in the various regions of the world, there are common triggers such as mental health, substance abuse and traumatic occurrences. In recent times, the spate of youth mortalities attributed to suicide have been on the increase (Nock *et al.*, 2018). Global mortality attributable to suicide is estimated to be over 800,000 individuals (Dendup *et al.*, 2020). Suicide is responsible for a third of all cases of mortality globally. Beside road accidents, suicide is a leading cause of mortality among adolescents and young adults worldwide (Campisi *et al.*, 2020).

In 2016, the crude suicide rate for young adults was estimated to be 10.6 per 100,000 population, with higher rates (13.5) among males, compared to (7.7) among females (Campisi *et al.*, 2020). There is an observed gender disparity with the proportion of suicide mortalities amongst the youth. Males tend to be at a higher risk compared to females. While it is acknowledged that females are more prone to experiencing suicidal thoughts and attempting suicide, the actual fatalities from suicides are higher among males than females (Kochanek *et al.,* 2019). This disparity is attributed to the fact that girls typically seek treatment for health issues more frequently than boys (Robinson, 2003). Moreover, boys face a higher risk than girls in expressing various problems, including substance use and involvement in criminal and legal issues (Berkout *et al.*, 2011). There are also differences in the ratio of male to female suicide deaths across different racial and ethnic groups. The gender disparity associated with suicide mortalities amongst the youth has been examined and explained by researchers. An explanation provided by Canetto, attributed the gender disparity in mortality due to suicide to

the diverse cultural gender norms. According to Canetto, some cultures perceive deaths by suicides as masculine while suicidal ideation is seen as feminine (Canetto, 2008).

In low and middle income countries, more than three quarters of the suicide related mortalities are reported (Dendup *et al.,* 2020). However, suicide in Sub-Saharan Africa is characterised by inadequate data, making it difficult to undertake targeted interventions. Analysis of existing suicide statistics in Africa, however, revealed substantial differences, making assessment of overall trends unclear. Nonetheless, it is observed that young people in the region are increasingly affected by this phenomenon. Reported values ranged from 0.004 to 0.17 per 1,000 population in different African countries. A global suicide study placed the prevalence in the WHO Africa Region at 0.06 cases per 1,000 population and in the WHO South-East Asia Region at 0.16 cases of suicide per 1,000 population (Värnik & Wasserman, 2016).

Similar to other African countries, Ghana has inadequate data on suicide in the country, however, there are indications of increasing suicide rates and behaviour among young people, which may be partly due to the poor and inaccessible mental health services in the country (Osafo *et al.*, 2015). Addressing suicide among young people would require a comprehensive approach that is evidence-based and culturally appropriate including not only improved mental health services but also dismantling the social stigma that prevents young people from seeking support.

e. Homicide

Homicides are a major cause of premature deaths that are often violent in nature. The definition of homicide varies within different contexts with various definitions having been used to describe the phenomena (Liem & Pridemore, 2011). Though homicides constituted less than a tenth of deaths due to injury at the turn of the century, mortality from homicides have been on

the ascendency in recent years (WHO, 2004). The level of information on homicide cases among the youth especially in low and middle income countries is scanty, however it remains a very important public health issue (Rogers & Pridemore, 2017). Homicides tend to be more associated with youth, poverty, substance use and the availability of weapons (WHO, 2009). It is thus not surprising that several studies have established high rates of homicide amongst the youth (Liem & Pridemore, 2011; Rogers, 2014). In 2015, the absolute cases of homicide amongst young people stood at 51,000 globally (Mathews *et al.*, 2019). This places the global homicide rate amongst the youth at 4.3 cases per 100,000 population (UNICEF, 2017).

A gender comparison of the homicide rate in 2015 revealed that the homicide rate among males was 6.8 cases per 100,000 population and this was four times more prevalent compared to females (UNICEF, 2017). A regional assessment of homicide cases in the world established the Caribbean and Latin America as the leading regions with the highest cases of homicide. In Latin America and the Caribbean, the homicide rate was estimated to be 22.1 homicide cases per 100,000 population. This is followed by West and Central Africa with a homicide rate of 5.4 cases per 100,000 population (UNICEF, 2017).

Interpersonal violence is a bane to national and global development. In addition, high levels of poverty, conflict and unemployment in Sub-Saharan Africa, often creates a conducive environment for deviant behaviour including homicides. Factors such as political instability, corruption and the absence of good governance also compound homicide rates. In addition, weakening community structures due, among others, to rapid urbanisation and the loss of social control systems, as well as easy access to firearms have increased violent crime rates in many Sub-Saharan African countries. There are, however, variations among and within the various regions of the continent. Botswana and Mauritius have lower homicide rates compared to South Africa and Lesotho (Mohammadi Nevisi *et al*., 2020). Nevertheless, homicide rates in South

Africa have seen a decline over the years due to the introduction of gun control legislations (Mathews *et al.*, 2019).

Ghana has been rated as one of the most peaceful countries in Africa. However, the country has had its fair share of violent crimes including homicides, much of which tend to be in the urban areas compared to the rural areas of the country. Wide economic disparities and weaker social cohesion in the urban areas have been blamed for these occurrences. Thus, while homicide rates in Ghana are relatively lower compared to other African countries, it is still an issue of grave concern requiring a comprehensive approach to prevention efforts that address issues concerning social cohesion, economic conditions and political stability.

f. Substance Abuse

Another contributor to the high mortality rates among young people is substance abuse. This burden is however strongly associated with geographical variations. It is a global issue; however, its patterns and consequences are determined by regional and local factors. Substance abuse comprising drugs and the use of tobacco, as well as alcohol use, pose health and social risks for the youth all over the world, but its impact varies across the various regions. Global substance abuse begins during adolescence with many young people using illicit drugs and tobacco by age 25 (Degenhardt *et al.*, 2018). It is observed that substance abuse among young people places a huge burden on global health. Rehm *et al.* (2009) observed that alcohol consumption contributes significantly to the proportion of the global burden of diseases and premature deaths.

In Sub-Saharan Africa, the prevalence of substance abuse is influenced by economic, social, and cultural factors. Alcohol consumption is generally elevated in the region due to cultural ceremonies and rites, while tobacco use is comparatively lower in comparison to developed

countries. However, both alcohol intake and tobacco use are on the rise due to marketing strategies used by tobacco companies targeting young people. The use of drugs is also on the rise driven by social determinants such as poverty, lack of education, conflict and exposure to violence. In Ghana, tobacco and alcohol abuse are prevalent especially among the youth in the urban areas of the country. Additionally, the abuse of prescription drugs appears to be increasing among urban youth (Okagua *et al.*, 2016), which is a reflection of the pressures experienced by young people in the country. This has implications for the healthcare system in the country with regard to its capacity to manage the abuse of prescription drugs in the country.

2.4 Trends in mortality

Although there has been a significant improvement in survival across the age spectrum since the turn of the twenty first century, this has not been felt universally. In general, global mortality rates witnessed a rise from 50.7 million deaths in 2000 to 56.5 million deaths in 2019, considering the distribution of age-specific death rates for both sexes and age groups under 20 years across countries (Abbafati *et al.*, 2020b). This means that in about two decades, there has been about 12.8 percent increase in the absolute cases of all-cause mortality. Increases in mortalities among adolescents and young adults between 15 to 29 years have been reported in countries that have been heavily affected by diseases and pandemics such as HIV and AIDS and other outbreaks.

However, over the years, the rate of mortality amongst the youth has seen a downward trend (Masquelier *et al.*, 2021). This is attributed to the nominal increase in the global population of young people as well as higher chances of survival. Efforts to reduce mortality amongst adolescents and young people have had relatively less attention globally and discussions on the issue has not been sustained in many countries (Reiner *et al.*, 2019; Viner *et al.*, 2014).

Compared to trends in child mortality, efforts to reduce adult mortality has not been continuous and it has had less attention and discussions in many countries.

Studies depict a significant decrease in mortality rates across all age ranges over the years (Case & Deaton, 2015). With respect to infant mortality, the decline has been quite significant, indicating huge achievements in public health. However, for young people, this decline has been slow and inconsistent. As observed in a study of mortality trends in children and young people across 50 countries globally by Viner *et al*., the rate of decline in mortality amongst the youth is about half the rate of decline in infants and children under 5 for the period 1955 to 2004 (Viner *et al*., 2011). Compared with the rate of decline across all other age groups, it appears that mortality decline amongst the younger economically active population is not encouraging. Furthermore, projections indicate that the rate of mortality amongst the youth would in a few years exceed the rate of mortality amongst infants if the current trend continues (Masquelier *et al.*, 2021).

A systematic analysis revealed that over a period of three decades, the probability of dying amongst adolescents and young people has decreased minimally (Masquelier *et al.*, 2021). Worldwide, the probability of a 15-year-old dying before reaching 25 years decreased from 17.1 deaths per 1,000 youth in 1990 to about 15.4 deaths per 1,000 youth in 2000. This was about 11.0 percent decline in the rate of mortality in the youth. In 2019, the probability of a 15-year-old dying before they turn 25 years further decreased to 11.4 deaths per 1000 youth. Thus, the annual rate of reduction in the probability of a 15-year-old dying before turning 25 years between 1990 and 2019 is 1.4 percent. Though there has been constant decline in the mortality rate amongst the youth, it is evident from the statistics that this rate is rather slow compared with declines in under-five mortality.

Sub-Saharan Africa had an annual reduction rate of 2.1 percent which is considered better than the global annual reduction rate. The Latin America and Caribbean regions have seen the lowest declines of 0.6 percent, followed by North America (0.9%) over the period from 1990 to 2019. Europe had the highest annual rate of reduction of about 3.0 percent while South Asia had a percentage reduction of 2.8 percent. The limitation to this statistic is that since the probability and annual rate reduction is a relative measure, there may be an increase in mortality cases, but the mortality rate or probability of dying may decrease if the population which is the denominator, increases rapidly. For example, in Sub-Saharan Africa, the number of deaths amongst the youth increased from 424,000 to 513,000 over a two-decade period of 1990 to 2019, contributing to a 20.8 percent increase in the absolute number of deaths (Masquelier *et al*., 2021). Therefore, the nominal presentation of the mortality cases together with the relative measure would assist policy makers to make informed decisions. Aggregated data from a study conducted by Patton *et al.* (2009) suggest that the mortality rate in Sub-Saharan Africa increases from adolescence (10 -14 years) and peaks at young adulthood (20 - 24 years). Amongst the youth, it has been realised that the rate of mortality worldwide is estimated to be 2.4 times higher among young adults compared to young adolescents (Patton *et al.*, 2009). Over the years the trend of mortality amongst the youth has been poorly measured. Thus, there is a gap in knowledge on how cause-specific mortality has evolved amongst the youth. There has been a significant shift in the leading causes of death among young people from communicable to non-communicable diseases. However, there are regional variations with mortality in developed countries mainly caused by increasing non-communicable diseases. Generally, mental health is becoming an issue of concern as it contributes significantly to youth mortality through its impact on suicide rates (Kassebaum *et al*., 2019).

In Sub-Saharan Africa mortality due to communicable diseases has declined but continues to contribute to youth mortality (Hagopian *et al.*, 2008). Substance abuse especially tobacco and alcohol abuse which impacts on youth mortality in developed countries is increasingly occurring in LMICs including Sub-Saharan African countries. In addition there is an increase in mortality due to violent deaths and injuries in the region (Norman *et al.*, 2012). Furthermore malnutrition and complications from child-birth among young women 15 to 25 years is a key challenge in Sub-Saharan Africa which increases the need for comprehensive maternal and child healthcare (Say *et al.*, 2014).

In Ghana communicable diseases account for a large proportion of all deaths but the country is experiencing increasing deaths due to NCDs as well as injuries including road traffic accidents (Ackaah & Afukaar, 2010). Others have also observed the trend of the growing contribution of NCDs such as hypertension and diabetes to youth mortality in the country (Boateng *et al.*, 2017; de-Graft Aikins & Agyei-Mensah, 2010).

Causes of mortality and the changes therein differ by age and sex depending on the regional and cultural context. On a global scale, road traffic injuries, suicides, and lower respiratory infections stand out as the primary causes of death among young individuals. Most mortalities that are associated with males occur from unintentional injuries. Males have therefore been consistently found to have a higher rate of mortality than females of the same age (Blum & Qureshi, 2011). As reported by Koné *et al.* (2015), males face a twofold higher likelihood of dying from a trauma or injury related cause in comparison to females. This discrepancy is also observable across various age groups, with individuals in their twenties exhibiting higher mortality rates from crashes, as indicated by Amo (Amo, 2014). This means that people of specific ages and sex are more prone to fatal accidents on roads, with nearly one in eight male deaths and one in fourteen female deaths (Mathers *et al.*, 2009) However, with increasing

numbers of females driving motor vehicles, the age-sex disparity between females and males for road traffic accidents has been narrowing overtime (A Bawah *et al*., 2014). There is also significant sex disparities in suicide cases where males are more likely to be affected compared to females (Kassebaum *et al*., 2019).

Complications arising from diseases have always been one of the most common causes of deaths among all ages and sexes throughout the world. According to Lozano *et al.*, (2012), diseases such as ischemic heart disease, lower respiratory infections, stroke, diarrhoea, malaria, and HIV and AIDS were the leading causes of premature mortality in 2010. The report also revealed that mortalities associated with ischemic heart disease and stroke among young people increased from 17 percent to 28 percent. Malaria deaths are also more focused in the young people between 15 and 20 years (Chisumpa *et al.*, 2019b).

In Sub-Saharan Africa the leading causes of mortality among young people include road traffic accidents and communicable diseases (Liu *et al*., 2022). Lozano *et al.,* (2012a) also observed that premature mortality in Sub-Saharan Africa due to communicable, maternal and nutritional causes accounted for 76 percent of mortalities in 2010. Studies have further shown that communicable, maternal and nutritional causes account for 24·9 percent of all mortalities among young adults between 15 and 29 years. Young women in Sub-Saharan Africa are especially affected by HIV and AIDS as a result of disparities in social and economic conditions (Murewanhema *et al*., 2022).

In a research study conducted in Ghana by Ohene *et al*. (2011), findings revealed a higher occurrence of deaths among males and older adolescents within the study population (Ohene *et al.*, 2011). The study further concluded that approximately half of the primary causes of

death were attributed to infections. This implies that individuals below the age of 30 face a significant burden of mortality from various infectious diseases.

There are significant sex differences with regard to deaths for males aged 15 to 29 years with respect to injuries, HIV and TB and non-communicable diseases, which were much higher than that of females in this category and age group. Mortality from maternal causes predominated all other causes of death among young women. A study in 2010 provides evidence to show that maternal causes of death accounted for 10.7 percent of deaths among young women in this age group (Lozano *et al.*, 2012). As most deaths from accidents and injuries are associated with males aged 15 to 29 years, majority of deaths from females in this age group are related to maternal factors (Ohene *et al.*, 2011). Among older adolescent females and those in their early twenties, 75 percent of maternal deaths were found to be consequences of abortion (Ohene *et al.*, 2011).

A study by Blum and Nelson-Mmari, (2004), identified HIV and AIDS as a leading cause of death among young individuals between the ages of 15 and 29 years in Africa. However, HIV and AIDS is not the leading cause of death in all countries in Africa. Ghana and other countries in the Western and Northern parts of Africa have relatively low prevalence of HIV and AIDS among their populations (UNAIDS, 2007). However, there are gender-specific concerns with regard to HIV and AIDS prevalence among young women in Ghana, which accounts for about 6 percent of maternal deaths (GHS, 2016). Countries in Southern Africa have high incidence of HIV and AIDS and women tend to have complications from the disease which is the leading cause of death among young people 15 to 29 years (Jamison *et al.*, 2006; Baingana, Thomas and Comblain, 2005).

Among the age group under study, adolescents aged 15 to 19 years have the lowest mortality rate according to WHO (2014). The leading causes of death among this age group as reported by WHO comprise of road traffic injuries, HIV and AIDS, suicide, lower respiratory infections and interpersonal violence. Over the past two decades, deaths associated with HIV and AIDS have tripled and jumped to become the second leading cause of death among adolescents and young adults throughout the world (WHO, 2014) with young women disproportionately affected as a result of social and economic conditions (Murewanhema *et al*., 2022). The total number of adolescent deaths for 2012 was estimated at 1.3 million, which shows about 12 percent decrease from the decade before. The decline in mortalities was observed throughout most parts of the world among all groups, except for males aged 15 to 19 years within the Americas and Mediterranean Regions. Evidence suggests that about 75 percent of deaths in the late adolescent stage and early twenties are due to unintentional injuries which consist of motor injuries, unintentional poisoning, and unintentional discharge of firearms with the latter being very common in developed or western countries. With regards to unintentional injuries, the mortality rate for males is 39 deaths per 100,000 compared to 14 deaths per 100,000 for females (Blum & Qureshi, 2011; Mulye *et al.* 2009). At this age, mortality among males caused by injuries and poisoning is higher compared to females (Liu *et al.*, 2012; Rutta *et al.*, 2001; Stanistreet & Jeffrey, 2003). Diseases, both infectious and non-communicable, play a considerable role in mortalities among young people. However, the general assumption that adolescence is a healthy period usually shifts attention away from the health problems that some of them encounter. The conditions that emerge during adolescence tend to affect the health and wellbeing across the lifecycle of a person and it presents an important area of public health due to the immediate and long-term implications.

It is noteworthy that similar to other countries in Sub-Saharan African countries, with high levels of infectious diseases, like Ghana, are experiencing multiple burden of diseases, with the emergence of non-communicable diseases which is becoming a key contributor to youth mortality alongside external injuries.

2.5 Maternal causes of death and gender disparities

Globally, deaths from maternal causes is a leading cause of death among women in the reproductive age group. WHO estimates that close to 810 women die from pregnancy and childbirth related causes every day, although these deaths are preventable. Regrettably, 94 percent of these deaths are from low-income areas. Maternal mortality is a critical issue in Sub-Saharan Africa with the region experiencing high maternal mortality rates resulting from complications from pregnancy and childbirth as well as the inadequate healthcare systems in the region. This is further exacerbated by the high incidence of HIV and AIDS among women accounting for 59 percent of the total population living with HIV and AIDS in the region (UNAIDS, 2018). Maternal mortality in Ghana was estimated at 308 per 100, 000 live births in 2017 (GSS *et al*., 2018). While far below figures in the developed regions of the world, this figure represents an improvement within the Sub-Saharan Africa context. However, maternal mortality rates among young women are high, contributing significantly to overall female mortality rates among young women 10 to 34 years.

2.6. Variations in causes of death by demographic, socioeconomic, behavioural and geographic characteristics

Several studies have established the variation of cause-specific mortalities by demographic, socioeconomic, behavioural and geographical factors of a defined population (Alarcão *et al*., 2020; Bogg & Roberts, 2004; Haghparast-Bidgoli *et al.*, 2018; Roth *et al.*, 2017; Singh *et al.*,

2013). Though there is seemingly less extensive research work conducted in this area amongst the youth, a few studies have explored and established the variation of cause-specific mortalities amongst the youth along socioeconomic, behavioural, demographic and geographic characteristics (Patton *et al*., 2009b; Singh *et al*., 2013). Individuals with lower socioeconomic status tend to more likely live in poorer environments and experience poor health outcomes which may eventually result in health complications and increase the death outcomes for such demographic groups (Zhao *et al.*, 2019). Causes of deaths are always connected to the socioeconomic factors of an individual or the community of residence. Research has shown that over 30 percent of all deaths in low and middle income countries occur at younger ages, from 15 years onwards, compared to 15 percent in wealthy regions (Mathers *et al.*, 2009). Preventable deaths occur in low socioeconomic communities, usually as a result of inadequate health facilities, poor nutrition and sanitation.

As more individuals from low socioeconomic backgrounds are consistently predicted to die from infectious diseases, those from high socioeconomic backgrounds are also deemed to die from non-communicable diseases (Houle *et al.*, 2014). In the United States cancer accounts for 45 percent of all deaths among 15- to 24-year-old (Mokdad *et al.*, 2016) while Sub-Saharan African countries largely contend with communicable diseases as a major contributor to youth mortality. This is because people from poor backgrounds are likely to live in and be exposed to surroundings with unhealthy sanitation thereby increasing their chances of infections. On the other hand, persons from higher socioeconomic backgrounds are more likely to have sedentary lifestyles. Lifestyle behaviours such as reduced physical exercise, excessive consumption of junk and spicy fast foods, frequent and excessive drinking of alcohol are strongly associated with increased chances of developing non-communicable disease conditions (Habib & Saha, 2010). In the United States of America, the youth in the most

deprived groups have 1.9 times higher all-cause mortality compared to the affluent. In addition, the risk of dying from homicide was found to be eight times more among financially deprived youth compared to youth from rich backgrounds. Poorer youth also have 1.5 times higher unintentional-injury mortality, and 8.8 times higher HIV and AIDS mortality than their richer counterparts (Singh *et al.*, 2013). Ghana is however being impacted by both global and regional influences. Communicable diseases accounts for 44.1percent of deaths among young people (Child *et al*., 2023). However, non-communicable diseases like hypertension and diabetes are on the rise accounting for 25 percent of deaths among young people (Boateng et al., 2017). It has also been observed that in the past few years road traffic accidents have increased by 7 percent (Agyei-Mensah & De-Graft Aikins, 2010).

The place of residence of a person is also important in determining the cause of death a person is likely to die from. Residence in poor communities such as slums increases the probability of death due to poor hygiene and diseases such as cholera, malaria as well as death due to violent crimes. Other geographical locations such as locations along major highways may also increase the risk of road traffic injuries. Young people living on the streets are highly marginalised and subject to numerous environmental and weather conditions. Residence in a very hostile community also impacts the survival rate of its population. The frequent exposure of young people to harsh conditions such as violence and abuse from peers, family, other adults and police heighten their risk of death (Woan *et al.*, 2013). A study among street-recruited homeless youth in California revealed that they had a mortality rate which was 10 times that of their peers in the general population, with the most common causes of death being suicide and drug-related complications (Auerswald *et al.*, 2016). Low and middle-income countries including Sub-Saharan African countries are also experiencing increases in risky behaviours among young people which accounts for 20 percent of youth mortality (Masquelier *et al*., 2021).

Changes in the weather and temperature as well as variable light-dark cycles and their interaction with varying infectious agents have been known to affect morbidity and mortality across different seasons (Moore, 2006). The relationship between seasonal patterns and mortality have long been established, especially in the more developed countries. For instance, more deaths have been observed during the colder winter months in countries in the northern hemisphere resulting from cardiovascular and respiratory diseases (Sakamoto-Momiyama, 1978). The desire to understand the impact of climatic change on disease patterns has resulted in studies across different regions on this phenomenon.

There is relatively little data on seasonal patterns of adult mortality in sub–Saharan African countries, with the exception of a few studies in West Africa, predominantly focusing on childhood mortality (Delaunay *et al*., 2001; Jaffar *et al*., 1997). Generally, in tropical countries such as Ghana, more deaths among young children have been observed in and around the end of the rainy season as a result of infectious agents that are prevalent during this season, in particular, malaria. However, the pattern was different in all other age groups except for infants, where Kynast-Wolf *et al* (2006) found that overall mortality was higher for all age groups during the dry season, except for infants (Kynast-Wolf *et al*., 2006).

As the overall health of the population improves and the epidemiological profiles of the population changes, the vulnerability of the population to seasonal pressures reduces, resulting in a reduction in seasonal pattern of deaths (Becker & Weng, 1998; Moore, 2006). Concomitantly, mortality in tropical countries have shifted from child to old-age mortality where countries are undergoing epidemiological transitions as observed in the Garu-Tempane District in Ghana (Engelaer *et al*., 2014). Azongo *et al* (2012) concluded that the association

between mortality and weather variability appeared to differ among different age groups and by sex with children and the elderly being more susceptible to short-term temperature-related mortality in a study in Northen Ghana (Azongo *et al*., 2012).

In terms of the relationship between educational level and mortality rate, education is found to enhance survival through better health behaviour. Better educated individuals tend to use modern medicine, have better hygiene practices and adopt healthy lifestyle behaviours which reduce their risk of death at a much better rate than people with no education (Chisumpa *et al.*, 2019b). There are complicated variations in the type of diseases associated with educational levels and sex. For instance, malaria deaths were higher among males with no education and tuberculosis deaths were also found to decrease with higher levels of educational attainment. Mortalities due to circulatory system diseases as well as injuries and accidents are higher among people with higher educational levels (Chisumpa *et al.*, 2019b).

A geographical analysis of mortality rates in 2014 revealed that, the mortality rate for the population aged 15 to 34 years was low in Hong Kong with a rate of 28.4 deaths per 100,000 population compared to 250.6 deaths per 100,000 population for Russia and an even higher mortality rate of 619.1 deaths per 100,000 population for South Africa (Singh *et al.*, 2015). This reveals differences in premature mortality across countries as a result of economic inequalities and prevailing morbidity contexts driven by violence, accidents and HIV and AIDS among others. It has also been established that rural-urban disparities influence the risk of mortality (San Sebastián *et al.*, 2020; Singh *et al.*, 2013). There is an apparent increase in mortality rates in rural areas compared to urban areas. Unintended injury related mortalities were found to be 2.3 times higher for youth resident in rural areas compared to others in urban areas (Singh *et al.*, 2013).

Deprived families face a higher risk of death due to injuries, with studies suggesting that poorer households are at increased risk of mortality. In Sub-Saharan Africa, some studies have shown a correlation between poverty and cause of death being closely linked to the low levels of economic growth and the lack of progress in reducing poverty (Jamison *et al.*, 2006). These contributed massively to the mortalities recorded in most parts of the region. Unintentional injuries that lead to loss of lives are about 30 to 80 percent rampant in high income countries compared to low-income countries (Patton *et al*., 2009a). Blum and Nelson-Mmari (2004) reported that injuries caused relatively fewer deaths among African youth compared to the same age group in other regions of the world (Blum & Nelson-Nmari, 2004). It has also been observed that the proportion of injuries and accidents resulting in deaths was highest among people who never married (Chisumpa *et al.,* 2019b).

In the Global Burden of Disease Studies in the latter part of the 20th century, it was estimated that Sub-Saharan Africa carries the highest burden of disease in the world (Lozano *et al*., 2012). These translate into high levels of adult mortality emanating from the multiple burdens of disease experienced by majority of the populations in the region (Christopher & Murray, 2015; Murray *et al*., 1996). It is important to note that in recent years non-communicable diseases account for more morbidities and mortalities than communicable diseases. Even among both men and women, most deaths are due to non-communicable conditions accounting for about six of 10 deaths globally (Mathers *et al.*, 2009).

From the turn of the millennia through to the past 20 years, several healthcare sector reforms have been undertaken in most countries across the African continent because of the dire healthcare challenges and hence primary healthcare has been prioritised in attempts to provide accessible healthcare to all citizens especially those in rural communities. Additionally,

improvement and advancement in health technologies have helped address the challenges posed by the health needs of young people thereby reducing deaths caused by diseases especially infectious ones. The pattern of change with regard to diseases is closely associated with improvement in socio-demographic development within most communities and increased assistance with health issues (Dieleman *et al*., 2017). An associated impact of this social and health advancement within the population is the broad improvements in vaccination, food and nutrition, sanitation, availability and accessibility to clean water (Kassebaum *et al*., 2019).

2.6.1. Demographic and socio-economic risk factors associated with mortality

Ageing communities across the globe face substantial tests with regard to their healthcare systems. The welfare needs of the aged will continue to rise and have a greater impact on the economy, social, and health structures of nations with the largest impact on developed countries (Naghavi *et al*., 2015). People aged 10 to 29 years are considered healthier than all other age ranges according to health metrics. However, due to certain unique characteristics of this age group, including their sexual and psycho-physical development, as well as their risk-taking behaviours, their health may be threatened. Thus, it is important to determine the prevalence of these risky behaviours and pursue effective health promotion programmes to encourage healthier behaviours and lifestyles (Boričić *et al*., 2015).

Risky behaviour may be described as "voluntary behaviour that follows the existence of a particular objective and/or subjective degree of risk or a specific type of behaviour that has been shown to increase the susceptibility of specific diseases or health disorders" (Boričić *et al*., 2015). Irwin (1990) claimed that these types of behaviour should be considered “risk-taking behaviour,” since they require individuals, specifically teenagers, who are actively and voluntarily engaged in circumstances, where they are conscious of the risks involved but unsure

of the results. This often ends up with negative consequences for their health (Naghavi *et al*., 2015). Risky behaviours in young people are multifaceted and influenced by various factors. Individual biological, psychological and sociological factors, particularly family circumstances and peer influence are significant in influencing risky behaviour (Snow & Beals, 2007; Viner *et al*., 2012).

The health status of young people in Ghana does not vary substantially from that of young people around the world, although there are some specific characteristics. In recent years, injuries, illnesses, economic pressures and their detrimental effects have characterised the nation and these in turn have impacted people, communities and the country's healthcare system. Thus, several studies have been carried out in this respect to evaluate the demographic and socio-economic risk factors linked with mortality.

Research indicates that males exhibit a higher likelihood than females to engage consistently or experimentally in risky behaviours (Boričić *et al.*, 2015). This trend extends to activities such as tobacco and drug use, bullying, and fighting across the majority of countries. However, these patterns are less closely associated with early sexual activity and smoking. According to data from the 2011 Youth Risk Behaviour Survey (YRBS), male students at American High Schools nationally were more likely to have participated in a physical fight, smoked, consumed alcohol or drugs, compared to their female counterparts. In contrast, older female students were more likely than males to report engaging in sexual activity (Centers for Disease Control and Prevention, 2020). In examining substance use among European students aged 15 to 16 years, aggregate country-level data from the European School Survey on Alcohol and other Substances (ESPAD), showed that, a slightly higher proportion of boys than girls reported alcohol and tobacco consumption in the past month, with the exception of non-prescription pill

use (ESPAD, 2015). Similar findings in China indicated that boys were more prone to reporting multiple health risk behaviours compared to girls (Xu *et al*., 2017).

In 2015, research conducted by Boričić *et al* (2015) revealed a notable increase in the prevalence of multiple health risk habits with age for both males and females (Boričić *et al*., 2015). Similar findings were observed in studies conducted in Japan and the United States (Takakura *et al*., 2001). Additional research has indicated that the prevalence of multiple risks tends to rise with age among males, but not necessarily among females (Sychareun *et al*., 2011). An investigation among adolescents in Serbia found that older individuals and those with low or moderate academic achievements displayed slightly higher risk levels compared to their counterparts with high school success (Boričić *et al.*, 2015). The study also indicated that both boys and girls from wealthier households engaged in multiple health risk behaviours more frequently than those from the poorest households (Boričić *et al.,* 2015). These findings were corroborated by results from a study among Danish adolescents which showed that alcohol use and drunkenness were associated with poor lower school achievements (Andersen *et al*., 2006).

Other factors associated with health risk behaviours include parental education (Grotvedt *et al*., 2008; McCabe *et al*., 2017) and family affluence (Levin *et al*., 2009; Richter *et al*., 2013). Weekly drinking seemed to be more widely recorded in some countries among males of high family wealth, compared to females (Levin *et al*., 2009). Research has also demonstrated a correlation between children from broken homes (Grotvedt *et al*., 2008) and patterns of smoking.

2.7. Theoretical Framework

The main theory underpinning this study of the causes of death and the trends and patterns of mortality among young persons in Ghana is the epidemiological transition theory (Omran, 1971) along with its modifications (Agyei-Mensah & De-Graft Aikins, 2010; Defo, 2014; Mercer, 2018; Omran, 2005).

2.7.1. Epidemiological Transition Theory

The association between socio economic development, mortality and life expectancies have long been documented since the 19th century (Banister & Zhang, 2005; Mackenbach, 1994). There is evidence to suggest that, survival of infants and children, to a large extent, is dependent on the economic and social conditions into which they are born, as poverty, ignorance and lack of basic services make them vulnerable to diseases and mortality (Rosero-bixby, 1990). The concept of the demographic transition was initially proposed in 1929 by demographer Warren Thompson, when he conceived the complex relationship between falling birth and death rates in various countries (Kirk & Kirkt, 2017). Since then, the idea has been discussed by various authors, evolving from a purely demographic perspective to incorporate other viewpoints, including morbidity, social, economic and cultural factors. In 1971, Omran developed the concept of epidemiological transformation by integrating Thompson's demographic transition models. This concept encompasses insights into the causes of death, drawn from mortality changes observed in England, Wales, Japan, and Sweden during the 19th century (Mercer, 2018; Omran, 1971; Santosa *et al.*, 2014a). The Epidemiological Transition Theory (ETT) has contributed significantly to understanding shifts in causes of mortality across countries and periods (Omran, 1971).

Omran's suggested epidemiologic transition theory (ETT), consists of three stages. *The age of pestilence and famine* – the initial or pre-transitional period is characterised by varying mortality rates influenced by epidemics, famines and wars. At this stage, the crude death rate (CDR) is high, ranging from 30 per 1,000 people to over 50 fatalities. Literature indicates that at this stage, the populations transformed from hunter-gatherer societies to agrarian societies, resulting in changes in the patterns of livelihoods and living conditions to a more settled lifestyle with humans cultivating crops and domesticating animals (McKeown, 2009a). This situation contributed to changes in population size and density as well as dietary habits, including the consumption of unwholesome food and water due to inadequate food handling and storage practices, as well as exposure to human and animal waste. Consequently, diseases resulting from dietary deficiencies, microbial exposure, infectious diseases and other illnesses from endemic causes were prevalent at this time, leading to high mortality and low life expectancies. In Sub-Saharan Africa, this stage is linked to diseases such as malaria and high infant mortality (Fotso *et al*., 2007).

The second stage - *the age of receding pandemics*, is a transitional phase. Mortality starts to decline, leading to an increase in life expectancy at birth from approximately 30 years to about 55 years. During this phase, advancements in sanitation, hygiene, nutrition, and progress in medicine and public health systems play a pivotal role in managing infectious and bacterial disease epidemics and pandemics (Olshansky & Ault, 1988; Omran, 1971). The reasons for the shift are complex and varied but have been attributed to changes as a result of social, economic, political, cultural and environmental factors (McKeown, 2009b). These transitions occur as countries industrialise accompanied by modern and urban style of living. Due to shifts in lifestyle, the patterns of disease and mortality transition from predominantly infectious diseases to chronic degenerative diseases associated with one's way of life. The theory posits that this

transition is accompanied by changes in the age distribution structure of the population (McKeown, 2009a). While western countries have experienced this transition many low- and middle-income countries (LMICs) including Ghana are now at this stage (Ayaga Bawah *et al*., 2016).

At the third stage of the ETT, mortality continues to decline and has been described by Omran as *the age of degenerative and man-made ailments.* In this phase, it is theorized that mortality is primarily attributed to human-induced and degenerative causes rather than infectious diseases. Life expectancy at birth undergoes an increase, reaching around 70 years, a pattern commonly observed in developed countries during the late 19th and 20th centuries, with the prevalence of non-communicable diseases (Mckeown, 2010; Omran, 1971).

The applicability of the ETT in low- and middle-income countries (LMICs) has been questioned when considering the epidemiological profiles of LMICs. In any given time, according to the ETT, there is a substantial change from one main cause of death to another as experienced by the high income countries, (HICs) where the transition followed a unidirectional path (Omran, 2005). The transition commenced with high, fluctuating mortality rates resulting from infectious diseases, famines and wars. Subsequently, mortality rates declined as degenerative diseases started to replace infectious diseases as the primary contributors to morbidity and mortality. In the final stages, non-communicable diseases become the primary causes of death and mortality rates stabilising at comparatively lower levels.

The initial concept presented by Omran presupposes a linear sequence in the changes of cause-specific mortality, both in terms of speed and timing, akin to what was observed in the industrialized countries of Western Europe and the United States of America. Nevertheless, it is noteworthy that not all countries undergo the transition in a uniform manner (Santosa *et al.*,

2014b). This makes it impractical to generalise the findings from HICs to the African context (Ayaga Bawah *et al*., 2016; Dalal *et al*., 2011). Indeed, the applicability of the model in LMICs has been questioned (Omran, 2005; Santosa *et al*., 2014a). Bawah *et al.*, (2016) observed variations in the ETT and challenged the universality of the model. Countries in Africa and Asia are at different stages and exhibit different trajectories in their epidemiological transition. Bawah *et al.* (2016), using data from four demographic surveillance sites across Africa and Asia, illustrated different epidemiological transition paths. According to them, the Agincourt DSS Site in South Africa, shows a counter transition, where overall mortality is increasing and mortality is prolonged. This is a result of the high deaths arising from communicable diseases, including HIV and AIDS as well as deaths from the rising NCD burden. In Matlab in Asia, on the other hand, there is evidence of a standard epidemiological transition with overall mortality falling as a result of declines in mortality from communicable diseases and an increase in the burden of NCDs. In the Navrongo HDSS Site in Ghana on the other hand, they observed a delayed transition. This is because despite the declines in overall mortality, the burden of disease is yet to shift from infectious causes to NCD causes (Ayaga Bawah *et al*., 2016).

From their observations, they conclude that the ongoing demographic and epidemiological transitions in low and middle-income settings do not conform to the classical transitions multifariously described. They argue in support of the concept of an "Age of triple health burden" that begun in the 1970s, comprising three main health burdens occurring simultaneously. Countries in these situations were faced with mortality from infectious and communicable diseases, as well as an increase in NCDs, all occurring in the midst of inadequate health systems and medical training (Allotey, P., Davey, T., & Reidpath, 2014; Ayaga Bawah et al., 2016; Omran, 1998).

Thus, universality of the ETT was questioned due to difficulty in aligning to all populations especially LMICs. The ETT was further criticised for ignoring social inequalities particularly social determinants of health especially in the early stages (Hussain, 2018). In view of this there has been increased discussions over the last two decades to determine whether existing theoretical structures in global health may provide any general guidelines for LMICs. This phenomenon arises due to unprecedented changes in morbidity and mortality patterns within populations of LMICs. Nations in the Global South are witnessing advancements in early childhood survival while concurrently experiencing the growth of their adult populations. Simultaneously, new infectious diseases like HIV and AIDS are emerging and others are resurfacing, particularly in LMICs. This includes diseases such as dengue fever, TB, cholera, and polio, alongside a surge in Non-Communicable Diseases NCDs (B. Defo, 2014).

Following Omran, some scholars have introduced additional stages to the theory of transition. Rogers and Hackenberg (1987) argued that the original theory lacked a connection to violent and accidental deaths due to behavioural factors. They introduced a fourth stage called the hybristic stage, reflecting a shift in the underlying causes of mortality and morbidity. The term 'hybris' denotes excessive self-confidence or a belief in invincibility. During the hybristic stage, morbidity and mortality are influenced by man-made infections, human behaviours, and potentially destructive lifestyles. Human habits, such as physical inactivity, poor diet, binge alcohol consumption, and cigarette smoking, elevate the risk of adverse health effects, including heart diseases, diabetes, liver cirrhosis, and lung cancer. This proposition aligns with the Nutrition Transition concept, which analyses changes in dietary habits (Popkin, 1993). In addition, Rogers and Hackenberg (1987) observed that while most infectious diseases dependent on the environment are eradicated during the hybristic stage, because of human behaviours and man-made causes, certain infectious diseases are growing in importance. HIV

and AIDS are well-known examples of such infectious illnesses. Others have called for a Sub-Saharan African Model that will take into consideration the African peculiarities.

As such, changes in public health and epidemiological discussions have evolved to take cognisance of genetic factors in addition to etiologic investigations of degenerative diseases alongside social, political and environmental factors. The various geographical contexts Western, Asian and Sub-Saharan African countries as well as comparison of their various experiences are considered. Thus, the discussions have evolved into an eco-epidemiological approach that incorporates the understanding that mortality occurs within multiple levels. It also considers changes that occur within the life span as the age distribution of the population changes as well as the understanding that diseases occur in individuals but interventions are undertaken within communities (McKeown, 2009b).

The conceptualisation of this study is therefore based on the understanding of the concepts of a multilevel eco-epidemiological life course model of mortality and the epidemiological transition theory. While the study uses the ETT, it acknowledges its limitations particularly its inadequate applicability in the different geographical settings and strives to provide an analysis suitable for the Ghanaian context.

2.8. Conceptual framework for the study of mortality among the youth in Ghana

This thesis is hinged on a modification of the concepts of a multilevel eco-epidemiological life course model of mortality (B. Defo, 2014) and the epidemiological transition theory as shown in Figure 2.1 below (Omran, 2005). The eco-epidemiological model depicts biological, social, environmental, and contextual factors operating at multiple levels to determine cause of death.

The ETT explains changes in the causes of death over time, due to behavioural changes. The main dependent variable of interest is the cause of death which is grouped as infectious diseases, non-communicable diseases, external injuries or trauma and maternal causes. The determinants of the causes of death in this thesis operate at multiple levels known as distal and macro-contextual factors, intermediate factors and proximate factors. The intermediate determinants of cause of death, include lifestyle behaviour such as smoking and alcohol consumption and place of death. Proximate determinants of cause of death, include a person's general health status conceptualised as having been on admission to a health facility 12 months prior to death, having undergone a surgical operation prior to death and the onset of death.

Distal factors encompass the social determinants of health that can determine the cause of death among young people. In fact, they are described as the "causes of the causes" of health inequalities among populations (Marmot, 2011). The distal and macro-contextual factors include:

i. demographic factors such as age, sex, marital status, and relationship to household head;
ii. socio-cultural and economic factors such as level of education, ethnicity, religion, occupation and employment status;
iii. geophysical factors such as district of residence, type of place of residence, season of death and year of death; and
iv. environmental pathology factors such as source of drinking water and type of toilet facility.

Demographic factors explain to a great extent the risk of dying from a particular cause. For instance, regarding sex, only women are exposed to risk of dying from maternal related causes whereas young men have a higher risk of suffering from injuries or dying from accidents

(Chisumpa *et al.*, 2019a). Overall, evidence from Africa and Asia indicates that men experience higher mortality rates than women across all population age groups (Streatfield *et al.*, 2014). Age is linked with cause of death as morbidity patterns and mortality rates differ with age. Evidence from Zambian vital registration systems between 2010 and 2012, shows that the risk of dying from non-communicable diseases increases with age, while the risk of dying from injuries and accidents reduces with age (Chisumpa *et al.*, 2019a). Marital support has been shown to be positively associated with the probability of surviving. From a study in South Africa among women aged 20 to 80 years, formerly divorced, widowed and separated women were shown to have a higher risk of mortality than their married counterparts (Shoko, 2011).

Social, economic and cultural factors have an overwhelming influence on morbidity and hence cause of death. Such factors used in this study include education, employment status, occupation, religion and ethnicity. Education is a well-known predictor of morbidity. In fact, higher educational attainment among young people is associated with lower prevalence of injuries and HIV, and better overall health conditions (Viner *et al.*, 2012). A study among young adults in Sweden found lower mortality due to falls among higher educated men compared to lower educated men, though there was not much difference among women by education (Kiadaliri *et al.*, 2018). Furthermore, the vital statistics of adults from the United States of America between 2010 and 2017 indicate an increasing life expectancy at age 25 among college-educated adults and a decline in life expectancy at 25 among those with lower education (Sasson & Hayward, 2019).

The little evidence available from studies tend to link unemployment with higher mortality rates across different populations (DeSilva *et al.*, 2009). Unemployment is linked with poorer self-rated health, particularly among men in Ghana (Sulemana *et al.*, 2019) and with increased

substance use in New Zealand (Boden *et al.*, 2017). Employment status aside, occupation-related deaths and injuries are among the leading causes of death globally (Courtenay, 1997; Steenland *et al.*, 2003). Some occupations are hazardous and may be associated with injuries while others may lead to long-term cardiovascular disease. The social context and dimensions of occupation can contribute to individuals' health and well-being (Gallagher *et al.*, 2015). Cultural factors such as religion and ethnicity have been associated with attitudes and beliefs towards health and wellbeing. It also influences other social determinants of health (Schnall *et al*., 2010).

Geophysical factors significantly influence morbidity in Ghana. For instance, some diarrheal disease risks and malaria are highest in the wet (rainy) season (Abu *et al.*, 2018; Osei-Tutu & Anto, 2016) while cerebrospinal meningitis is most prevalent in the hot dry season (Nii *et al.,* 2014; Wulifan *et al.*, 2022). This conceptual framework, therefore, considers the year and season of death as determinants of cause of death.

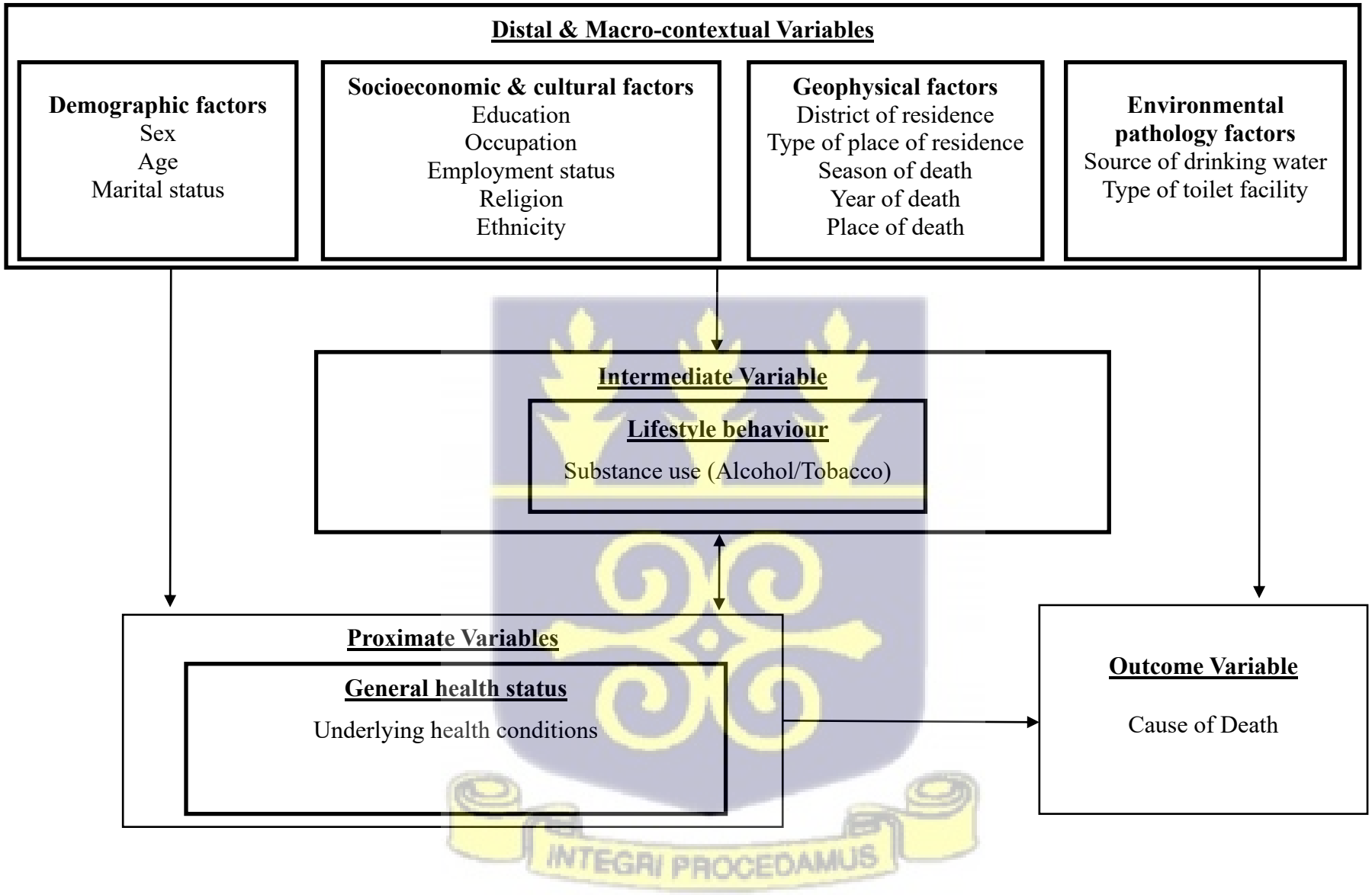
With regard to the environmental pathology factors, the main source of drinking water and type of toilet facility in a household are predictors of sanitation conditions. Thus, individuals from households with unimproved water sources and unimproved toilet facilities are likely to die from infectious causes than their counterparts from households with improved water sources and toilet facilities. Lifestyle behaviours are known to be risk factors for specific causes of death. For instance, use of tobacco and alcohol may be linked with cardiovascular disease risks while alcohol consumption may be further linked with injuries and accidents. Indeed, life expectancy is inversely influenced by these mortality patterns which are caused by increasing prevalence of NCDs and risky behaviours such as substance abuse.

Existing medical and health technology can influence the health and well-being of people, and by extension, their cause of death. The distance to a health facility is linked with delays in deciding to use a health facility as well as access to healthcare. An individual's place of death is a proxy indicator of their access to healthcare and can adequately predict the cause of death. The general health status of an individual when they are alive is a key determinant of their cause of death. Having undergone a surgical operation prior to death or having been on admission in the 12 months prior to death are precursors to the cause of death of an individual. Thus, having an underlying health condition significantly influences the probability of dying from any morbid event (Mercer, 2018).

This chapter examined the causes and patterns of mortality among young people 10-34 years taking into consideration the global, regional and country contexts. Non-communicable diseases, road traffic accidents and suicides were reported as the leading causes of death globally (Haagsma *et al*., 2016; Lozano *et al*., 2012). In Sub-Saharan Africa there is a high prevalence of communicable diseases even though non-communicable diseases are on the rise. Mortality patterns in Ghana are being influenced by global and regional occurrences with a concerning rise in road traffic accidents. The chapter also considers the gender perspective of causes of death among young people focusing on maternal mortality and HIV and AIDS rates among women and the vulnerability of males to road traffic accidents and injuries. The chapter further considers the role of risky behaviour and their contribution to mortality, especially in LMICs. It was noted that risky behaviour such as substance abuse contributes significantly to mortality in LMICs. It was further noted that the observed mortality patterns have implications for Sub-Saharan Africa which lags behind global average life expectancy due to its peculiar mortality patterns which reflects the double burden of both communicable and non-communicable diseases as well as inadequate healthcare systems. In order to understand and

develop targeted interventions, the study adopts a context-specific approach of an interplay of the different types of diseases and socio-economic conditions as well as risky behaviours to guide the study.

Figure 2.1 Conceptual framework for the study of the factors associated with youth mortality.



CHAPTER THREE

METHODOLOGY

3.1. Introduction

This chapter presents information on the methodology employed in the study. It comprises information on the design of the study, study area, data source and type, variables used in the analysis, the methods of data analysis and data limitations.

3.2. Study design

The study utilised a quantitative research design. This design is predicated on the research objective of assessing causes of death which requires an analysis of data on reported causes of death independently validated by physicians (Sulemana Abubakari, 2017).

3.3. Data source

The study retrieved and used data from the Kintampo Health and Demographic Surveillance System (KHDSS) covering the period 2005 to 2015. The study used data on the causes of death and individuals' sociodemographic, economic, behavioural and environmental attributes. The dataset comprised data on 1,834 young people (883 females and 951 males) aged 10 to 34 years who died in the KHDSS Surveillance Area between 2005 and 2015. The Health and Demographic Surveillance System (HDSS) is a continuous system of collecting data on demographic and health events within the KHDSS Surveillance Area. The HDSS sites collect data on the three main components of demographic change: fertility, mortality and migration. The HDSS also collects data on vital demographic events as well as individuals' demographic and social attributes. The study population includes all persons who were enumerated during

the baseline census in 2003. Persons born to enumerated women are also registered and included in the surveillance system. Persons who move into the Demographic Surveillance Area (DSA) and reside there for a minimum of 90 days are also registered into the demographic surveillance system. People leave the surveillance system, either through death or out-migration. The data is updated biannually with physical visits to all households within the coverage of the surveillance sites. Demographic events of all registered individuals are recorded, including their deaths, regardless of where the individual dies, whether it be in a health facility, at home or elsewhere. This study used HDSS data to examine causes and risks of death and the associated sociodemographic correlates among young people.

3.3.1. Kintampo demographic surveillance area

The Kintampo Health and Demographic Surveillance System (KHDSS) of the Kintampo Health Research Centre (KHRC) was set up in 2005 with 139 communities in the Kintampo North Municipality and Kintampo South District. As of 2015, the communities have grown from 139 to 160. KHDSS lies in the forest-savannah transitional zones between the wet semi-equatorial and tropical continental climates (Coordinating Council, 2019). Its strategic location makes it the geographical centre of Ghana. Based on the definition of rural and urban populations by the Ghana Statistical Service, the area is largely rural (53.1%) with about 52.3 percent of the population being females. The area covers over 83 percent of the administrative population with approximately 9,956 sq. km. (KHRC, 2020). Trained field workers update the surveillance system twice a year with the first updates from January to June and the second updates from July to December. All compounds are enumerated and identified with unique numbers. An initial census is conducted to provide baseline demographic data (sex and date of birth) on all residents after which subsequent and regular rounds of data collection are done to update the system by registering all new individuals and households. Demographic events

collected routinely are pregnancies, births, deaths and migration. With the help of community key informants (CKIs), events that occur in between rounds are collected.

3.3.2. Verbal autopsy

Verbal autopsy (VA) is a method of determining an individual's cause of death and cause-specific mortality in populations without a well-established vital registration system or medically-certified cause of death data (Soleman *et al.*, 2006). Trained interviewers conduct verbal autopsies, employing a questionnaire to gather information about the signs, symptoms, and demographic traits of a recently departed individual. The information is typically obtained from someone closely acquainted with the deceased, often a next of kin or caregiver (Thomas, D'Ambruoso, *et al.*, 2018). Within Sub-Saharan African communities, obstacles to medical autopsies arise, encompassing cultural factors, deaths occurring beyond health facilities, insufficient equipment, and challenges in delivering histological and toxicological services to substantiate and validate clinical diagnoses. Additionally, there may be limitations with personnel resources (Awini *et al.*, 2014; Thomas, D'Ambruoso, *et al.*, 2018; Yawson *et al.*, 2014). Verbal autopsy is conveniently and widely used to collect data for disease surveillance and support planning and policy formulation (Soleman *et al.*, 2006). This method was used to collect data on causes of death of persons in the DSA and fed into the DSS. Each household within the Kintampo North Municipality and Kintampo South District was visited and the heads of the households (or any knowledgeable person) is interviewed. Questions as to whether a death has occurred during the surveillance were asked and if any death has occurred, a VPM questionnaire is completed to obtained further details. These questions comprise of the deceased's basic demographics such as age, education, occupation, as well as information regarding the deceased's date of death and illness before death are ascertained.

3.3.3. WHO Inter-VA

Although verbal autopsy has proven to be the best available approach in obtaining information on the causes of death in settings with poor or no routine death certification, it has also proven to be costly and slow in low and middle income countries (Flaxman *et al.*, 2018; Fottrell & Byass, 2010). This is due to the dependence on physicians who are needed to code the VAs. To address this challenge and to ensure standardisation of data collected, the WHO developed a probabilistic model, the Inter-VA, to interpret VAs for the determination of causes of death (Byass *et al.*, 2003; Desai *et al.*, 2014; Leitao *et al.*, 2013, 2014). Analysis of the cause of death by the Inter-VA, is based on the Bayes' theorem, which calculates the probability of a set of probable causes of death based on given signs, symptoms and circumstances reported by the interviewer. These signs, symptoms and circumstances are extracted from a set of VA questionnaire and then processed to give at least three possible causes of death together with their likelihood. The WHO Inter-VA version 5.1 model was used on the KHDSS data to estimate causes of death of those aged 10 and 34 years from 2005 to 2015.

3.3.4. Data processing

A paper-based questionnaire comprising of both closed and open form was used. The questions were grouped in batches of 50 dependent on the form type and entered into the Health Records System (HRS2). Subsequent to data entry, a validation check on the forms is conducted by Data Supervisors. The recorded information is then stored in a relational database system created with Visual FoxPro version 5. However, a transition between 2019 to 2015, moved the process towards electronic data collection through OpenHDS and ODK software, with MySQL serving as the primary data management tool. OpenHDS functions as a comprehensive multi-component data platform for Health and Demographic Surveillance, employing a client-server architecture and utilising Android-based tablets for on-the-spot digitisation of data. Tablet data

is regularly synchronised whenever internet connection is available. Following the data synchronisation, the data from the tablets is uploaded to the KHRC dedicated virtual or physical server, with routine automatic backups and additional backup on a separate server or external hard drive. The collected data undergoes cleaning and migration from the ODK server to the OpenHDS server, facilitated by Mirthconnect, which identifies errors such as data inconsistencies.

3.3.5. Statistical analysis

All analysis were done in STATA version 14.0. Basic descriptive statistics such as frequency, spatial maps and graphs were used to describe all important variables. Time at risk of an event (death) was calculated for each individual registered within the surveillance system. Time due to migration (move-out) was, however, subtracted from the risk. Mortality rates were calculated by dividing the number of deaths by the time at risk. The mortality rate, age-specific mortality rate, sex-specific mortality rate, and the mortality rate by residence were presented as deaths per 1,000 person-years.

3.4. Variables and measurement

The variables used in this study were selected based on established relationships identified from the literature review. While the conceptual framework presents a comprehensive relationship with multiple factors, some of the variables indicated in Chapter Two were omitted from the analyses. This is because this study relies solely on data from the Kintampo HDSS which does not include data on these variables. This, however, did not have any significant impact on the study. The categorisation of the variables in the study are shown in Table 3.1 below.

Table 3.1 Key variables and measures

Variable	Definition	Categories
Cause of death	Broad causes of death	Infectious Non-communicable External injuries/trauma Maternal Indeterminate
Sex	Sex of dead person	Male Female
Age	Age at time of death	10-14 years 15-19 years 20-24 years 25-29 years 30-34 years
District of residence	District or Municipal Assembly where deceased resided at time of death	Kintampo North Kintampo South
Educational attainment	Highest educational level attained by deceased at death	No Education Primary Middle/Junior High School (JHS) Secondary plus
Marital status	Marital status of the deceased at time of death	Never Married Married/cohabiting
Main source of drinking water	Main source of drinking water of the household of the deceased	Improved Unimproved
Type of toilet facility	Main type of toilet facility by the household of the deceased	Improved Unimproved
Type of place of residence	Urban or rural status of the locality where deceased lived prior to death	Rural Urban
Ethnicity	Ethnic group to which deceased person belonged	Akan Grushi/Gurma/Mande Mole/Dagbani Other
Religion	Main religion to which deceased person was affiliated prior to death	Christian Muslim Traditionalist/Other No religion
Occupation	Main economic activity of the deceased prior to death	Farmer Non-farmer Student

Variable	Definition	Categories
Season of death	Climatic season during which the deceased person died	Wet Dry
Place of death	Place where deceased was deemed to have died	Health facility Home Traditional healer / Other
Year of death	Year in which the deceased died	2005 – 2015
Presence of underlying conditions	Indication whether the deceased lived with a health condition prior to death	No Yes
Substance use	Whether deceased used alcohol, tobacco or any psychotic drug	No Yes

3.4.1 Dependent variable

The dependent variable in this study is cause of death. There were four known categories of causes of death: infectious diseases, non-communicable diseases, external injuries/trauma and maternal causes. The last category of cause of death (maternal causes) applies only to women and so for men there are three broad causes of death. Where a cause of death could not be allocated to any of the four predefined categories or if a cause of death was unknown, it was grouped as "indeterminate". This constituted a fifth category which is shown in the descriptive analyses but excluded from the regression analyses. There were about 303 cases of undetermined cause of death in this study.

3.4.2 Independent variables

The independent variables, based on the conceptual framework (Figure 2.1), include age at death, sex, educational attainment, marital status, water source, type of toilet facility, type of place of residence, district of residence, ethnicity, religion, occupation, season of death, place of death, presence of underlying conditions and substance use. Age, sex, marital status,

educational attainment, ethnicity, religion and occupation are individual socioeconomic characteristics of the deceased persons. The water source and type of toilet facility are household level variables which are indicators of the water and sanitation situation in the deceased person's household when they were alive. Improved water sources include pipe borne water, borehole, tube well, protected well, rain water, protected spring, bottled water and sachet water. Improved toilet facilities include water closet and ventilated improved pit. All others are unimproved. A deceased person is said to have had underlying conditions if they had ever been diagnosed of any of the following conditions: heart disease, hypertension, varicose veins, kidney disease, asthma, TB, epilepsy, diabetes, jaundice or hepatitis, leprosy, cancer, HIV and AIDS or any other serious illness. Substance use is a lifestyle indicator which measures tobacco smoking and alcohol consumption.

3.5. Methods of data analysis

Three main approaches were employed in analysing the data to answer the research questions of the study. These include a trend analyses of mortality patterns, competing risk analyses of the relative contribution of each cause of death to overall mortality and regression analyses to identify the significant factors associated with the relative odds of dying from a broad cause of death. Separate analyses were conducted for males and females.

3.5.1. Trend analysis

Trend analysis involves the comparison of data overtime to identify patterns or changes in patterns overtime. In this study, overall mortality and population data are used to compute mortality rates per annum for the study area. These rates are compared between males and females over the period of the study. Further, the relative contributions of each broad cause of

death to overall mortality are compared for the period. This analysis is done by sex, age and type of place of residence.

3.5.2. Competing risk analysis

Competing risk analysis refers to a particular form of survival analysis aimed at accurately measuring the marginal chance of an outcome in the presence of competitive activities. It is assumes that alternative causes of death impact mortality experiences independently (Abubakari S. *et al*., 2019). Traditional methods to describe survival process, such as the Kaplan Meier product-limit process, are not built to handle the competitive dynamics of multiple causes of the same occurrence, because they appear to yield unreliable predictions when analysing the marginal likelihood of cause-specific events. However, in analysing the marginal likelihood for cause-specific events, such approaches appear to yield erroneous results. This is because they are not meant to consider the conflicting existence of multiple causes for the same occurrence. Competing risks occur when subjects can experience one or more events or outcomes which 'compete' with the outcome of interest.

3.5.3. Descriptive statistics

The DSS data was analysed at univariate and bivariate levels to describe the characteristics of the study population and to show the statistical association between the distal, mediating and intermediate variables on one hand and the dependent variable, cause of death, on the other hand. At the univariate level, frequency tables are used to describe the distribution of the socio-demographic characteristics of the population who had died during the study period. The bivariate level of analysis includes the use of cross tabulations and chi-square tests to determine variations in cause of death by the socio-demographic, economic and environmental characteristics of the dead persons.

3.5.4. Regression analysis

Multinomial logistic regression (MLR) models are run to determine the relative odds of dying from a particular cause of death rather than a reference cause. The MLR is used because the dependent variable is categorical with more than two categories. For the female analysis, the variable includes a 'maternal death' category which is not applicable to the males.

3.5.5. Life table analysis

Life Tables have historical significance in the field of demography, since it was first introduced by John Graunt in the 17th century, when he attempted to estimate the average survival probabilities and expected age of death for individuals (Connor, 2022). Although the use of life tables has evolved, their fundamental technique with regards to their construction and analysis has barely changed. The most commonly used measure of life tables is life expectancy at birth (LEB), which measures the expected number of years a person will live if he or she was exposed to the mortality patterns of that population.

Over time, other disciplines have borrowed the concept and life tables have since become applicable in a variety of settings, where age-specific probabilities are required to estimate the mean length of time an individual undergoes a particular event. The concept has been used in the insurance industry to construct actuarial life tables that estimate the probability of death, sicknesses and disability and aids insurers in the pricing of insurance products and the projection of insured future events (Dhaene *et al*., 2002). The United Nations Educational, Scientific and Cultural Organisation (UNESCO) has also relied on the concept of life tables to estimate school life expectancy. School Life Expectancy (SLE) is a measure of the number of years of education a child of school entering age would receive during his/her lifetime in school, assuming enrolment rates remained the same (Barakat, 2012; UNESCO, 2008).

Life expectancy is not only a measure of the overall level of mortality and the age-specific mortality patterns that prevails in a population but is also an important measure of development due to its inherent comparability in relation to other mortality rates, rendering it a preferred measure. (Klenk *et al*., 2007). As a result, life expectancy at birth has been accepted as a proxy indicator of a nation's socio-economic status and development (Miladinov, 2020; Sharma, 2018). The inclusion of life expectancy in international frameworks, such as the SDGs, underscores its significance as a critical measure for tracking progress and promoting global development.

In this study, multiple decrement life tables are used to analyse the impacts of the different causes of death on life expectancy in the Kintampo Demographic Surveillance Area in the period of the study by sex. The analyses include determining the improvement in life expectancy if specific causes of deaths are reduced or eliminated.

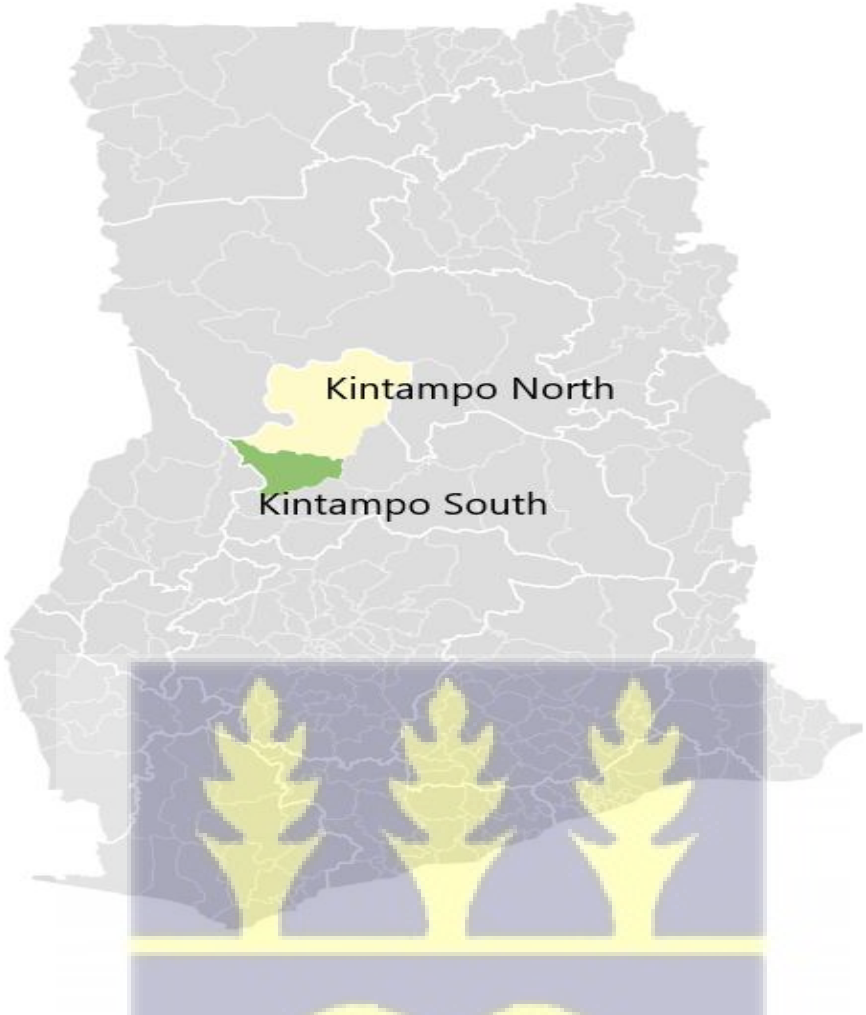
3.5.6. Analytical approach

In line with the objectives of the study, different approaches were employed to analyse the data. The first stage of data analysis involved the computation and comparison of mortality rates in the entire population versus that of the study population which included youth aged 10 to 34 years. Further analyses were conducted to show differences in mortality patterns and trends by sex. In addition, multivariate analyses were conducted to determine the relationships between the independent variables and the cause of death using multinomial logistic regression models. All statistical tests were conducted at an alpha level of 0.05. This study further attempts to estimate life years to be gained by elimination of a broad cause of death.

3.6. Study area

This study is set in the Bono East Region (formerly part of the Brong Ahafo Region) in the Middle Belt Development Zone of Ghana (Figure 3.1). Although current data from the 2021 Population and Housing Census (PHC) is available, this study also relies on data from the 2010 PHC which depicts the population characteristics of the study population during the period of study. According to the preliminary results of the 2021 Population and Housing Census, Ghana has a total population of about 31 million (30,832,019) with a higher female proportion of 50.7 percent. Prior to 2018 there were ten (10) administrative regions in Ghana. There are currently sixteen (16) regions with six (6) new regions carved out of the previous ten (10). The most populous region is the Greater Accra Region with 17.7 percent of the population of Ghana, while the Ahafo Region has the lowest population with 1.8 percent. The Bono East Region is the tenth most populous region with 3.9 percent of the total population. Ghana has a youthful population with about 35.3 percent under 15 years, (0-14) and 38.2 percent between 15 and 35 years. A larger proportion (57 percent) live in urban areas with an average population density of 129.3 persons per square kilometre. The sex ratio is about 97 males per 100 females.

Figure 3.1 Map of Ghana showing the Kintampo study area



3.6.1 Kintampo North Municipality

The Kintampo North Municipality (Figure 3.2) was elevated to a Municipal Assembly from a district after it was carved out of the erstwhile Kintampo District in 2004. The Kintampo Municipal is located between latitudes 8°45'N and 7°45'N and longitudes 1°20'W and 2°1'E and covers an area of about 5,108 km2 (Ghana Statistical Service, 2014b). The total population of the Municipality, based on the 2021 Population and Housing Census (PHC) was 139,508 with a population density of 28.7 persons per square kilometre. The sex ratio stands at 99.3 males for every 100 females. The municipality has a higher urban population (58.6%) than rural based on the localities with a population of 5,000 or more. When availability of urban infrastructure is considered then it has an urban population of only 5.4 percent. Kintampo

Municipal has seven sub-districts with Kintampo as its administrative capital. The location of the Municipality, in the centre of Ghana positions it as a transit point for people and goods between northern and southern Ghana (Ghana Statistical Service, 2014b). There is a high composition of interregional migrants (39%) mainly from Northern Ghana and the Ashanti Region while about 15 percent of the population are from other districts within the region. Over half of the economically active population (aged 15 or older) are employed as skilled agriculture, forestry and fisheries workers, followed by service and sales workers who make up about a fifth of the labour force.

Figure 3.2 Map of the Kintampo North Municipality showing study communities

3.6.2 Kintampo South District

Similarly, Kintampo South District (Figure 3.3) was established in 2004 when it was carved out of the old Kintampo District. The district lies between latitudes 8°15'N and 7°45'N and longitudes 1°20' West and 2°10' West and covers a surface area of about 1,491 km^2 (Ghana Statistical Service, 2014a). The 2021 PHC, showed that the total population of the district was 89,126 with a population density of 60 persons per square kilometre. There are about 104 males for every 100 females in the district which is much higher than the national average. The district is predominantly rural (85 percent) but it has a higher urban population (9.6 percent) than Kintampo North Municipality if urban infrastructure is taken into consideration. At 4.2 persons, the average household size is above the national average of 3.6 persons. Kintampo South District has five sub-districts with its administrative capital located in Jema. About 38 percent

of residents are interregional migrants who come mainly from the northern regions. About a tenth of the population are migrants from other districts within the region As expected of its largely rural population, about four-fifths of the economically active population is employed in the agriculture, forestry and fisheries sectors (Ghana Statistical Service, 2014a).

Figure 3.3 Map of the Kintampo South District showing study communities

3.7. Data limitations

Data limitations include inconsistent recording of cause of death. The dataset has a high proportion of deaths whose main causes are undetermined, particularly for females. For this study, it is assumed that the undetermined causes of death could have resulted from the various causes of death and were thus allocated proportionally among the known causes of death. Allocating the undetermined causes of death among the known causes, however, increases the

number of deaths to each broad cause of death. Nevertheless, as employed in similar studies, this approach was adopted to avoid the undetermined causes of death being considered as a competing cause of death (A. A. Bawah & Binka, 2007).

The use of verbal autopsies has limitations such as subjectivity and limited precision, however, they are most useful in the absence of complete medical diagnoses or for areas without vital registration systems. In contexts like that of the KHDSS, verbal autopsy data is useful for population-level mortality analysis to help identify major health challenges and the correlates of major causes of death (Garenne, 2014; Garenne & Fauveau, 2006; Thomas, Ambruoso, *et al.*, 2018).

CHAPTER FOUR

CAUSES OF DEATH, TRENDS AND PATTERNS OF PROBABLE CAUSES OF DEATH AMONG YOUNG PEOPLE

4.1. Introduction

This chapter presents an overview of the broad causes of death among young people 10 to 34 years in the Kintampo Health and Demographic Surveillance System (KHDSS) and the distribution of the specific causes of death in the different population groups during the 2005 to 2015 period. It concludes by describing the trends and distribution in the causes of death from 2005 to 2015 among the population aged 10 to 34 years by age, sex and rural-urban residence.

4.2. Broad versus specific causes of death in the KHDSS

The broad and specific causes of death are distributed differently among young males and females. Overall, there are more deaths to infectious causes, NCDs and external injuries or trauma among males than females. Tables 4.1 to 4.4 show the distribution of specific causes of death by sex from the KHDSS from 2005 to 2015, grouped according to each broad cause of death. Table 4.1 displays the distribution of the main infectious causes of death. From deaths due to infectious causes, pulmonary tuberculosis had the highest proportion of deaths (30.7%) for young people 10 to 34 years. Pulmonary tuberculosis was the highest infectious cause of death amongst females (29.3%) and the second highest among males with 31.5 percent. Tuberculosis has long been a leading cause of morbidity and mortality globally (WHO, 2022). Other and unspecified infectious diseases had the second-highest proportion of cause of death with 27.1 percent and was highest among males (33.9%) but the third highest among females with 16.1 percent.

Table 4.1 Specific causes of infectious deaths among young people 10 – 34 years in KHDSS by sex

Infectious cause of death	Overall		Female		Male	
	No	%	No	%	No	%
Pulmonary tuberculosis	250	30.7	91	29.3	159	31.5
Other & unspecified infectious diseases	221	27.1	50	16.1	171	33.9
Acute respiratory infections/pneumonia	149	18.3	17	5.5	132	26.2
HIV & AIDS related death	123	15.1	90	28.9	33	6.5
Malaria	52	6.4	46	14.8	6	1.2
Meningitis and encephalitis	17	2.1	14	4.5	3	0.6
Measles	2	0.2	2	0.6		
Haemorrhagic fever	1	0.1	1	0.3		
Total	**815**	**100.0**	**311**	**100.0**	**504**	**100.0**

Source: KHDSS, 2005 - 2015

There was a higher incidence of deaths related to HIV and AIDS among females than males. Deaths from HIV and AIDS related causes also constituted a much higher proportion of deaths among females, being the second highest infectious cause of death. Despite overall decline in infectious diseases globally, the recent increases in the incidences of infectious diseases has been attributed to the emergence and/or re-emergence of infectious diseases that have been occurring since the beginning of the twenty-first century (Dye, 2014; Fenollar & Mediannikov, 2018). Deaths due to measles and haemorrhagic fever, which were the least infectious causes, occurred only among females. During the study period, haemorrhagic fever had the lowest proportion of infectious diseases probable cause of death with 0.1 percent and among females with 0.3 percent. Measles had the second-lowest proportion of infectious diseases probable cause of death with 0.2 percent and among females with 0.6 percent. However, among males,

meningitis and encephalitis and malaria had the lowest and second-lowest proportion of infectious diseases probable cause of death with 0.6 percent and 1.2 percent, respectively.

Due to its association with lifestyle, poor eating habits and alcohol and tobacco consumption, NCDs are becoming increasingly common in developing countries (de-Graft Aikins & Agyei-Mensah, 2010; Habib & Saha, 2010). Table 4.2 displays the distribution of deaths due to specific NCD causes by sex. From the study population, digestive neoplasms constituted the highest proportion of NCD deaths among both male and female youth populations. Other and unspecified cardiac diseases were the second highest among males (13.1%) and among females (12.7%), but the third highest among males though with a slightly higher proportion (13.3%) than females. Notably, epilepsy which was the fourth specific cause of NCD deaths among females was not recorded as a cause of death among males. Sickle cell with crisis had the lowest proportion of NCDs probable cause of death with 1.3 percent among females. However, among males, diabetes mellitus and reproductive neoplasms MF had the lowest proportion of NCDs probable cause of death with 0.9 percent each.

Table 4.2 Broad and specific causes of NCD Deaths by sex

NCD cause of death	Overall		Female		Male	
	No	%	No	%	No	%
Digestive neoplasms	75	19.6	29	18.5	46	20.4
Other & unspecified cardiac diseases	50	13.1	20	12.7	30	13.3
Liver cirrhosis	48	12.6	11	7.0	37	16.4
Diarrhoeal diseases	39	10.2	18	11.5	21	9.3
Severe malnutrition	34	8.9	14	8.9	20	8.9
Respiratory neoplasms	31	8.1	1	0.6	30	13.3
Acute cardiac disease	27	7.1	9	5.7	18	8.0
Acute abdomen	23	6.0	11	7.0	12	5.3
Epilepsy	16	4.2	16	10.2		
Other & unspecified NCDs	14	3.7	13	8.3	1	0.4
Stroke	11	2.9	8	5.1	3	1.3
Renal failure	6	1.6	3	1.9	3	1.3
Diabetes mellitus	4	1.0	2	1.3	2	0.9
Reproductive neoplasms MF	2	0.5			2	0.9
Sickle cell with crisis	2	0.5	2	1.3		
Total	**382**	**100.0**	**157**	**100.0**	**225**	**100.0**

Source: KHDSS, 2005 - 2015

Furthermore, among the probable cause of death by external/trauma, road traffic accidents had the highest proportion overall (51.7%), with females recording 51.4 percent and 51.7 percent for males. Table 4.3 shows the various specific types of external injuries or trauma causes of death and their contributions. Other transport accidents had the second-highest overall proportion with 13.5 percent among females and 18.6 percent among males. Accidental exposure to smoke fire & flame had the lowest proportion of external/trauma probable cause

of death with 0.5 percent, and males accounted for 0.6 percent. However, among females, exposure to the force of nature had the lowest proportion of probable cause of death by external injuries/trauma with 2.7 percent.

Table 4.3 Broad and specific causes of external injuries/trauma deaths by sex

External injury/trauma cause of death	Overall		Female		Male	
	No.	%	No.	%	No.	%
Road traffic accident	108	51.7	19	51.4	89	51.7
Other transport accident	37	17.7	5	13.5	32	18.6
Contact with venomous plant/animal	31	14.8	5	13.5	26	15.1
Accidental fall	13	6.2	1	2.7	12	7.0
Intentional self-harm	7	3.3	1	2.7	6	3.5
Accidental drowning & submersion	5	2.4	5	13.5	-	-
Accidental poisoning & noxious substances	3	1.4	-	-	3	1.7
Assault	2	1.0			2	1.2
Exposure to force of nature	2	1.0	1	2.7	1	0.6
Accidental exposure to smoke fire & flame	1	0.5	-	-	1	0.6
Total	**209**	**100.0**	**37**	**100.0**	**172**	**100.0**

Source: KHDSS, 2005 - 2015

Additionally, among the specific maternal causes, abortion-related deaths had the highest proportion with 54.5 percent and obstetric haemorrhage had the second-highest proportion with 23.1 percent. Pregnancy-related sepsis had the third-highest proportion with 8.3 percent.

However, ruptured uterus had the lowest proportion of maternal cause of death with 0.8 percent, and pregnancy-induced hypertension had the second-lowest proportion with 1.7 percent. The percent distribution of maternal causes of death among females is shown in Table 4.4.

Table 4.4 Percentage distribution of maternal causes of death in the KHDSS

Maternal cause of death	**Overall**	
	No.	**%**
Abortion-related death	66	54.5
Obstetric haemorrhage	28	23.1
Pregnancy-related sepsis	10	8.3
Ectopic pregnancy	7	5.8
Other and unspecified maternal diseases	4	3.3
Reproductive neoplasms MF	3	2.5
Pregnancy-induced hypertension	2	1.7
Ruptured uterus	1	0.8
Total	**121**	**100.0**

Source: KHDSS, 2005 - 2015

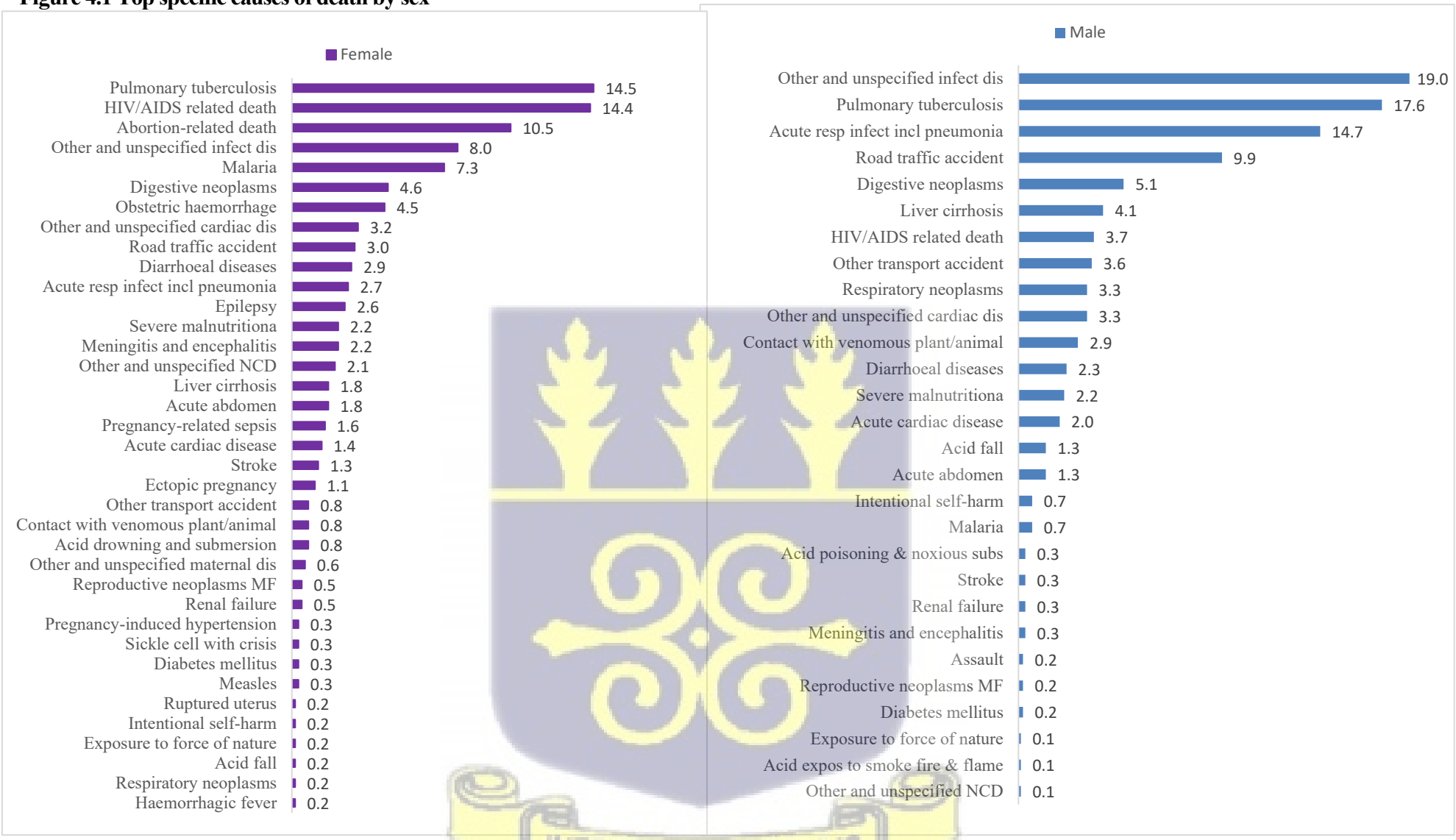
Despite liberal abortion laws in Ghana, access to safe, legal abortion in public health facilities is limited and not well patronised. This could be due to stigma and provider biases with regards to abortion. Aniteye *et al* (2013) confirmed health providers' views shaping the provision of safe-abortion services as a result of conflicts between the provider's religious and moral beliefs about the sanctity of foetal life and their duty to provide safe-abortion care services. (Aniteye & Mayhew, 2013). These findings resonate with other studies that have confirmed unsafe

abortions to be a leading cause of maternal mortality, especially among young females in Sub-Saharan Africa (Berer, 2017).

4.3. Specific causes of death by sex in the KHDSS (2005 to 2015)

Figure 4.1 shows the contribution of each specific cause of death to overall mortality among young people by sex. Overall, there are fewer specific causes of death among males than females, even when maternal causes are not included. The figure shows that among female deaths, pulmonary tuberculosis and HIV and AIDS related deaths were the leading specific cause of death at 14.5 percent and 14.4 respectively. This is consistent with findings from a study of the Kilite-Awlealo Health and Demographic Surveillance System (KA-HDSS), where tuberculosis and HIV and AIDS were found to be the leading causes of death among women of reproductive ages (Melaku *et al*., 2014), remaining among the top three killer diseases for women worldwide (Connolly & Nunn, 1996; WHO, 2022). Abortion-related deaths was the third leading specific cause of death (10.5%). For females, other and unspecified infectious diseases were the fourth leading specific cause of death (8.0%). Malaria, which was the fifth leading specific cause of death among women (7.3%), contributed less than one percent of all determined deaths among males and did not make the top 10 leading specific causes of death among males.

Figure 4.1 Top specific causes of death by sex



However, among males, road traffic accidents were the fourth leading specific cause of death and constituted about 10 percent of deaths compared to three percent of female deaths. Haemorrhagic fever, respiratory neoplasms, accidental fall, exposure to forces of nature, intentional self-harm, and ruptured uterus were the least specific causes of death among females (0.2%). Among male deaths, other and unspecified infectious diseases were the leading causes of death (19.0%), and pulmonary tuberculosis was the second leading cause of death (17.6%). Acute respiratory infections, including pneumonia, were the third leading specific cause of death (14.7%). However, other and unspecified NCDs, accidental exposure to smoke, fire and flame, and exposure to forces of nature were among the least specific causes of death among males (0.1%) each. Diabetes mellitus, reproductive neoplasms myelofibrosis (MF), and assault were the second least specific causes of death among males (0.2%).

4.4. Trends in youth mortality in the KHDSS (2005 to 2015)

As depicted in Figure 4.2, there is a downward trend in overall mortality rates among both male and female groups. However, there are distinct fluctuations in the downward trend among males. Interestingly, females begin the period with a slightly higher mortality rate (3.0 deaths per 1000 female youth) than males (2.7 per 1000 male youth) but the decline in female mortality is steadier and they end the horizon with lower mortality rates (1.6 deaths per 1000 female youth) than males (1.8 deaths per 1000 male youth). With the exception of 2007 and 2009, when there was a fluctuation in male mortality, female youth mortality rates have remained lower than male mortality rates during the study period.

Figure 4.2 Trends in youth mortality by sex in the KHDSS (2005 – 2015)

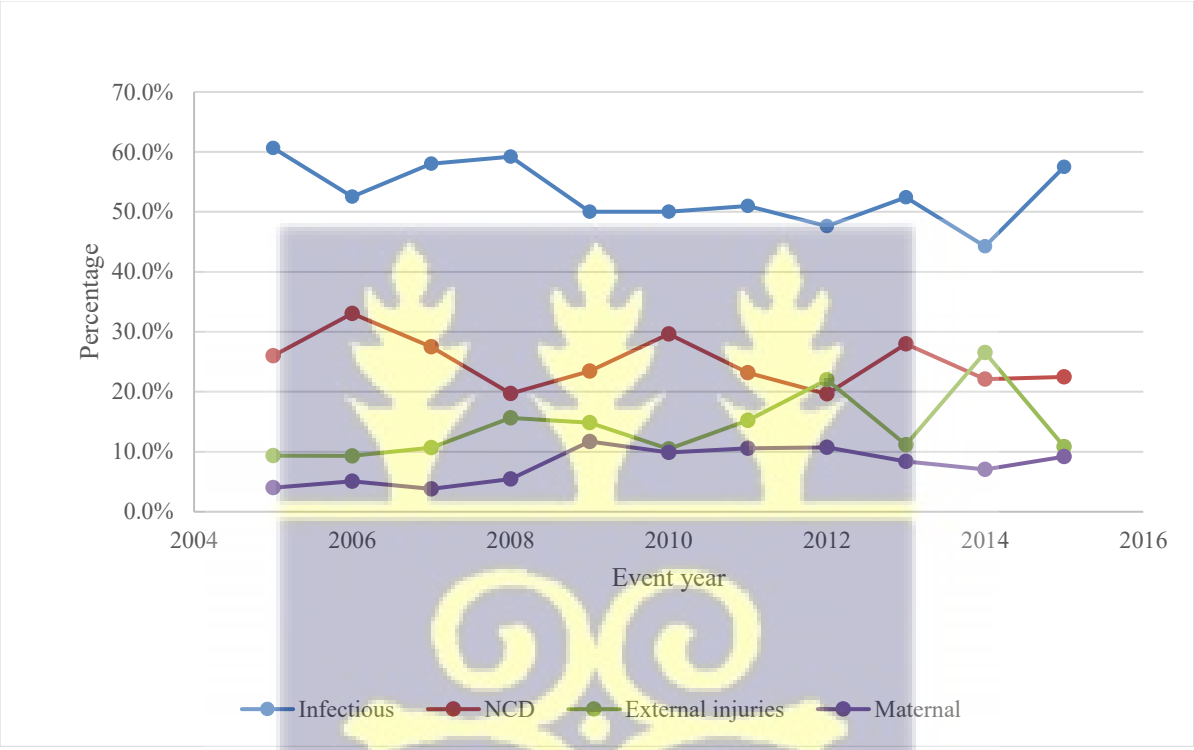
Source: KHDSS, 2005 -2015

4.5. Trends in broad causes of death in the KDHSS (2005 to 2015)

There is an uneven distribution of the broad causes of death among young people aged 15 to 34 years over the study period for the target population. From Figure 4.3 below, infectious diseases are the leading causes of death accounting for about half of all deaths within the period. This is consistent with studies that have established that Sub-Saharan Africa continues to bear the brunt of infectious diseases compared to non-communicable diseases and injuries (Ayaga Bawah et al., 2016). Over the study period, the highest proportion of deaths attributable to infectious causes occurred in 2005 (60.7%) and the lowest (44.2%) in 2014. NCDs are the second highest causes of death but are overtaken by external injuries and trauma in 2012 and 2014. Some fluctuations were observed in the causes of death for NCDs and external trauma, with an inverse variation in the causes of death between the two from 2009 to 2015 with NCDs

typically dominating during this period. Maternal causes had the lowest proportion essentially because it occurs only amongst females. Overall, the proportion of deaths attributable to maternal causes seems to be increasing over the period. The highest proportion of deaths attributed to maternal causes was in 2009 (11.7%), and the lowest proportion was in 2007 (3.8%).

Figure 4.3 Trends in youth mortality by sex in the KHDSS (2005 – 2015)



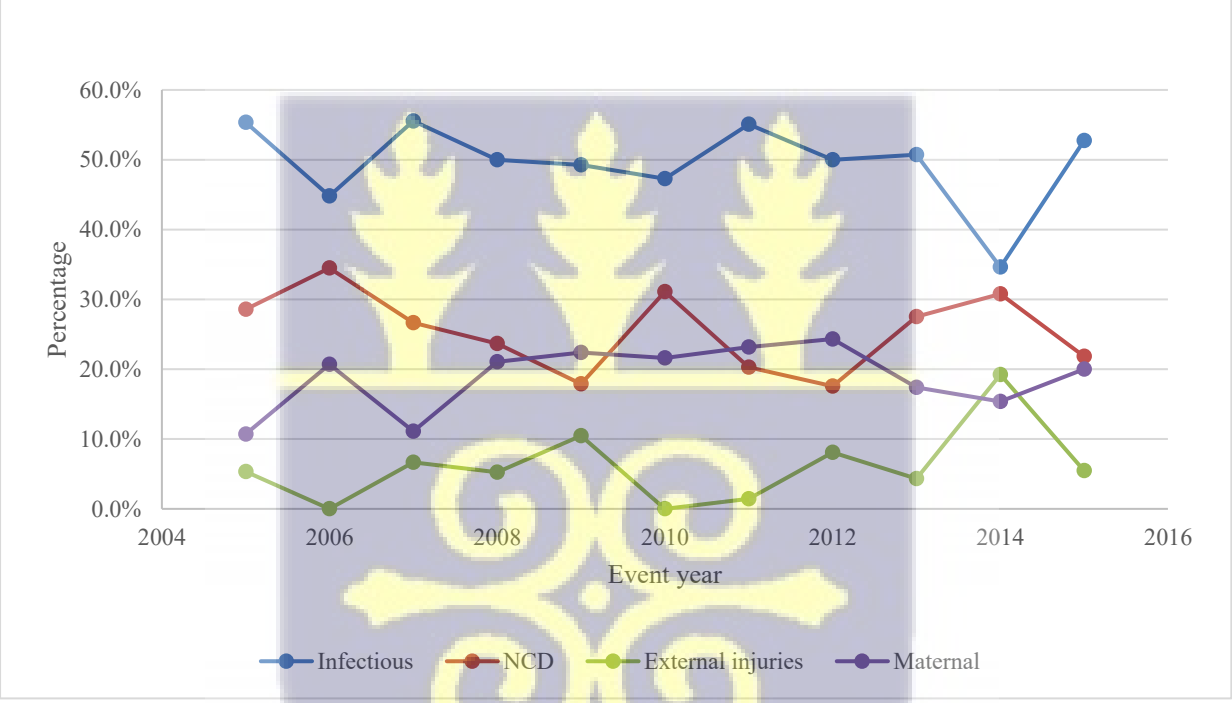
Source: KHDSS, 2005 - 2015

4.6. Trends in the causes of death among females in KHDSS (2005 to 2015)

From Figure 4.4, trends in the causes of death for females show that, infectious causes were the highest cause of death among females. The proportion of deaths attributed to infections peaked at about 55.6 percent in 2007 but recorded its lowest proportion at 34.6 percent in 2014. At their lowest in 2014, infectious causes are still higher than any other cause of death. Deaths

attributable to NCDs and maternal causes were the second and third highest respectively and fluctuated inversely for the study period. Where there was a decline in NCDs there was a sequential increase in maternal causes. Generally, external injuries and trauma had the lowest proportions (below 11%) of broad causes of death among females in the KHDSS sites except for 2014 (19.2%) where it is marginally higher than maternal causes. The highest proportion of deaths attributed to external trauma/injuries was about 19 percent in 2014 but was zero in 2006 and 2010.

Figure 4.4 Trends in broad causes of death among females in the KHDSS (2005-2015)



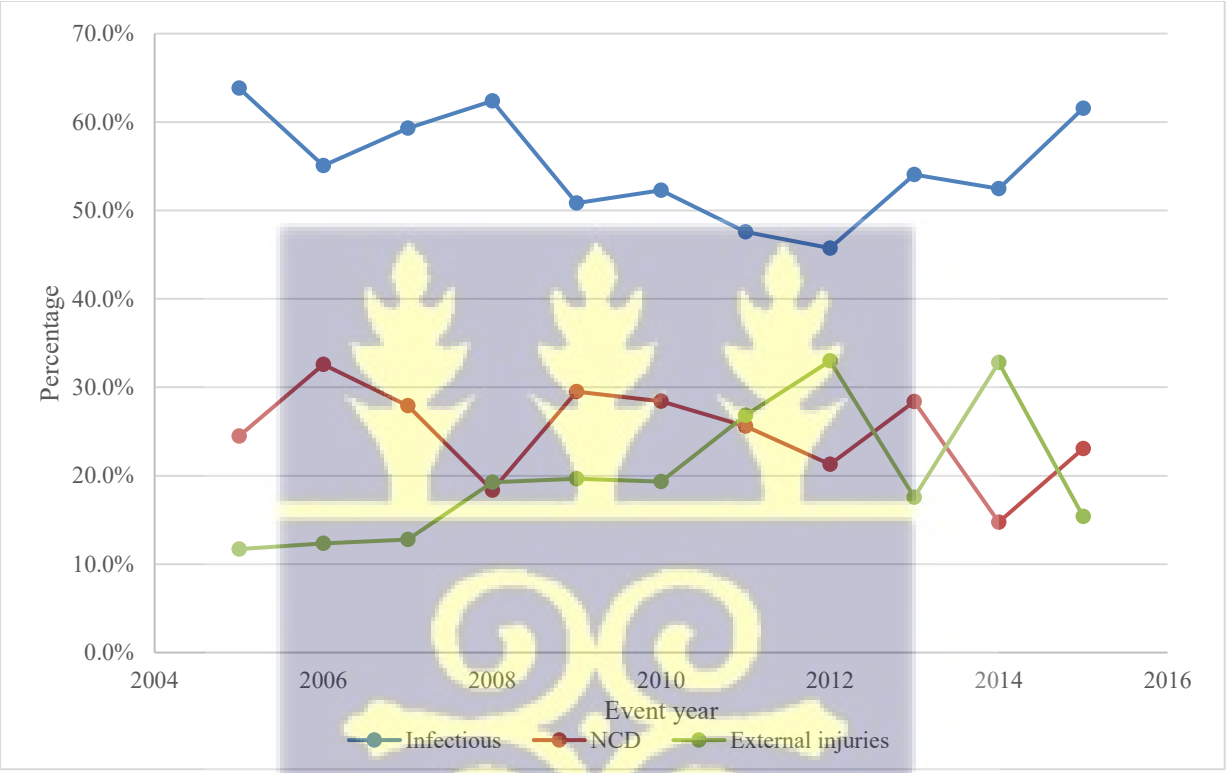
Source: KHDSS, 2005 - 2015

4.7. Trends in broad causes of death among males in the KHDSS (2005 to 2015)

There appears to be a little more uniformity in the trends in causes of death among males than females in the study period. As shown in Figure 4.5, infections are the leading broad cause of

death among males, beginning at about 64 percent and fluctuating downwards to about 46 percent in 2012 and rising to above 60 percent by 2015. Comparing NCDs and external injuries/trauma, there was a contrasting relation where one declines as the other rises, similar to females. It appears, however, that NCDs were the second leading cause of death until 2010 but was overtaken in 2012 and 2014 by external trauma/injuries.

Figure 4.5 Trends in broad causes of death among males in the KHDSS (2005-2015)



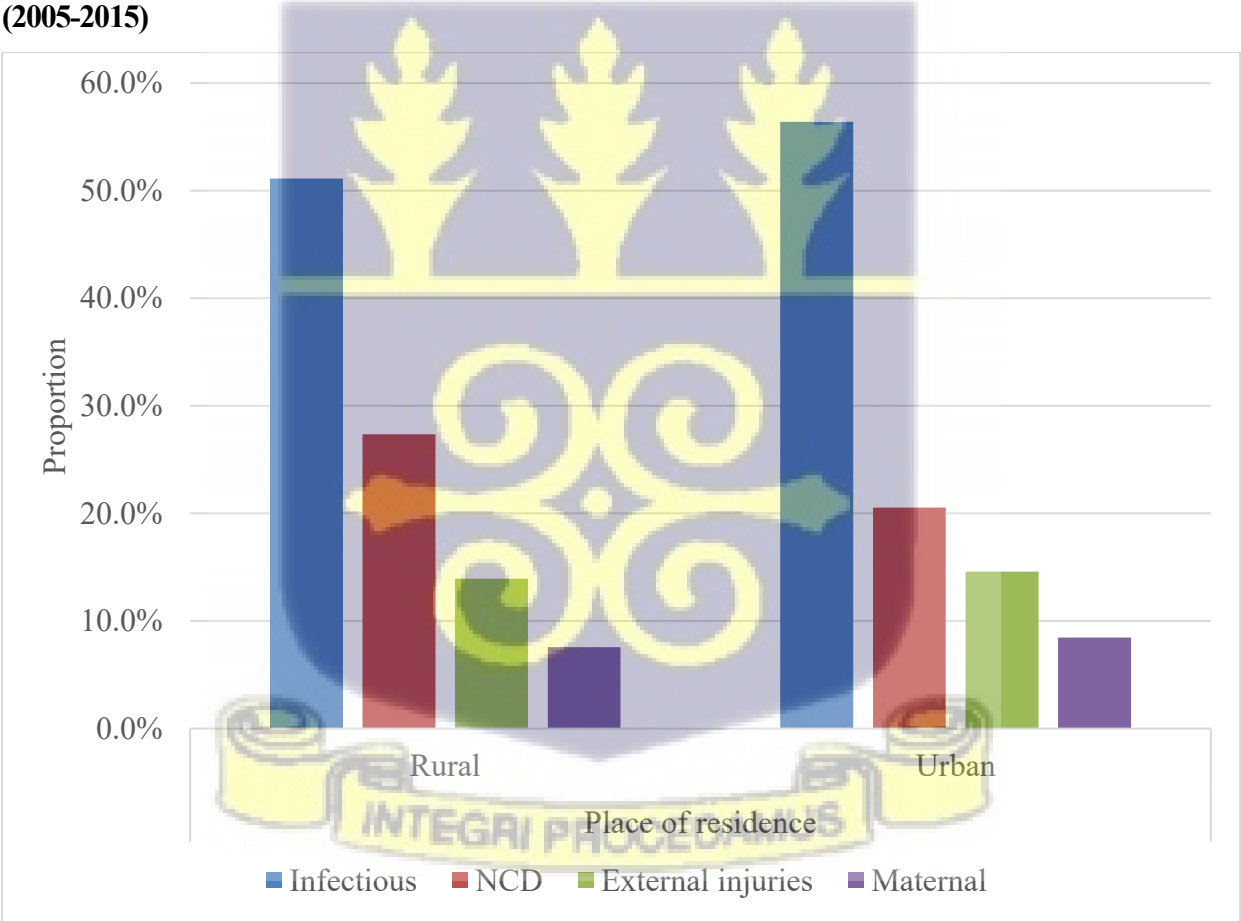
Source: KHDSS, 2005 - 2015

4.8. Distribution of broad causes of death in rural and urban places of residence in the KHDSS (2005 to 2015)

Overall, there were about twice as many deaths in rural areas (1,154 deaths) as there were in urban areas (677 deaths). It is to be noted that localities in the KHDSS are classified as urban if they have a population of 5,000 or more. Thus, it is difficult to determine whether there is a

rural disadvantage in mortality patterns on the basis of population size only, but not also on the availability of social amenities. From Figure 4.6, the distributions of causes of death in rural and urban areas follow a similar pattern, with infectious causes being the highest, followed by NCD, external injuries/trauma and maternal causes being the least. Contrary to expectations, however, the proportion of deaths due to infectious causes was higher in urban areas than in rural areas whereas the proportion of deaths due to NCD causes were higher in rural areas. The proportions of deaths attributed to external injuries/trauma and maternal causes were about same for both urban and rural areas (14 and 18% respectively).

Figure 4.6 Percent distribution of broad causes of death by type of place of residence in the KHDSS (2005-2015)

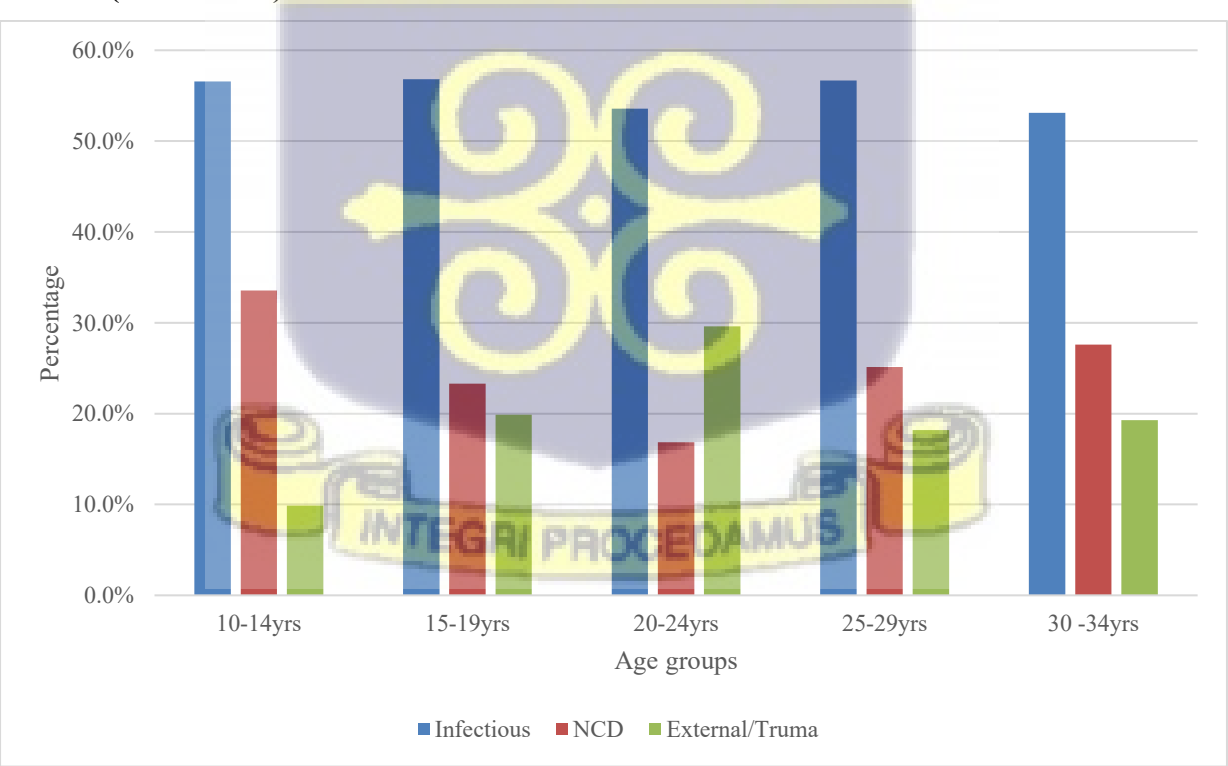


Source: KHDSS, 2005 – 2015

4.9. Distribution of age group by broad causes of death by sex in the KHDSS (2005 to 2015)

From Figure 4.7, infectious diseases had the highest proportion of probable cause of death across all age groups among males. This is followed by NCD deaths across all age groups except among those aged 20 to 24 years. Among males in the same age group, external injuries and trauma were the second highest cause of death and the overall highest proportion of deaths due to external injuries and trauma. Furthermore, males aged 20 to 24 years had the lowest proportion of deaths due to infectious causes and NCDs among all ages. Deaths due to NCDs follow a U-pattern among young males with those aged 10 to 14 years and 30 to 34 years having the highest proportions. Deaths due to external injuries and trauma are lowest among those aged 10 to 14 years.

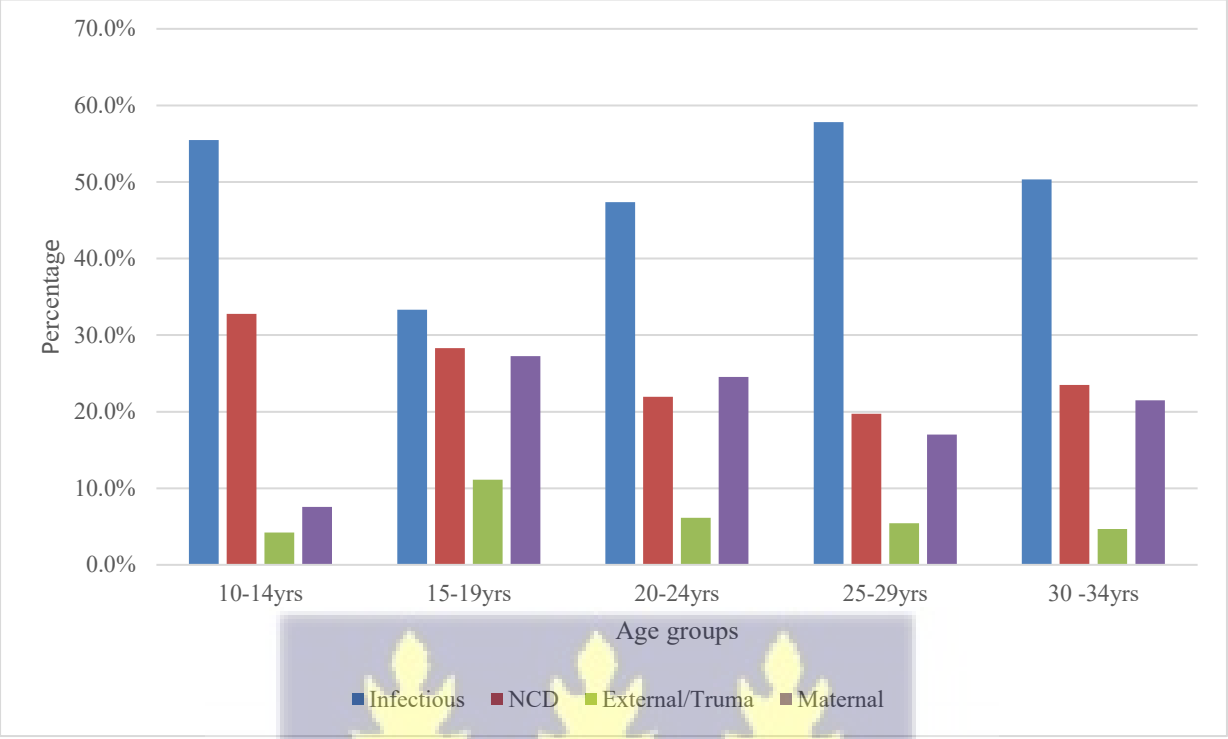
Figure 4.7 Percentage distribution of age groups by broad causes of death among males in the KHDSS (2005 to 2015)



Source: KHDSS, 2005 - 2015

Among females, infectious causes were the highest cause of death while external injuries and trauma were the least cause of death across all ages (Figure 4.8). The highest proportion of deaths due to infectious causes was observed among those aged 25 to 29 years (58%) and lowest among those aged 15 to 19 years (33%). The proportion of deaths due to NCDs was highest among females aged 10 to 14 years (33%) and reduces with increasing age to its lowest among those aged 25 to 29 years (20%) but slightly higher among those aged 30-34 years (24%). NCDs had the second-highest proportion across all age groups except among those aged 20 to 24 years where deaths from maternal causes were higher. External injuries and trauma contributed least to deaths across all ages. The proportion of deaths due to external injuries and trauma was lowest among females aged 10 to14 years (4.2%) and 30 to34 years (4.7%) but highest among those aged 15 to19 years (11%). Maternal causes of death were lowest among females aged 10 to14 years (8%) and highest at 15 to19 years. The observation that maternal causes were highest among the age group 15 to 19 contradicts observations in other countries that have shown maternal deaths to be highest among females aged 20 to 34 years (Blanc et al., 2013). It is to be noted that it is only among females aged 20-24 years that the proportion of deaths due to maternal causes is higher than NCDs.

Figure 4.8 Percentage distribution of age groups by broad causes of death among females in the KHDSS (2005 to 2015)



Source: KHDSS, 2005 - 2015

4.10. Discussion of results

Overall, there are declines in mortality rates over the years which suggests improved health status for the population with time. The progress is much quicker and more consistent among females than males. The results show a multiple burden of disease concurrent morbidities, particularly with more deaths from infectious causes and non-communicable diseases. This reflects findings from an autopsy-based study from a major teaching hospital that most deaths among adolescents are due to communicable and non-communicable causes (Ohene *et al.*, 2011), calling for health care providers to pay key attention to such groups when they present with these illnesses.

The distribution of broad causes of death indicate that infectious diseases contribute highly to mortality among young people in the KHDSS. Globally, infectious diseases have continued to remain a leading cause of death, responsible for about 10 million deaths per year (Fenollar & Mediannikov, 2018). This suggests that the KHDSS in the study period is in the early stages of the epidemiological transition.

The mortality experience among males and females shares some similarities and differences with regards to the specific causes of death. For instance, there is a notable gender disparity in the proportion of deaths related to HIV and AIDS, consistent with findings from previous studies in Sub-Saharan Africa (Chisumpa & Odimegwu, 2018; Mberu et al., 2015) that HIV and AIDS is more prevalent among women with accompanying higher mortality. With regards to non-communicable diseases, there are notable differences in the proportions of deaths due to liver cirrhosis, respiratory neoplasms, epilepsy and stroke.

Though there appears to be differential mortality experiences among the different age groups, there are unclear non-linear patterns. Given that these findings are based only on analyses involving data on young people aged 10 to 34 years only, this cannot be generalised to all population age groups where there are clear patterns of mortality among different population subgroups by age.

CHAPTER FIVE

RELATIVE RISK OF DYING FROM BROAD CAUSES OF DEATH

5.1. Introduction

This chapter presents results from analyses of the correlates of the broad causes of death by sex. The first sub-section shows an individual description of all the independent variables using frequency distributions. The second sub-section presents tests of the statistical association between the independent variables and the broad causes of death. The last sub-section presents results of multivariate analysis to predict the probability of dying from the broad causes of death for specific socio-demographic groups.

5.2. Relative risk of dying from infectious and maternal causes

In Table 5.1 the distribution of the independent variables in the study are presented. A total of 1,531 cases were included in the analyses of this study. During the period under review, more than half of the target population who died (59.1%) were males. This is contrary to estimates from the 2010 census that among adolescents and youth, the overall number of deaths was higher for females (Kwankye & Ansah, 2013). Overall, the proportion of deaths increased with age for both sexes with the highest proportion of all deaths recorded in the population aged 30 to 34 years (22.6%) and the lowest proportion among young people aged 10 to 14 years (17.1%). The data also revealed that the unmarried population experienced a higher mortality rate, comprising 63.0% of all deaths. This trend was more pronounced among males, with 79.5% of unmarried deaths, as compared to their female counterparts (refer to Table 5.1 for further details). Besides, of all the deaths in the period, the highest proportion (33.6%) of the

dead had primary education while the lowest proportion (13.0%) had secondary or higher education. Notably, those with no education constituted a lower proportion (25.1%) than those with primary and Middle/JSS education. Both proportions of the dead with no education (28.1%) and secondary or higher education (19.9%) were higher among females than their male counterparts (24.2% and 11.1% and respectively).

Table 5.1 Percentage distribution of broad causes of death by socio-demographic, economic, physical, behavioural, and health-related factors

Socio-Demographic and Other Factors	Male (%)	Female (%)	Total	Percent
Sex				
Female	-	100	626	40.9
Male	100	-	905	59.1
Participant Age group				
10 – 14	15.7	14.6	262	17.1
15 – 19	16.3	13.8	276	18.0
20 – 24	20.6	19.5	314	20.5
25 – 29	23.8	25.9	333	21.8
30 – 34	23.7	26.2	346	22.6
Marital status				
Single	79.5	13.6	948	63.0
Married/Co-habiting	20.5	86.4	558	37.1
Educational status				
None	24.2	28.2	304	25.1
Primary	34.4	29.2	406	33.6
Middle/JSS	30.3	22.7	343	28.4
Secondary Plus	11.1	19.9	157	13.0
Source of water				
Improved	49.7	50.2	756	50.2
Unimproved	50.3	49.8	749	49.8
Toilet facility				
Improved	26.7	33.6	441	29.1

Socio-Demographic and Other Factors	Male (%)	Female (%)	Total	Percent
Unimproved	73.3	66.4	1077	71.0
Place of Residence				
Rural	67.0	57.8	969	63.3
Urban	33.1	42.2	562	36.7
Ethnicity				
Akan	30.7	37.5	297	23.3
Grushi/Gruma/Mande	20.3	21.8	267	21.0
Mole/Dagbani	38.1	30.4	560	44.0
Other	10.9	10.3	149	11.7
Religious background				
Christian	40.7	43.5	645	50.7
Muslim	28.8	28.3	384	30.2
Traditional/Other	9.4	8.7	120	9.4
None	21.1	19.5	124	9.7
Occupational status				
Farmer	34.5	54.7	525	38.2
Non-Farmers	9.3	0.8	93	6.8
Student	56.2	44.5	756	55.0
District of Study Population				
Kintampo North	59.7	60.8	907	59.9
Kintampo South	40.3	39.2	608	40.1
Season of the year				
Wet season	48.9	47.2	745	48.7
Dry season	51.1	52.8	786	51.3
Alcohol intake				
No	77.4	94.7	1274	83.2
Yes	22.6	5.3	257	16.8
Smoking				
No	89.3	99.9	1429	93.3
Yes	10.7	0.1	102	6.7

Socio-Demographic and Other Factors	Male (%)	Female (%)	Total	Percent
Having an underlying health condition				
No	89.0	98.8	1417	92.6
Yes	11.0	1.2	114	7.5
Place of Death				
Health Facility	39.8	38.1	602	39.3
Home	55.8	53.7	828	54.1
Traditional Healer /Other	4.4	8.2	101	6.6
Total	**905**	**626**	**1531**	**100.0**

Source: KDHSS, 2005 – 2015

A high proportion (50.2%) of the people who died had improved source of water, while majority (71.0%) had unimproved toilet facilities. This appears inconsistent with studies that have shown a positive correlation between a better health status and a reduction in the chances of death in households with a higher economic status, including the use of improved toilet facilities and sources of drinking water (Brockerhoff & Hewett, 2000). In addition, reflective of the low rate of urbanisation in the study area, over 60.0 percent of the people who died lived in rural areas. The highest proportion (44.0%) of the people who died belonged to the Mole/Dagbani ethnic group, followed by the Akans (23.3%) while people from other ethnic groups constituted the lowest proportion (11.7%). Largely following the patterns of religious affiliation in the KHDSS, a little over half of the people who died were Christians (50.7%) whilst Muslims constituted (30.2%). A little over half of the youth who died were students, and the lowest proportion (6.8%) of people who died were non-farmers. Kintampo North Municipality had a higher proportion (59.9%) of the deaths compared to Kintampo South District which is in line with the population distribution in the KHDSS. Similar patterns were

observed for both males and females with regards to source of water, toilet facility, urban-rural residence, ethnicity, district of residence, and religious affiliation.

Furthermore, a slightly higher proportion (51.3%) of deaths occurred during the dry season for both males and females. This reflects findings in Burkina Faso that overall mortality among adults was higher in the dry season than the wet season. In analysing the dynamics of mortality by age groups, Kynast-Wolf *et al* (2006) found that overall mortality among adults peaked in the early dry season in all age groups except for infants compared with the rainy season (Kynast-Wolf *et al*., 2006).

Also, majority of the people who died did not take alcohol (83.2%) neither did they smoke (93.3%). However, the proportions who took alcohol or smoked were much higher among males (22.6% and 10.7% respectively) than among females (5.3% and 0.1% respectively). Likewise, majority of the people who died had no underlying health conditions (92.6%) with a higher proportion of males (11%) having had an underlying condition than females (1.2%). Notably, the highest proportion (54.08%) of deaths occurred at home, and the lowest proportion (6.6%) of the deaths happened at the traditional healer or in other places apart from a health facility. Available studies on the use of traditional medicines have found that, traditional medicines are of significance in health seeking behaviour of Ghanaians, particularly in rural areas in Ghana. The use of traditional medicine is rooted in psycho-social and cultural factors and is often considered to be more affordable and easily accessible (Gyasi *et al*., 2011; Springs, 1997) . A study by Tabi *et al* (2006) revealed that literate individuals in Ghana make healthcare decisions that involve traditional medicine, modern medical practices, or a combination of both. Factors such as educational background, familial and peer influences, as well as spiritual

or religious beliefs strongly shape these choices (Tabi *et al*., 2006). The choice of a traditional healer could be a contributory factor to the high number of deaths that occurring at home.

5.3. Bivariate analysis

5.3.1. Broad causes of death by deceased persons background characteristics by sex

Table 5.2 presents results of bivariate tests of associations between the background characteristics of the dead and their broad causes of death by sex. There are some significant differences and similarities between males and females in the broad causes of death by age. Among females, the age group with the highest proportion of infectious deaths were those aged 25 to 29 years while those aged 15 to 19 years had the lowest proportion of infectious deaths. Those aged 15 to 19 years however had the highest proportions of deaths from external injuries and maternal causes. Females aged 10 to14 years had the highest proportions of deaths from NCDs, but the lowest from external injuries and maternal causes. Similarly, among males those aged 10 to 14 years had the highest proportions of NCD deaths but the lowest proportion of deaths due to external injuries. Unlike among females, males aged 20 to 24 years had the highest proportion of deaths due to external injuries but the lowest NCD related deaths.

There were some differences between marital status and the cause of death between males and females. The proportions of infectious diseases and maternal deaths were lower among single deceased women while NCDs and external injury deaths were higher for them. Among males, however, the proportions of NCDs and external injury deaths were lower among the single deceased men while infectious disease deaths were higher for them.

With regards to education, the proportions who died from infectious diseases were highest for the deceased with secondary or higher education among both males and females while the

proportions who died from NCD related deaths were lowest for the same group. While the proportions who died from external injuries increased with higher educational levels among women, the lowest proportion of external injury deaths was among men who had secondary or higher education and those with primary education. Women with secondary or higher education had the lowest proportion of maternal deaths while those with no education had the highest. As has been established by numerous studies, secondary and higher education for females reduces the probability of females dying from maternal causes (Meh *et al.*, 2019; Rutaremwa *et al.*, 2015; Senkyire *et al.*, 2022).

With regards to household source of water when the deceased was alive, there is very little difference among males and females across all the various causes of death. With regards to toilet facility however, a higher proportion of female deaths due to infectious diseases were those who had improved toilet facilities who also had higher proportions for all other causes of death. Among men, however, while those with improved toilet facilities had higher proportions of infectious deaths and NCDs they had lower proportions dying from external injuries. The proportions dying from infectious diseases were higher in urban than rural areas for both males and females. The proportions dying from NCDs and maternal causes were higher among rural women while the proportion dying from external injuries was higher among urban women. The study found that living in an urban area made a young person more likely to die from an infectious cause than from a non-communicable cause. This could be attributed to the poor sanitary conditions among others in urban slums that have elevated the risks of infectious diseases. Undeniably, poor sanitation and hygiene practices have been found to be the main causes of mortality and morbidity in urban informal settlements, where majority of the dwellers are young (Zerbo *et al.*, 2020). Furthermore, deceased young females were 50 percent more likely to die from maternal causes than from infectious causes in the dry season. This is not too

different from what has been observed in studies that found higher numbers of death from maternal causes in the wet season (Etard *et al.*, 2003; Ronsmans *et al.*, 2003). For both males and females, dying at a traditional healer or other location was more likely to be from an external injury than from an infectious cause. This contradicts a study from KA-DHSS in Ethiopia that found 40 percent of external causes of death happened at home. These findings reflect the social determinants of health theory which posits that health and health behaviours are largely influenced by social factors which operate at the individual, family, community and even national levels (Marmot, 2011; Viner *et al*., 2012).

Table 5.2 Broad causes of death by socio-demographic and other factors by sex

Factors	Females				Males		
	Infectious (n=314)	NCD (n=382)	External/ Trauma (n=209)	Maternal (n=121)	Infectious (n=504)	NCD (n=225)	External/ Trauma (n=172)
Age (years)							
10-14	55.1	33.1	4.2	7.6	54.9	34.7	10.4
15-19	33.3	28.3	11.1	27.3	57.6	22.0	20.3
20-24	47.4	21.9	6.1	24.6	54.5	16.5	29.0
25-29	58.2	19.9	4.8	17.1	56.7	25.7	17.6
30-34	50.3	23.5	4.7	21.5	53.8	27.4	18.8
	χ^2= 33.5833 p = 0.001				χ^2= 28.3162 p = 0.000		
Marital status							
Single	46.1	31.7	7.0	15.2	56.8	24.2	18.9
Married/Co-habiting	52.1	21.0	5.1	21.8	48.2	27.4	24.4
	χ^2= 11.7418 p = 0.008				χ^2= 4.4058 p = 0.110		
Educational status							
None	52.7	24.2	3.3	19.8	51.2	26.3	22.5
Primary	45.9	33.9	5.5	14.7	56.2	24.6	19.2
Middle/JSS	57.9	17.1	6.6	18.4	54.3	24.0	21.7
Secondary Plus	64.5	11.3	11.3	12.9	65.3	17.9	16.8

	χ^2= 18.6216 P = 0.029				χ^2 = 5.9142 P = 0.433		
Source of water							
Improved	50.8	25.2	5.1	18.9	55.3	24.8	19.9
Not improved	49.0	24.7	6.9	19.4	55.7	24.3	20.0
	χ^2 = 0.9732 p = 0.808				χ^2= 0.0377 p = 0.981		
Toilet facility							
Improved	55.6	31.7	7.3	19.5	58.9	25.4	15.7
Unimproved	47.1	21.0	5.3	18.8	54.0	24.7	21.3
	χ^2 = 9.7887 p = 0.020				χ^2= 3.5352 p = 0.171		
Residency status							
Rural	45.4	29.7	4.9	20.0	54.8	25.4	19.9
Urban	56.3	18.0	7.4	18.4	56.9	23.5	19.6
	χ^2 = 13.8534 p = 0.003				χ^2 = 0.4475 p = 0.800		
Ethnic group							
Akan	58.1	23.2	2.6	16.1	62.0	21.8	16.2
Grushi/Gruma/Mande	47.8	23.5	6.6	22.1	54.2	29.8	16.0
Mole/Dagbani	46.0	24.1	7.2	22.8	52.6	26.3	21.1
Other	50.7	25.3	8.0	16.0	58.1	17.6	24.3
	χ^2= 10.1427 p = 0.339				χ^2 = 8.1869 p = 0.225		
Religious background							
Christian	49.2	23.8	6.0	21.0	56.1	25.8	18.2

Muslim	51.9	19.5	6.5	22.2	53.3	22.6	24.1
Traditional/Other	58.6	22.4	5.2	13.8	54.8	25.8	19.4
None	37.8	44.4	4.4	13.3	59.5	27.8	12.7
	$\chi^2 = 14.9137$ p = 0.093				$\chi^2 = 5.6156$ p = 0.468		
Occupational status							
Farmer	51.6	24.0	5.0	19.5	55.9	26.0	18.1
Non-Farmers	100.0	0.0	0.0	0.0	48.3	24.7	27.0
Student	52.2	27.1	6.4	14.3	55.8	24.4	19.8
	$\chi^2 = 6.3895$ p = 0.381				$\chi^2 = 3.7650$ p = 0.439		
District of study Population							
Kintampo North	53.1	21.4	6.5	19.0	52.8	26.2	21.0
Kintampo South	45.8	29.3	5.2	19.7	59.3	22.8	17.8
	$\chi^2 = 5.8219$ P = 0.121				$\chi^2 = 3.7467$ P = 0.154		
Season of the year							
Wet season	49.8	22.7	6.1	21.4	54.2	26.6	19.2
Dry season	49.8	27.2	5.8	17.3	56.7	23.0	20.3
	$\chi^2 = 2.6801$ p = 0.444				$\chi^2 = 1.5534$ p = 0.460		
Alcohol use							
No	50.0	24.8	5.5	19.7	56.8	22.3	20.9
Yes	47.8	26.1	10.9	15.2	51.2	32.7	16.1

	$\chi^2 = 2.5675$ P = 0.463				$\chi^2 = 9.8056$ P = 0.007		
Smoking prevalence							
No	49.84	24.92	5.91	19.33	56.7	22.9	20.4
Yes	-	-	-	-	46.1	39.2	14.7
					$\chi^2 = 13.0405$ p = 0.001		
Having an underlying health condition							
No	49.4	25.0	6.0	19.5	54.6	23.8	21.6
Yes	72.7	18.2	0.0	9.1	62.1	32.0	5.8
	$\chi^2 = 2.6498$ p = 0.449				$\chi^2 = 14.8667$ p = 0.001		
Place of Death							
Health Facility	47.2	20.5	5.9	26.4	58.0	23.0	19.0
Home	52.0	29.5	3.5	15.0	57.9	28.4	13.7
Traditional Healer /Other	46.2	7.7	38.5	7.7	28.0	9.3	62.7
	$\chi^2 = 70.5068$ p = 0.000				$\chi^2 = 100.2803$ p = 0.000		

χ^2: Pearson Chi-Square p: p-value

Source: KDHSS, 2005 - 2015

Ethnicity significantly predicted causal mortality especially among female youth. Females of Akan descent were less likely to die from external injuries, infectious diseases and maternal causes compared to other ethnicities. Studies describing ethnic differences in age- and cause-specific mortality in other countries have shown that ethnic minority groups have higher mortality than the native population of the host country (Bos *et al.*, 2004; Mackenbach *et al.*, 2017). This could be the case where Akans are indigenous in the Bono Region and constitute the majority ethnic group. Among both males and females, the proportions whose deaths were due to infectious causes were lowest for the Mole-Dagbani and highest among the Akan. The proportions of deaths due to NCDs among females were highest among the Other ethnic groups but highest among deceased Grusi/Gurma/Mande males. Furthermore, external injury deaths were highest among the Other ethnic groups. Concerning religion, the proportions of deaths attributable to infectious causes were highest among women who belonged to Traditional or Other religions and among men who had no religion. The proportions of deaths due to external injuries for both males and females were highest among deceased Muslims and lowest among those with no religion. Additionally, the proportion of maternal deaths was highest among deceased Muslim women and lowest among those with no religion. All the non-farmer females (4) died of infectious diseases. Higher proportions of female student deaths were attributable to infections, NCDs and external injuries while higher proportions of maternal deaths were to farmers. With regards to males, the highest proportions of infectious diseases and NCD deaths were among famers while the highest proportion of accidents was among non-farmer workers.

Among females, the proportion of infectious disease deaths were higher in Kintampo North while NCD deaths and maternal deaths were lower there. The proportions of external injury deaths among both males and females were higher in Kintampo North. Among males, the proportion of infectious disease deaths was lower in Kintampo South while NCD deaths

constituted a higher proportion there. While the proportion of infectious disease deaths among females was the same for both the dry and wet seasons, a higher proportion of external injuries and maternal deaths occurred in the wet season while a higher proportion of NCD deaths occurred in the dry season. Among males, however, higher proportions of infectious disease and external injury deaths occurred in the dry season while a higher proportion of NCD deaths occurred in the wet season. Among women, higher proportions of infectious diseases and maternal deaths occurred to women who did not take alcohol while higher proportions of NCD and external injury deaths occurred to women who used alcohol. Among men, a higher proportion of infectious disease deaths were to men who did not take alcohol. Similar to women, a higher proportion of NCD deaths were to men who took alcohol. Contrary to expectation a lower proportion of external injury deaths occurred to men who took alcohol. A higher proportion of infectious disease death were to persons who had underlying conditions. However, among women only, deaths due to persons without underlying conditions had higher proportions of NCD, external injury and maternal deaths. Among men, a higher proportion of NCD deaths were to persons who had an underlying condition, but they had a lower proportion of external injury deaths.

Among women, the highest proportion of deaths due to infectious diseases and NCDs occurred at home while those who died at the health facility had the highest proportion of maternal deaths. Among both males and females, the highest proportions of external injury deaths occurred at the traditional healer's or other locations. Among males, the highest proportions who died from infectious diseases occurred at the health facility while the highest proportion of NCD deaths occurred at home.

5.4. Multivariate analysis

In this section, a multinomial regression model was fitted to predict the effects of explanatory variables on the probable causes of mortality (infectious diseases, NCDs, external injuries/trauma and maternal) in the KHDSS from 2005 to 2015 among females only in Model 1 and males in Model 2. The likelihood ratio chi-square test was utilised to test the statistical significance of the association between the explanatory variable and the probable causes of death (infectious diseases, NCDs, external injuries/trauma, and maternal) of models 1 and 2.

Table 5.3 displays the relationship between explanatory variables and probable causes of death (infectious diseases, NCDs, external injuries/trauma, and maternal) in the KHDSS from 2005 to 2015 among females (Model 1). The model explains about 16 percent of the variations with 317 observations and a log-likelihood of -304.33157. The model's Wald $\chi 2$ (prob>chi2) is significant at a 99 percent confidence level signifying that the model is a good fit.

The results indicate that age significantly predicts the probable cause of death among females. The Relative Risk Ratio (RRR) for NCDs, compared with infectious causes of death, shows that females aged 15 to19 were significantly more likely to die from the NCDs than infectious causes, compared to females aged 10 to 14 years. Females aged 15 to19 years had an increased relative risk of dying from non-communicable disease than infectious causes by more than four times (RRR=5.46; $p<0.01$) compared to those aged 10 to14 years. Likewise, the Relative Risk Ratio (RRR) for external injuries/trauma and infectious causes of death shows that females aged 15 to19 were significantly more likely to die from external injuries/trauma than infectious causes compared to females aged 10 to14. Females aged 15 to19 had an increased relative risk of dying from external injuries/trauma than infectious causes (RRR=14.55; $p<0.05$) compared to those aged 10 to 4 years.

Similarly, the RRR for maternal and infectious causes of death shows that females aged 15 to 19, 20 to 24 and 30 to 34 were significantly more likely to die from maternal causes than infectious causes than females 10 to 14 years. Females aged 15 to19 years had an increased relative risk of dying from maternal than infectious causes by more than five times (RRR=5.61; $p<0.05$) compared to females aged 10 to 14 years. Moreover, females aged 20 to 24 years had an increased relative risk of dying from maternal than infectious by more than four times (RRR=4.11; $p<0.05$) compared to those aged 10 to14 years. Furthermore, females aged 30 to 34 years had an increased relative risk of dying from maternal than infectious causes by more than three times (RRR=3.64; $p<0.05$) compared to those aged 10 to14 years. With regards to education, the results indicate that compared with their counterparts with no education, women with secondary or higher education were less likely to have died of maternal causes than infectious causes (RRR=0.54; $p<0.05$).

Residential status also significantly influences the probable causes of death among females. The Relative Risk Ratio for non-communicable diseases and infectious causes of death as well as external injuries/trauma causes of death shows that females who live in urban places are less likely to die from non-communicable diseases than infectious causes and more likely to die from external injuries/trauma than infectious causes compared to their female counterpart who lived in rural areas. Females who lived in urban areas had 0.5 times less relative risk of dying from non-communicable than the infectious causes (RRR=0.50; $p<0.1$) compared to females who lived in rural areas. In contrast, females who lived in urban places had an increased relative risk of dying from external injuries/trauma than infectious causes by more than four times (RRR=4.60; $p<0.1$) compared to those in rural areas.

Table 5.3 Multinomial logistic regression for the relationship between explanatory variables and broad causes of mortality in the KDHSS from 2005 to 2015 among females (Model 1)

Determinants of causes of death	Non-Communicable Disease (NCD) Vs. Infectious cause Relative Risk Ratio (RRR) Standard Error (SE)	External Injuries /Trauma Vs. Infectious cause RRR (SE)	Maternal cause Vs. Infectious cause RRR(SE)
Age Group			
10 - 14	1.00	1.00	1.00
15 - 19	5.46*** (3.15)	14.55** (17.01)	5.61** (4.10)
20 - 24	2.30 (1.20)	1.88 (2.19)	4.11** (2.66)
25 - 29	1.41 (0.75)	0.48 (0.63)	2.01 (1.36)
30 - 34	1.56 (0.87)	0.61 (0.75)	3.64** (2.38)
Educational Status			
No education	1.00	1.00	1.00
Primary	1.81 (0.78)	2.32 (2.48)	1.35 (0.66)
Middle/JSS	0.59 (0.30)	0.87 (0.84)	0.70 (0.34)
Secondary Plus	0.50 (0.28)	5.516 (5.76)	0.54 (0.29)*
Residence			
Rural	1.00	1.00	1.00
Urban	0.50* (0.20)	4.60* (3.81)	1.18 (0.48)
Ethnic Group			
Akan	1.00	1.00	1.00
Grushi/Gruma/Mande	1.08 (0.59)	8.29* (10.49)	2.04 (1.15)
Mole/Dagbani	1.49 (0.71)	16.52** (18.76)	2.57* (1.29)
Other	1.20 (1.17)	9.42** (10.62)	1.26 (0.85)
Religious background			
Christian	1.00	1.00	1.00
Muslim	0.83 (0.35)	0.72 (0.51)	0.74 (0.31)
Traditional/Other	0.93 (0.56)	0.49 (0.65)	0.46 (0.33)

None	3.06** (1.58)	0.20 (0.32)	1.36 (0.90)
District			
Kintampo North	1.00	1.00	1.00
Kintampo South	0.82 (0.33)	0.85 (0.71)	1.14 (0.49)
Underlying Health Condition			
No	1.00	1.00	1.00
Yes	0.78 (0.98)	2.00 (0.00)	0.57 (0.72)
Season of the Year			
Wet Season	1.00	1.00	1.00
Dry season	1.28 (0.42)	1.70 (1.05)	0.50* (0.19)
Alcohol prevalence			
No	1.00	1.00	1.00
Yes	0.93 (0.55)	3.06 (3.47)	0.98 (0.65)
Place of Death			
Health Facility	1.00	1.00	1.00
Home	1.50 (0.51)	0.23** (0.16)	0.47** (0.16)
Traditional Healer/ Other	1.24 (0.00)	9.52** (8.83)	0.31 (0.35)
Log likelihood = -304.33157	Pseudo R2 = 0.1604	Prob > chi2 = 0.0001	

Number of observations =317

*** p<0.01; ** p<0.05; *p<0.1

Source: KHDSS, 2005 to 2015

In addition, ethnicity significantly predicts the cause of death among females. The Relative Risk Ratio for external injuries/trauma and infectious cause of death shows that females of Grusi/Gruma/Mande, Mole Dagbani, and other ethnicities were significantly more likely to die from external injuries/trauma than infectious causes compared to Akan females. Females of Grusi/Gruma/Mande ethnicity had an increased relative risk of dying from external injuries/trauma than infectious causes by more than eight-fold (RRR=8.29; p<0.1) compared

to females of Akan ethnicity. Females of Mole/Dagbani ethnicity had over sixteen times relative risk of dying from external injuries/trauma as infectious causes (RRR=16.52; p<0.05) compared to females of Akan ethnicity. Moreover, females of other ethnicities had an increased relative risk of dying from external injuries/trauma than infectious causes (RRR=9.42; p<0.05) compared to females of Akan ethnicity. Furthermore, Mole Dagbani females were significantly more likely to die from maternal than infectious causes compared to Akan females (RRR=2.57; p<0.1).

The results further reveal that religion significantly affects the relative risk of females dying from communicable diseases compared to infectious diseases. Females with no religious affiliation were significantly more likely (RRR=3.06; p<0.05) to die from non-communicable than infectious causes compared to female Christians. Besides, the season of the year also significantly affects the cause of death among females. Young females who died in the dry season were half as likely to die from maternal as infectious causes (RRR=0.50; p<0.1) compared to those who died in the wet season.

Lastly, young females who died at home had a reduced relative risk of dying from external injuries/trauma (RRR=0.23; p<0.05) and maternal causes (RRR=0.47; p<0.01) than infectious causes compared to females who died in a health facility. Also, females who died at the traditional healer's or in other locations were more than nine times as likely to have died from external injuries/trauma as infectious causes (RRR=9.52; p<0.05) compared to females who died in a health facility.

Table 5.4 displays the relationship between the explanatory variables and probable cause of death (infectious diseases, NCDs, and external injuries/trauma) in males in the KHDSS for the same period (Model 2). The model explains about 24 percent of the variations with 638

observations and a log-likelihood of -570.18872. The model's Wald $\chi 2$ (prob>chi2) is significant at 99 percent confidence interval, indicating that the model is a good fit.

The results indicated that age significantly predicts the probable cause of death among males. Compared to their counterparts aged 10 to14 years males aged 15 to19 had reduced relative risk of dying from non-communicable diseases than infectious causes (RRR=0.54; p<0.1). In addition, males aged 20 to 24 years had decreased relative risk of dying from non-communicable disease than infectious causes by 0.47 times (RRR=0.47; p<0.05) compared to males who were 10-14 years. In contrast, males aged 15 to 19 were more likely (RRR=3.04; p<0.05) to die from external injuries/trauma than infectious causes compared to males who were 10 to14 years.

Furthermore, the results indicate that educational status significantly influences the probable cause of death among males. Young males with secondary or higher education were less likely (RRR=0.41; p<0.05) to die from external injuries/trauma than infectious causes compared to those with no education.

Table 5.4 Multinomial logistic regression for the relationship between explanatory variables and probable causes of mortality in the KDHSS from 2005 to 2015 among males (Model 2)

Determinants of causes of death	Infectious cause of death Vs. Non-Communicable Disease (NCD) Relative Risk Ratio (RRR) Standard Error (SE)	Infectious cause of death Vs. External Trauma cause of death Relative Risk Ratio (RRR) Standard Error (SE)
Age Group		
10 - 14	1.00	1.00
15 - 19	0.54* (0.19)	1.46 (0.63)
20 - 24	0.47** (0.17)	3.04** (1.31)
25 - 29	0.55 (0.20)	1.65 (0.79)
30 - 34	0.55 (0.20)	1.67 (0.79)
Educational Status		
No education	1.00	1.00
Primary	0.92 (0.26)	0.90 (0.29)
Middle/JSS	0.84 (0.24)	0.64 (0.21)
Secondary Plus	0.70 (0.27)	0.41** (0.18)
Residence		
Rural	1.00	1.00
Urban	1.09 (0.27)	0.58 (0.17)
Ethnic Group		
Akan	1.00	1.00
Grushi/Gruma/Mande	1.38 (0.47)	0.78 (0.33)
Mole/Dagbani	1.40 (0.41)	1.07 (0.36)
Other	0.74 (0.32)	1.34 (0.58)
Religious background		
Christian	1.00	1.00
Muslim	1.06 (0.29)	1.14 (0.34)
Traditional/Other	0.77 (0.29)	1.04 (0.47)
None	0.92 (0.30)	0.60 (0.25)
District		

Kintampo North	1.00	1.00
Kintampo South	0.66* (0.16)	0.78 (0.21)
Underlying Health Condition		
No	1.00	1.00
Yes	1.48 (0.44)	0.26** (0.15)
Season of the Year		
Wet Season	1.00	1.00
Dry season	0.90 (0.18)	0.98 (0.22)
Alcohol prevalence		
No	1.00	1.00
Yes	2.18*** (0.56)	0.64 (0.20)
Place of Death		
Health Facility	1.00	1.00
Home	1.29 (0.28)	0.71 (0.18)
Traditional Healer/Other	1.45 (0.78)	8.72*** (3.42)

Log likelihood = -570.18872 Pseudo R2 = 0.0981 Prob > chi2 < 0.0001 Number of observations = 638

***** p<0.01; ** p<0.05; *p<0.1**

Source: KDHSS, 2005 – 2015

In addition, the district of residence significantly predicts the cause of death among males. The Relative Risk Ratio (RRR) shows that males from Kintampo South District were significantly less likely (RRR=0.66; p<0.1) to die from non-communicable diseases than infectious causes compared with males from Kintampo North Municipal. Additionally, having underlying health conditions significantly predicts the cause of death among males. Males with underlying health conditions had a lower relative risk (RRR=0.26; p<0.05) of dying from external injuries/trauma than from infectious causes compared to those with no underlying health conditions.

Furthermore, the results show that alcohol prevalence significantly predicts the cause of death among males. From the table, males who took alcohol were significantly more than twice as likely to die from non-communicable disease as infectious causes compared to males who did not take alcohol (RRR=0.2.18; $p<0.01$). Lastly, the place of death significantly predicts the cause of death among males. Males who died at the traditional healer or other locations had an increased relative risk (RRR=8.72; $p<0.001$) of dying from external injuries/trauma than infectious causes compared to those who died in a health facility.

5.5. Discussion of results

Following the social determinants of health (Marmot, 2006), this study investigated the underlying determinants of dying from any of the broad causes relative to others. The model offers substantive insights into the factors that significantly affect the causes of mortality among young people in the KHDSS from 2005 to 2015. While age is a significant factor contributing to death for both males and females, the cause of death varies by sex. Males, for instance, are more susceptible to external injuries/trauma in their late teens, whereas females of the same age group have a heightened risk of death from NCDs and maternal causes.

Education is an important predictor of health knowledge and access to care. The findings of this study indicates that secondary or higher education is related to lower likelihood of dying from maternal causes than infectious causes among women. Among young males, having secondary or higher education is associated with a lower likelihood of dying from external injuries or trauma. This aligns with the broader literature that suggests that higher education often correlates with lower risk-taking behaviour and better access to healthcare (Chisumpa *et al*., 2019b).

Additionally, factors like religion and seasonality, often considered less critical, also show significant effects. For instance, the fact that females aged 15 to 19 years are more likely to die from external injuries or trauma relative to infectious causes raises concern about the lifestyle risks that this age group may be exposed to. This finding is similar among males and warrants the need to target young persons with behavioural interventions that reduce their exposure to external injuries. Furthermore, age indicates determines reproductive health behaviours, thus, younger women aged 10 to 14 years are less likely to die from maternal causes than their older counterparts who have begun or are in their reproductive ages. With regards to dying from non-communicable diseases relative to infectious causes, the relationship is non-linear even as there are differences between males and females. Age is linked with type of cause of death not only through physiological disposition but also through social and behavioural pathways.

Regarding the relationship between rural-urban residence and cause of death, urban women are more likely to die from external injuries or trauma but less likely to die from NCDs. Risky behaviour among young people is common in urban areas in many low and middle-income settings. In Ghana where the definition of urban is based on having a population of 5,000 and above and not necessarily the presence of modern urban amenities (Ghana Statistical Service, 2014a; Ghana Statistical Services, 2021). Some places defined as urban exhibit poor slum characteristics. Residence in poor urban communities increases the risk of dying from violent crimes and road or traffic-related accidents.

With regards to ethnicity, women from the Grusi/Gurma/Mande and Mole Dagbani are more likely to die from external injuries or trauma than their Akan counterparts. Other studies from the area have referred to these other ethnicities as migrant ethnic groups (Abubakari S. *et al*.,

2022; Sulemana Abubakari, 2017), who engage in more hazardous occupations or may have heightened lifestyle or behavioural risks.

Having underlying health conditions is associated with less likelihood of dying from external injuries or trauma. Some underlying health conditions such as stroke, epilepsy and hypertension may lead to external injuries and it is unclear from this study the link between external injuries and underlying conditions. Nonetheless, considering that over two-thirds of external injury or trauma deaths among males are related to road or traffic accidents (Table 5.4), it gives an indication why underlying conditions may be associated with less likelihood of dying from external injuries or trauma.

Furthermore, alcohol use is associated with dying from non-communicable diseases among young males. Alcohol consumption is a lifestyle behaviour associated with increased risk of developing non-communicable diseases (J. Addo *et al*., 2012), thus it is as expected that it linked with a higher likelihood of dying from non-communicable diseases among young males in Ghana.

Given the model's robustness and the range of variables considered, these findings could be instrumental in guiding public health policies targeted at reducing female mortality in the KHDSS area. Interventions could range from awareness campaigns focused on younger females regarding NCDs and external injuries to community-specific interventions based on ethnicity and residential status.

CHAPTER SIX

ELIMINATING COMMUNICABLE, NON-COMMUNICABLE OR UNINTENDED CAUSES OF DEATH AMONG YOUNG PEOPLE

6.1. Introduction

This chapter provides a comprehensive examination of mortality among young people aged 10 to 34 in the KHDSS area from 2005 to 2015. It outlines the primary objective, which includes estimating the probability of dying either from an infectious cause, a non-communicable disease or an external injury/trauma. Additionally, the chapter introduces the concept of Youth Life Expectancy (YLE), as a measure for estimating the potential gains in life through the reduction/elimination of a specific cause of death. This chapter concludes by making a compelling argument for investments in the health of young people based on the insights derived from these analyses.

6.2. Youth Life Expectancy

The concept of Youth life expectancy (YLE) is important for this study and is defined as the number of years remaining that a person from age 10 can expect to live assuming the age-specific mortality patterns remain constant and also that, the period of youth terminates at 34 years. The concept assumes that the period of youth commences and ends at a particular stage. Thus, a person enters youth at age 10 and exits at age 34. Consequently, using life tables, this study estimates the total number of years of "youth 'to be lived by a person, between the ages of 10 and 34 years for males and females separately. It also measures the total gains in life

expectancy, if a particular cause of death is reduced or eliminated across the different ages and by sex.

In this study, a cohort of 1,834 young people aged 10 to 34 years who died in the Kintampo Surveillance Area between 2005 and 2015 were studied. The young people were made up of 883 females and 951 males. This study applies life table techniques to determine youth mortality survival patterns, using mortality data from the KHDSS, and derives the Youth Life Expectancy (YLE) for the cohort, thereby estimating the remaining number of years a person is expected to live between the ages of 10 and 34 years, when the period of youth commences and ends. This will facilitate the evaluation of the impact of various interventions on life expectancy and offer valuable insights into the benefits of preventing or reducing specific causes of death among young people.

6.2.1. Scenarios of reducing mortality from different causes

Goal three of the SDGs on "Good Health and Well-being" aims to ensure healthy lives and promote wellbeing for all persons at all ages (United Nations, 2015). Four of the 13 targets of this goal relate to factors that affect mortality among young people. Consequently, in this study, three hypothetical scenarios have been set. For each scenario, the study computes YLE for young people between ages 10 and 34, when a particular cause of death is either eliminated or reduced in line with the SDG target. The scenarios are presented as follows.

Scenario 1: Eliminating infectious disease deaths

SDG Target 3.3 aims to "end the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combat hepatitis, water-borne diseases and other communicable diseases by 2030" (United Nations, 2015). Achieving this target therefore requires efforts

to eradicate communicable diseases. Under this scenario estimates for YLE are computed to arrive at the expected gains in YLE if infectious diseases were hypothetically eliminated. This offers an optimistic outlook on the profound impact of reaching global health targets on youth life expectancy.

Scenario 2: Reducing NCDs by a third

This is based on SDG Target 3.4 which aims to reduce premature mortality from non-communicable diseases by a third through the prevention and treatment of illnesses as well as the promotion of mental health and well-being by 2030 (United Nations, 2015). This scenario entails estimating YLE based on a reduction of NCD causes by a third among young people 10 to 34 years and the gains in life expectancy thereof. Reducing NCDs by a third, particularly among young people will delay deaths from NCDs and improve longevity.

Scenario 3: Halving deaths due to external injuries and trauma

Under this scenario, the study shows the expected gains in YLE if deaths due to external injuries and trauma were reduced by fifty percent in line with SDG Target 3.6 which aims to "halve the number of global deaths and injuries from road traffic accidents by 2030" (United Nations, 2015). This addresses a key area of youth mortality often overlooked in healthcare policies.

Scenario 4: Eliminating maternal mortality

SDG Target 3.1 aims to "reduce the global maternal mortality ratio to less than 70 per 100,000 live births by 2030" (United Nations, 2015). Maternal mortality is a critical issue worldwide, particularly in Africa and is considered a human rights issue. Every woman has the right to life, health, and well-being. Addressing maternal mortality is a fundamental

aspect of upholding a basic human right. Consequently, for this scenario, the study computes YLE for young females between ages 10 and 34, when maternal mortality is eliminated.

6.3. Estimation procedure

Using data on deaths and population by age and sex, observed mortality rates (m-rates and notated as ${}_nm_x$) are computed for the study population. The formula for computing death rates for each age group is given as follows:

$$ {}_nm_x = \frac{{}_nD_x}{{}_nPYO_x} $$

where:

${}_nm_x$ = central death rate in the age interval x to x+n

${}_nD_x$ = observed deaths

PYO_x = person years of observation in the interval x to x+n

x = age at start of interval

n = width of interval

Using the simplified conversion formulae (Preston *et al.*, 2001), the life table mortality rates (q-rates, notated as ${}_nq_x$) are derived from the m-rates. The q-rates represent the probability of dying in a life table. The simplified conversion formula is given as:

$$ {}_nq_x = \frac{2 \cdot n \cdot {}_nm_x}{2 + n \cdot {}_nm_x} $$

where ${}_nq_x$ is the probability of dying.

Note: With data from clinical records, it is possible to directly estimate the effects of eliminating or reducing deaths from individual broad causes on youth mortality in the study population (Ayaga Bawah & Binka, 2007). However, in low- and middle-income settings, such as in the KHDSS, assessing the effect of eliminating broad causes of death on mortality involves employing cause-deleted life tables to indirectly estimate the number of person-years gained, assuming a broad cause is eliminated or reduced in line with the corresponding SDG targets. Bawah et at (2007) were able to estimate the total number of person-years that would have been saved if malaria is eliminated and the gains in life expectancy that would have accrued in their study of longitudinal demographic surveillance data from northern Ghana. This was achieved by utilising multiple-decrement life tables and associated multiple-decrement under the assumption that death operates independently of the other individual broad causes of death, even though, in reality, death can be attributed to multiple causes (Ayaga Bawah & Binka, 2007). This caveat notwithstanding, each death is assigned a primary cause of death by physicians after verbal autopsy which is usable in practice because to determine the interdependence of multiple causes of death is cumbersome (Ayaga Bawah A. *et. al.*, 2007; Abubakari S. *et al*., 2019).

6.4. Youth life expectancy and the probability of dying (qx) in each age group

Table 6.1 presents a general life table with e_x and q_x values for female and male youth. The results in Fig 6.1 show that even with an additional broad cause of death, girls aged 10 have a slightly higher YLE (24.63 years) than their male counterparts (24.46 years). This observation that young women have a higher life expectancy than their male counterparts corroborates the findings from South Africa among young persons aged 15 to 24 years (de Wet-Billings, 2021). Table 6.1 also shows that the higher youth life expectancy for females continues across all ages. Among males, the probability of dying (q_x) increases steadily with age. Among females,

however, the q_x drops in the age interval 15 to 19 where it is lowest and increases with age thereon. This could signify the impact of different risk factors that become more prevalent as young people transition into adulthood.

Figure 6.1 Comparison of Youth Life Expectancy for males and females

Source: KHDSS, 2005 – 2015

Table 6.1 A general multiple decrement life table for young persons aged 10-34 years in the KHDSS, 2005-2015

Age (x)	PYO	D^{All}	D^{Inf}	D^{NCD}	D^{Ext}	D^{MM}	${}_na_x$	${}_nm_x$	${}_nq_x$	l_x	${}_nd_x$	nLx	T_x	e^x
Female														
10-14	107022	118	65	39	5	9	2.5	0.0011	0.0055	100000	550	498626	2462889	24.63
15-19	118568	99	33	28	11	27	2.5	0.0008	0.0042	99450	414	496215	1964263	19.75
20-24	108275	114	54	25	7	28	2.5	0.0011	0.0053	99036	520	493880	1468048	14.82
25-29	71980	146	85	29	7	25	2.5	0.0020	0.0101	98516	994	490094	974168	9.89
30 -34	51005	149	75	35	7	32	2.5	0.0029	0.0145	97522	1414	484074	484074	4.96
Total	**456850**	**626**	**312**	**156**	**37**	**121**	-	-	-	-	**3892**	-	-	-
Male														
10-14	98540	144	79	50	15	-	2.5	0.00146	0.00728	100000	728	498180	2445846	24.46
15-19	111326	177	102	39	36	-	2.5	0.00159	0.00792	99272	786	494395	1947666	19.62
20-24	114266	200	109	33	58	-	2.5	0.00175	0.00871	98486	858	490284	1453271	14.76
25-29	78024	187	106	48	33	-	2.5	0.00240	0.01191	97628	1163	485232	962987	9.86
30 -34	51496	197	106	54	37	-	2.5	0.00383	0.01895	96465	1828	477755	477755	4.95
Total	**453652**	**905**	**502**	**224**	**179**	-	-	-	-	-	**5363**	-	-	-

Source: KHDSS, 2005 - 2015

Note:

- Not applicable

PYO Person years of observation

D^{All} Observed deaths due to all causes

D^{Inf} Observed deaths due to infectious causes

D^{NCD} Observed deaths due to non-communicable diseases

D^{Ext} Observed deaths due to external injuries / trauma

D^{MM} Observed deaths due to maternal causes

${}_{n}a_{x}$ Average number of years lived in the interval by those who died in the interval

${}_{n}m_{x}$ Mortality rate for persons aged x to x+n

${}_{n}q_{x}$ Probability of dying between ages x and x+n

l_{x} Number surviving at the beginning of age interval

${}_{n}d_{x}$ Number of deaths between age x and x+n

${}_{n}L_{x}$ Number of person-years lived between ages x and x+n

T_{x} Number of person-years lived at age x and beyond to age 34

e_{x} Youth life expectancy at exact age x

6.5. Effects of eliminating infectious causes of death among young persons

Table 6.2 displays the relative gain in YLE by sex, if infectious causes of death in the target population were eliminated. From the results, if infectious disease mortality were hypothetically eliminated, the average number of years lived by a young female between ages 10 and 34 years increases from 24.63 to 24.81 years, representing an increase in YLE of 0.18 years. Similarly for males, without infectious disease mortality, the average number of years lived between ages 10 and 34 years potentially increases from 24.46 years to 24.76 years. Thus, eliminating infectious diseases among male youth aged 10 to 34 years increases the youth life expectancy by 0.31 years. It is important to note that eliminating infectious causes of death

increases the YLE at all exact ages beginning at each age interval for both males and females. The results demonstrate a relatively higher life expectancy at every age for both sexes.

Table 6.2 Associated single decrement life table for causes of death without infectious causes in the KHDSS (2005-2015) among young females and males

Age	${}_nq_x$	${}_nq_x^{Inf}$	${}_nq_x^{-Inf}$	l_x^{-Inf}	${}_nL_x^{-Inf}$	T_x^{-Inf}	e_x^{-Inf}
Female							
10-14	0.0055	0.0030	0.0025	100000	499383	2481244	24.81
15-19	0.0042	0.0014	0.0028	99753	498073	1981862	19.87
20-24	0.0053	0.0025	0.0028	99476	496693	1483789	14.92
25-29	0.0101	0.0059	0.0042	99201	494960	987096	9.95
30-34	0.0145	0.0073	0.0072	98783	492136	492136	4.98
Male							
10-14	0.0073	0.0040	0.0033	100000	499178	2475848	24.76
15-19	0.0079	0.0046	0.0034	99671	497521	1976670	19.83
20-24	0.0087	0.0047	0.0040	99337	495700	1479149	14.89
25-29	0.0119	0.0068	0.0052	98943	493439	983449	9.94
30-34	0.0189	0.0102	0.0088	98433	490009	490009	4.98

Source: KHDSS, 2005 - 2015

Note:

${}_nq_x^{Inf}$ probability of dying from infectious causes

${}_nq_x^{-Inf}$ probability of dying with infectious causes eliminated

l_x^{-Inf} number surviving at the beginning of age interval with infectious causes eliminated

${}_nL_x^{-Inf}$ Number of person-years lived between ages x and x+n with infectious causes eliminated

${}_nT_x^{-Inf}$ Number of person-years lived at age x and beyond to age 34 with infectious causes eliminated

e_x^{-Inf} Youth life expectancy at exact age x with infectious causes eliminated

6.6. Effects of reducing non-communicable disease causes of death by a third among young persons

Table 6.3 shows the associated single decrement life table for all other causes of death excluding one-third of NCD deaths among females and males, in line with the SDG targets. Overall, the gains in youth life expectancy is higher among males than females if NCD deaths are reduced by a third. The table shows the hypothetical gains in YLE if NCD causes were reduced by a third. Reducing NCD causes of death by a third increases female YLE from 24.63 to 24.66 years, i.e., 0.03 years. The table shows the hypothetical gains in male youth life expectancy if NCD causes were reduced by a third. Reducing NCD causes of death by a third increases male YLE from 24.46 to 24.54 years. The observed sex difference in gains in youth life expectancy aligns with findings among South African youth aged 15 to 24 years, if the three leading causes of NCD deaths (heart disease, cancer and diabetes) are eliminated (de Wet-Billings, 2021).

Table 6.3 Associated single-decrement life table for all causes of death excluding one-third the non-communicable disease causes of death among young females and males

Age	${}_nq_x$	${}_nq_x^{NCD}$	${}_nq_x^{-1/3NCD}$	$l_x^{-1/3NCD}$	${}_nL_x^{-1/3NCD}$	$T_x^{-1/3NCD}$	$e_x^{-1/3NCD}$
Females							
10-14	0.0055	0.0018	0.0049	100000	498777	2466154	24.66
15-19	0.0042	0.0012	0.0038	99511	496615	1967377	19.77
20-24	0.0053	0.0012	0.0049	99135	494470	1470762	14.84
25-29	0.0101	0.0020	0.0094	98653	490940	976292	9.90
30-34	0.0145	0.0034	0.0134	97723	485351	485351	4.97
Males							
10-14	0.0073	0.0046	0.0057	100000	498564	2454141	24.54
15-19	0.0079	0.0030	0.0069	99426	495411	1955577	19.67
20-24	0.0087	0.0026	0.0078	98739	491759	1460166	14.79
25-29	0.0119	0.0054	0.0101	97965	487349	968407	9.89
30-34	0.0189	0.0097	0.0157	96974	481058	481058	4.96

Source: KHDSS, 2005 – 2015

Note:

${}_nq_x^{NCD}$ probability of dying from NCD causes

${}_nq_x^{-1/3NCD}$ probability of dying with NCD causes reduced by a third

$l_x^{-1/3NCD}$ number surviving at the beginning of age interval with NCD causes reduced by a third

${}_nL_x^{-1/3NCD}$ Number of person-years lived between ages x and x+n with NCD causes reduced by a third

$T_x^{-1/3NCD}$ Number of person-years lived at age x and beyond to age 34 with NCD causes reduced by a third

e_x^{-Inf} Youth life expectancy at exact age x with NCD causes reduced by a third

6.7. Effects of eliminating external injuries/trauma causes of death among young persons

Table 6.4 shows the associated single decrement life table for all other causes minus one-half of external injuries/trauma causes of death. Similar to both infectious causes and NCD deaths, halving deaths due to external injuries increases youth life expectancy for males than females. The table shows the hypothetical gains in female YLE if causes of death due to external injuries/trauma were reduced by half. Halving external injuries/trauma causes of death increases female YLE from 24.63 years to 24.64 years i.e., 0.01 years as shown in Table 6.4. The table shows the hypothetical gains in male YLE if causes of death due to external injuries/trauma were reduced by half. Halving external injuries/trauma causes of death increases female YLE from 24.46 years to 24.69 years i.e., 0.24 years.

Table 6.4 Associated single-decrement life table for all causes of death excluding half the deaths from external injuries/trauma among young females and males in the KHDSS

Age	${}_nq_x$	${}_nq_x^{Ext}$	${}_nq_x^{-1/2Ext}$	$l_x^{-1/2Ext}$	${}_nL_x^{-1/2Ext}$	$T_x^{-1/2Ext}$	$e_x^{-1/2Ext}$
Females							
10-14	0.0055	0.0002	0.0054	100000	498655	2464006	24.64
15-19	0.0042	0.0005	0.0039	99462	496331	1965351	19.76
20-24	0.0053	0.0003	0.0051	99071	494092	1469020	14.83
25-29	0.0101	0.0005	0.0099	98566	490405	974928	9.89
30-34	0.0145	0.0007	0.0142	97596	484523	484523	4.96
Males							
10-14	0.0073	0.0022	0.0062	100000	498453	2468505	24.69
15-19	0.0079	0.0073	0.0043	99381	495847	1970052	19.82
20-24	0.0087	0.0153	0.0011	98957	494526	1474206	14.90

25-29	0.0119	0.0082	0.0078	98853	492333	979680	9.91
30-34	0.0189	0.0130	0.0125	98080	487347	487347	4.97

Source: KHDSS, 2005 – 2015

Note:

Nq_x^{Ext} probability of dying from external injuries/trauma

${}_nq_x^{-1/2Ext}$ probability of dying with external injuries/trauma deaths halved

$l_x^{-1/2Ext}$ number surviving at the beginning of age interval with external injuries/trauma deaths halved

${}_nL_x^{-1/2Ext}$ Number of person-years lived between ages x and x+n with external injuries/trauma deaths halved

$T_x^{-1/2Ext}$ Number of person-years lived at age x and beyond to age 34 with external injuries/trauma deaths halved

$e_x^{-1/2Ext}$ Youth life expectancy at exact age x with external injuries/trauma deaths halved

6.8. Effects of eliminating maternal causes of death among young females

Table 6.5 shows the associated single decrement life table for all other causes minus maternal causes of death. The table further shows the hypothetical gains in YLE if causes of death due to maternal causes were eliminated. Eliminating maternal causes of death increases female YLE from 24.63 to 24.69 years. This represents the second highest gain in YLE among females.

Table 6.5 Associated single decrement life table for causes of death without maternal causes in the KHDSS (2005-2015) among young females

Age	${}_nq_x$	${}_nq_x^{MM}$	${}_nq_x^{-MM}$	l_x^{-MM}	${}_nL_x^{-MM}$	T_x^{-MM}	e_x^{-MM}
10-14	0.0055	0.0004	0.0051	100000	498730	2469402	24.69
15-19	0.0042	0.0011	0.0030	99492	496707	1970671	19.81
20-24	0.0053	0.0013	0.0040	99191	494971	1473964	14.86
25-29	0.0101	0.0017	0.0084	98798	491924	978993	9.91
30-34	0.0145	0.0031	0.0114	97972	487069	487069	4.97

Source: KHDSS

Note:

${}_nq_x^{MM}$ probability of dying from maternal causes

${}_nq_x^{-MM}$ probability of dying with maternal deaths eliminated

l_x^{-MM} number surviving at the beginning of age interval with maternal deaths eliminated

${}_nL_x^{-MM}$ Number of person-years lived between ages x and x+n with maternal deaths eliminated

${}_nT_x^{-MM}$ Number of person-years lived at age x and beyond to age 34 with maternal deaths eliminated

e_x^{-MM} Youth life expectancy at exact age x with maternal deaths eliminated

6.9. Decomposition of the total change in Youth Life Expectancy (YLE) for all causes of death

A decomposition analysis of age-and cause-specific mortality was undertaken on deaths of young people aged 10 to 34 years in the KHDSS from 2005 to 2015 for males and females separately. The purpose of this is to establish the contributions of the different causes of death to YLE within each age group, assuming that the distribution of deaths is constant in each group by applying Arriaga's (1984) decomposition method (Preston *et al*., 2001). This information is important as it will enable policy makers to put in place the appropriate policy interventions targeted at the age groups that would yield the highest gains in youth life expectancy in line with the SDGs.

From the results, YLE is estimated at 24.63 years for females and 24.46 years males respectively, in the ten-year period from 2005 to 2015 (Table 6.1). Using data constructed from the multiple and associated single decrement life tables, Table 6.6 below shows the decomposition of gains in YLE for males and females (10 – 34 years) of the KHDSS area from 2005 to 2015 if infectious diseases were eliminated. From the results, gains in YLE varied for males and females with males having a slightly higher advantage than females across all ages. The results reveal a total change in YLE of 0.48 years for females and 0.75 years for males.

The table also highlights gender disparities in the effects of eliminating infectious causes. Males show a 0.298484 change in the 10 to 14 age group. which is considerably higher than the change noted for females (0.18244), underlying the importance of gender-sensitive interventions in public health programming.

Table 6.6 Decomposition of estimated changes in youth life expectancy if infectious causes were eliminated among young females and males 10 – 34 years in the KHDSS, 2005 - 2015

Age	${}_nq_x$	${}_nq_x^{Inf}$	${}_nq_x^{-Inf}$	l_x^{-Inf}	${}_nL_x^{-Inf}$	T_x^{-Inf}	e^x	e_x^{-Inf}	YLE Change	% Change
Female										
10-14	0.0055	0.0030	0.0025	100000	499383	2481244	24.63	24.81	0.18244	38
15-19	0.0042	0.0014	0.0028	99753	498073	1981862	19.75	19.87	0.11767	25
20-24	0.0053	0.0025	0.0028	99476	496693	1483789	14.82	14.92	0.09605	20
25-29	0.0101	0.0059	0.0042	99201	494960	987096	9.89	9.95	0.06045	13
30-34	0.0145	0.0073	0.0072	98783	492136	492136	4.96	4.98	0.02200	5
Total	-	-	-	-	-	-	-	-	**0.47861**	**100**
Male										
10-14	0.0073	0.0040	0.0033	100000	499178	2475848	24.46		0.298484	40
15-19	0.0079	0.0046	0.0034	99671	497521	1976670	19.62	19.83	0.21187	28
20-24	0.0087	0.0047	0.0040	99337	495700	1479149	14.76	14.89	0.130217	17
25-29	0.0119	0.0068	0.0052	98943	493439	983449	9.86	9.94	0.079535	11
30-34	0.0189	0.0102	0.0088	98433	490009	490009	4.95	4.98	0.02812	4
Total	-	-	-	-	-	-	-	-	**0.748226**	**100**

Source: KHDSS, 2005 - 2015

The results are similar when deaths from NCDs are reduced by one third. In this scenario, males once again have a higher advantage in life expectancies than their female counterparts with a slight increase of 0.08 years for females compared to 0.19 years for males (Table 6.7). This analysis underscores age- and gender-specific outcomes in life expectancy changes under a scenario where the mortality from NCDs is reduced by one half. From the results in Table 6.7 below, among females aged 10 to 14, there is an increase in life expectancy of 0.03154 years, accounting for 39 percent of the total change in YLE. Considering that this age bracket is crucial for cognitive and emotional development (Benzies & Mychasiuk, 2009), even marginal gains in life expectancy could have long-term societal benefits. Comparatively, for males within the same age group, the life expectancy gain is more pronounced at 0.08141 years, comprising 42 percent of the total YLE. The significantly higher percentage suggests that young males are disproportionately affected by NCDs in the KHDSS area.

The results from the KHDSS data also reveals that for females in the 15 to 19 age group, the increase is 0.02049 years, making up 25 percent of the total change in YLE. In view of the high mortality rates among this age group from maternal causes of death, it envisaged that even modest increases could potentially impact maternal and child health outcomes of young females. The benefits of changes in YLE, when NCDs is reduced, tapers off with age for both males and females. For young females aged 25 to 29 years and 30 to 34 years, the life expectancy gains are 0.00623 and 0.00659 years, respectively, contributing 8 percent to the total change for each group. At these ages, the risk factors for NCDs may be more entrenched, implying the need for targeted interventions (Nugent, 2008).

Table 6.7 Decomposition of estimated changes in youth life expectancy if infectious causes were eliminated among young females and males 10 – 34 years in the KHDSS, 2005 - 2015

Age	${}_nq_x$	${}_nL_x$	${}_nq_x^{NCD}$	${}_nq_x^{-1/3NCD}$	$l_x^{-1/3NCD}$	${}_nL_x^{-1/3NCD}$	$T_x^{-1/3NCD}$	e^x	$e_x^{-1/3NCD}$	YLE Change	% Change
Female											
10-14	0.0055	498626	0.0018	0.0049	100000	498777	2466154	24.63	24.66	0.03154	39
15-19	0.0042	496215	0.0012	0.0038	99511	496615	1967377	19.75	19.77	0.02049	25
20-24	0.0053	493880	0.0012	0.0049	99135	494470	1470762	14.82	14.84	0.01590	20
25-29	0.0101	490094	0.0020	0.0094	98653	490940	976292	9.89	9.90	0.00623	8
30-34	0.0145	484074	0.0034	0.0134	97723	485351	485351	4.96	4.97	0.00659	8
Total	-	-	-	-	-	-	-	-	-	**0.08076**	**100**
Male											
10-14	0.0073	498180	0.0046	0.0057	100000	498564	2454141	24.46	24.54	0.081407	42
15-19	0.0079	494395	0.0030	0.0069	99426	495411	1955577	19.62	19.67	0.048749	25
20-24	0.0087	490284	0.0026	0.0078	98739	491759	1460166	14.76	14.79	0.028193	15
25-29	0.0119	485232	0.0054	0.0101	97965	487349	968407	9.86	9.89	0.025219	13
30-34	0.0189	477755	0.0097	0.0157	96974	481058	481058	4.95	4.96	0.010677	5
Total	-	-	-	-	-	-	-	-	-	**0.194246**	**100**

Source: KHDSS, 2005 - 2015

The data presented in Table 6.8 provides a nuanced examination of the potential changes in YLE among young people 10 to 34 years in the KHDSS over a ten-year period, from 2005 to 2015, if mortality from injuries/trauma are hypothetically reduced by one half. This analysis is helpful in highlighting the complex effect of injury/trauma on public health, particularly among young people. As shown in Table 6.8, reducing injuries and trauma deaths by one half would result in additional gains in youth life expectancies for females (0.03 years) and males (0.63 years). For the female population between ages 10 to 34, the change in YLE indicates a 0.03360 (or 3.36%) potential increase in life expectancy, should injury/trauma causes be reduced by half. This increment appears to be most pronounced in the 10 to 14 years age group, with a 30 percent change and diminishes as age increases. On the other hand, males exhibit a more substantial increase in YLE, with a total change of 0.634948 (or 63.5%). The highest gains are observed in the younger ages. This demonstrates the more profound impact of injury/trauma on young males as a result of their heightened risky behaviours compared to females.

Table 6.8 Decomposition of estimated changes in youth life expectancy if injury/trauma causes were reduced by one half among young females and males 10 – 34 years in the KHDSS, 2005 - 2015

Age	${}_nq_x$	${}_nL_x$	${}_nq_x^{Ext}$	${}_nq_x^{-1/2Ext}$	$l_x^{-1/2Ext}$	${}_nL_x^{-1/2Ext}$	$T_x^{-1/2Ext}$	e^x	$e_x^{-1/2Ext}$	YLE Change	% Change
Female											
10-14	0.0055	498626	0.0002	0.0054	100000	498655	2464006	24.63	24.64	0.01006	30
15-19	0.0042	496215	0.0005	0.0039	99462	496331	1965351	19.75	19.76	0.00984	29
20-24	0.0053	493880	0.0003	0.0051	99071	494092	1469020	14.82	14.83	0.00802	24
25-29	0.0101	490094	0.0005	0.0099	98566	490405	974928	9.89	9.89	0.00108	3
30-34	0.0145	484074	0.0007	0.0142	97596	484523	484523	4.96	4.96	0.00460	14
Total	-	-	-	-	-	-	-	-	-	**0.03360**	**100**
Male											
10-14	0.00728	498180	0.0022	0.0062	100000	498453	2468505	24.46	24.69	0.225054	35
15-19	0.00792	494395	0.0073	0.0043	99381	495847	1970052	19.62	19.82	0.203191	32
20-24	0.00871	490284	0.0153	0.0011	98957	494526	1474206	14.76	14.90	0.137367	22
25-29	0.01191	485232	0.0082	0.0078	98853	492333	979680	9.86	9.91	0.050475	8
30-34	0.01895	477755	0.0130	0.0125	98080	487347	487347	4.95	4.97	0.018861	3
Total	-	-	-	-	-	-	-	-	-	**0.634948**	**100**

Source: KHDSS, 2005 - 2015

The data presented in Table 6.9 below, reveals the estimated changes in youth life expectancy if maternal causes of death are reduced by 77 percent among young females aged 10 to 34 years in the KHDSS area for the period 2005 to 2015. As observed in Table 6.9, the data illustrates that the most significant changes in YLE, when considering reduction in maternal causes, occur in the younger age groups (10-19 years). For example, the age group 10-14 sees a change in life expectancy (YLE Change) of 0.06402, which accounts for 33 percent of the total change. As age increases, the incremental contribution to life expectancy becomes marginal. For the age group 30 to 34, the YLE change is only 0.01153, making up just 6 percent of the total change. This is consistent with global trends where early life interventions often provide the most substantial benefits to life expectancy (Doyle *et al*., 2009).

Although maternal mortality rates have been decreasing globally, it remains a significant cause of lower life expectancy among young females (Wang *et al*., 2016). This is more so in Sub-Saharan Africa, including Ghana, where varying factors, including cultural, educational and infrastructural constraints contribute to this elevated risk (Say *et al*., 2014). From the results, maternal causes of death had a higher probability of occurring among younger females between the age group 10 to 14 years (0.0004) compared with older females aged 30 to 34 years (0.0031). This aligns with findings that maternal mortality is a critical issue among younger age groups, particularly in Sub-Saharan Africa (World Health Organization, 2019).

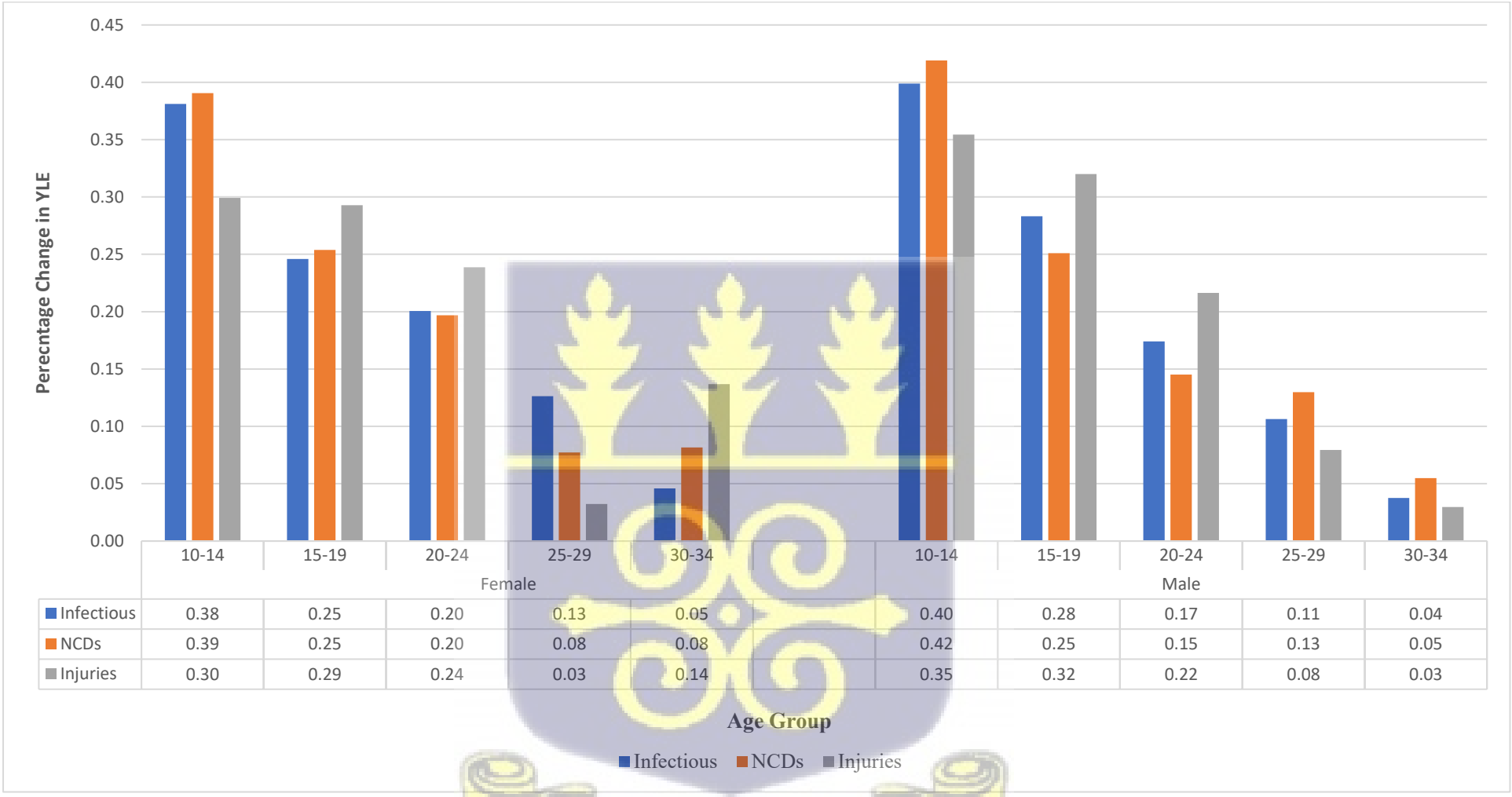
Table 6.9 Decomposition of estimated changes in youth life expectancy if maternal causes were eliminated among young females 10 – 34 years in the KHDSS, 2005 - 2015

Age	${}_nq_x$	${}_nL_x$	${}_nq_x^{MM}$	${}_nq_x^{-MM}$	l_x^{-MM}	${}_nL_x^{-MM}$	T_x^{-MM}	e^x	e_x^{-MM}	YLE Change	YLE % Change
Female											
10-14	0.0055	498626	0.0004	0.0051	100000	498730	2469402	24.63	24.69	0.06402	33
15-19	0.0042	496215	0.0011	0.0030	99492	496707	1970671	19.75	19.81	0.05730	30
20-24	0.0053	493880	0.0013	0.0040	99191	494971	1473964	14.82	14.86	0.03990	21
25-29	0.0101	490094	0.0017	0.0084	98798	491924	978993	9.89	9.91	0.01905	10
30-34	0.0145	484074	0.0031	0.0114	97972	487069	487069	4.96	4.97	0.01153	6
Total	-	-	-	-	-	-	-	-	-	**0.19180**	**100**

Source: KHDSS, 2005 - 2015

Fig 6.2 below provides an overview of the decomposition of changes in youth life expectancy, by sex, age and cause of death (infectious diseases, NCDs and injuries). This enables the examination of the implications of the changes in YLE and how these could be integrated within a broader health-policy framework, particularly in alignment with SDG 3, which emphasizes the promotion of well-being and assurance of healthy lives for all. From the results, it is evident that for females in the 10-14 and 15-19 age groups, the changes in YLE if infectious diseases, NCDs, and injuries are reduced ranges from 0.25 years to 0.39 years. Interestingly, as age progresses, gains in life expectancy if deaths from injuries are reduced decreases to 0.03 for ages 25 to 29 years. For young males, the changes in YLE appear to be relatively even when infectious diseases, NCDs, and injuries are reduced in the younger age group of 10-19 years. However, for the older ages, from 25 to 34 years, injuries seem to become less of a contributing factor to YLE, most likely as a result of reductions in risk-taking behaviours usually observed in early adulthood (Arnett, 1999).

Figure 6.2 Comparison of Decomposition of estimated changes in youth life expectancy by causal mortality among young females and males 10 – 34 years for KHDSS, 2005 – 2015



	Female					Male				
	10-14	15-19	20-24	25-29	30-34	10-14	15-19	20-24	25-29	30-34
Infectious	0.38	0.25	0.20	0.13	0.05	0.40	0.28	0.17	0.11	0.04
NCDs	0.39	0.25	0.20	0.08	0.08	0.42	0.25	0.15	0.13	0.05
Injuries	0.30	0.29	0.24	0.03	0.14	0.35	0.32	0.22	0.08	0.03

Source, KHDSS, 2005 - 2014

6.10. Discussion of Results

The result of the analysis underscores the potential gains in life expectancy for both young males and females if the various causes of death are mitigated or eradicated. The chapter begins by deriving YLE and then estimate the remaining years a person from age 10 is expected to live if the period of youth hypothetically begins at age 10 and ends at 34 years. Importantly, the results identify which causes of death have a more pronounced impact on YLE for males and females separately.

The increase in YLE for both males and females, when infectious diseases are eliminated, suggests potential advancements in achieving SDG Target 3.3 in Ghana. Successes recorded in reducing the burden of infectious diseases may be attributable to improved access to healthcare including better management of diseases, such as malaria and water-borne diseases as well as successful vaccination campaigns. Furthermore, although the gains in YLE are modest, when NCDs are reduced by a third among young people, the reduction aligns with progress towards SDG Target 3.4 of decreasing premature mortality from NCDs. However, further efforts will be needed to enhance the impact and reach the one-third reduction goal. Ongoing monitoring of NCD prevalence, access to healthcare for NCDs and the effectiveness of preventive measures will help ensure progress if this SDG target is to be attained.

With respect to SDG Target 3.6, halving deaths due to external injuries directly contributes to the goal of reducing deaths and injuries. The observed gains in YLE, especially for males, also indicate advancement in efforts to reduce deaths from trauma and injuries among young people. Monitoring road safety measures, emergency response systems and injury prevention programmes will be crucial to accelerate progress in reducing external injuries. For females, the increase in YLE when maternal mortality is eliminated, suggests progress in addressing

maternal health in Ghana . This is attributable to improvements in access to maternal healthcare as well as family planning initiatives among young females.

From a health policy perspective, the greater the gain in life expectancy, the more attention is required to achieve that target (Chisumpa *et al*., 2019b). Unfortunately, not much systematic focus has been placed on understanding the causes of death among young people and the impact of attaining the mortality-related SDG targets among young people globally. Evidence from the KHDSS demonstrates the need to target young people's health and the associated gains when causes of death are reduced among young people in line with the SDG targets. In an analysis of global and regional trends in mortality among young people 15 to 24 years, Masquelier *et al* (2021) concluded that urgency is required to accelerate progress in reducing youth mortality, especially in Sub-Saharan Africa, where the burden of mortality is progressively concentrated. They further postulate that if the current trends continues, a number of countries will see youth mortality exceed under-5 mortality (Masquelier *et al*., 2021).

The results affirm the longevity of females compared to males, even in the period of youth. However, there are significant differences in the gains in survival across the various age groups and the causes of death for both males and females. For instance, Fig 6.2 demonstrates that, whilst reducing NCDs among young males accounted for the highest percentage gains in life expectancy for males aged 10 to 14 years (42%), followed by the elimination of infectious diseases. Among young males aged 10 to 14 years, reducing NCDs by one third yielded the highest percentage gains in YLE (42%) followed by gains made from eliminating infectious diseases (40&). This was similar among females with the highest percentage gains in YLE (38%) resulting from the elimination of NCDs followed closely by infectious diseases (38%).

Reducing deaths from injuries/trauma accounted for the least percentage gains of 35% for males and 30 % for females among the same age group.

Conversely, eliminating deaths from injuries and trauma among young people between the ages of 15 and 24 years ultimately had the greatest impact on survival. Fig 6.2 shows a gain of 0.32 years and 0.22 years for males 15 to 19 years and 20 to 24 years respectively. Similarly, among females gains in YLE when injuries/trauma is reduced by half resulted in the highest gains (0.29 years and 0.24 years) for females aged 15 to 19 and 20 to 24 years respectively. The least gain in YLE is occurred when deaths from NCDs are reduced by half among males aged 15 to 24. (0.25 years for 15 – 19 and 0.15 years for 20 – 24 years). The same applies for females aged 20 to 24 years (0.20 years) with infectious diseases showing an equal gain in YLE among females 15 – 19 years. The results showed significant differences between males and females aged 25 to 29 years. From Fig 6.2, the results indicate that among females, infectious diseases would yield the highest gains (0.13 years) in this age group and injuries yield the lowest gains (0.03 years).

CHAPTER SEVEN

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1. Introduction

The primary aim of this study is to investigate the patterns and determinants of youth mortality in the KDHSS in Ghana and to estimate the gains in life expectancy through the elimination/reduction of specific causes of death among young people. This chapter summarises the key findings on cause-specific mortality among young people aged 10 to 34 years in the KHDSS between 2005 and 2015, as well as the socio-demographic factors associated with their causes of death. It further presents the impact of eliminating specific causes of death in line with the SDGs and the corresponding impact on youth life expectancy. The chapter concludes by presenting the value and contribution of the study, offers some policy recommendations and proposes opportunities for future research.

7.2. Summary

Young people are major contributors to national development and economic prosperity, yet there has been little progress in reducing mortality among this group over the past thirty years. Understanding why young people die and what they die from and how this impacts their longevity is key in preventing premature mortality. This study focuses on mortality among young people aged 10 to 34 years in the Kintampo North Municipality and Kintampo South District of the Bono East Region of Ghana from 2005 to 2015. It underscores the significance of studying cause-specific mortality among this age group aligned with targets under SDG 3 which aims to ensure healthy lives for all.

The study objectives include identifying primary causes of mortality among young people aged 10 to 34 years, analysing trends, assessing risk factors and evaluating the potential gains in life expectancy if causes of mortality are hypothetically reduced or eliminated. Relying on the Epidemiological Transition Theory (ETT) as its main theoretical framework, the study examines the applicability of the ETT to low- and middle-income countries (LMICs), such as Ghana, highlighting the diverse epidemiological transition paths in these regions and their marked deviation from the classical transitions observed in western industrialised countries.

The study utilised longitudinal data from the Health and Demographic Surveillance System (HDSS) of the Kintampo Health Research Centre (KHRC) from 2005 to 2015. The dataset contained 1,834 deaths of young people (883 females and 951 males) obtained from verbal autopsies (VA) with family members of the deceased individuals concerning the symptoms and circumstances surrounding their death. Analysis of the cause of death data was undertaken using the WHO Inter-VA version 5.1 model.

Four main approaches were employed in analysing the data with separate analyses conducted for males and females. First, there was an assessment of the trends and levels of each cause of death by sex to identify mortality patterns overtime. Competing risk analysis of the relative contribution of each cause of death to overall mortality as well as regression analysis were conducted to identify the significant factors associated with the relative odds of dying from a broad cause of death. The study introduces the concept of Youth Life Expectancy and uses multiple decrement and associated single decrement life tables to estimate the effect of separately eliminating or reducing the broad causes of death on YLE, assuming scenarios in which each cause of death is reduced or eliminated in line with the targets of the SDGs. Youth Life Expectancy (YLE) is defined as the remaining years a person aged 10 can expect to live

assuming the age-specific mortality patterns remain constant and also that, the period of youth spans from 10 to 34 years.

The study found that, the primary cause of mortality among young people in the study area were from infectious causes, with pulmonary tuberculosis being the leading cause of infectious deaths (30.7%) among young people. There were variations in the specific causes of death for both males and females. For instance, the results indicate that, thrice more females died from HIV and AIDs (28.9%) than males (6.5%), reflecting gender disparities with regard to HIV and AIDS morbidity. Similarly, more females died from malaria (14.8%) than their male counterparts (1.2%).

NCDs ranked the second highest cause of death for both males and females. Digestive neoplasms emerged as the leading cause of death, accounting for 19.6 percent of all NCD-related deaths among both males (20.4%) and females (18.5%). This was followed by deaths from cardiac diseases (13.1%) with slight variations between both sexes. Notably, other causes of NCD related deaths, including liver cirrhosis, respiratory neoplasms and acute cardiac diseases were high contributors of causes of death to males (16.4%, 13.3% and 8.0% respectively) than females (7.0%, 0.6% and 5.7% respectively).

Deaths from external injuries contributed the least to cause-specific mortality among the youth. From the results, road traffic accidents (51.7%), were the leading causes of external injury-related deaths for both young males and females. This is followed by other transport accidents (17.7%) and contact with venomous plants or animals (14.8%). Males experienced more deaths from external injuries and trauma compared to their female counterparts. Notably, deaths from accidental drowning and submersion were reported only among females in the KHDSS.

Likewise, deaths from accidental poisoning and noxious substances were only among males. The data shows among young females, that abortion-related deaths are high, constituting 54.5% of all maternal deaths in the KHDSS areas. This is followed by obstetric haemorrhage (23.1%) and pregnancy-related sepsis (8.3%). Deaths from ruptured uterus (0.8%) and pregnancy-induced hypertension (1.7%) were the least causes of death among females.

Overall, the analyses revealed a downward trend in mortality rates for young people in the study population over the period with variations in the specific causes of death among males and females, generally reflecting global trends in mortality. The examination of mortality trends among young individuals in the Kintampo Health and Demographic Surveillance System (KHDSS) reveals distinct patterns for both males and females. The risk of NCDs increases consistently with age. For both males and females, there is a noticeable rise in the risk of NCDs, external injuries/trauma and maternal causes of death as they transition from early to late adolescence. Higher education emerged to have a negative impact on NCDs but increases the risk of death from external injuries/trauma. Geographic variations, ethnic disparities, and religious differences contribute to diverse mortality outcomes for both males and females.

The study underscored the potential gains to be made in life expectancy for both males and females if the various broad causes of death are mitigated or reduced. Younger females have slightly better life expectancies but experience significant risk from infectious diseases. This aligns with global trends where females generally have better life expectancies but are still vulnerable to specific causes of mortality. From the results, both males and females, seem to benefit most from the elimination of infectious causes of death leading to significant increases in life expectancy, particularly among the younger age groups. It is however important to note that, these gains are not uniformly distributed across sex and age groups. The results also

suggests that the most significant gains in YLE could be achieved through focused interventions targeting injuries and trauma for both sexes but more profoundly among males between 15 and 24 years. Continuous monitoring, data-driven evaluations and a collaborative approach involving various stakeholders will be essential to assess progress and make informed decisions for further interventions. These findings contribute significantly to ongoing global discussions on youth mortality, a subject relatively understudied, especially in sub-Saharan Africa, despite the crucial implications for the socio-economic development, as well as for the health and well-being of young people as they transition into adulthood.

The study findings provide evidence that aligns with key SDG targets related to health and demonstrate the urgent need for targeted health policy interventions if Ghana and similar countries are to achieve the health-related SDGs. The progress indicated by the scenarios demonstrates the potential impact of targeted interventions in reducing youth mortality and contributing to the broader global health agenda outlined in SDG 3. It is however important to consider the intersectionality of these scenarios. For instance, maternal health interventions may also impact infectious disease mortality and vice versa. It is also essential to ensure a focus on equity so that interventions benefit all segments of the population, regardless of socio-economic factors or geographical location. Thus, assessing the impact of healthcare policies, including their implementation and effectiveness is essential in identifying areas for improvement.

This thesis advances knowledge by providing a comprehensive and context-specific analysis of mortality transition among young people in Ghana. Through the examination of the causes of death, the research contributes to an understanding of the unique challenges and risk factors associated with youth mortality, thereby providing a better understanding of the complex

factors influencing their mortality. It also offers practical implications for public health policy and other interventions tailored to the distinct needs of young populations with a specific focus on Ghana.

7.3. Recommendations

Based on the findings from the study, some policy actions are proffered for consideration. They range from healthcare infrastructure to causes of mortality among young males and females in Ghana. The recommendations focus on a multidimensional approach to addressing the cause specific mortality concerns among young people that ultimately may help Ghana inch closer towards achieving the targets under the national development agenda and SDG3.

Disease management

Given the fact that, infectious diseases are still a leading cause of death among young people in Ghana, it is imperative that efforts are made to strengthen infectious disease control, including reinvigorating existing strategies targeting infectious diseases in Ghana. Additionally, efforts should be made to prevent and manage NCDs among the youth. Preventive measure must include health education and promotion to address issues such as sexual health, substance abuse and mental well-being. This will empower the young people with knowledge to make informed health decisions.

Furthermore, considering the increasing trend of injuries and trauma among young people in Ghana, trauma care management needs to be a policy priority in Ghana. Measures to be pursued in this regard include, strengthening trauma response by investing in trauma care facilities in all district hospitals, especially in accident-prone areas. Additionally, Government must ensure road safety measures are implemented. Road safety laws and construction codes must be

strictly enforced and reviewed where necessary to reduce road traffic accidents and the relevant institutions adequately resourced to provide the needed responses.

Global and Regional Collaboration

The challenges identified in the study may benefit from concerted global and regional collaborative policy initiatives that aim to promote youth well-being and reduce premature mortality. For instance, partnerships with international bodies and countries that have made significant strides in healthcare can provide roadmaps, as well as financial and technical support for countries with large youthful populations, such as Ghana, struggling to achieve targets under the SDGs to reduce premature mortality among the youth. It is thus recommended that Ghana advocates for the prioritisation of youth health outcomes within the SDGs and other international frameworks. This would require strengthening collaboration at the sub regional, continental and global levels to ensure policies addressing youth mortality align with broader SDG targets. Such advocacy should focus on prioritising youth health outcomes in international frameworks due to the limited attention it has received compared to the other population groups as well as the implications it has for national development efforts especially in developing countries. Some initiatives under such a collaborative initiative could include injury prevention strategies, sharing of best practices and support for implementing evidence-based interventions focused on young people. Support for data sharing and surveillance related to youth health will also provide timely information on emerging health threats among young populations.

Investment in Youth-Centred Research

The dearth of data on youth morbidity and mortality, especially in Sub–Saharan Africa, points to the need for greater investments in youth centred research. Government should promote research initiatives focused on understanding the health needs and challenges of young people,

whilst at the same time exploring effective interventions and innovative healthcare delivery models that impacts social determinants of youth mortality. The three health and demographic surveillance centres of the country should be supported in the collection, analyses and documentation of epidemiological surveillance data. Similarly, the relevant agencies should utilise the data to facilitate evidence-based policy making and programming which may require capacity building of the agencies and staff.

Integrated healthcare systems

The triple burden of disease often necessitates care that goes beyond specialised treatments for a single ailment. Having an integrated healthcare system allows for a more holistic approach to health care that ensures individuals receive comprehensive care. Young people often face a myriad of interconnected factors that influence their health and well-being and ensuring that they can access quality health care from various specialties, including reproductive health, mental health and preventive care is key to their overall wellbeing. Such a system must incorporate features that make healthcare more accessible and youth-friendly, age-specific and sex-sensitive. It is important to ensure that considerations for confidentiality, non-judgmental attitudes and services that resonate with the unique needs and preferences of young individuals are ensured.

An integrated health systems approach also guarantees seamless coordination among different health service providers, avoiding fragmented care and enhancing overall health outcomes. Such an integrated health system also optimises resource utilisation by avoiding redundancies and ensuring that interventions are tailored to the specific needs of the target group, such as young people. This efficiency is vital for healthcare systems aiming to provide quality care within resource constraints such as Ghana. Countries like Australia, Canada, and Singapore

have implemented integrated care models that have shown positive outcomes in managing complex health challenges among young people. These models emphasise collaboration, information sharing, and a patient-centred approach.

7.4. Future Studies

The thesis sheds light on mortality and life expectancy among young people in Ghana. However, to build upon these findings and work towards more effective interventions, a few areas which this study suffered from may warrant further academic attention in order to provide invaluable insights for policy formulation and implementation. These include the following:

Specific Causes of Death

While the study broadly explores mortality causes, a deeper dive into specific diseases, infections and types of injuries would be instrumental in ensuring targeted interventions are instituted and that limited resources are directed to where they are needed most urgently. For instance, breaking down infectious diseases into malaria, tuberculosis, and HIV and AIDS could result in more focused policy recommendations. In addition, different populations face varying risks under the specific causes of death. Further analysis of each of the specific causes of death will allow a more accurate identification of high-risk populations. For instance, certain infectious diseases may be more prevalent in specific geographic regions, and tailored interventions can be implemented to address these regional disparities. This will allow for a more detailed, nuanced and actionable understanding of mortality factors among young people and elicit the appropriate interventions.

Cultural and Behavioural Factors

Understanding the cultural and behavioural elements influencing health outcomes is essential for comprehensive and effective public health interventions. Social norms, culture and behaviour play pivotal roles in shaping health-related decisions, yet they are frequently overlooked in traditional health studies. Individuals within a community often adhere to established social norms and cultural practices, which influence their dietary habits, physical activity levels and healthcare-seeking behaviours. Cultural practices may shape perceptions of illness and influence whether individuals would seek timely medical attention.

Secondly, the influence of cultural and behavioural elements on risk and mortality extends beyond individual choices to community-level dynamics. Cultural norms can shape communal practices, affecting the prevalence of risk factors within a population. Social norms and cultural beliefs often intersect with structural determinants of health, such as access to healthcare, education, and socioeconomic status. Unfortunately, there is a paucity of data on socio-cultural and behavioural factors and their impact on mortality, especially among young people in Ghana. Ignoring these elements risks perpetuating health disparities and limiting the impact of interventions in diverse and dynamic communities. The results, deaths from accidental drowning and submersion (comprising 13.5%) were reported to be probable causes of deaths among only females in the KHDSS. Likewise, deaths from accidental poisoning and noxious substances (1.7%) were only among males. This could be indicative of some social, cultural or environmental factors, which warrants further interrogation. The relatively high percentage of deaths from venomous plant/animal contacts is worrying, considering that these causes of death can be easily prevented. Further academic studies on mortality and cultural and behavioural elements among young people in Ghana, is thus crucial for a clearer understanding of health outcomes. These studies will provide insights into the intricate interplay between culture,

behaviour and health, offering the foundation for the development of contextually relevant and effective public health strategies.

Lifestyle Factors

Lifestyle-related causes such as substance abuse, risky sexual behaviour and lack of physical activity are underexplored in the thesis due to lack of data. However, these could be significant contributing factors to mortality and deserve detailed investigations. The scarcity of literature addressing lifestyle-related causes, encompassing substance abuse, risky sexual behaviour and lack of physical activity, in the context of young people's health is a notable gap that warrants urgent attention. Despite the profound influence of these lifestyle factors on the well-being and mortality of young individuals, there is a dearth of comprehensive academic studies delving into the specifics of their impact within this demographic group particularly in Sub–Saharan Africa including Ghana. This lack of tailored research results in a limited understanding of the distinct challenges faced by young individuals, hindering the development of targeted preventive strategies. Moreover, the interconnectedness between lifestyle-related causes and broader social issues, such as mental health and educational attainment, is often overlooked in the current literature. However, young people face unique challenges and vulnerabilities that contribute to engaging in these behaviours. Understanding the multifaceted connections between lifestyle choices and broader social determinants is vital for designing interventions that consider the holistic well-being of young individuals.

The dearth of literature on lifestyle-related causes among young people is of particular attention, given their susceptibility to external influences such as peer pressure and their addiction to social media. Bridging this gap is essential for advancing understanding of the specific challenges and influences shaping the health outcomes of young individuals and will

contribute to the development of evidence-based interventions, policies, and practices that promote the well-being and mitigate premature mortality among young people.

7.5. Conclusions

Contrary to the perception that mortality is high among infants, children under five and the elderly, increasing reports of death among young people makes a case for a rethinking of this perception. The relative contribution of the different causes of death to overall youth mortality varies by country, depending on several factors, including the level of development and urbanisation among others.

The objective of this thesis was to explore the causes and patterns of youth mortality in the KDHSS area with particular focus estimating the potential gains in Youth Life Expectancy (YLE). The findings offer substantial insights for public health policy not just in Ghana but also for other regions experiencing similar challenges, particularly in Sub-Saharan Africa. The thesis strongly emphasizes the need for age- and gender-sensitive policy interventions, particularly in addressing the emerging issue of injuries and trauma among young males aged 15-24. This is of immediate policy concern considering the risk-taking behaviours often associated with the youth, particularly males.

The study's broader implications are particularly pertinent in the context of SDG 3, emphasising the need for concerted efforts to enhance youth survival and overall health outcomes. It offers recommendations that address specific health challenges within the dynamic socio-cultural landscape of Ghana, acknowledging Ghana's unique triple burden of disease, encompassing infectious diseases, NCDs and injuries, as well as inadequate health infrastructure. This underscores the necessity for integrated and context-specific healthcare

strategies tailored to the unique challenges faced by young people in Ghana, highlighting the need to give equitable attention to the health and mortality of young people in Ghana.

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APPENDIX

APPENDIX 1

STUDY QUESTIONNAIRE

KINTAMPO HEALTH RESEARCH CENTER KINTAMPO DEMOGRAPHIC SURVEILLANACE SYSTEM ADULT VPM FORM_ENGLISH (29 09 05)	**ADULT VPM Form No.** **(Adult male deaths, aged 12 years and over and women over 50 years)**	FORMNO

Instructions to interviewer: Introduce yourself and explain the purpose of your visit. Ask to speak to the caretaker or any other person who was present during the illness that led to death. If this is not possible, arrange a time to revisit the household when caretaker will be home. Before interviewing the person explain to him/her that participation in the interview is voluntary; s/he can refuse to answer any question and s/he can stop the interview at any time. Explain to him/her that the information provided is only for research purposes and will be confidential

I. IDENTIFICATION & DEMOGRAPHIC DATA OF THE DECEASED

1.1 Name of deceased: _____

1.2 Perm ID of deceased: | | | | | | | | | | | | | P ERMID

1.3 Age of deceased:…… | | | | AOD

1.4 Sex of deceased:…… 1. Male 2. Female SEX

1.5 Compound ID:…….. | | | | | | | COMPID

1.6 Compound Name: _____

1.7 Interviewer Name:…… | | FS

1.8 Date of Interview: (dd/mm/yy) | | | | | | | | | | | | DINT

1.9 What was the marital status of the deceased?

1. Unmarried	2. married	3.Divorced/separated	4. Widowed

MSD

1.10 Highest level of education of deceased:

1. Primary	2. Secondary	3. Tertiary	4. None

HEDUCD

1.11 Occupation of deceased:

1. Farmer	2. Trader	3.Gov't/Priv't comp.Employee
4. Other (specify):		

OCCD

II. IDENTIFICATION OF RESPONDENT

2.1 Name of respondent: _____

2.2 Relationship of respondent to the deceased:

1. Spouse	2. Daughter	3. Son	4. Mother	5. Father
6. Other (specify):				

ROR

2.3 Highest level of education of respondent:

1.Primary	2. Secondary	3. Tertiary	4. None

HEDUC_R

III. BACKGROUND INFORMATION ON THE DEATH

3.1 Date of death (dd/mm/yy): | | | | | | | | | DOD

3.2 For how long was s/he ill before s/he died?.....

1.		DAYS
2.		WEEKS
3.		YEARS

3.3 Where did s/he die ?

1. Hospital	2. Other health facility	3.On route to hospital or health facility
4: Home	5. Other (specify):	

DIEL

IV. OPEN HISTORY QUESTION

4.1Could you tell me about the illness/events that led to her/his death? Prompt: Was there anything else?

Instructions to interviewer - Allow the respondent to tell you about the illness in his or her own words. Do not prompt except for asking whether there was anything else after the respondent finishes. Keep prompting until the respondent says there was nothing else. While recording, underline any unfamiliar terms.

4.2 Summary of signs & symptoms reported by respondent

Symptoms	START (from time of death)	END (from time of death)	Severity Mild/Moderate =1 Severe=2
4.2.1			
4.2.2			
4.2.3			
4.2.4			
4.2.5			
4.2.6			
4.2.7			
4.2.8			
4.2.9			
4.2.10			

4.3 list of hospitalizations (hospital admission) in the past 2 years (begin with more recent hospitalisations in descending order)

Name of Health facility	Date (Month/year)	Reasons for hospitalisation
1.	/ /	
2.	/ /	
3.	/ /	
4.	/ /	
5.	/ /	

4.4 Do you know the cause(s) of his/her death?

1. Yes	2. No	8.NK

RKC

4.5 If the answer is YES probe to specify the cause(s):

Cause
(1)_____
_____

Cause
(2)_____
_____

4.7 Did the deceased suffer from any of the following illness?

Hypertension:	1. Yes	2. No	8. NK	HYP
Other heart diseases	1. Yes	2. No	8. NK	OHEA
Diabetes:	1. Yes	2. No	8. NK	DIAB
Epilepsy:	1. Yes	2. No	8. NK	EPI
TB:	1. Yes	2. No	8. NK	TB
HIV/AIDS:	1. Yes	2. No	8. NK	HIV
Leprosy	1. Yes	2. No	8. NK	LEP
Asthma	1. Yes	2. No	8. NK	ASTH
Cancer	1. Yes	2. No	8. NK	CAN

If yes to cancer, please specify type:	8. NK	9. NA	CANTYP

4.8 Did the deceased suffer from any other illness?

1. Yes	2. No	8. NK	ODIS

If yes, please specify
_____

V. INJURY/ACCIDENTS:

5.1 Did s/he sustain any injury which led to his/her death?	1. Yes	2. No	8. NK	INJ

If the answer is 2, or 8 proceed to Q5.3

5.1.1 *If yes ask* What kind of injury or accident? *Allow respondent to answer spontaneously.*

					TINJ
1. Transport accident (pedestrian)	2. Transport accident (passenger/driver)	3.Fall	4. Drowning	5. Poisoning (specify)	
6. Animal bite	7. Other bites or sting	8. Burn	9. Firearm	10. Sharp object- e.g. knife	11. Circumcision
12. Assault/abuse (specify):		13. Other (specify):		88. NK	99. NA

5.1.2 If answer to 5.1.1 is 6, please specify.	1. Dog	2. Snake	3. Other (specify):	8. NK	9. NA	ANBI

5.1.3 Was the injury accidental or intentional ?.....	1. Accidental	2. Intentional	8. NK	9. NA	INJTY

5.1.4 Did s/he die at the site where the accident or injury occurred?.....	1. Yes	2. No	8. NK	9. NA	DSPOT

5.1.5 How many days did s/he survive before s/he died?	1<24 hours	2.>24 hours	8. NK	9. NA	INJDU

5.1.6 Did s/he receive medical care before death?	1. Yes	2. No	8. NK	9. NA	MDCARE

5.2 Did s/he have an ongoing chronic illness or was sick in the month before the accident or injury?	1. Yes	2. No	8. NK	9. NA	OILL

5.3 Do you think that s/he committed suicide?.....	1. Yes	2. No	8. NK	9 NA	SUI

If the answer is 2, or 8 proceed to VI

5.3.1 How did s/he commit suicide? *Allow respondent to answer spontaneously.*

1. Hanging	2. Poisoning	3. Burns	4.Gunshot	5. Others (specify):	8. NK	9 NA	TSU

Please check: If the deceased died from injury or accident (if 5.1 is yes) skip to section 9

VI: LEADING QUESTIONS TO ELICIT SIGNS & SYMPTOMS OF THE FINAL ILLNESS

6.1 FEVER:

6.1.1 During illness that led to death did s/he have fever? *(If the answer is 2, or 8 proceed to Q 6.2)*	1. Yes	2. No	8. NK	9. NA	FEV
6.1.2 How many days did s/he have fever? ……			888 NK	999. NA	DFE
6.1.3 Was the fever:	1.Mild/moderate	2. Extremely high	8. NK	9. NA	SFE
6.1.4 Was the fever continuous or on and off?	1. Continuous	2. On & Off	8. NK	9. NA	TFE
6.1.5 Did s/he have chills/rigor……	1. Yes	2.No	8. NK	9. NA	RIG

6.2 RASH:

6.2.1 During illness that led to death, did s/he have rash? *If the answer is 2 or 8 proceed to Q6.2.6)*	1. Yes	2. No	8. NK	9. NA	RAS
6.2.2 Where was the rash located? Face	1. Yes	2. No	8. NK	9. NA	RFACE
Trunk	1. Yes	2. No	8. NK	9. NA	RSTRG
Extremities	1. Yes	2. No	8. NK	9. NA	REXTR
All over the body	1. Yes	2. No	8. NK	9. NA	RALLB
Other(specify): _____	1. Yes	2. No	8. NK	9. NA	ROTHE

+……
……

6.2.3 How many days did s/he have rash? ……				888. NK	999. NA	DRA

6.2.4 Did the skin crack/split or peel after the rash started?	1. Yes	2. No	8. NK	9. NA	SKIRAS

6.2.5 What did the rash look like?

1. Measles rash	2. Rash with clear fluid	3. Rash with pus	8. NK	TRA
4. Other (specify):			9. NA	

6.2.6 Did s/he have red eyes?.....	1. Yes	2. No	8. NK	9. NA	SEY
6.2.7 Did s/he have itching of skin?.....	1. Yes	2. No	8. NK	9. NA	ITC
6.2.8 Did s/he have bleeding from the body openings? *Do not include menstruations*.	1. Yes	2. No	8. NK	9. NA	BLEEO
6.2.9 Did s/he have pins and needles in feet?.....	1. Yes	2. No	8. NK	9. NA	PNEEF

6.3 WEIGHT LOSS:

6.3.1 Had s/he lost weight recently before death?	1. Yes	2. No	8. NK	9. NA	LOW

If the answer is 2, or 8 proceed to Q6.4

6.3.2 How long before death ?	1. Days	2. Months	3. Years	8. NK	9. NA	DLOW

6.3.3 Was the loss of weight:……..	1. Mild/Moderate (a little)	2. Severe (a lot)	8. NK	9. NA	SL W

6.3.4 How did s/he look like at the end of her/his life ?	1. Normal	1. Extremely thin and wasted	8. NK	9. NA	HSLW

6.4 PALLOR/JAUNDICE

6.4.1 Did s/he look pale (anaemic)?	1. Yes	2. No	8. NK	9. NA	PAL
6.4.2 Did s/he have yellow discoloration of the eyes?.....	1. Yes	2. No	8. NK	9. NA	JAU

6.5 OEDEMA/SWELLING:

6.5.1 Did s/he have ulcer on any part of the body	1. Yes	2. No	8. NK	9. NA	ULC

6.5.1.1 *If yes to 6.5.1* , please specify where is the ulcer located ?

_____

6.5.2 Had s/he have swelling around ankle?	1. Yes	2. No	8. NK	SAA
6.5.2.1 How many days did s/he have the swelling? ……		888. NK	999. NA	DSAA
6.5.3 Did s/he have puffiness of the face?	1. Yes	2. No	8. NK	PUF
6.5.3.1 *If yes*, ask how many days did the swelling last……		888. NK	999. NA	DPUF
6.5.4 Did s/he have swelling in the neck?	1. Yes	2. No	8. NK	SWN
6.5.4.1 *If yes*, ask how many days did the swelling last……		888. NK	999. NA	DSWN
6.5.5 Did s/he have swelling in the armpit?	1. Yes	2. No	8. NK	SWA
6.5.5.1 *If yes*, ask how many days did the swelling last……		888. NK	999. NA	DSWA
6.5.6 Did s/he have swelling in the groin?	1. Yes	2. No	8. NK	SWG
6.5.6.1 *If yes*, ask how many days did the swelling last?.....		888. NK	999. NA	DSWG
6.5.7 Did s/he have swelling of joints?	1. Yes	2. No	8. NK	SWJ
6.5.7 1 *If yes*, ask how many days did the swelling last?.....		888. NK	999. NA	DSWJ

6.6 COUGH:

6.6.1 Did s/he have cough? *(If the answer is 2, or 8 proceed to Q6.6.6)*	1. Yes	2. No	8. NK	9. NA	COU
6.6.2 How many days did s/he have cough? ……			888. NK	999. NA	DCO
6.6.3 Was the cough productive (sputum)?.....	1. Yes	2. No	8. NK	9. NA	PCO
6.6.4 Did s/he cough blood?.....	1. Yes	2. No	8. NK	9. NA	BCO
6.6.5 When was the cough worse?.....	1.Day	2.Night	3. Same	8. NK / 9. NA	COUW
6.6.6 Did s/he have night sweats?.....	1. Yes	2. No	8. NK	9. NA	NCOU
6.6.7 Did s/he have shortness of breathing?..... *If the answer is 2, or 8 proceed to Q6.7*	1. Yes	2. No	8. NK	9. NA	DIB
6.6.8 How many days did s/he have breathlessness?.....			888. NK	999. NA	DDB
6.6.9 Did s/he have noisy breathing?.....	1. Yes	2. No	8. NK	9. NA	NDDB

6.7 CHEST PAIN:

6.7.1 Did s/he have chest pain?	1. Yes	2. No	8. NK	9. NA	CHP
6.7.1.1 How did the pain start?.....	1. Suddenly	2. Gradually	8. NK	9. NA	HCHP

6.7.2 Where was the pain? *(Please show where the sternum is located)*	Over the sternum	1. Yes	2. No	8. NK / 9. NA	PSTER
	Over the heart/in the arm	1. Yes	2. No	8. NK / 9. NA	PHEAR
	Ribs	1. Yes	2. No	8. NK / 9. NA	PRIBS

Other (specify):	1. Yes	2. No	8. NK	9. NA	POTHE

6.7.3 When resting, was the pain:…….	1. Continuous	2. On & Off	8. NK	9. NA	RPAIN
6.7.4 When in activity, was the pain:……..	1. Continuous	2. On & Off	8. NK	9. NA	APAIN

6.7.5 When s/he had an attack of severe pain, how long did it last?

	1. <30min	2. >30min but <24hours	3. >=24=hours	8. NK	9. NA	DCP

6.7.6 Did s/he have palpitation?.....	1. Yes	2. No	8. NK	9. NA	PALP

6.8 DIARRHOEA:

6.8.1 Did s/he have diarrhoea?	1. Yes	2. No	8. NK	9. NA	DIAR

If the answer is 2, or 8 proceed to Q6.9

6.8.2 How many days did s/he have diarrhoea? ……			888. NK	999. NA	DDI

6.8.3 Was the diarrhoea continuous?.....	1. Yes	2. No	8. NK	9. NA	TDI

6.8.4 What was the consistency of stools?.....	2. Soft	3.Watery	8. NK	9. NA	CSDIA

6.8.5 When the diarrhoea was severe, how many times did s/he pass stool in a day? ……		88. NK	99. NA	FDI

6.8.6 Did s/he pass blood in the stool?.....	1. Yes	2. No	8. NK	9. NA	BTS
6.8.7 Did s/he have sunken eyes?.....	1. Yes	2. No	8. NK	9. NA	SUNK

6.9 VOMITING:

6.9.1 Did s/he have vomiting? *If the answer is 2, or 8 proceed to Q6.10*	1. Yes	2. No	8. NK	9. NA	VOM
6.9.2 How many days did s/he have vomiting? ……			88. NK	99. NA	DVO
6.9.3 When the vomiting was severe, how many times did s/he vomit in a day? ……			88. NK	99. NA	FVO

6.9.4 What did the vomit look like?

1. Watery fluid	2. Yellowish fluid	3. Coffee coloured fluid	4. Blood	CVO
5. Faecal matters	6. Other (specify):		8. NK	9. NA

6.10 ABDOMEN:

6.10.1 Did s/he have abdominal pain? *(If the answer is 2, or 8 proceed to Q6.10.6)*	1. Yes	2. No	8. NK	9. NA	ABP

6.10.2 What type of pain was it?

1. Cramp	2. Dull ache	3. Burning pain	4. Others	8. NK	9. NA	CAP

6.10.3 How many days did s/he have the pain?.....			88. NK	99. NA	DAP

6.10.4 Where exactly was the pain?

1. Lower abdomen	2. Upper abdomen	3. All over the abdomen		SAP
4. Middle abdomen	5. Others (specify):		8. NK	9. NA

6.10.5 What was the severity of the pain?.....

1. Mild/moderate	2. Severe	8. NK	9. NA	TAP

6.10.6 Was s/he unable to pass stool for some days before death?.....

1. Yes	2. No	8. NK	CON

6.11 ABDOMINAL DISTENSION:

6.11.1 Did s/he have distension of abdomen?

1. Yes	2. No	8. NK	9. NA	ABD

If the answer is 2 , or 8 proceed to Q6.12

6.11.2 How many days did s/he have abdominal distension?.....

		88. NK	99. NA	DAD

6.11.3 Did the distension develop rapidly within days or slowly over weeks?

1. Rapid	2. Slow	8. NK	9. NA	TAD

6.12 SWALLOWING:

6.12.1 Did s/he have difficulty/pain on swallowing?

1. Yes	2. No	8. NK	9. NA	DSW

If the answer is 2, or 8 proceed to Q6.13

6.12.2 How many days did s/he have difficulty/pain on swallowing?

		88. NK	99. NA	DDS

6.13 MASS:

6.13.1 Did s/he have any mass in the abdomen?.....

1. Yes	2. No	8. NK	9. NA	ABM

If the answer is 2, or 8 proceed to Q6.14

6.13.2 Where exactly was the mass?

Right upper abdomen	1. Yes	2. No	8. NK	9. NA	RUAB
Left upper abdomen	1. Yes	2. No	8. NK	9. NA	LUAB
Lower abdomen	1. Yes	2. No	8. NK	9. NA	LWAB
Other(specify):	1. Yes	2. No	8. NK	9. NA	OTAB

6.13.3 How long (days) did s/he have the mass …….. *(convert if months or years)*				888. NK	999. NA	DAM

6.14 HEADACHE:

6.14.1 Did s/he have headache?	1. Yes	2. No	8. NK	9. NA	HEA

6.15 STIFF NECK:

6.15.1 Did s/he have neck pain?.....	1. Yes	2. No	8. NK	9. NA	NPN
6.15.2 Did s/he have stiff neck?.....	1. Yes	2. No	8. NK	9. NA	STN

6.15.2.1 *If yes*, for how many days? …….			88. NK	99. NA	DSN

6.16 LEVEL OF CONCIOUSNESS/CNS:

6.16.1 Did s/he experience any change in the level of consciousness?	1. Yes	2. No	8. NK	9. NA	LUC

If 2, or 8 please skip to question 6.17

6.16.2 What was the level of his/her consciousness?

1. Confused	2. Unconscious	3. Other:	8. NK	9. NA	TUC

6.16.3 If confused or unconscious, for how many days?				888. NK	999. NA	DUC

6.16.4 How did it start?

1. Suddenly	2. Rapidly within a day	3. Slowly over few days		FFI1
4. Others (specify):			8. NK	9. NA

6.17 FITS:

6.17.1 Did s/he have fits?	1. Yes	2. No	8. NK	9. NA	FIT

If the answer is 2, or 8 proceed to Q6.18

			888. NK	999. NA

6.17.2 How many days did s/he have fits?……						DFI
6.17.3 When fits were most frequent, how many did s/he have per day?.....			88. NK	99. NA		FFIN
6.17.4 Between fits was s/he:……..	1. Awake	2. Unconscious	8. NK	9. NA		BFA
6.17.5 Did s/he have difficulty in opening the mouth during fits?	1. Able to open	2. Unable to open	8. NK	9. NA		LOC
6.17.6 Did s/he have stiffness of the whole body during fits?.....	1. Yes	2. No	8. NK	9. NA		OPI
6.17.7 How many days did s/he have stiffness?.....			88. NK	99. NA		DSTIF

6.18 PARALYSIS:

6.18.1 Did s/he have paralysis of one side of the body?.....	1. Yes	2. No	8. NK	9. NA		HEM

If the answer is 2, or 8 proceed to Q6.19

6.18.2 How long did the paralysis take to develop?	1. Instantly	2. Over hours	3. Over days		HQUI
	4. Over months	5. Over years	8. NK	9. NA	

6.18.3 How many days did s/he have paralysis?.....				888. NK	999. NA	DHE
6.19 Did s/he have paralysis of lower limbs?.....	1. Yes	2. No	8. NK	9. NA		PAR

If the answer is 2,8 or 9 proceed to Q6.20

6.19.1 How many days did s/he have the paralysis?.....				888. NK	999. NA	DPA

6.20 URINE COLOUR:

6.20.1 Was there any change in the colour of urine?.....	1. Yes	2. No	8. NK	9. NA	BIU

If the answer is 2, or 8 proceed to Q6.21

6.20.2 What was the colour of urine?

1. Dark yellow	2. Coffee like	3. Blood stained	8. NK	9. NA	URC

6.20.3 How many days did s/he have the change in urine?.....				888. NK	999. NA	DBU

6.21 URINE AMOUNT:

6.21.1 Was there any change in the amount of urine s/he passed daily?	1. Yes	2. No	8. NK	9. NA	CQU

If the answer is 2, or 8 proceed to Q6.22

6.21.2 How much urine did s/he pass in a day?

1. Too much	2. Too little	3. No urine at all	8. NK	9. NA	AQU

6.21.3 How many days did s/he have the change in amount of urine?				888 NK	999. NA	DQU

6.22 Did s/he have difficulty or pain in passing urine?.....	1. Yes	2. No	8. NK	DPU

If the answer is 2, or 8 proceed to Q7.1

6.22.1 What type of difficulty did s/he have?

			TDP
1. Unable to pass urine	2. Continuous dribbling of urine		
3. Burning sensation while passing urine	4.Intense pain		
5. Other (specify)	8. NK	9. NA	

7.1 SURGERY/OPERATION:

7.1.1 Did s/he have any operation before death?.....	1. Yes	2. No	8. NK	9. NA	HOP

If the answer is 2, or 8 proceed to Q8.0

7.1.2 How many days before death did s/he have the operation?				888. NK	999. NA

OPD

7.1.3 If yes ask for the site of operation…….	1. Abdomen	2. Heart	3.Head	4. other:	8. NK	9. NA

SSITE

NOTE: **If the deceased is a female and >50 years old proceed to Q 8.22**
If the deceased is a male, proceed to Q9

8.0: PREGNANCY/DELIVERY

8.1 Was she pregnant at the time of death?.....	1. Yes	2. No	8. NK	9. NA	PRE

8.2 How many months was she pregnant? …….		88. NK	99. NA	MPR

If not pregnant at time of death, please ask:

8.3 Did she deliver within 42 days (6 weeks) before death?.....	1. Yes	2. No	8. NK	9. NA	DEL

If the answer is 2, or 8 proceed to Q8.15

8.4 How many days before her death, did she deliver? ……..		88. NK	99. NA	EDD

8.5 Did she have high fever during the pregnancy or after delivery (within a days/weeks before she died)……	1. Yes	2. No	8. NK	9. NA	FPR

8.6 Where did she deliver?.....	1. Hospital	2. Other health facility	3.On route to hospital or health facility	DELIV
	4. Home	5. Other (specify):	8. NK	9. NA

8.7 Who managed the delivery when the child was born?	1.Health professional (Doctor, midwife, nurse)		2. Traditional birth attendant			WMAD
	3. Relatives	4. Mother alone	5.Other (specify):	8. NK	9. NA	
8.8 Did she have obstructed labour?.....	1. Yes	2. No	8. NK	9. NA		OBS
8.9 How long was she in labour?.....	1. <24hours	2. >=24hours	8. NK	9. NA		DDE
8.10 Did she have difficulty in delivering placenta?.....	1.Yes	2. No	8. NK	9. NA		DDDE
8.11 Did she have too much bleeding before the baby was born?……	1. Yes	2. No	8. NK	9. NA		BBEF
8.12 Did she have too much bleeding after the baby was born?.....	1. Yes	2. No	8. NK	9. NA		BAFT

8.13 What was the mode of delivery?

1.Vaginal delivery	2. Vacuum or forceps	3. Abdominal Operation	8. NK	9. NA	MDE

8.14 Was baby born alive?.....

1. Alive	2. Stillborn	8. NK	9. NA	BALV

8.14.1 If baby born alive, ask how is the baby now?.....	1. Died before 7 days	2. Died after 7 days		HBABY
	Healthy	Unhealthy	8. NK	9. NA

8.15 Did she have an abortion before her death?.....	1. Yes	2. No	8. NK	ABOR

If response is 2 or 8 skip to Q 8.20

8.16 How many days before her death, did she have an abortion?.....			88. NK	99. NA	DABO
8.17 Did she have heavy bleeding after the abortion?.....	1. Yes	2. No	8. NK	9. NA	BLAB
8.18 Did she have high fever after the abortion?.....	1. Yes	2. No	8. NK	9. NA	FABO

8.19 Was the abortion induced?.....	1. Yes	2. No	8. NK	9. NA	INAB
8.20 Did she have seizures shortly before she died?.....	1. Yes	2. No	8. NK	9. NA	SEIZ
8.21 Did she have any previous complicated delivery?.....	1. Yes	2. No	8. NK	9. NA	PCD
8.22 Did she have any swelling or ulcer in the breast?.....	1. Yes	2. No	8. NK	9. NA	BTU

9.0 LIFE STYLE
9.1 ALCOHOL ABUSE

9.1.1 Did the deceased ever drink alcohol? ……	1. Yes	2.No	8. NK	ALC

If response is 2 or 8 skip to Q 9.2

9.1.2 If yes how long had s/he been drinking alcohol? ……..	1.Less than a year	2. 1-5 years	3. 6-10 years.		ALCD
	4.11-15 years	5. >15 years	8. NK	9. NA	

9.1.3 How often did he/she drink alcohol? ……..	1.Daily	2. Weekly	3.Fortnightly		ALCOF
	4. Once in a while		8. NK	9. NA	

9.1.4 How often did he/she get drunk? ……..	1.Daily	2. Weekly	3.Fortnightly	ALCDK
	4. Once in a while	8. NK	9. NA	

9.1.5 Which kind of alcohol did the deceased consume?

Beer	1. Yes	2.No	8. NK	9. NA	BEER
Spirits	1. Yes	2.No	8. NK	9. NA	SPIR
Wines	1. Yes	2.No	8. NK	9. NA	WINE
Traditional brews	1. Yes	2.No	8. NK	9. NA	TBRW

Traditional illicit brews specify:_____	1. Yes	2.No	8. NK	9. NA	TIBRW
Others (specify): _____	1. Yes	2.No	8. NK	9. NA	OTDK

9.1.6 What was the source of the alcohol s/he drank?

Bar	1. Yes	2.No	8. NK	9. NA	BAR
Brewed it himself/herself home	1. Yes	2.No	8. NK	9. NA	HOM
Friends and/or relatives brews	1. Yes	2.No	8. NK	9. NA	FRIE
Local traditional brewer	1. Yes	2.No	8. NK	9. NA	LTRA
Others (specify) _____	1. Yes	2.No	8. NK	9. NA	OTSO

9.1.7 Was the deceased ever in trouble as a result of drinking alcohol?	1. Yes	2.No	8. NK	9. NA	ALCTR

9.1. 8 If yes, what kind of trouble was s/he in

Trouble with the law	1. Yes	2.No	8. NK	9. NA	TLAW
Violence (domestic rape etc?)	1. Yes	2.No	8. NK	9. NA	VIOL
Got ill (type of illness)	1. Yes	2.No	8. NK	9. NA	ILL
Neglect of responsibility (family break-ups, job loss etc	1. Yes	2.No	8. NK	9. NA	NRES
Other specify _____ ___	1. Yes	2.No	8. NK	9. NA	TOTH

9.2. CIGARETTE SMOKING

9.2.1 Did the deceased ever smoke tobacco? ……..	1. Yes	2.No	8. NK	SMOK

If response is 2 or 8 skip to Q 9.3

9.2.2 If yes how long had s/he been smoking?	1.Less than a year	2. 1-5 years	3. 6-10 years.	DSMOK

4. 11-15 years	5. >15 years	8. NK	9. NA

9.2.3 How often did he/she smoke?

1.Chain-smoked	2. Hourly	3.Daily	4. Weekly	SMOKOF
5. Fortnightly	6. Once in a while	8. NK	9. NA	

9.2.4 How much tobacco did s/he smoke per day ……

1.Less that 5 sticks	2. Less than 1 packet	3. 2-5 packets		NSMOK
4. More than 5 packets	5. Other (specify)	8. NK	9. NA	

9.2.5 Which type of tobacco did the deceased consume?

Filtered cigarette	1. Yes	2.No	8. NK	9. NA	FILC
Unfiltered cigarette	1. Yes	2.No	8. NK	9. NA	UFIL
Pipe	1. Yes	2.No	8. NK	9. NA	PIPE
Cigar	1. Yes	2.No	8. NK	9. NA	CIGA
Others (specify) _____ ___	1. Yes	2.No	8. NK	9. NA	OTTA

9.2.6 What was the source of the tobacco s/he smoked?

Bar	1. Yes	2.No	8. NK	9. NA	CBAR
Local retailer	1. Yes	2.No	8. NK	9. NA	CLOC
Home made pipe	1. Yes	2.No	8. NK	9. NA	HPIP
Friends and or /relatives	1. Yes	2.No	8. NK	9. NA	CFRI
Others (specify) _____	1. Yes	2.No	8. NK	9. NA	COTH

9.3. DRUG ABUSE

9.3.1 Did the deceased ever use drugs? ……	1. Yes	2.No	8. NK	UDRG

If response is 2 or 8 skip to Q 10.0

9.3.2 If yes how long had s/he been using drugs?	1.Less than a year	2. 1-5 years	3.6-10 years.	DDRG
	4. 11-15 years	5. >15 years	8. NK	9. NA

9.3.3 How often did he/she get high? ……	1.Daily	2. Weekly	3.Fortnightly		DRGOF
	4. Monthly	5. Once in a while	8. NK	9. NA	

9.3.4. Which type of drugs did the deceased consume?.....

Heroine	1. Yes	2.No	8. NK	9. NA	HER
Cocaine	1. Yes	2.No	8. NK	9. NA	COC
Ecstasy	1. Yes	2.No	8. NK	9. NA	ECS
Marijuana	1. Yes	2.No	8. NK	9. NA	MAR
LST	1. Yes	2.No	8. NK	9. NA	LST
Prescription drugs*	1. Yes	2.No	8. NK	9. NA	PDG
Anabolic steroids	1. Yes	2.No	8. NK	9. NA	ANA
Inhalants	1. Yes	2.No	8. NK	9. NA	INH
Others (specify)** _____	1. Yes	2.No	8. NK	9. NA	OTD

*Specify (e.g amphetamines, hallucinogens, diazepam, phethidine, etc)……

** Specify (eg glue, correction fluid, paint thinner, etc)……

9.3.5 Was the deceased ever in trouble as a result of taking drugs?	1. Yes	2.No	8. NK	9. NA	DRGTR

9.3.6 If yes what kind of trouble was s/he in?.....

Trouble with the law	1. Yes	2.No	8. NK	9. NA	TLAWD
Violence (domestic rape etc?)	1. Yes	2.No	8. NK	9. NA	VIOLD
Got ill (type of illness)	1. Yes	2.No	8. NK	9. NA	ILLD
Neglect of responsibility (family break-ups, job loss etc	1. Yes	2.No	8. NK	9. NA	NRESD

Other specify _____	1. Yes	2.No	8. NK	9. NA	TOTHD

10.0: TREATMENT AND RECORDS

10.1 Treatment

10.1.1 Did s/he receive any drug during the illness?.....	1. Yes	2.No	8. NK	TREAT
10.1.2 Did s/he receive any antibiotics during the illness?.....	1. Yes	2.No	8. NK	ANTIB
10.1.3. Did s/he receive any anti-malarial drug during the illness?.....	1. Yes	2.No	8. NK	ANTIM

10.1.4 Which anti-malarial drug did s/he receive?.....	1.Choroquine	2.Fansidar	3.Quinine	
	4.Other	8. NK	9. NA	ANTIM_T

11. Interviewer's comments and observations

_____

_____

_____

Certify correct on:							**By:**		**CCB**