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TITLE

LEVELS AND FACTORS ASSOCIATED WITH HOMICIE-RELATED DEATHS IN A RURAL SOUTH AFRICAN POPULATION

A research report submitted to the School of Public Health, University of the Witwatersrand, Johannesburg, for the partial fulfillment of the requirements for the degree of Master of Science in Medicine in [Population Based Field Epidemiology].

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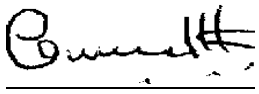
DECLARATION

I, George Omondi Otieno, hereby declare that this report is the result of my own independent work. It is being submitted for the degree of Master of Science in Medicine in the field of Population Based Field Epidemiology at the University of the Witwatersrand, Johannesburg. This work has not been previously submitted in substance for any degree, and is not being concurrently submitted in candidature for any degree.

Signature: 

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25th day of October, 2010

DEDICATION

I dedicate this research report to my beloved wife Millicent Akeyo, the rock of my family. Thank you for your constant prayers, patience, support, encouragements and understanding. Special thanks for upholding the family in my absentia. You are a constant inspiration to me.

ABSTRACT

Background: World Health Organization **(**WHO) estimates that more than 1.6 million people die every year because of violence and out of these deaths, homicide accounts for almost one third. Ninety percent (90%) of homicide are thought to occur in low and middle income countries. South Africa has one of the most disturbing rates of homicide in the world. These high homicide rates besides resulting in reduced life expectancy also have serious health, social and economic consequences.

Aim: The study aimed at quantifying the burden as well as and identifying factors associated with homicide deaths in rural KwaZulu-Natal in South Africa during the period of 2000 to 2008.

Objectives: To estimate a 9 year period (2000-2008) homicide incidence rates as well as identify factors associated with homicide-related deaths. Further, the analysis described spatial distribution of homicide-related deaths in a rural South African population.

Design: Analytical longitudinal study.

Methods: Using data drawn from the Verbal Autopsies (VAs) conducted on all deaths recorded during annual demographic and health surveillance over a 9-year period (2000-2008), Kaplan-Meier (K-M) survival estimates of incidence rates were used to estimate the cumulative probability of death until the end of the period. Estimates were reported by sex and residency. Weibull regression methods were used to investigate factor associated with homicide deaths. Kulldorff spatial scan statistics was used to describe homicide clustering.

Results: With 536 homicide-related deaths, and 814, 715 total Person Years of contribution, the study found an overall incidence rate of 66 (95% CI= (60, 72) per 100, 000 Person Years of

Observation (PYOs) for the period studied. Death due to firearm was reported the leading cause of mortality (65%). Most deaths occurred over the weekends (43%), followed by Friday (16.2%).The highest homicide incidence rates were recorded in 2001 (90; 95% CI= (71, 111) per 100,000 person years at risk and 2004 (86; 95% CI= (68, 108) per 100,000 person years at risk. Males had a rate that was about six times more than females 115 (95% CI=105,127) per 100,000 PYOs. Age-specific homicide rate were highest among males aged 25-29 years (209.90 per 100,000 PYOs) and females aged 50-54 years (78 per 100,000 PYOs). Resident, age, sex, education, socioeconomic status, and employment independently predicted homicide risk. The study identified two geographical clusters with significantly elevated homicide risk.

Conclusion: A significant six fold difference in homicide rate existed between males and females. Sex differential increases with age, with males aged 15-54 years the most likely to be killed, and females aged 55 years and above having the highest homicide rate. Increase in wealth status and level of education increases one's risk of homicide. Employment per se was protective from homicide risk. Firearm was the leading cause of mortality. Most deaths occur over the weekend. Two geographical areas with elevated homicide risk were observed. These findings underscore the need to have timely information and strategies for effective violence prevention program to subgroups and areas at risk.

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DFINITION OF TERMS

Hazard ratio (HR): Broadly equivalent to relative risk (RR). Risk at time (t) divided by risk at baseline. Hazard ratio of one means that there is no difference in survival between the two groups, whereas hazard ratio of greater than one means that survival was better in one of the groups.

Households: This refers to the social groups to which people belong and consists, in most cases, of the family group and any other people who live closely with the family.

Head of the household: Is the household member considered by other household members to be their head. It is usually, but not always, a senior male member of the household

Individuals: This refers to the individual members of the household. These people are the subject of greatest interest and together they make up the population that is studied by the Africa Centre Demographic Information System (ACDIS) project.

Demographic Surveillance System: This is a set of field and computing operations to handle the longitudinal follow-up of well-defined entities or primary subjects (individuals, households, and residential units) and all related demographic and health outcomes within a clearly circumscribed geographic area (INDEPTH Network).

Resident: These are full members of the DSS at all times

Non-resident: Non-membership following a resident episode or non-membership episode prior to any residency

Verbal Autopsy (VA): A technique used for collecting information on cause-specific mortality where the medical certification of death is incomplete.

Wealth Index: Proxy measure of the wealth of households which is based on household characteristics and ownership of assets.

Incidence Rate (IR): Also called incidence density. Incidence rate, like the incidence risk measures the number of new cases per population in a given time period; however it relates the number of new cases to the total person-time at risk.

External cause of death: Refers to any mechanism, circumstance or event that preceded deaths, e.g. firearm, stabbing

SaTScan: Free software developed by Martin Kulldorff (Harvard Medical School) for the spatial and space-time analysis.

ACRONYMS AND ABBREVIATIONS

ACDIS	Africa Centre Demographic Information System
KZN	KwaZulu-Natal
ACDHS	Africa Centre Demographic and Health Survey
DSA:	Demographic Surveillance Area
DSS:	Demographic Surveillance System
CDC	Centre for Disease Control and Prevention
HR	Hazard Ratio
INDEPTH	International Network for Continuous Demographic Evaluation of Populations and their impact on Health in Developing Countries.
PCA	Principal Component Analysis

PYO	Person Years of observation
SES	Socio-Economic Status
WHO:	World Health Organization
VA:	Verbal Autopsy
NIMSS:	National Injury Mortality Surveillance System.
SAPS:	South African Police Service
ANC:	Africa National Congress
IFP	Inkatha Freedom Party
CSVR	Centre for the Study of Violence and Reconciliation
GIS	Geographical Information System
VTS	Vertical Transmission Study
ICD-10	International Classification of Diseases
SA-MRC	South African Medical Research Council
KEMRI	Kenya Medical Research Institute

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CHAPTER ONE: INTRODUCTION AND LITERATURE REVIEW

This chapter presents background information, rationale for the study and a framework for the understanding of the epidemiology of homicide-related deaths.

1.0 INTRODUCTION

Violence involves an act intended to cause destruction, pain or suffering to oneself or others. World Health Organization (WHO) defines violence as: The intentional use of physical force or power, threatened or actual, against oneself, another person, or against a group or community that either results in or has a high likelihood of resulting in injury, death, psychological harm, maldevelopment or deprivation[1]. Globally, violence has become one of the leading public health issues[2]. No country or community is untouched by violence, with over 1.6 million people worldwide losing their lives to violence every year[3]. Violence is among the leading causes of death for people aged 15-44 years worldwide, accounting for 14% of deaths among males and 7% of deaths among females[4]. Virtually everybody suffers violence, and it takes many forms including physical, sexual and psychological [5.] Homicide is an extreme form of violence, and it remains a significant problem within all communities and nations[6]. National and International definition of homicide vary from society to society. The definition may or may not include assaults leading to death, infanticide, assisted suicide or euthanasia. Homicide-related violence accounts for a significant proportion of non-natural deaths, and contributes a lot to loss of years of expected life[7].

The 2002 world report on violence and health, published by the World Health Organization (WHO, Geneva) lists South Africa among the top ten homicidal countries with a 2003 rate of 51 per 100,000 population [1].

With over 45 million people, and a population already burdened by high HIV/AIDS related deaths ; violence is the second leading cause of premature death in South Africa, and homicide accounts for 56% of fatal injuries among individuals aged 15-34 [8;9]. It is believed that a culture of violence grew up in South Africa during the apartheid era and especially after the infamous Soweto uprising of 1976 when young people turned away from education to fight apartheid instead[10]. Government figures released at the end of 1995 reported that a serious crime was committed every 17 seconds, over 50 people were murdered every day and a robbery was reported every six minutes, earning South Africa the reputation of being the most dangerous in the world outside war zone[11].

KwaZulu-Natal, the largest province in South Africa is struggling with the ravaging effects of HIV/AIDS epidemic and continues to experience some of the worst form of violence[12]. Most of the violence in Kwazulu-Natal is thought to be politically instigated and usually occur during election time [13;12] Anthea Jeffery, in his book The Natal Story: Sixteen years of conflict (1997), unravels some of the major causes of violence in Natal. According to Anthea, KwaZulu-Natal is home to the Inkatha Freedom Party (IFP) which controls the provincial government. Attempts by any other political party, and especially the ANC to gain foothold has resulted in open war between political parties[12]. The province has witnessed some of the most cruel massacres and assassinations, such as the infamous Nongoma massacre (1995), Richmond killings (1997-1998) and the Shobashobane massacre as revealed by Rupert Taylor who is a lecturer at the department of political studies University of the Witwatersrand[13].

While the seriousness of homicide is well recognized, its determinants are not well understood. Conducting research to uncover the level, causes and correlates is pertinent in its prevention.

The analysis sought to understand the epidemiology of homicide and document subgroups and geographical areas of high risk which could then be useful in determining preventive strategies.

1.1 Problem Statement

Fifteen years after the end of apartheid, South Africa continuous to experience high levels of violence which testifies that it is still not conflict-free[10]. Post apartheid South Africa has become a violent and dangerous place and its people imperiled by some of the highest murder, rape, and HIV infection rates in the world[14]. National Injury Mortality Surveillance System (NIMSS) figures released in 2005 indicated the homicide rate was 72.5 per 100,000 populations, about five times the world average rate of 14 per 100,000 populations. Although violence on the street has earned South Africa a reputation as "crime capital of the world," the South African homes too provide little refuge[15]. Cases of homicide in South Africa remain disturbingly high, exerting a heavy toll on lives and constituting one of the most significant public health crises.

1.2 Justification for the study

Homicide is the worst form of violence, and despite its extreme negative consequences, it is also one of the least studied and most poorly understood form of violence. It is estimated that; every year, more than 1.6 million people die because of violence. Of these deaths, homicide accounts for almost one-third with *90%* occurring in low and middle income countries[16].Homicide-related deaths provide an indication of the extent of lethal violence in a particular community or country. Therefore an exceptionally high level of violent deaths sets South Africa apart internationally. Research leading to a more thorough understanding of the factors associated with different forms of homicidal violence could have both basic and applied implications towards developing effective solutions for preventing homicide.

1.3 Literature review

In 1996, the World Health Assembly declared violence a major public health issue with WHO sounding the alarm by releasing the first World Report on Violence and Health, and launching a Global Campaign on Violence Prevention[17]. WHO estimates that close to 4 400 people die every day because of intentional acts of self-directed, interpersonal, or collective violence [18]. Recent estimates shows that homicide, the most extreme form of violence is among the leading cause of death worldwide[2;19], and affects all populations, regardless of age, sex, income, or geographic region. In 1990, there were an estimated 563,000 homicides worldwide. Overall homicide rates ranged from 1.0 per 100,000 in established market economies to 44.8 per 100,000 in sub-Saharan Africa with peaks among males aged 15-24 years old, and among females aged 0-4 years old[20].

Levels of Homicide

The prevention of violence, according to public health approach, begins with the estimation of magnitude and impact of the problem[21].

The seventh United Nations Surveys of crime trends over 16-years period (1920-2000) reported a global homicide rate of 10 per 100,000 inhabitants[22], whereas WHO estimated the global homicide rate in the late 1990s to be 8.8 per 100,000 populations[21]. The United Nations Survey further suggests that majority of European Union member and accession states (with exception of Estonia, Latvia and Lithuania) fall below the global average, and the most prominent exception among the developed countries is the United States which falls above the global average (10 per 100,000 populations). The survey revealed that homicide rates tend to be higher in developing countries and, in particular in middle-income and developing countries that have experienced either sustained periods of civil conflicts or political transitions, such Colombia, The

Russian Federation and South Africa. Geneva Declaration on Armed Violence and Development estimated that there were approximately 490,000 intentional homicides worldwide in 2004. The study done by WHO in 2004 estimated that the global rate was 7.6 intentional homicides per 100,000 populations for [23]. An estimated 50,000 people die annually in the United States of America as a result of violence related injuries, and homicide is the second leading cause of death for persons aged 25-34 years, and the third leading cause of death for persons aged 35-44 years, and the fourth for persons aged 1-14 years[24]. Recent statistics show that homicide in America is disproportionately higher among African American communities, with Philadelphia having the highest murder rate among the cities. Eric Schneider argues that in 2006, an African American male in North Philadelphia had a better chance of dying from violence than did a U.S. soldier in Iraq[25].

Homicide rates vary considerably by region, ranging from 0.9 per 100 000 populations in the high-income countries of Europe and parts of Asia and the Pacific, to 17.6 per 100 000 in Africa and 36.4 per 100 000 in Latin America[19]. Estimates show that about 63 000 people die annually in the European Union (EU) from intentional injury, but there is wide variation in mortality from intentional injury across the EU[26]. Research indicates that relatively low rates of youth homicide are found in most of Western Europe while high rates are found in some south-eastern European countries[26].

According to Mark et al, the available data for sub-Saharan Africa shows comparative high levels of homicide: between 17 to 20 incidents per 100,000 inhabitants. Although there is no clear overall trend, but there does appear to be steady decline from the mid-1990s onwards[22].

A United Nation survey of 69 countries in 1998 on external cause of death revealed South Africa to be second only to Columbia in having one of the highest firearm-related homicide deaths worldwide[27]. In 2007-2008, South Africa Police Service (SAPS) recorded 18 487 homicides at a rate of 38·6 per 100 000 population—a fall of 42% since 1994, when the rate was 66·9 per 100 000 population[28]. The great majority of these deaths were men with a rate of 113 per 100, 000 which was eight times the global rate (8.2 per 100,000). In 2002 the homicide rate for the entire population was 48 per 100,000 populations. In comparison; Russia's murder rate was 21 per 100,000, Brazil was 19, the USA had a rate of 5.6, and most of Europe was under four homicides per 100,000 people.

South African National Burden of Disease Study 2000 indicated that injury mortality rates are particularly high in the Western Cape, Gauteng and Mpumalanga provinces, with males having higher rates than females[29].

A demographic study of homicide–suicide in the Pretoria region over a 5 year period by Shirley et al found that the annual incidence of homicide–suicide events in the Pretoria region ranged between 0.8 per 100,000 to 1.3 per 100,000 of the total population, with an average annual incidence of 1 per 100,000 over the period studied[30].

A cross-sectional study to examine the incidence and patterns of intimate femicide-suicide in South Africa and to describe the factors associated with an increase in the risk of suicide after intimate femicide found out that South Africa has a rate of intimate femicide-suicide that exceeds reported rates for other countries[31;32]. The study also highlighted the public health impact of legal gun ownership in cases of intimate femicide. Surprisingly, empirical evidence reveals that at least half of female victims were killed by their male intimate partners[33].

Socio-Economic Correlates of homicide

Previous studies have consistently found that poverty is a major economic source of homicide[34-36].

Research on the causes of homicide has focused on two competing theoretical models, one stressing the importance of socioeconomic condition[37], and the other emphasizing the existence of subculture of violence[38].

Messner designed his research to focus on the violence-inducing consequences of poverty, and addressed the question: Is homicide rate "better predicted by measures of poverty corresponding to the relative approach or by measures reflecting the subsistence approach?" The primary objective of the study was to estimate the effect of income inequality and poverty on the homicide rate. His analysis yielded no significant effect of income inequality, but a surprising negative effect of poverty on homicide rate was found[37-39]. The study recommended a serious consideration of the linkages between poverty, inequality, and homicide rate.

On the other hand, Blau derived hypothesis from a micro sociological theory of social structure [40], asserting that inequality is the primary economic source of criminal violence. Blau's and Messner's arguments emphasize the socially disorganizing consequences of inequality, especially racial economic inequality in a democratic society. Such inequality, they contend, will increase the likelihood of disrupted social relations, thus increasing the likelihood of "nonrealistic conflict" (e.g., violent crime like homicide). The two studies have been corroborated by micro analysis indicating that homicide offenders are disproportionally drawn from the ranks of the poor [41].

William Alex Pridemore from Indiana University Department of Criminal Justice took advantage of the unique natural experiment of the collapse of the Soviet Union to examine the association between socioeconomic change and homicide. Attempts by the Russian government in the early 1990s to launch a program of privatization which was meant to convert the command economy to a free market, resulted in severe economic instability and uncertainty, thus leading to massive poverty, and consequently played a role in ensuring problems like interpersonal violence[35]. He measured the negative effects of socioeconomic change by creating an index of changes in population size, unemployment, privatization, and foreign investment. The findings indicated that between 1991 and 2000 regions that strongly experienced the negative effects of socioeconomic change were regions where homicide rates increased the most. Further analysis of the individual components of this index revealed that regions with greater increases in unemployment experienced greater increases in homicide rates[42;43]. However, Eric Schneider had a different view with regard to poverty and homicide rate; whereas he concurred with William that poverty is associated with homicide, he however argued that the association is not direct[25]. According to Eric, Unemployment, for example, has no demonstrable effect on homicide rates, and poor communities do not necessarily have high homicide rates. Homicide dropped most dramatically during the Great Depression; perhaps because everyone was in dire straits, this was true as well during economic panics in the nineteenth century and during the collapse of Soviet Union

In the twentieth century, homicide had been concentrated geographically in poor urban communities, perhaps because enduring poverty in a country of plenty is more galling than the temporary shared misery of economic downturns, argued Eric[25].

The root cause of violence in South Africa has not changed much since the apartheid era, and according to the Johannesburg-based Centre for the Study of Violence and Reconciliation (CSVR), South Africa's current high rate of violent crime is related to economic and social marginalization as it was during the 1980s. Before independence , rural poverty generated massive migration to urban centers and since migration was contrary to the official policy, housing, infrastructures and services were not provided to black South Africans living in urban townships; grinding poverty, massive unemployment and scarcity of even basic resources led to criminal activities.

A detailed analysis of the relation between socio-economic inequalities and violence, based on survey data from 63 countries, shows that income inequality (measured by the Gini coefficient), low economic development, and high levels of gender inequity are strong positive predictors of rates of violence, including homicides and major assaults[44;45] According to Coovadia et al, poverty and inequality are crucial dynamics that have contributed to South Africa's burden of violent injury deaths. They described how apartheid and colonial policies were used to generate great wealth for small racial elite while most of the population lived in abject poverty[46]. Redistribution of wealth has nominally been national policy since 1994, but income inequality has grown. South Africa had the worst income inequality and the highest rate of homicide of the 63 countries studied. After income inequality, unemployment, in particular male youth unemployment (as in the case of South Africa), was the most consistent correlate of homicides and major assaults[47].

Doolan et al (2007) study of experience of violence and socioeconomic position in South Africa identified some disparities across the socioeconomic structure with respect to violent outcomes. The study found that with respect to socioeconomic position, employment and education were

risk factors for violent deaths at the individual level, whereas having wealth was protective against violence at the household level (OR: 0.32; 95% CI: 0.12-0.89)[9].

Homicide by Age and Gender

Homicide, like any other health problem in the world, is not distributed evenly among sex or age groups. As far as WHO is concerned, the highest rate of homicide in the world is found among males aged 15-25 years (19.4 per 100 000 population), followed closely by males aged 30–44 years (18.7 per 100 000 population)[19].

Empirical evidence has shown that youth homicide rates increased between 1985 to1994, especially among youths in the 10–24-year-old age group[19;35;48]

WHO Global Burden of Disease Project for 2000 estimated that 199, 000 youth homicides (9.2 per 100 000 population) occurred globally[49]. An average of 565 children, adolescents and young adults between the ages of 10 and 29 years die each day as a result of interpersonal violence. Males accounted for 77% of all homicide cases and had rates that were more than three times those of females (13.6 and 4.0, respectively, per 100 000 population)[50].

In the same year, South Africa recorded 654 homicides of children younger than 5 years, representing an estimated 0·6% of all child deaths for that year globally[49;45]. Homicide rates for such children were estimated at 14 per 100 000 for boys and 11·7 per 100 000 for girls, which is more than double the corresponding rates in low-income (6·1) and other middle-income (5·1) countries[28]. In 1999, South Africa recorded 3 797 homicides deaths of women, giving an overall homicide rate (24.7 per 100 000) that was six times higher than the rate worldwide (4.0 per 100000)[33].

Homicide involving young people is the most visible form of violence in society and harms not only the victims, but friends, families, and community as a whole. Youth homicide contribute greatly to the global burden of premature deaths[51;52]. Almost everywhere, youth homicide rates are substantially lower among females than males, suggesting that being a male is a stronger demographic risk factor. The ratio of male to female homicide rate tends to be higher in those countries with higher male homicide rates[53].

A distinct feature of violence in South Africa is the disproportionate number of young men as victims and perpetrators of homicide[28]. The highest victimization rate are seen in men aged 15-29 years (184 per 10000)[28], and in some areas like Cape Town's townships, the rates were more than twice this number. Deaths of men from homicide outnumber those of women by more than five (7:1), and the highest age-specific mortality rates for murder by an intimate partner are for women aged 14–44 years[54].

South Africa is still not left out in terms of gendered homicide. Although there are limited studies on female strangulation, there are few studies that have reported sporadic cases of female strangulation. A register-based cross sectional investigation of female homicidal strangulation, as reported in the National Injury Mortality Surveillance System for the four cities (Cape Town, Johannesburg, Pretoria and Durban) found out that the rate ranges from 1.71/100 000 to 0.70/100 000 for the period 2001 to 2005[55]. The study found that most strangulation occurred from the early morning hours and across typical working hours.

Drug and Alcohol Use

Heavy alcohol use has also been found to elevate the risk of murder[56;57]. In 2002, Brazil had one of the world's highest homicide rates, nearly four times higher than that for United States, and in the same year, it accounted for an estimated 28% of all homicide that occurred in America, a region that has the highest homicide rate[58]. This high rate of homicide was explained by illegal drug and firearm trafficking[59]. In the United States of America, drug trafficking is associated with increased mortality, accounting for one third of homicide-related deaths[60].

On the other hand South Africa has one of the highest alcohol consumptions in the world per head for all individuals who drink alcohol[61]. A retrospective mortuary-based study of female homicides ages 14 years and older in Western Cape Province of South Africa in 1999, showed that a raised median blood alcohol concentration at the time of death was positively associated with being killed in a rural setting[62].

Spatial Distribution of Homicide

Geographical Information System (GIS) is a computerized system for input, storage, management, and analysis of data that can be precisely linked to a geographical location. Over the past decade, GIS has achieved remarkable recognition as a useful tool for making strategic decisions whenever data is found to have a spatial distribution[63]. In the US for example, federal, state, and local governments continue to use GIS for assessment and planning in such areas as housing, land use, natural resources, and environmental monitoring[64;65]. Companies are using it to expand and consolidate existing businesses, and perform market analysis. It has also been used to illustrates spatial distribution of diseases and wildlife[66-68]. The ability to model the spatial

distribution and change in the distribution of variables or phenomenon is of considerable importance in the field of research, yet this has received little attention from epidemiologists and statisticians.

Homicide prevention depends fundamentally on identifying factors related to excess homicide in population groups. Spatial method allows the identification of geographical areas where homicides may be concentrated, which populations should receive special attention in planning measures to prevent violent deaths. Sevgi et al (2005) argue that most risks and health-promoting behaviors are not distributed uniformly across population, but tend to cluster in specific communities[69;70].

In South Africa spatial distribution modeling has been done exhaustively in cases of forestry, pathogens, and diseases[71;72]. The spatial recording of crime incident locations was only conducted by South Africa Police Service in 2001[73]. Once spatial distribution can be adequately modeled, then distribution and abundance can be monitored efficiently over time, and future changes can be predicted.

Homicide by Mechanism/ External cause

An epidemiologic assessment of violent deaths indicates that firearms are the most commonly used weapons to commit homicide[27;74;75]. Gun control has been shown to be effective in reducing the homicide rate[76]. Both legal and illegal firearms contribute to high homicide rates. In the United States for example, all firearms enter the public marketplace through a federal licensee; a store or individual licensed by the government to sell firearms. Relatively high levels of firearm use and gun ownership have long been identified with the American southern culture[77], and the use of firearms has been identified as an area of public concern[78;78;79] . A study done by Douglas Wiebe et al on homicide and geographic access to gun dealers in the United States found that in

major cities, gun homicide rates were higher where federal firearm licensee were more prevalent (RR = 1.70, 95% CI 1.03–2.81)[74].

According to the National Injury Mortality Surveillance System (NIMSS) report released in 2007, the leading cause of death in South Africa was homicide violence accounting for 35.8% of all fatal injuries. The report indicate that nearly 40% of the 11 983 violence-related deaths were inflicted by sharp objects and just more than one-third by firearms. There were 6.5 male deaths for every female death. Blunt objects were the major external cause of violence for those aged 0-4, 10-14, 60-64, 70-79 and 85+ years. Most violence-related deaths occurred in and around private homes.

From the literature, there are contradicting findings with regard to association between socio-economic and homicide. Cummings et al observed that much of the research, including the present study on the relationship between SES and homicide uses arbitrary measure of SES or SES as a confounder rather than a determinant of homicide outcome[34;80].

High rates of homicide are found in sub-Saharan Africa and in the developing countries. South Africa homicide rate is dropping slowly, but it is still among the world highest. Apart from studies done by NIMSS, only few studies have been conducted on homicide in South Africa compared to other countries like US, and most of these studies are cross-sectional in nature. Youths aged 14-34 are at greater risk of homicide, with males bearing the greatest brunt. GIS remains underutilized as a research and decision-making tool in public health, especially with regard to non-natural injuries. Apart from study by Breetzke et al which described the spatial distribution of high offenders, other studies are yet to describe the spatial distribution of homicide in South Africa.

1.4 Research question

What are the levels and factors associated with homicide deaths in a rural area of northern KwaZulu-Natal in South Africa during the period of 2000 to 2008 years?

1.4.1 Objectives

i. To quantify homicide incidence rate in a rural South African population for a period of 9-years (2000-2008).

ii. To identify factors associated with homicide-related deaths in a rural South African population during the period 2000-2008.

iii. To describe spatial distribution of homicide-related deaths in a rural South African population.

CHAPTER 2: METHODOLOGY

This chapter presents the research design, the methodology used, the study population from which the sample was drawn, study sample as well as the data source. It discusses the procedures that were followed for inclusion and exclusion of participants and discusses ethical considerations. It also presents a brief overview of the different statistical and analysis techniques that were used.

2.1 Research design

The design adapted was analytical longitudinal study. Using data drawn from the Verbal Autopsies (VAs) conducted on all deaths recorded during annual demographic and health surveillance over a 9-year period (2000-2008), We investigated the levels and factors that are associated with homicide related deaths in a rural South African population. All residents and non-residents in the demographic surveillance site as of 1st January 2000 to 31st December 2008 were included in the analysis. Persons contributed exposure time from January 1, 2000 to December 31, 2008, until death, out-migration, and loss to follow or end of study. I also described the spatial distribution of homicide deaths in the study area.

2.2 Demographic characteristic of the study area

Africa Centre Demographic Surveillance area covers the southern part of the tribal areas of Umkhanyakude district, 250 kilometers north of Durban, the most populous and least mountainous part of the Hlabisa Municipality in northern KwaZulu-Natal (KZN). The study area is 435 square kilometers in size and includes deep rural areas, a township and peri-urban informal settlements. The study population of approximately 140,380 people has membership in about 11,538 households.

.The population is predominantly Zulu, although it is a largely rural area, subsistence agriculture is not common; it is mainly cash economy with people seeking employment in nearby town of Richards Bay, Empageni, or on the commercial firms like sugar cane or forestry. The majority of the people are very poor with two in five adults unemployed. The primary sources of income for most households are waged labour and pensions. Living standards, literacy rates and access to electricity and clean water differ widely, though overall, social and environmental conditions are better than many other countries in sub-Saharan Africa. Life expectancy has been severely affected by HIV/AIDS pandemic, averaged life expectancy stood at 63 years at the beginning of the AIDS epidemic and it is likely that it has dropped as the impact of the epidemic is being felt in the area[81].

Unlike in many other parts of Africa, where homesteads are clustered in clearly identifiable villages, rural population in KwaZulu-Natal live in scattered multi-generational homesteads of varying size (1-100 people).The area experience substantial circulatory in and out migrations.

2.2.2 Household asset data

To measure socioeconomic status, we created a wealth index using household assets data collected almost at the beginning of the surveillance in 2001. An asset index is frequently used as a measure of absolute deprivation in Demographic and Health Surveys in the place of measures of individual or household income, which may not adequately represent wealth in many settings, and according to Morris, the indices are valid proxies of wealth in rural Africa[82].

The following 22 items were combined into a single aggregate measure using Principal Component Analysis, and households were ranked using the index, and then divided into quintiles from poorest (‘‘1’’) to wealthiest (‘‘5’’).

Electricity; ownership of television, video , telephone land line, refrigerator, car, telephone, washing machine; use of electricity or wood for cooking; use of electricity or wood for heating; presence of piped drinking water in dwelling; has flush toilet, earth floors, mud walls, plastered walls, radio, block-maker, bicycle, wheelbarrow and video cassette recorder and wheelbarrow

2.3 Africa Centre Demographic Information System

Established in 1997, the Africa Centre for Health and Population Studies is a joint initiative of University of KwaZulu-Natal (UKZN) and the South African Medical Research Council SA-MRC). ACDIS started data collection in January 2002[83]. It was initially established with the intention of measuring the outcome of interventions in areas with limited vital registrations; before it was started, repeated consultations were held with traditional and other leaders in the Hlabisa district in general and in the Mpukunyoni area in particular. The local tribal authority granted the research team permission for community entry. However, the decision to participate in the research was left with the household heads and individuals[81].

Ethical approval for the ACDIS research was obtained from the Research Ethics Committee of the Nelson R. Mandela School of Medicine, University of Natal. The ethical approval is renewed annually due to the longidunal nature of the study[81]. However, like any other DSS, the complication in the consent process specific to surveillance activities related to concept of autonomy, the position of individual within the household and community, the nature of longitudinal surveillance have received only slight attention. The principle of respect, beneficence and justice as outlined in the 1979 Belmont report does differentiate between medical practice and research, but no provision is made for surveillance. Therefore ACDIS has formed External Relations Unit to enhance and sustain positive relationship with the community,

respond to community expectations, and give feedback to the community on the opportunities and challenges of the interaction between the community and the Africa Centre. Besides ACDIS has got nested interventional studies like free HIV treatment programs.

The study population includes all household members, both resident and non-resident in the area. Unlike other DSS, ACDIS record information on residents as well as non-residents who retain membership at the household in the demographic surveillance area. Residents are individuals who constantly reside within the demographic surveillance area, non residents are further divided into two categories- those who had prior residency before they move out and those with no prior residency. Demographic and health information is collected every 6 months from all registered households, with one senior member reporting on all resident and non-resident individual members of the household. Data is collected prospectively on births, deaths, migration, education, pregnancies, employment status, and marital status. Household socio-economic, employment and education data are collected once a year. Teams of trained field workers collect this information from each household using structured and unstructured questionnaire in the local language. Quality check is done by trained field supervisors by randomly visiting samples of households.

ACDIS has also developed and maintained a Geographical Information System (GIS) that allows spatial analysis of any the variable they collect in the area. All homesteads and facilities in the study area have been mapped by field workers using differential global positioning systems and the homesteads database is continuously updated as new homesteads are built as part of the ongoing surveillance program[83].

In addition to the data collected within the household surveillance, a number of studies are nested and linked to the ACDIS, for instance Vertical Transmission Study (VTS), migration, fertility and economic studies and illness and death studies.

2.4 Verbal Autopsy data

Verbal Autopsy (VA) is a method of ascertaining causes of death from the circumstances, events, symptoms and signs of illness experienced by the deceased before death as reported by the caretaker[84].

Just like any other country in the sub Saharan Africa, South Africa's reporting system of health-related issues is weak[85;86]. Information on the causes of adult deaths in developing countries is relatively scarce, and one of the reasons for the scarcity is the difficulty of obtaining population based data on causes of deaths[87]. While there are options like mortuaries and health service-based notification for obtaining data on cause of death, in most sub-Saharan countries, these are just but a fraction of the actual burden[88]. Poor vital registration or notifications exist, and this explains why we did not link VA data with any other data, and why ACDIS data is not linked to the same. Chandramohan et al. recently described various factors that influence the validity of the results obtained through the use of this technique and suggested that these include: distinctive features of the fatal disease that can be easily recognized and remembered by lay people, the relative prevalence of the disease, characteristics of the deceased and design and assessment of the questionnaire[89].

Demographic Surveillance System uses **v**erbal autopsy technique to estimate probable cause of death that occurs outside the hospital. All deaths identified through the half yearly visits were notified by the DSS regular supervisors to the nurses. Five nurses specifically trained and under

strict supervision collected data by conducting an interview with the closest caregiver of the deceased to ascertain the history and the symptoms of the illness that preceded death[81]. The verbal autopsy questionnaire is designed to have the most important part where the respondents (closest caregiver of deceased) describe all the symptoms and signs preceding death in his/her own words and validate their diagnosis against medical records if available.

After data collection, the DSS physicians then diagnose cause of death from nurse's notes, and make an independent review of the information collected to come up with the probable cause of death. Where there is no agreement between them in diagnosis, a third coder is blinded to their assessment so as to make a further independent diagnosis.

If two of the three diagnoses correspond, a consensus is reached among the three coders and a decision is reached otherwise the cause of death would remain undefined. (The consequence of this failure to agree makes it hard to compare results across regions and countries, hence lack standardization).

The causes of death are identified and classified into four main categories using International Classification of Disease (ICD-10); namely: - (1) Injury-intentional and (2) unintentional, (3) non communicable diseases, (4) AIDS.

2.5 Cluster detection

ACDIS has developed and maintains a GIS capacity that allows the spatial analysis of any of the variables collected. To operationalise fieldwork, the DSA is divided into work-load equivalent areas using the GIS-based methodology.

To test the hypothesis of no clustering verses alternative of spatial clustering of homicide, 63, 464 individuals with complete information on bounded structure identifications, longitude and latitude were included in the analysis. Using SaTScan spatial cluster detection programme, we provided geographic coordinates for each location (latitudes and longitudes). For bounded structures with exact coordinates, we combined the data and treated them as a single location. We also developed a case file with location identifications, number of cases for the specified location, first date of observation, survival time and whether an individual was censored or not. 1 and 0 were used to represent censored and non-censored respectively.

A spatial scan statistic is a cluster detection test that uses estimated incidence/prevalence data (Exponential model used in this instance) and is able to both detect the location of clusters and evaluate their statistical significance without the problems associated with multiple testing[90]. This is done by gradually scanning a window across space and time[91]. Purely spatial imposes a circular window on the map, and for each circle, a likelihood ratio statistics is computed to test the null hypothesis that there is no elevated rate of homicide if compared with the external distribution (i.e. higher than expected). The circle with the maximum likelihood becomes the most likely cluster, implying that it is least likely to have occurred by chance. The P-value of the most likely and secondary cluster is determined by conducting Monte Carlo replications of the data set.

The assumed that the number of new cases in each neighborhood to be exponentially distributed. Under the null hypothesis of uniform distribution of homicide, and when there are no covariates, the expected number of cases in each area is proportional to its population size

2.6 Primary data Source

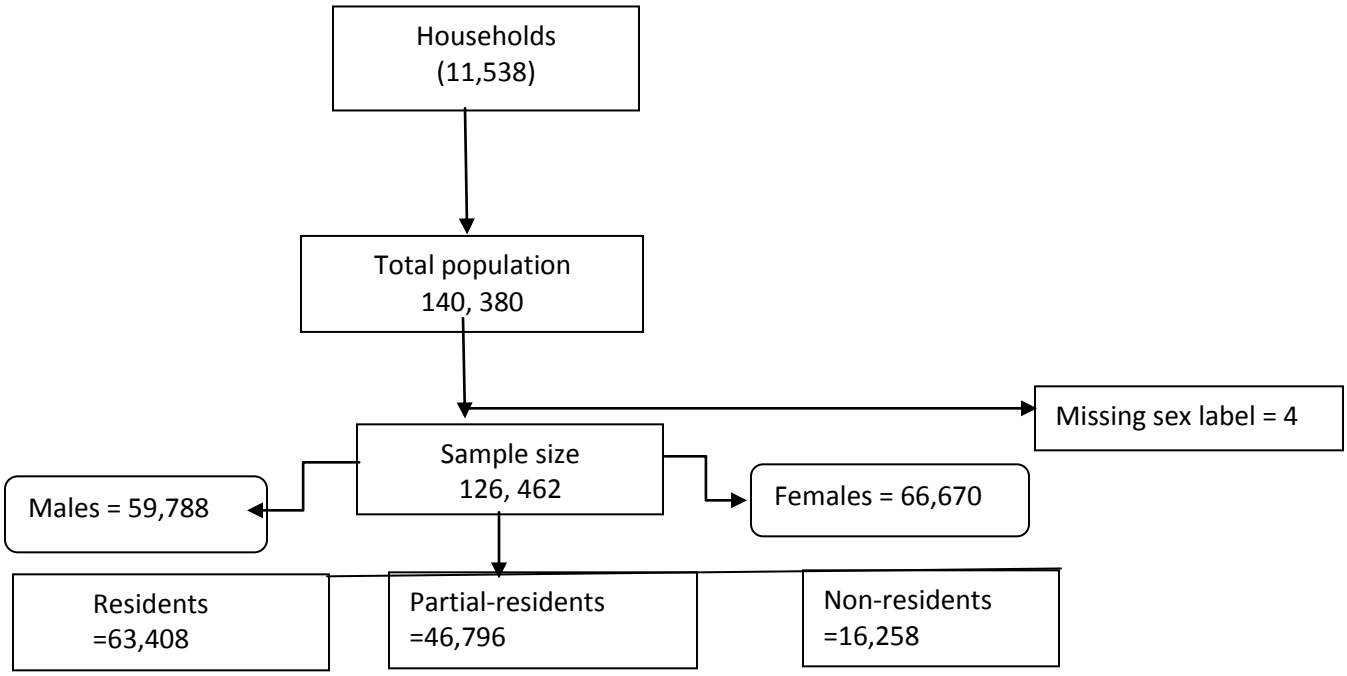
Demographic Surveillance Site (DSS) data provides a comprehensive and systematic recording of an annual basis of all vital events like births, deaths, pregnancies, and other associated demographic, health and socio-economic indicators.

Data for this analysis was extracted from the Africa Centre Demographic Information System (ACDIS) database which includes information on all individuals, education level, household assets, employment status, resident, religion, sex, and data collected through verbal autopsy method was used to identify homicide-related deaths between January 1, 2000 and December 31, 2008.

2.7 Study sample

A study must be adequately powered to achieve its aim. This study employed a non-probability sampling method, therefore to ensure results are not coincidental, We needed enough power in this study that would give the ability to detect or find if indeed these are homicide risk factor; the problem was carefully defined, participants were selected from the appropriate population, and most importantly adequate sample size was used (126,462), large enough to give us enough power. Study population constituted all individuals, residents, partial-resident and non-resident of the Africa Centre DSA as at January 1, 2000 to December 31, 2008. The sample size included a total of 126, 462 individuals; 66, 670 females and 59, 788 males with missing information on

sex for 4 persons. This sample size comprised of 63,408 residents, 46,796 partial residents and 16,258 non-residents.



2.8 Inclusion and Exclusion criteria

A person was eligible if she/he was a registered resident or non-resident as at January 1, 2000 to December 31, 2008.

2.9 Sampling technique

Due to time and cost constraints, ACHDSA has a sampling frame of all households with data collected at individual level as well as household level; and verbal autopsies provide mortality data. This therefore provided us with readily available population. All individuals both residents and non-residents who befit my inclusion criteria were included in this study, that is registered individuals as at January 1, 2000 to December 31, 2008.

2.2.0 Measurement

2.2.1 Outcome variable

Homicide is broader in scope, but for the purposes of this study it was defined as intentional killing of one human being by another human being or criminal negligence that causes the death of another person. This definition was inclusive of assaults leading to death. To get the number of deaths due to homicide, it was measured by cause of death using the relevant ICD-codes for homicide: - namely abuse and neglect, blunt object, cut/pierce, fight, unarmed, firearm and others.

A binary outcome variable called **event** was generated that took the value "1" if an individual died from any of the ICD-codes for homicide and "0" if alive or died from other causes were.

Homicide incidence rate was measured by dividing the total number of homicide-related deaths by the calculated Person Years of Observation (PYOs) of all participants at risk, expressed per 100,000 person years observed.

2.2.2 Risk factor variables

All explanatory variables were measured at baseline, and were assumed to be constant over time.

Resident: Each person's time under surveillance is split into three residency episodes namely: - full time residency, partial-residency following a residency episode, and non-residency episode prior to any residency.

Age (years): was categorized into five years age group as- (0-5, >9-14, >14-19, >19-24, >24-29, >29-34, >34-39. >39-44, >44-49, >49-54. >54-59, >59-64, and 65+) for the descriptive statistics; otherwise was treated as a continuous variable at the inferential analysis. The categorization was to assess different risk in different age groups.

Sex: was measured as male or female.

Education level: the highest education level completed was collected for all individuals aged 6 years and above and was treated as a continuous with none being the lowest and masters being the highest; otherwise was grouped into 3 categories referring to none, primary (1-7), secondary (8-12), tertiary (over 12 years) for descriptive analysis.

Employment: employment data was collected on all individuals aged 18 years and over measured as (not employed, employed part time, employed full time); employment data is also collected half yearly, and status assigned to an individual was the observation during 2001 as closely as possible to January 1, 2002.employment data is also collected a half yearly

Area: Area of resident was categorized as, urban, peri-urban, rural and outside DSS area.

Socioeconomic position: was measured using index based on ownership of assets, cooking material, source of drinking water, material of the floor, and divided into quintiles as 1st Quintile, 2nd Quintile……5th Quintile representing, poorest, very poor, poor, less poor and least poor respectively.

Religion: this was categorized into :- (Zionists, Nazareth, Lutheran, Apostolic affiliated, Catholic, Faith mission, Africa evangelic, and Holy burner).

2.2.3 Quality Control

Homicide cases that never befitted the definition were considered censored, but contributed to the denominator. Independent categorical variables with missing observations were coded 999 and labeled unknown in order to maintain the sample size in the multivariate analysis.

The quality control section in Africa Centre DSS is responsible for ensuring completeness and accuracy of data collected from the field; ensure that fieldworkers and data processing teams

comply with set processes and standard operating procedures; diagnosing and reporting on levels, patterns and trends of data errors (both during collection and processing).

2.3 Data Processing

2.3.1 Data Extraction, cleaning and management

ACDIS data is handled using custom-design relational database. The system allows easy linkage between individual to events and other episodes. Data is normally captured in SQL 2000 and transferred to STATA 11.0 for cleaning and analysis. Various datasets were merged together using either individual unique identify or household identify. The following four datasets were merged together using STATA11.0: - individual dataset, verbal autopsy dataset, demography dataset, and household asset dataset. Relevant ICD-10 codes for homicide such as Y06-Y07 (abuse and neglect), Y00(blunt object), X99(cut/pierce), Y04 (fight, unarmed), X93-X95 (firearm), and X85-92, X96-X98, Y01-Y03, Y05, Y08-Y09 (other) were used for the analysis to identify homicide-related deaths. Data quality was assessed by checking for the missing records or observations, duplicate records, internal consistencies and validity of response.

2.4 Data Analysis

2.4.1 Descriptive statistics

Descriptive statistics; mean (standard deviation), frequencies and percentages were used to describe continuous and categorical variables respectively. Chi-square tests or Fishers exact tests were used to determine the association between categorical variables, while t-test or non-parametric equivalent tests were used to compare groups for continuous variables.

2.4.1.1 Homicide Incidence Rate

Individuals contributed to Person-Years of Observation denominator as at 1st January, 2000 to 31st December, 2008. Individual was censored (stopped contributing to the denominator) at death, lost to follow up, out-migration or end of the study. Homicide incidence rates were computed for the entire period of the study factoring all the PYOs contribution of both resident partial-residents and non-residents. Similarly homicide incidence rates were estimated separately by residency and sex using Kaplan-Meier (K-M) survival estimates of incidence (mortality) rates, and were expressed per 100, 000 person years of observation.

2.4.1.2 Survival Curves

Survival curves estimating cumulative mortality were estimated using Kaplan-Meier (K-M) survival methods and the log-rank test was used to test for equality of survival functions between stratified variables like sex, resident, area, and socioeconomic status.

2.4.2 Inferential statistical analysis

To assess factors associated with homicide-related deaths, we rejected semi parametric Cox proportional hazard model in favour of Weibull parametric regression models because of lack of proportional hazard. Univariate and multivariate Weibull parametric regression model were instead fitted, with covariates put one by one to assess their individual effect on homicide while controlling for potential confounders and effect modifiers. Unlike the Cox model which assumes proportional hazards, the Weibull function allows the hazard function to either increase or decrease monotonically over time. It has the flexibility and ability to take the shape which best fits data. Weibull failure velocity (P) determines the shape of the underlying hazard function. If P>1, then the hazard is monotonically increasing, i.e the observations are falling at a fast rate as

time goes on, but if P<1, then the hazard is monotonically decreasing, meaning the observations are falling at a slower rate with time. In this analysis the risk of homicide declines over time velocity (P) is 0.6340149 about (ln_p= 12% per year). The hypothesis that the risk is constant over time was soundly rejected. All estimates were reported at 95% confidence level, and all comparisons done at the 5% significant level.

All variables with P-values<=0.2 in the unadjusted model were included in the final multivariate model.

To identify clusters of violence due to homicide (either as high or low), and to test the hypothesis that homicide deaths were uniformly distributed within the Demographic Surveillance Area (DSA), We employed a purely spatial distribution scan statistics using exponential probability model which is designed for survival time data and is ideal for handling censored observations. We applied Kulldorff spatial scan statistics by imposing a circular window on the map, and allowing the centre of the circle to move across the study region.

For any given position of the centre, the radius of the circle changes continuously so that it can take any value from zero up to a specified maximum value. The test was set to scan for clusters of high and low rates.

For each circle, a likelihood ratio statistics was computed to test the null hypothesis that there is no elevated rate of homicide if compared with the external distribution (i.e. higher than expected). The circle with the maximum likelihood became the most likely cluster, implying that it is least likely to have occurred by chance. The P-value of the most likely and secondary cluster was determined by conducting Monte Carlo replications of the data set.

2.5 Ethical Consideration

The primary project was cleared by an ethics committee in KwaZulu-Natal University. Approval from the University of Witwatersrand Committee for Research on Human Subjects was also obtained (ethical approval number **M10350**). Written permission was obtained from Africa centre for the use of their dataset. Retrieved data was handled with care and access was limited to few individuals. Project assigned participant study identity numbers were used instead of their names in order to maintain confidentiality and privacy.

CHAPTER THREE: RESULTS

This chapter presents the research findings. Analysis combined residents, partial residents and non-residents. Separate multivariate analysis stratified by sex on homicide risk factors was examined.

3.1 Background characteristics of the study sample.

Table 3.1 shows baseline characteristics of the participants included in this study stratified by homicide or not. The comparative group composed of individuals who are alive or died of other causes other than homicide. A total of 126, 462 individuals were included in the study. There were 59, 788 (42.6%) males and 66, 670 (47.5%) females. The total number of homicide recorded during the whole period (2000-2008) was 536. Out of these deaths, 446 (83.2%) were males while 90(16.8%) were females. The majority of the populations stay in rural areas (52%). Most survivors of homicide attained tertiary level of education (41%), while primary education level recorded the highest cases of homicide (34%).

Table 3.1 Socio-demographic factors and homicide risk in a rural setting KwaZulu-Natal

Individual risk factors	Sample(n)	Homicide n (%) Total dead= 536	A live/other deaths n (%) Total alive=125,926	P*-value
Residency	**126462**			
Resident		240(44.8)	63169(50.2)	
Partly-resident		143(26.7)	46653(37.1)	
Non- residency		153(28.5)	16104(12.8)	<0.001
Education	**126462**			
None		52(9.7)	18514(14.7)	
Primary		183(34.1)	36379(28.9)	
Secondary		126(23.5)	18225(14.5)	
Tertiary		176(32.8)	52808(41.9)	< 0.001
Sex	**125922**			
Female		90(16.8)	66580(52.9)	
Male		446(83.2)	59342(47.1)	<0.0001
Employment**	**49446**			
Not employed		207(57.7)	28255(57.6)	
Employed full time		119(33.2)	13667(27.8)	
Employed part time		33(9.19)	7165(14.6)	0.005
Socio-economic status	**49401**			
Poorest		40(16.3)	9896(20.1)	
Very poor		44(`17.9)	9239(18.8)	
Poor		44(17.9)	10299(21.0)	
Less poor		71(28.9)	10634(21.6)	
Least poor		47(19.1)	9087(18.5)	0.006
Area of resident	**123331**			
Rural		226(42.5)	64143(52.23)	
Peri-urban		137(25.8)	33579(27.3)	
Urban		16(3.0)	8973(7.3)	
Outside DSS		153(28.8)	16104(13.1)	<0.001
Religion	**41553**			
Zionist		87(42.0)	17015(41.2)	
Nazareth		47(22.7)	10545(25.5)	
Lutheran		22(10.6)	3026(7.3)	
Apostolic		25(12.1)	4311(10.4)	
Catholic		9(4.4)	2882(7.0)	
Faith mission		5(2.4)	1441(3.5)	
Africa Evangelic		8(3.9)	1175(2.8)	
Holy burner		4(1.9)	951(2.3)	0.344
Age group (years)	**126462**			
0-4		7(3.2)	31190(24.8)	
5-9		2(0.4)	14249(11.3)	
10-14		28(5.2)	14655(11.6)	
15-19		86(16.0)	14246 (14.3)	
20-24		100(18.7)	12188(9.7)	
25-29		83(15.5)	9521(7.6)	
30-34		54(10.1)	7211(5.7)	
35-39		40(7.5)	5849(4.6)	
40-44		39(7.3)	4456(3.5)	
45-49		18(3.4)	3119(2.5)	
50-54		19(3.5)	2336(1.9)	
55-59		22(4.1)	1889(1.5)	
60-64		12(2.2)	1541(1.2)	
65+		26(4.86)	3476(2.76)	<0.001

3.2 External cause of death

Figure 3.1 below shows by percentages the external cause of homicide. Deaths by firearms took the lead by 65%, with handguns accounting for 53.1% , and other unspecified firearm contributing 11.9%. The second leading external cause of death were sharp objects (22.1%), and the least being sex, bodily force rape (0.19%).

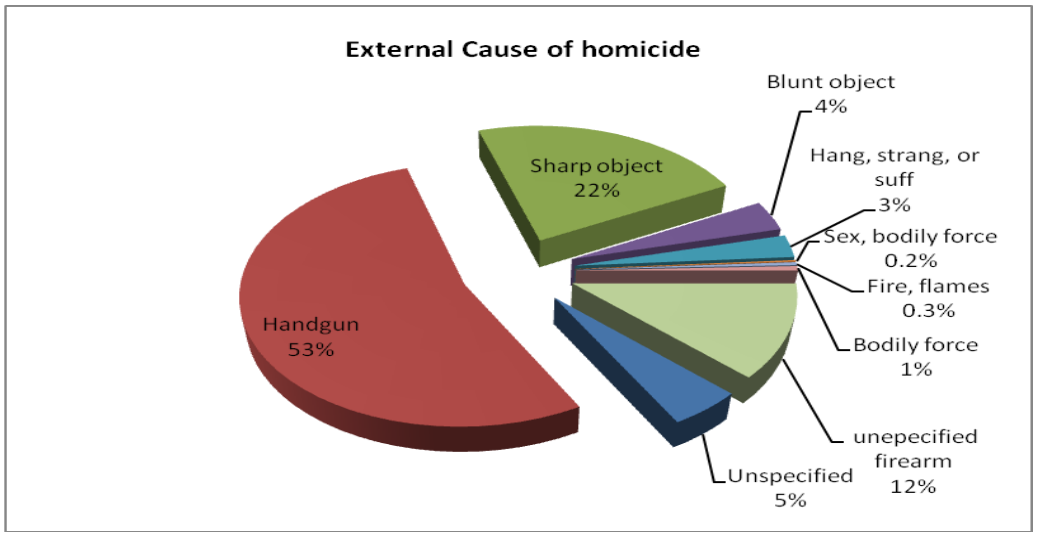


Figure 3.1 Leading external cause of homicide

3.3 Day of death

Peak days of death for homicide were Saturdays (21%), followed by Fridays (16.2%), Sunday (15.7%) and Monday (14.4%) as shown by **Figure 3.2**

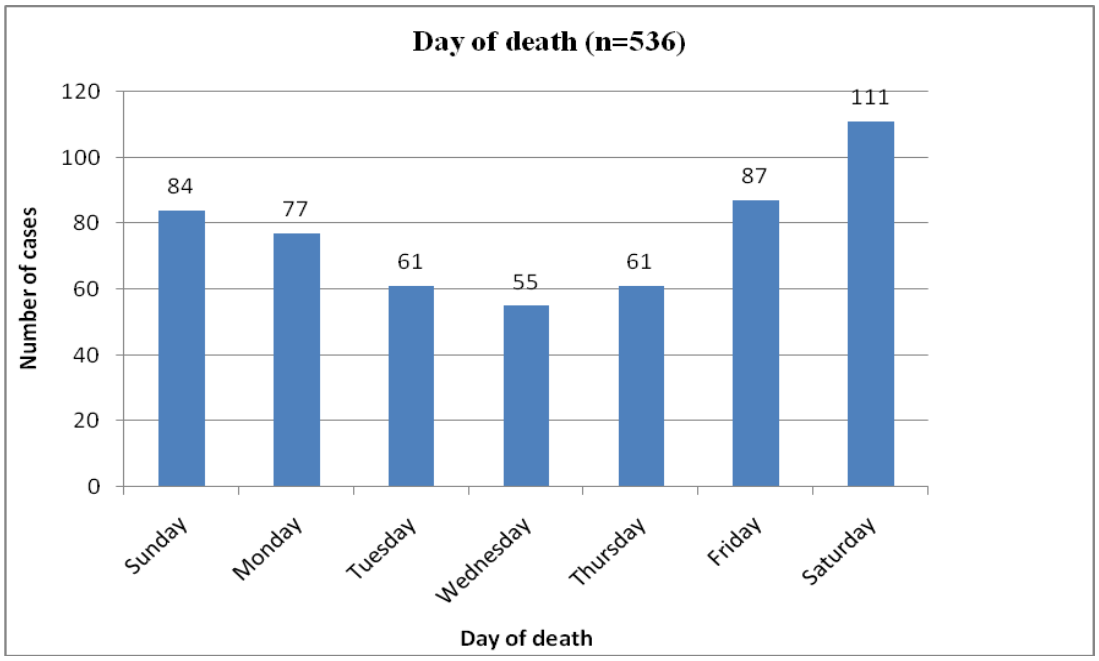


Figure 3. 2 Day of death

3.4 Homicide deaths and survival

Females had a lower chance of experiencing homicide deaths than males as shown by the Kaplan-Meier homicide survival curve estimate in **Figure 3.3**. Log- rank test (Chi-squared (1) = 256.15 Pr > Chi-squared = 0.0000).

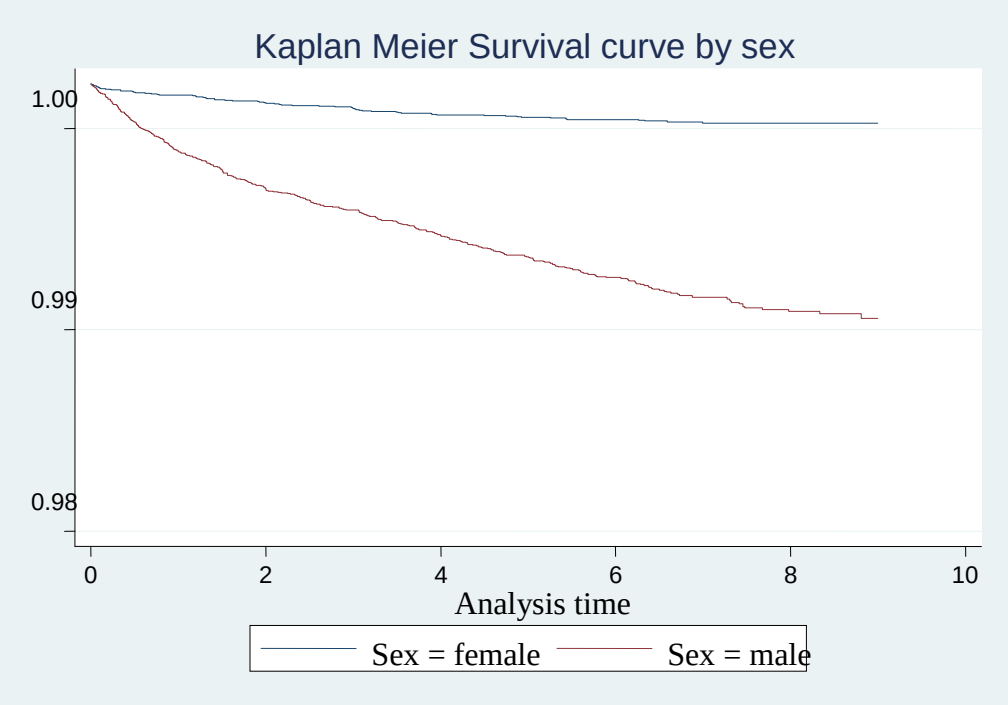


Figure 3. 3. Homicide and sex survival

Non-residents had the worse homicide survival experience Log-rank (Chi-squared = 89.85 Pr > Chi-squared =0.0000), whereas partial-residents had a high chance of experiencing homicide at the beginning, but as time go by, their chances of survival reduce and they catch up with resident as shown in **Figure 3.4**.

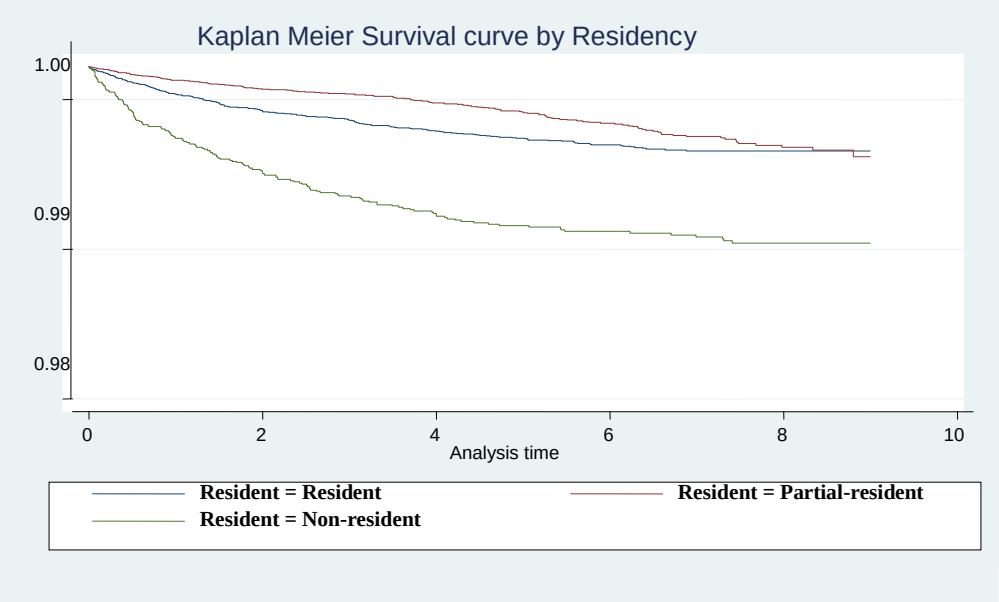


Figure 3.4 Homicide and residency survival

Residence in urban centers had a better homicide survival probabilities compared to their rural and peri-urban counterparts, while peri-urban recorded worse homicide survival as shown in **Figure 3.5**. Log-rank test (Chi-squared = 88.71 Pr > Chi-squared =0.0000).

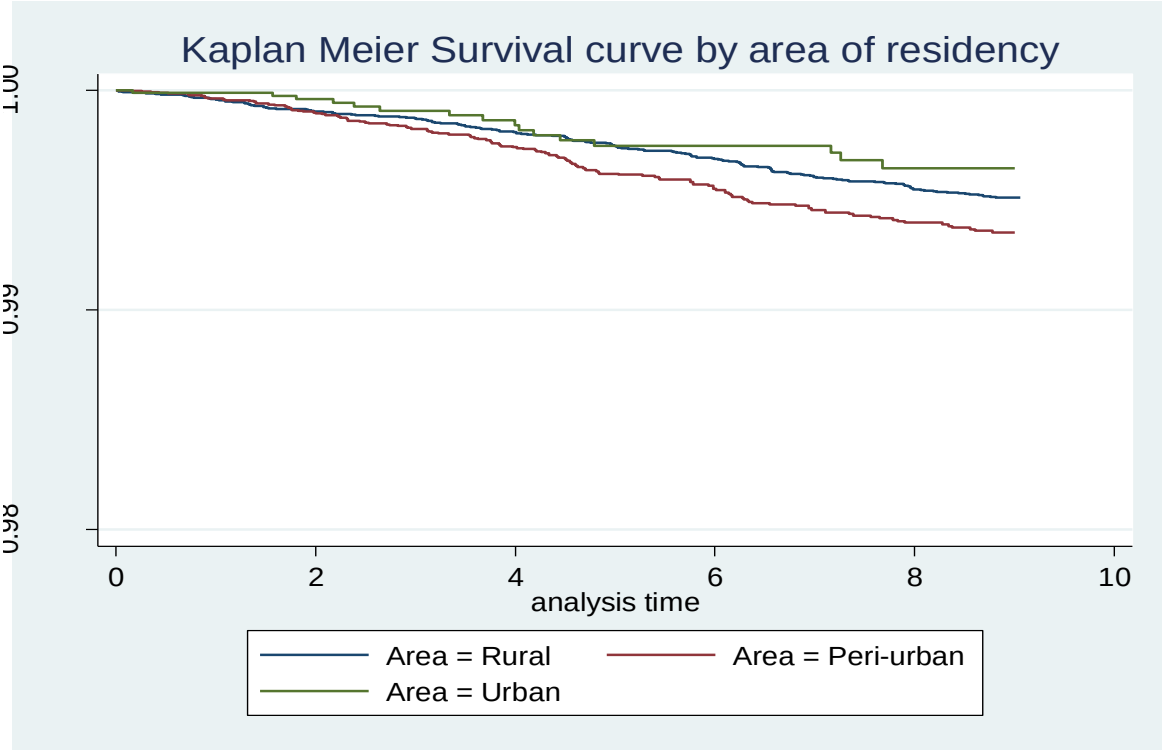


Figure 3.5 Homicide and area of resident survival

In terms of socioeconomic position and homicide, survival seemed similar across the wealth quintiles except the less poor category of individuals that showed the worst survival compared to the rest of the other groups Log-rank test (Chi-squared = 88.71 Pr > Chi-squared =0.0000) as shown in **Figure 3.6** below.

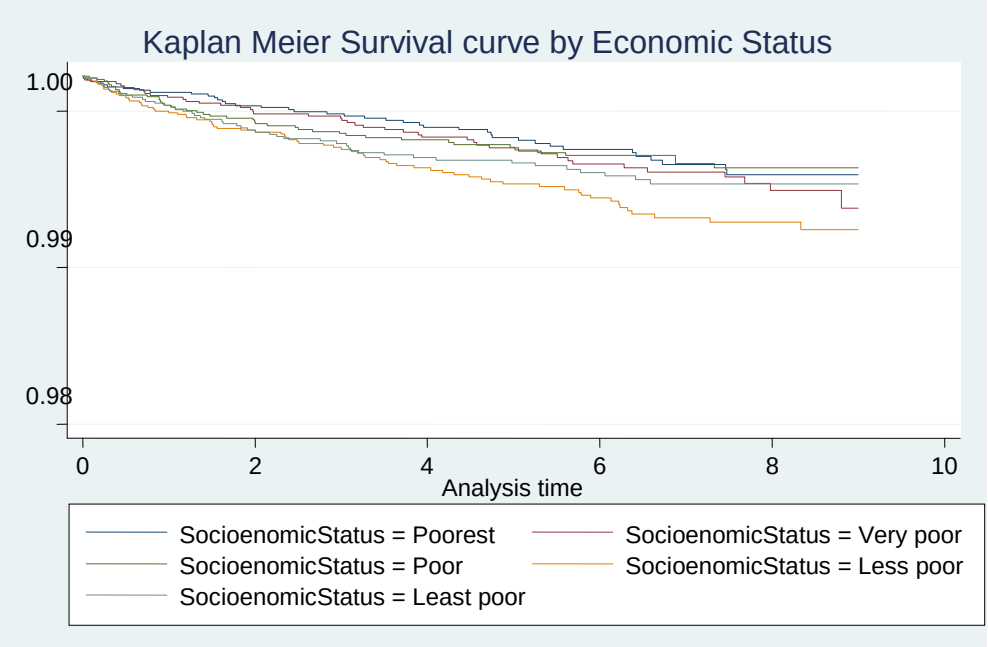


Figure 3.6 Homicide and socioeconomic survival

3.5 Homicide Incidence rate

With 536 homicide-related deaths, and 814, 715 total Person Years of follow-up, the study found an overall incidence rate of 66 homicide deaths per 100, 000 PYOs (95% CI= (60, 72) for the whole 9 year period (2000-2008). Male and female incidence rates were 115.38 (95% CI= (105, 127) per 100, 000 PYOs and 21 (95% CI= (17, 26) per 100,000 PYOs respectively with males being about six times more likely to experience homicide deaths than females. According to residency, non-residents had the highest homicide incidence rate at 197 (95% CI= (167, 231) per

100,000 PYOs over the entire period of the study, followed by resident 67 (95% CI= (59, 76) per 100,000 PYOs), then partial- resident 45 (95% CI= (38, 53) per 100,000 PYOs.

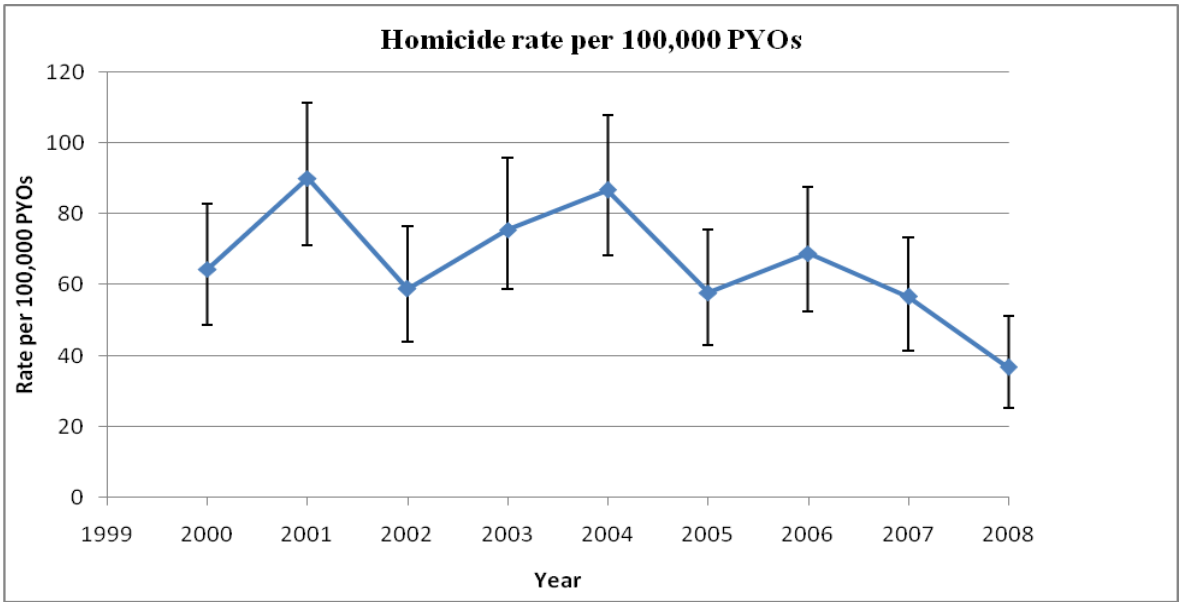
3.5.1 Homicide rate trend across 9-years period (2000-2008)

Homicide rates calculated for each year are displayed in **Table 3.2** and **Table 3.3** in the (**Appendix 2 & 3**). **Table 3.2** reports combined rates for both residents, partial-residents and non-residents, whereas **Table 3.3** reports rates for residents only.

Both tables are represented by **Figure 3.7** and **Figure 3.8** respectively and describe homicide rates across the years studied.

Figure 3.7 shows a fluctuating homicide rate within the period 2000 to 2006; followed by a steady slow decline which does not show clear trend as shown by the overlapping confidence bands. The highest homicide incidence rates were recorded in 2001 (90; 95% CI= (71, 111) per 100,000 person years at risk and 2004 (86; 95% CI= (68, 108) per 100,000 person years at risk.

Figure 3.7: Homicide –rate trend for all from 2000 to 2008



On the other hand, residents, as shown by **Figure 3.8** experienced the highest homicide rates in 2004 compared to the rest of the years (73; 95% CI=(54, 97) per 100, 000 person years at risk and 2001 (69; 95% CI= (51, 92). The general trend for resident is quite similar to the trend for the entire population since it is a subset of the entire population, although resident rate peaked in 2004, unlike the entire population that peaked in 2001. **Figure 3.8** for residents shows a sharp linear decline of homicide rate between the years 2006 to 2008. This represented a significant decrease of 38% as shown by the non-overlapping confidence bands in **Figure 3.8.**

Figure 3.8 : <u>Homicide rates –trend for Resident 2000-2008</u>

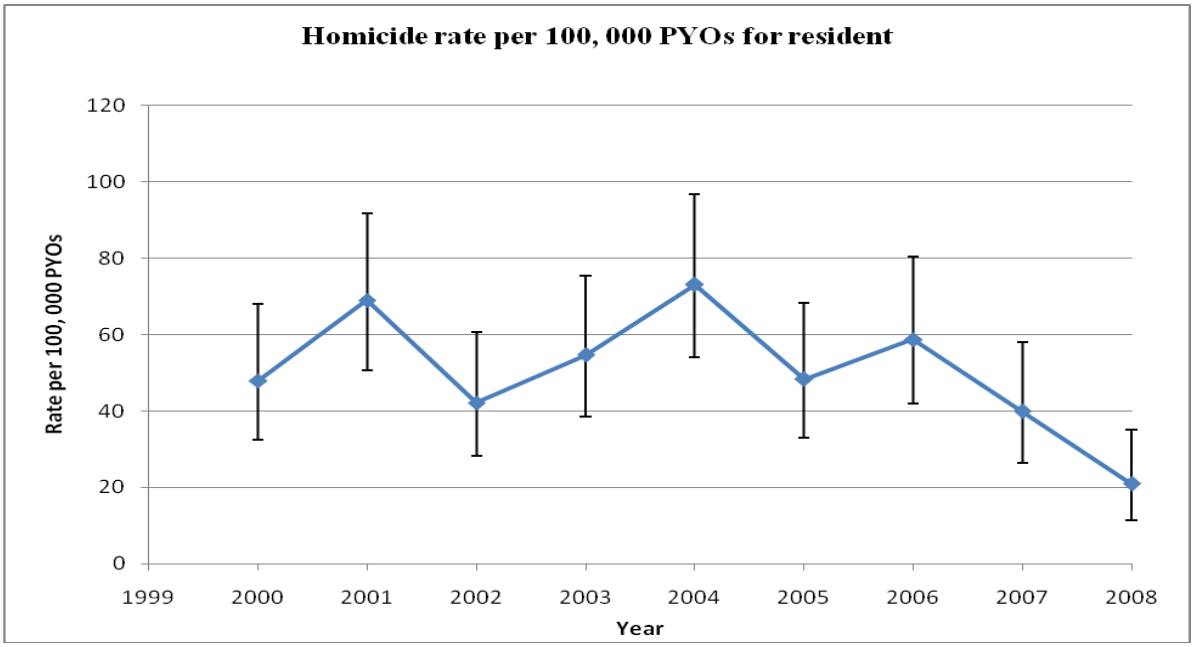


Table 3.2 Homicide rate by sex and age group for the period 2000-2008

Variable	PYOs	Cases	Rate per 100,000 PYOs	95%CI
MALES				
Age groups				
0-4	51920.59	3	5.90	(0.40,10.70)
5-9	54749.13	1	1.83	(0.04,10.20)
10-14	56949.74	25	43.9	(28.4, 64.80)
15-19	55930.98	7	137.6	(108.6,173.1)
20-24	48344.64	82	169.6	(134.9,210.5)
25-29	37145.21	78	209.9	(165.9,262.1)
30-34	27563.88	48	174.1	(128.4,230.9)
35-39	21083.36	37	174.5	(123.6,241.9)
40-44	17064.62	34	199.2	(137.9,278.4)
45-49	13661.98	17	124.4	(72.5,199.20)
50-54	10256.94	9	87.8	(40.10,166.5)
55-59	7276.35	15	206.1	(115.4,340.0)
60-64	5586.57	7	125.3	(50.4,258.20)
65+	10460.08	13	124.3	(66.2,212.50)
TOTAL	**418,003**	**446**		
FEMALES				
Age groups				
0-4	51476.92	4	7.79	(2.10,19.92)
5-9	54506.48	1	1.8	(0.40,10.20)
10-14	57236.53	3	5.2	(1.10,15.33)
15-19	57548.50	9	15.6	(7.10,29.70)
20-24	51221.67	18	35.1	(20.8,55.50)
25-29	40809.12	5	12.2	(3.90,28.61)
30-34	31610.86	6	18.9	(6.90,41.36)
35-39	25036.55	3	11.9	(2.50,35.05)
40-44	21576.22	5	23.2	(7.50,54.10)
45-49	17010.40	1	5.8	(0.40,32.81)
50-54	12803.99	10	78.1	(37.4,143.6)
55-59	9790.97	7	71.5	(28.7,147.3)
60-64	8588.13	5	58.2	(18.9,135.8)
65+	23459.63	13	55.4	(29.5,94.70)
TOTAL	**462,676**	**90**		

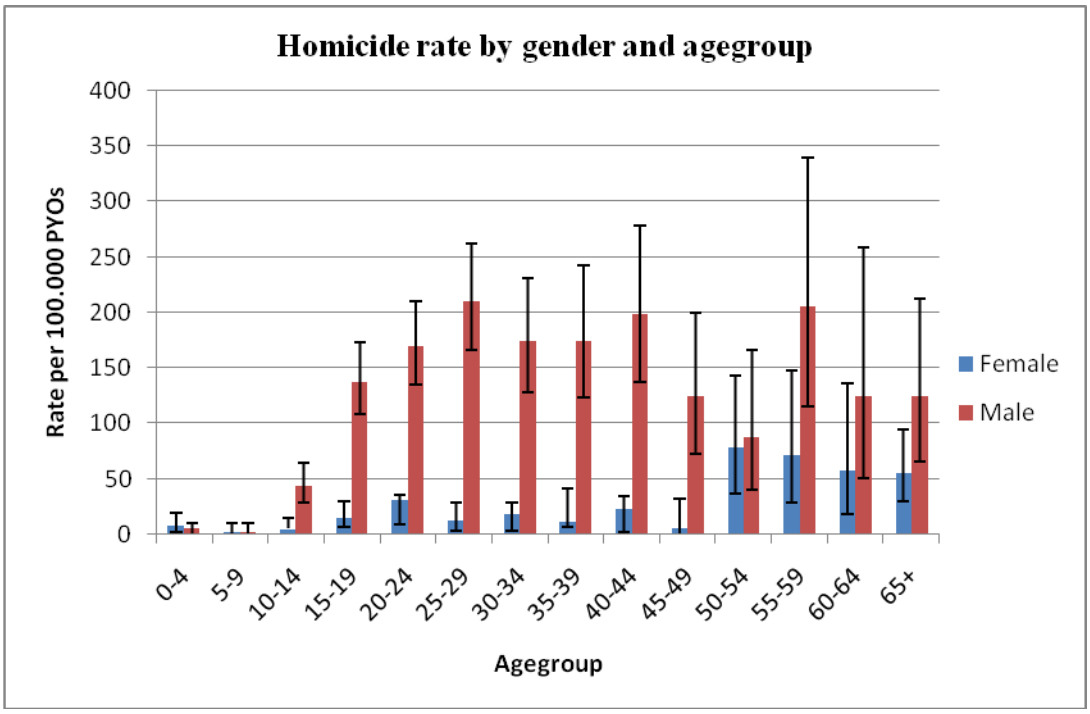


Figure 3. 9 Homicide rate by gender and age group

Table 3.5 Unadjusted Weibull regression model of factors associated with homicide death

Variable	Hazard Ratio (HR)	95% CI	P-value
Resident			
Resident	1		
Partial-resident	0.66	(0.54 0 .81)	<0.001
Non- resident	2.95	(2.41 3.61)	<0.001
Education	1.09	**(**1.06 1.12)	<0.001
Sex			
Female	1		
Male	5.6	(4.38 6.88)	<0.0001
Employment			
Not employed	1		
Employed full time	1.21	(0.97 1.52)	0.094
Employed part time	0.58	**(**0.39 0 .58)	0.004
Socio-economic status			
Poorest	1		
Very poor	1.22	(0.79 1.89)	0.349
Poor	1.10	(0.77 1.70)	0.645
Less poor	1.73	(1.17 2.55)	0.006
Least poor	1.37	(0.89 2.09)	0.024
Area of resident			
Rural	1		
Peri-urban	1.33	(1.07 1.64)	0.008
Urban	0.76	(0.43 1 .20)	0.213
Religion			
Zionist	1		
Nazareth	0.87	(0.61 1.24)	0.439
Lutheran	1.44	(0.91 2.31)	0.119
Apostolic	1.12	(0.72 1.75)	0.630
Catholic	0.63	(0.32 1.25)	0.191
Faith mission	0.68	(0.28 1.68)	0.404
Africa Evangelic	1.29	(0.65 2.76)	0.490
Holy burner	0.79	(0.29 2.18)	0.660
Age	1.15	(1.13 1.17)	<0.001

Table 3.5 above presents the unadjusted hazard ratios with 95% confindence intervals obtained from univariate Weibull regression models for the analysis of risk factors associated with homicide in the period 2000 to 2008. The results show that partial-resident had about 34% statistically significant reduced risk of homicide compared to resident (HR=0.76; 95%CI=0.62, 0 .94), whereas non-resident had about 3 times increased risk of homicide compared to resident ((HR=2.95; 95%CI=2.41 3.61).

One year increase in schooling resulted in a significant 9% increase risk of homicide (HR=1.09; 95%CI=1.06, 1.12). Males were about six times more likely to experience homicide deaths than females (HR=5.6; 95%CI=4.38, 6.88)

In terms of employment, part time employees showed 42% statistically significant reduced homicide risk (HR=0.58; 95%CI=(0.39, 0 .58) compared to unemployed category, whereas full time employees experienced 22% increase risk of homicide but the increase was not statistically significant (HR=1.21; 95%CI=0.97, 1.52). Univariate analysis revealed that being in the higher wealth index is associated with increased risk of homicide. Individuals in the higher socioeconomic status category had a statistically significant increase in homicide risk of about 73% compared to those in the lower socioeconomic status (HR=1.73; 95%CI=1.17, 2.55). Whereas least poor individuals had a significant 37% increased risk of homicide compared to the poorest individuals (HR=1.37; 95% CI= 0.89, 2.09). Individuals who live in peri-urban areas had a significant 33% increased risk of homicide compared to those who live in the rural areas (HR=1.33; 95% CI= 1.07, 1.64)

There was 15% significant increase in homicide risk for every one year increase in age (HR=1.15; 95%CI=1.13, 1.17) when age was treated as a continuous variable. Religion was not statistically significant in the univariate model.

Table 3.4: Adjusted Weibull regression model of factors associated with homicide deaths

Variable	Hazard Ratio (HR)	95% CI	P-value
Resident			
Resident**	1.00		
Partial-resident	0.62	(0.4849 0 .7901)	<0.001
Non-resident	1.77	(1.2940 2.4114)	<0.001
Education	1.0022	**(**1.0019 1.0024)	<0.001.
Sex			
Female**	1.00		
Male	6.03	(4.7230 7.7226)	<0.001
Employment			
Not employed**	1.00		
Employed full time	0.67	(0.5251 0.8444)	0.001
Employed part time	0.14	(0.0889 0 .2055)	<0.001
Socio-economic status			
Poorest**	1.00		
Very poor	1.18	(0.7694 1.8225)	0.442
Poor	1.04	(0.6798 1.6112)	0.836
Less poor	1.62	(1.0942 2.3951)	0.016
Least poor	1.32	(0.8616 1.0233)	0.202
Age	1.01	(1.0082 1.0199)	0.019
Age_Sex	0.98	(0.9746 0.9972)	<0.001

3.6: Multivariate analysis of factors associated with homicide

All the variables with p-value less or equal to 0.2 were included in the final multivariate regression model. The following variables remained statistically significant in the adjusted multivariate model: - resident, age, education, employment, socioeconomic status and sex. I removed area of residency because of collinearity that existed between residency and area of resident because individuals who are considered non-residents are also the same individuals who live outside the DSS area.

From **Table 3.6** above, partial-resident had a significant 38% reduced risk of homicide compared to resident (HR=0.62; 95% CI=0.4849, 0 .7901), while non-resident showed 77% significant increase risk of homicide, (HR=1.77; 95% CI=1.2940, 2.4114) in an adjusted model. There was a significant 0.002% increased risk of homicide with one year increase of schooling ((education level) (HR=1.0022; 95% CI=1.0019, 1.0024)).

In this final multivariate model, employment per se was protective from the risk of homicide. Full time employees had 33% significant reduced risk of homicide compared to not employed category (HR=0.67; 95% CI=0.5251, 0.8444), while part time employees had 86% statistically significant reduction of homicide (HR=0.14; 95% CI=**0**.0889, 0 .2055). In terms of socioeconomic status, individuals who are considered not so poor had a 62% increased risk of homicide compared to the poorest category, this reduction in risk was statistically significant (HR=1.62 95% CI=1.0942, 2.3951), while the least poor category showed about 32% non-significant increased risk compared to the poorest category (HR=1.32; 95% CI=0.8616, 1.0233). There was no significant difference in homicide risk among the very poor, poor and least poor categories as indicated in the final adjusted model in **Table 3.6** above.

Interactions were checked between age and sex, education and socioeconomic status, employment and education, resident and employment, education and resident. Interaction term was not significant except in the case of sex and age (Age-sex; p-value= <0.001). Further analysis was done below to investigate the interaction between sex and age.

Table 3.5 Stratified multivariate analysis of factors associated with homicide death

	Male			Female		
Variable	**HR**	**95% CI**	**P-value**	**HR**	**95% CI**	**P-value**
Resident						
Resident**	1					
Partial-resident	0.57	(0.44,0.72)	<0.001	0.36	(0.19,0.65)	0.001
Non-resident	1.81	(1.31,2.51)	<0.001	0.87	(0.43,1.76)	0.705
Education	1.002	(1.001,1.002)	<0.001	1.001	(1.001,1.002)	<0.001
Employment						
Not employed**	1					
Employed full time	0.61	(0.46,0.80)	<0.001	1.43	(0.78,2.64)	0.241
Employed part time	0.17	(0.11,0.27)	<0.001	0.25	(0.07,0.81)	0.021
Socio-economic						
Poorest**	1					
Very poor	1.31	(0.79,2.14)	0.287	0.75	(0.30.1.88)	0.549
Poor	1.27	(0.79,2.07)	0.320	0.35	(0.11.1.11)	0.770
Less poor	1.85	(1.18,2.89)	0.007	0.77	(0.32.1.68)	0.568
Least poor	1.38	(0.85,2.26)	0.189	0.87	(0.34.2.18)	0.769
Age group						
0-14	1					
15-24	13.96	(7.22,26.98)	<0.001	5.80	(1.87,28.43)	0.002
25-34	24.15	(12.09,48.25)	<0.001	9.34	(2.59,33.60)	0.001
35-44	22.16	(10.88,45.12)	<0.001	7.30	(1.87,28.43)	0.002
45-54	13.18	(6.16,28.19)	<0.001	9.01	(2.21,36.83)	0.002
55-64	17.18	(7.78,37.94)	<0.001	31.51	(8.48,117,11)	<0.001
65+	11.57	(5.01,26.74)	<0.001	25.66	(6.95,94.74)	<0.001

3.7 Stratified analysis of homicide risk factors by sex

To investigate the interaction between age and sex, and to assess risk factors by sex, I did separate multivariate analysis for males and females. Resident, employment, socio-economic status, education and age group independently predicted homicide risk for males as shown by **Table 3.7** above. It was also the same case for females except socio-economic status which did not remain statistically significant.

Although both males and females partial-residents were significantly protected from the risk of homicide compared to residents; females enjoyed more protection than males, 64% (HR=0.36; 95% CI=0.19, 0.65) and 42% (HR=0.57; 95% CI=0.44, 0.72) respectively. Non-resident males experienced 81% significant increased risk of homicide compared to residents (HR=1.81; 95% CI=1.31, 2.51), whereas female non-residents showed 13% non-significant reduced risk of homicide (HR=.87; 95% CI=0.43, 1.76). There was 0.002% significant increased risk of homicide for males (HR=1.002; 95% CI=1.001, 1.002), and 0.001% significant increased homicide for females (HR=1.001; 95% CI=1.001, 1.002) with increase in the number of years of schooling.

Part-time and full time male employees enjoyed significant 83% (HR=0.17; 95% CI=0.11,0.27) and 39% (HR=0.61; 95% CI=0.46, 0.80) protection from the risk of homicide respectively compared to non employed males. While only part-time female employees experienced a significant 75% reduced risk of homicide compared to non-employed females (HR=0.25; 95% CI=0.07, 0.81). In contrast, female full-time employees showed a 43% increased risk of homicide (HR=1.43; 95% CI=0.78, 2.64), but this increase was not statistically significant. In terms of socio-economic status, males who belong to less poor group had a significant 85%

increased risk of homicide death (HR=1.85; 95% CI=1.18, 2.89), compared to the poorest category. Females on the other hand appeared protected across all the wealth categories, and the protection seemed to diminish with increase in wealth although this protection was not statistically significant.

The interaction between sex and age is clearly visible in this stratified analysis. Sex differential is observed, with males aged 15-54 having the highest risk of homicide than their female counterparts within the same age group compared to 0-14 age group. Males aged 25-34 were 24 times more likely to experience homicide death (HR=24.15; 95% CI=12.09,48.25), than males aged 0-14, Likewise females aged 55 and above were more at increased risk of homicide than their male counterparts within the same age group. Female's homicide risk seemed to increase with age, peaking in age group 55 to 64 (being 32 times more likely to experience homicide related death compared to age group (0-14) (HR=31.51; 95% CI=8.48,117,11), as shown in **Table 3.7** above.

Table 3.6 Purely Spatial analysis: Scanning for clusters with short or long survival using the exponential model.

Cluster	Individuals	Number of cases	Expected cases	Log likelihood	P-value
1	6832	66	35.27	12.3290	0.042
2	4823	52	25.02	12.3208	0.042
3	6645	13	34.13	9.3354	0.466
4	5	2	0.011	8.3918	0.742
5	37	4	0.20	8.2902	0.766
6	18	3	0.079	8.0148	0.837
7	22	3	0.089	7.6645	0.945
8	5	2	0.018	7.6645	0.914
9	1952	1	9.95	6.7787	0.996
10	5904	13	30.24	6.7657	0.996

Table 3. 7 Statistically significant clusters

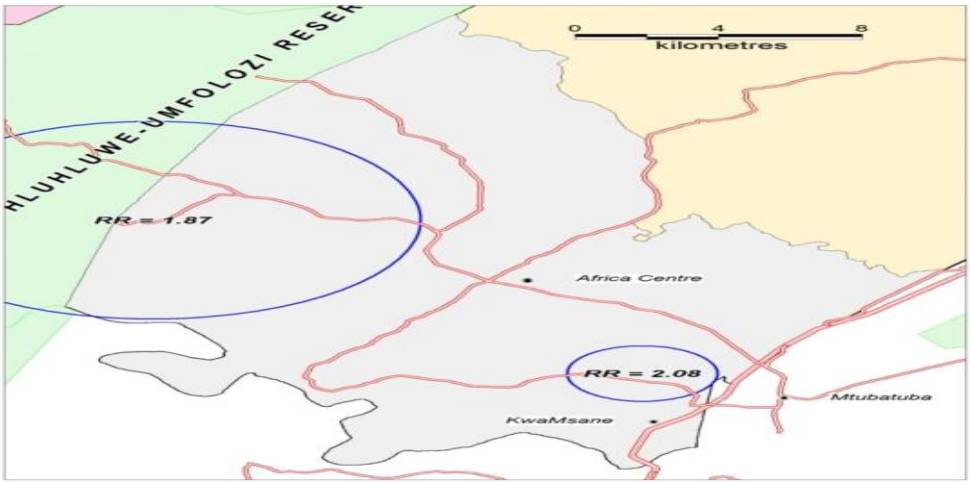
Cluster No.	Radius (km)	Cases	RR	Log likelihood	P-value	description
1	7.45	66	1.87	12.33	0.042	High-density settlement
2	2.10	52	2.08	12.32	0.042	Peri-Urban/high/ HIV

3.8 Detection of homicide clustering

The results of the purely spatial scan statistics using exponential survival models time data revealed a considerable geographical variation in homicide rate across the study area as shown by **Table 3.8**. From the **Table 3.8** above, 10 different clusters were identified, but only two clusters did not occur by chance (were statistically significant at 5% level of significant). Cluster 1 was the most likely cluster with significant increased homicide risk (RR= 1.87; P=0.042); having 87% increased risk of homicide compared to the rest of the DSA. Cluster 2 was the

secondary location with shorter significant survival time (RR= 2.08; P=0.042), where the risk of homicide was observed to be 2 times of those outside the area as shown by **Table 3.9**.

Figure 3.10: Location of two significant clusters with elevated rate of homicide



The most likely cluster with significantly reduced survival time was the vicinity of North-western part of DSA covering Hluhluwe Umfulozi reserve area as shown by **Figure 10** above. Secondary cluster with shorter survival was found around the township of KwaMsane South Eastern part of Africa Centre DSA.

From the results, the study quantified incidence rate as 66 per 100,000 PYOs for the period studied (2000-2008). Residency, employment, socio-economic status, education and age group emerged as homicide risk factors in the final multivariate analysis, except socio-economic status which did not remain statistically significant for females. Description of the spatial distribution of homicide identified two geographical areas with elevated risk of.

CHAPTER FOUR: DISCUSSION

To the best of my knowledge, this is the first ever longitudinal population based cohort study to provide important information on levels, correlates, and spatial distribution of homicide-related deaths in KwaZulu-Natal (KZN) province in South Africa. The study is unique in that it examined all of the homicides that occurred in a defined, culturally homogeneous community over an extended time period. It is worth noting that comparative analysis of intentional homicide must be considered carefully. This is because the legal definition of intentional homicide differs among studies. The definition may or may not include assaults leading to death, infanticide and assisted suicide or euthanasia.

4.1 External cause of death

An investigation of external causes of death in KZN revealed that firearm-related fatalities made up a substantial proportion (approximately 65 percent) of all violent deaths, and that firearm ranked as the leading external means of death, followed by sharp object 22%, and blunt object 4%. Our findings are in agreement with several reports that firearm-related mortality was the major component of homicide[92-94]. According to United Nations survey of 69 countries, South Africa has one of the highest firearm related homicide rate in the world[95]. Previous studies of violent death have called particular attention to the magnitude of firearm use in both homicides and suicides[27;79;96]. Relatively high levels of firearm use and gun ownership have long been identified with the American southern culture[77], and the use of firearms has been identified as an area of public concern[78;78;79] In 2002, a total of 5,719 homicide occurred in Sao Paulo city in Brazil. Firearm and sharp objects were used in 62.0% and 4.7% of all incidents, respectively.

Top five external causes of death for the year 2000 according to NIMSS were firearm, sharp objects, vehicle accident, and blunt objects and in that order. 2007, NIMSS suggested that nearly

40% of homicides were committed with sharp objects and just over a third resulted from gun shots. According to professor Rachel et al study (2009), guns play a major role in violence and homicide in South Africa, and the rate of firearm ownership is among the highest in the world, with a third of all female and male (39%) homicides committed with guns[97]. The shocking statistics is that the numbers of guns are increasing annually in South Africa, with the Central Firearm Registry receiving about 18,000 to 20,000 new applications monthly[96]. Further estimates suggest that there are 11 to 13 million firearms in South Africa, out of which 4 million are illegally owned[96;98] . Provincial police figures released in 1996 showed that most firearm murders occurred in KZN (32%), followed by Gauteng (30%). NIMSS (2007) revealed that the peak days of homicide were Saturday (25.3%), followed by Sunday (23.2%), then Friday (12.6%)[99]. That finding was replicated in this study.

4.2 Magnitude of homicide

While the study demonstrates a general slow temporal decline of homicide rate in KZN over the period studied, the rate still remains pretty high. With a mean of 5.9 years of follow-up, the study reported an overall homicide incidence rate of 66 per 100,000 person years of observation for the period studied, one of the highest rates by any standard. The rate is nearly eight times higher than the global homicide mortality estimate of 8.8 deaths per 100,000 population in 2000[1], and nearly six fold significant difference in homicide rate observed between males and females, was higher than the three-fold difference seen at the global level (men 13.6/100,000; women 4.0/100,000)[100]. Male and female incidence rate were 115 per 100,000 and 21 per 100,000 PYOs respectively. The present study supports Mohamed Seedat and colleagues findings that the dominant feature of violence in South Africa is the disproportionate role of young men as

perpetrators and victims [101]. This study demonstrates that males bore the greatest brunt of homicide compared to females. Across all age groups, male homicide rates were substantially higher than females, with homicide survival curves by gender showing males having low survival compared to females.

This rate was in fact far much higher than the homicide rate reported by Outwater et al (2005) study in Dar es Salaam which was 12.57 per 100, 000 PYOs[53]. The present study finding conforms to previous studies that have consistently reported uneven distribution of homicide rate by sex, with rates substantially lower among females than males, suggesting that being a male is a stronger demographic risk factor[19;28;53;102].

The reported rate is comparable to the rate reported for the whole country in 2003 when South Africa was second to Columbia among the top ten countries for homicide (51 per 100,000 population)[95]. Shahnaaz et al (2002) reported 85.44 homicide/100,000 population) in Cape Town in 2002[55]. This rate was almost equal to (72 per 100,000 population) rate reported by NIMSS in 2000 which was thought to have overestimated homicide by approximately 7%.

The most striking findings are the high rates of homicide observed in 2001 and 2004, which were 89.62 and 78 per 100,000 person years at risk respectively. This high rate in 2001 is in line with July-September 2001 figures released by South African Police Service (SAPS) as part of the statistics for the first three quarters of 2001 when recorded crime increased between 2000 and 2001 and peaking in 2001[103]. Increase in 2004 could have been attributed to turbulent political transition; the rivalry between ANC and the IFP resulted into killings during the presidential and parliamentary elections in 2004. Elections-time in KZN is synonymous with political violence[104].

4.3 Correlates and determinants of homicide

My final multivariate model revealed that the likelihood of an average male person falling victim is strongly influenced by his age, sex, socioeconomic position, place of residence, level of education and whether an individual was employed or not. Similar findings were noted among females except in the case of socioeconomic status which was not associated with homicide.

The study established a 38% significant reduction in homicide risk among partial-residents compared to residents. Female partial-residents were about 20% less likely to be victims of homicide than male partial-residents. On the contrary, male non-residents were more likely to experience homicide-related death compared to residents, while female non-residents enjoyed a non-significant slight reduction in the risk of homicide death. As it is the case; partial-residents and non-residents are in most cases outside the DSA, either working in the nearby townships or far away. The discrepancy between these two findings requires further investigation. In my view, more research is needed to unearth the place of death and possibly the offender. At the time of the study, we were unable to check the place of death because there was lots of missing information.

Much research has established strong connection between age and homicide[105-107]. A dramatic rise in homicide in the latter 1980s peaked during 1990s, and then declined at an equally dramatic rate was better understood only by examining rates in specific age, sex and racial group[108].

This study found that despite the high level of homicide in KZN, the risk is not uniformly distributed, clear differences existed by age and gender as revealed by the stratified multivariate analysis, with males aged 15-54 having higher risk of homicide compared to females of the same age category, and females age 55+ having greater risk than males of the same age category, and

female homicide risk increasing with age. Some previous comparative studies have found similar results[109;110]. High risk of homicide observed among women aged 55+ conforms to Shahnaaz et al.(2008) study which found that in three of the major cities in South Africa, the highest homicide rates were reported in the over 60 years category, with Durban, the closest major city to the surveillance having the highest rate, and Cape Town reporting the high rate of occurrence for the 50-59 year of age category[55].

The low homicide survival among males could be attributed to the dominant ideology of masculinity, wide gun ownership which is mainly a male phenomenon, and the social enactment of rage. Criminology has shown that certain communities are affected by violence; the theory is that these people exist on the fringe of the society. They see violence as natural phenomenon. There are chances that more often than not male South African men involve themselves in risk-taking behaviors to demonstrate toughness and bravery, always at the forefront, ready to fight in defense of 'honor' and 'status'[101]. This in turn translates into death, hence become victims and perpetrators of violence. This could be one possible explanation of high rates of homicide among males in KwaZulu-Natal.

Furthermore the study demonstrated that increasing age was associated with higher levels of risk in females, peaking in 55-64 age groups. Similar findings were found by Shahnaaz et al. (2008) on female homicidal strangulation study in South Africa's major cities. Shahnaaz study found out that in three of the major cities, the highest risk of homicide were reported in the over 60 years category with Durban, the closest major city to the surveillance area having the highest rate, and also Cape Town reporting high rate of occurrence for the 50-59 year age category[55].

Social factors such as socioeconomic status (SES) are viewed as fundamentals determinant of illness and death for other health outcomes[111]. Studies suggest that SES is an important risk factor for injury mortality[43;112;113] .

South Africa's unique political history and the resulting social and economic inequalities have been identified as contributing factors in the high rate of interpersonal violence[101;114]. Poverty level in South Africa stands at 45%, and does not seem to be falling: nearly 20 million of the populations live at or below the poverty line. Poverty is largely coupled with high and rising unemployment, and widening income inequality (Gini coefficient 0.58)[36]

Several other factors are also known to indicate those at risk of violence related deaths including; poverty, lack of education, unemployment, alcohol, substance abuse intimacy and power[34;37;115]. Contrary to previous studies that have found poverty to be a major economic source of homicide[34;35], the present study found out that belonging to a higher socioeconomic status increases ones risk of homicide among males, with less poor reporting significant 85% increased risk of homicide compared to poorest, although the other wealth category among males showed increased risk, they did not remain statistically significant in the stratified multivariate analysis; but in the univariate analysis, the least poor category was significant. Cubbin et al. study of socioeconomic inequality in injury found that increasing on SES has a strong inverse association with the risk of homicide and fatal unintentional injuries[34]. Findings on the association between homicide, socioeconomic status and employment are in total agreement with study done by Mthatha in 2006 which found that poverty and unemployment are probably the factors behind the cause of high violence in the area[116].

This low survival observed among males in the higher socioeconomic position may imply that increase in wealth increases one's risk of homicide, especially the less poor category that is

perceived to be economically better off and may be vulnerable because of less protection as compared to the least poor category. But this could be better understood if SES is used as a determinant of homicide outcome rather than a confounder[80]. The study supports Eric Schneider's view that although being in the lower socioeconomic position predicts homicide[25], there is no direct causal relationship between poverty and homicide, but it contradicts a study on the experiences of violence and socioeconomic position in South Africa (Doolan et, 2007) which found that being in the wealthiest quintile is protective against violent death[9]. Females on the other hand appeared protected from the risk of homicide, but this was not statistically significant.

With respect to employment; being employed per se was protective against homicide as revealed by the multivariate analysis; moreover the data suggested that being employed part time or full time was significantly associated with reduced risk of experiencing homicide. This finding may be explained in part by the reduced risk associated with working away from homicide prone areas, or being able to stay away from activities that would lead to homicide like binge drinking, involvement in an election campaign because these individuals are busy at least for some days in a week, thus having less exposure time, hence do not become a target for murder. This finding contradicts a major national study done by Doolan et al in 2007 which found that employment was a risk factor for violent deaths[9], but supports her findings that education is a risk factor for violent deaths. Thestudy therefore provides more evidence for the protective effect of employment observed in other studies.

Alcohol has often been cited as a contributing factor in fatal and non fatal injuries in South Africa [62;117;118]. Although it does not emerge clearly in this study, it is likely that alcohol is a significant contributing factor, the association between alcohol and homicides is among the possibilities warranting further investigation, given the fact most homicide deaths occurred

during weekends and Fridays. Wolfgang noted that history of alcohol use by victims and/or suspects was greater for homicide occurring over the weekend (Saturdays, 73% versus Monday, 41%)[119].

4.4 Spatial distribution of homicide

Scan statistics uses a different statistical probability model depending on the nature of the data. The spatial scan statistics with Bernoulli and Poisson are commonly used in detecting clusters in spatial count data; however, neither of the two models is applicable to survival data. I employed scan statistics based on an exponential model that is meant for uncensored or censored continuous survival time. The study found two geographical clusters with significantly elevated risk of homicide compared to the entire demographic area, and therefore I rejected the null hypothesis of no clustering.

These two locations are known to be violent prone, and are considered "hot spots". In addition, South Eastern location (peri-urban) is also known to bear the highest HIV prevalence, and is also a home to the two warring political parties (NAC and IFP). Further analysis is needed to understand the cause of violence in these particular clusters.

In a population already burdened by HIV-related mortality, the additional mortality burden from violence has substantial health, social and economic consequences. A recent study from this area found that HIV-related causes accounted for 71.5% of deaths in the 25-49 year age group [120].However, with the expanding HIV treatment programme in the area, there is the likelihood of reduction in HIV-related deaths, thus, violent-related mortality are likely to become more prominent if not checked.

4.3 Study limitations

- A number of limitations should be considered when interpretation the findings from this study. First, our study was done on a defined, culturally homogeneous community. In a culturally homogeneous population, it is possible that people's behavior, perception of violence and violent nature may differ from other communities. This might limit our generalizability to other populations.
- There was likelihood of underestimate of homicide rate; especially for those people who died in hospitals after being poisoned or shot.
- The verbal autopsy (VA) is an epidemiological tool that is widely used to ascribe causes of death by interviewing bereaved relatives of the deceased who were not under medical supervision at the time of death. More often than not, VAs never attains one hundred percent sensitivity and specificity.

The following biases might have risen from verbal autopsy technique

- VA assumes most causes of death have distinct symptom that can be recognized, remembered and reported by lay respondent, and that it is possible to classify causes into meaningful categories. Accuracy of the estimates depends on the family members' knowledge of the event leading to cause of death. This is likely to lead to a recall bias due to time lag.
- Causes of deaths have limited reliability when reported by lay person and can be subjective. They may be subject to under or over reporting.
- Data collection is subject to the quality of interviewing skills by field workers and as well the quality of the VA questionnaire.

- Other weaknesses stem from inability to measure the association of HIV/AIDS and marital status with homicide because of the biases that might have risen due to high prevalence of HIV/AIDS in the area and also due to the fact that in KZN, marriage happens at advanced age due to high price for dowry (commonly known as lobola).
- Other variables of interest like place of death, drugs use and the perpetrator of homicide were missing.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

5.1 Conclusion

High firearm fatalities observed in this study imply that gun ownership represents a danger to the public. The findings of this study add to the body of research by identifying factors associated with homicide-related deaths. The present study provided more evidence for the protective effect of employment observed in other studies. Females aged 55 and above were at a greater risk of experiencing homicide compared to males of similar age group. Study observed two geographical areas with elevated homicide risk.

5.2 Implication of the study and Recommendation

Based on the findings, the study puts forward several recommendations to reduce incidence of homicide and preventive intervention strategies with regard to factors associated with homicide.

5.2.1 Unemployment and income inequality escalate homicide

The present study indicated that employment per se was protective from risk of homicide, but wealth increases the risk of homicide.

- Study therefore proposes federal jobs policy. Work has been the antidote in the past. This will reduce the gap and engage both the offenders and the victims.

5.2.2 Males are disproportionately at increased risk of homicide victimization.

Like in any other part of the world, South Africa's men from across the racial spectrum are raised to see themselves as superior, and taught to be tough, brave, and strong and respected. Heavy drinking, carrying weapons, and always ready to defend honor with a fight. The ensued violence often has very severe consequence[97].

- I therefore recommend strict legislation that deals severely with the offenders. There is also need to strengthen legal and criminal justice systems to be competent, efficient and trustworthy. The government needs to do more to stump out corruption within the law enforcement circles and support a more positive public image.
- To effectively contain violent-related deaths, there is need to involve all relevant stakeholders to take the lead in promoting discussion at both local and national levels about acceptable and unacceptable behavior, engaging with the public to change the often permissive attitudes that exist towards violence, and to nurture and ensure community cohesion and peace.

5.2.4 Death by firearm is more prevalent

High levels of firearm fatalities and violence imply gun ownership represents a danger to the public health. Much as it is justified to own a gun for recreational or personal protection; more often than not, these guns end up in the wrong hands. By the time I was doing this study, the government amnesty for gun license renewal was almost expiring with just few people managing to renew their licenses. Community policing and gun control can help: limiting the number of weapons that can be sold to an individual or forbidding the sale of automatic weapons.

- Community policing can be achieved by improving the accessibility of anonymous reporting hotlines, as well as the public's awareness of such mechanisms.

Finally I recommend more longitudinal studies to closely monitor the trend of homicide and to keep up to date with the emerging risk factors.

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Appendix 1: Ethical approval forms

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BIOMEDICAL RESEARCH ETHICS ADMINISTRATION
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02 February 2010
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PROTOCOL: A socio-demographic platform for population-based reproductive health research in a rural health district of KwaZulu-Natal. Dr A J Herbst. Ref: E009/00

RECERTIFICATION APPLICATION APPROVAL NOTICE

Reference Number:	E009/00
Approved:	20 November 2009
Expiration of Ethical Approval:	19 November 2010

I wish to advise you that your application for Recertification dated 07 October 2009 for the above protocol has been noted and approved by a sub-committee of the Biomedical Research Ethics Committee (BREC) for another approval period. The start and end dates of this period are indicated above.

If any modifications or adverse events occur in the project before your next scheduled review, you must submit them to BREC for review. Except in emergency situations, no change to the protocol may be implemented until you have received written BREC approval for the change.

The approval will be ratified by a full sitting of the Committee at a meeting to be held on **09 March 2010.**

Yours sincerely

pp Ms D Ramnarain
Senior Administrator: Biomedical Research Ethics

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Mr George O Otieno

CLEARANCE CERTIFICATE	**M10350**
PROJECT	Levels and Factors Associated with Homocide-Related Deaths in a Rural South African Population
INVESTIGATORS	Mr George O Otieno.
DEPARTMENT	School of Public Health
DATE CONSIDERED	26/03/2010
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 14/04/2010 **CHAIRPERSON** ..... (Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : E Marinda

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

Appendix 2: Trends in homicide rates per 100,000 P YOs

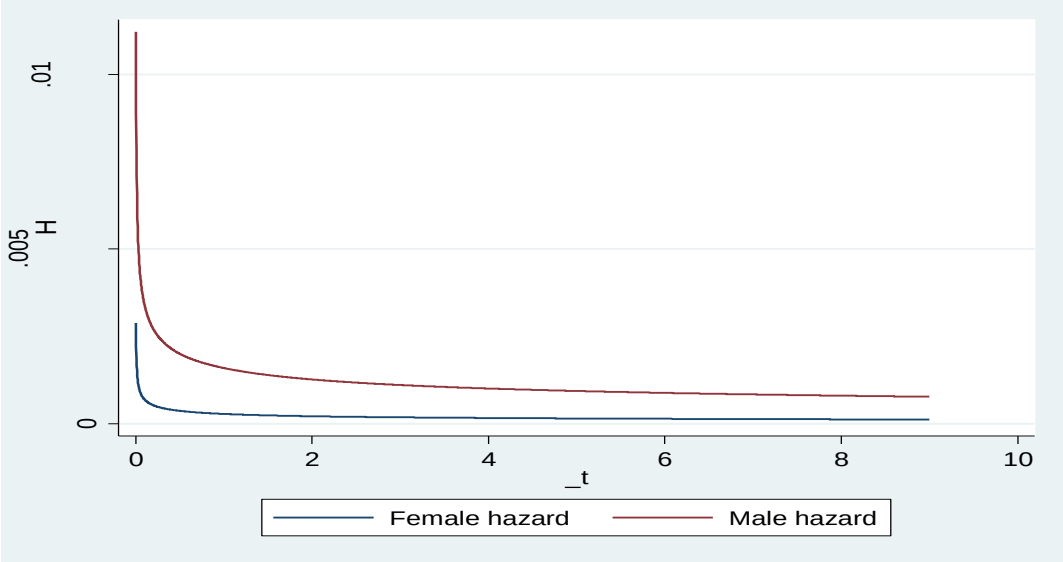
YEAR	Deaths	PYOs	Rates/100,000	95% CI
2000	58	90298.59	64.23	(48.77,83.03)
2001	81	90376.76	89.62	(71.18,111.4)
2002	53	90612.41	58.49	(43.81,76.51)
2003	68	89948.15	75.60	(58.71,95.84)
2004	78	90286.04	86.39	(68.29,107.82)
2005	52	90110.66	57.71	(43.10,75.67)
2006	62	90626.66	68.41	(52.45,87.70)
2007	51	91442.61	55.77	(41.53,73.33)
2008	33	90455.55	36.48	(25.11,51.23)

Appendix 3: Trend in homicide rates per 100,000 PYOs for Resident

YEAR	Deaths	PYOs	Rates/100,000	95% CI
2000	31	64626.43	47.97	(32.59,68.09)
2001	42	68080.97	69.04	(50.72,91.80)
2002	23	68766.55	42.17	(28.24,60.57)
2003	31	67732.13	54.63	(38.46,75.30)
2004	37	67041.83	73.09	(54.07,96.63)
2005	21	66210.74	48.33	(33.06,68.23)
2006	28	66335,47	58.79	(41.81,80.37)
2007	16	67688.35	39.89	(26.29,58.04)
2008	11	66914.55	20.92	(11.44,35.10)

Appendix 4: Homicide Diagnostics

Distribution of hazards



Cumulative distribution