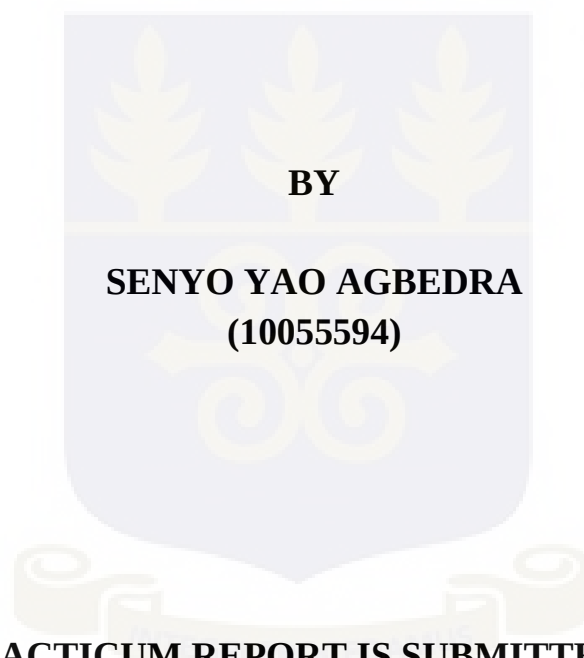


**UNIVERSITY OF GHANA
COLLEGE OF HEALTH SCIENCES
SCHOOL OF PUBLIC HEALTH**

**SPATIAL DISTRIBUTION OF HIV/AIDS CASES AND
ACCESSIBILITY TO TREATMENT CENTERS IN SUNYANI
MUNICIPALITY**



**THIS PRACTICUM REPORT IS SUBMITTED TO THE
UNIVERSITY OF GHANA, LEGON, IN PARTIAL FULFILMENT OF
THE REQUIREMENTS FOR THE AWARD OF MASTER OF
SCIENCE DEGREE IN HEALTH INFORMATICS**

JULY, 2018

DECLARATION

I Senyo Yao Agbedra, the author of this field practicum report hereby declares that except for the references to other people's work which has been duly acknowledged and cited, this work is a product of my own efforts as a student of University of Ghana School of Public Health, College of Sciences. This work is submitted in partial fulfilment of the requirement for the Masters of Science Degree in Health Informatics 2017/2018. This work has never been submitted either in part or whole in any other institution for the award of a degree.

.....

Senyo Yao Agbedra

(Student)

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Date

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Dr. Seth K. Afagbedzi

(Supervisor)

.....

Date

DEDICATION

This work is first dedicated to the Almighty God for giving me the strength and knowledge to successfully complete this research.

I also dedicated this work to my Late Parents Mr. & Mrs. Agbedra in blessed memory and finally my Rotary international Partners in Nanaimo in British Colombia in Canada most especially Professor Ken Hammer and Bev Hilton.

ACKNOWLEDGMENT

My utmost appreciation goes out to all the faculty members of the Biostatistics Department-School of Public Health for all their efforts in my training, most especially my supervisor Dr. Seth K. Afagbedzi.

I am also grateful to all my course mates who in one way or the other have helped me in the course of my study.

Finally, my profound gratitude and love to my family especially my lovely wife Mrs.Elizabeth Agbedra and my sweet children Kafui Peace Afi Agbedra, Elorm Cecilia Adzo Agbedra, Emmanuel Elikem Korku Agbedra not forgotten my dear sister Dzifa Agbedra and her daughter Joycelyn Yayra Nartey, Winfred Dotse-Gborgbortsi, Patience Nornor-Quadzi and Dr.Williams Obinkyere (University of Minnesota).

ABSTRACT

Introduction

Satisfactory allocation of resources is essential as far as efforts to combat HIV/AIDS menace, especially in Africa. In determining HIV patients location, the nature of services must be in line with the behavioral, geographic and the social characteristics of the patients. This study, therefore, examined the spatial distribution of HIV cases and accessibility to treatment centers in the Sunyani Municipality.

Methods

To enable spatial analysis of HIV patterns, the locations of clients were geocoded. The 978 cases came from 44 unique communities in the Sunyani municipality. Summary descriptive statistics of demographic characteristics and other important HIV indicators were done. Spatial analysis was done to show the distribution of HIV cases in the Municipality. Also, Morans' I statistics were computed to find out if there was clustering. Paired t-test was done to determine the mean distance traveled to the ART centers. Placemarks were used to extract locations, it was exported as xml and converted into geodatabase feature classes using ArcGIS conversion tools.

Results

From the study, most communities such as Fiapre, Odumase, and Abesim with a high prevalence of cases were located at the periphery of the municipality. Also, communities along New Dormaa to Chiraa stretch recorded a high number of cases compared with other other communities linking the municipality. However, access to the ART centers in the periphery communities was low with the minimum distance traveled been 5.96km.

Conclusion

The results suggested that analysis of facility-based data could provide a more robust estimation of a broad spatial distribution of the HIV case in the Municipality. However, similar analyses should be conducted in other Municipalities with equally high prevalence rates to assess whether these patterns are observed elsewhere.

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LIST OF ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ART	Anti-Retroviral Therapy
ARV	Anti-Retroviral
CDPC	Centre for Disease Control and Prevention
GHS	Ghana Health Service
GIS	Geographic Information System
GSS	Ghana Statistical Services
HAART	Highly Active Anti-Retroviral Therapy
HIV/AIDS	Human Immunodeficiency Virus
HSS	HIV Sentinel Survey
ID	Identification
KP	Key Populations
MHD	Municipal Health Directorate
MOH	Ministry of Health
NACP	National AIDS/HIV Control Programme
PLWH	People living with HIV/AIDS
PMTCT	Preventing Mother-to-child transmission
STD	Sexually Transmitted Disease
TB	Tuberculosis
UN	United Nations
UNAIDS	United Nations Program on HIV and AIDS
UNICEF	United Nations International Children's Emergency Fund
USAIDS	United States Agency for International Development
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Background

The Human Immunodeficiency Virus and the Acquired Immune Deficiency Syndrome (HIV/AIDS) represents a health problem worldwide and remains one of the World's deadliest disease. Piot et al. (2001) specified that since the diseases identification many years ago, the magnitude of the HIV/AIDS epidemic has surpassed all expectations. According to UNAID (2016), a projected 36 million people worldwide are presently infected with the virus with over 20 million already dead from the menace and sub-Saharan Africa recorded the worst conditions. The increase experienced with the transmission of the virus has caused a great impact on the social, population and on the growth of the economy. Although in some areas, improvement in the condition has been realized, the total disease eradication when completely stopped would have severe long-term effects on the health, social and economy well into the 21st century. In spite of progress in treatment and care recently the virus keeps spreading throughout the world. (Parker, 2002).

Parker (2002), argued that the epidemic is fueled in all societies by structural disparities and the virus has progressively been centered in societies all over the world that are in the underprivileged, most relegated sectors. The link between the virus as well as the social and the development of the economy has become a key discussion by policymakers on how to respond effectively to the epidemic (Parker, 2002). In Africa, the occurrence of the HIV/AIDS epidemic has become a great challenge to governments on the continent and national governments and civil society groups are playing roles in raising awareness to control the spread of the virus (Fobil & Soyiri, 2006). Whiteside (2002), indicated that in

Africa, HIV/AIDS represents a key threat to development, poverty alleviation and growth of the economy although the complete magnitude of the devastation caused to the continent is unknown. The epidemic has been recognized and documented in Ghana and currently covers all socio-economic facets of life. According to Fobil and Soyiri (2006), the projected infection rate has become greater than before and regardless of strategies by governments and organizations, the virus dominance is not decreasing.

To understand HIV/AIDS for effective implementation of measures to curd the virus, the study of the geography is critical to revealing an accurate presentation of the pattern of the disease currently (Nneka Ezike-Dennis, 2007). Nneka Ezike- Dennis (2007) posited that the region essential for concern is the mode through which the growth and variation of HIV/AIDS occur within a spatial unit. The only nationwide population-based survey in Ghana on HIV occurrence was conducted in 2003 during the Ghana demographic and health survey (GSS, 2010). Unfortunately, however, these surveys are usually expensive, time-consuming and sometimes confronted with major ethical challenges for which reason they are infrequently used.

Although Ghana has an integrated disease surveillance system there seems to be a current trend where donor sponsored disease control program prefer to operate vertically build surveillance systems in parallel to an integrated disease surveillance system which has been criticized for untimeliness and poor quality of output data.

In Ghana, the National HIV/AIDS control program (NACP) has developed its own sentinel surveillance system known as the HIV Sentinel Survey (HSS) to monitor HIV prevalence rates in the whole country (Koka., Ahorlu. & Agyeman, 2013). Data on HIV is collected in all the health facilities over Ghana. Regional HIV prevalence is calculated as a simple mean of the HSS site-specific prevalence with a region. The national HIV/AIDS prevalence rate

is, however, modeled using HSS data, demographic health survey as well as other programme data. The national median HIV prevalence rate which is regularly quoted in the HSS annual report is also estimated.

Ghana currently has (40) HSS sites in all ten regions with most regions having four sites. Since risk factors for disease transmission are non-homogeneously distributed within any region sentinel site locations have been chosen to reflect intra-regional socio-economic and cultural diversity.

However, their numbers are not adequate to do the work. In fact, it will be impracticable to expect each district to have a sentinel site to allow for estimation of the district prevalence rates because of cost implications. Spatial epidemiology methods, however, provide an alternative means of optimizing the benefits of surveillance data by providing predictions for unmeasured locations (WHO, 2011). Earlier studies have revealed that the virus prevalence is subject to spatial autocorrelation which is the degree of the interdependent among data points arranged in a three-dimensional grid. The Spatial function in Geographic Information Systems (GIS) which is based on the concept of spatial autocorrelation is therefore, an appropriate geospatial model for analyzing disease prevalence rates. Applying GIS in epidemiological studies has many advantages, it serves as a powerful visualization tool which can depict spatial and temporal trends in morbidity rates at different geographical scales even when the data imperfect. In fact by making information visually appealing and simple to understand it can serve as a very effective tool for public health advocacy among decision makers and the general population (Kalpeni & Zulu, 2008).

The study will, therefore, seek to explore the usefulness of the spatial distribution modeling as a tool to show how HIV cases are spatially distributed and also look at the geographical location in the Sunyani Municipal area in the Brong Ahafo Region of Ghana.

1.2 Problem Statement

HIV/AIDS is spreading at an alarming rate globally putting everyone at risk. It strikes down most people in their prime age. As it affects the economically active labor force, it threatens productivity thereby worsening Sub-Saharan African economies in particular and the world at large (WHO, 2001). In spite of progress in prevention as well as social interventions for the virus, the rates of infection and new cases keep increasing (Centers for Disease Control and Prevention, 2005). Accordingly, public health professionals are progressively changing their effort from approaches that focus wholly on individual risk factors to those that reflect the multifaceted and influential impact of the socio-physical environment (Thomas et al., 1999; Aral et al., 1996 & Ross et al., 2004). Ellen (2003) reiterated that a lot of researchers have detected that HIV dominance and occurrence tend to gather in geographically defined hyperendemic regions and these regions are frequently categorized by high levels of racial or ethnic discrimination with low socioeconomic status having high rates of homicide and other criminal activities.

Ghana is experiencing a mixed HIV epidemic characterized by a relatively low occurrence in the overall population and a high prevalence among key populations (KP) and has been characterized by a comparatively higher HIV prevalence in urban sites compared to rural sites (GHS/MOH, 2015). The GHS/MOH (2015) indicated that urban HIV prevalence was twice as much as the rural prevalence thus establishing Ghana's epidemic as strongly urban. The 2015 national HIV prevalence was estimated at 3.2% compared with HIV prevalence for Sunyani which was 3.8% and has increased to 4.2 in 2016 above the national median prevalence.

Although the municipalities battle against HIV/AIDs is achieving results as the prevalence rate for HIV/AIDs is declining, this presents a great opportunity to work towards ending the epidemic by identifying other interventions to help curb this menace. To be able to achieve

a sustainable development goal it would be important to identify factors that affect HIV control and barriers to treatment adherence. The geographic distribution of HIV in the Sunyani East municipality has not been studied to provide the understanding that will enable effective design and adoption of interventions in problem areas.

The burden of HIV in the municipality may not be uniform but varies geographically as such understanding the locations with most people infected with the virus will enable the government and other agencies assign resources to those areas to help curb the spread of the virus. Reducing the risk of infection and treatment to adverse outcome can be evaluated by knowing the geographic distribution and identifying high-risk areas. The inability to intensify the control measures at certain specific locations may be accounting for the poor program indicators.

The application of GIS to examine the situation geographically and to identify significant clusters would give a good account of the HIV situation in the municipality for targeting efforts and further research. Although measures have been put in place in the municipality to fight the HIV/AIDS menaces recognizing the geographic clustering of HIV has consequences not only for examining fundamental etiology but for devising actual interventions. This study will, therefore, assess the spatial distribution of HIV cases in the Sunyani Municipal in the Brong Ahafo region with high HIV prevalence.

1.3 Research Objectives

1.3.1 Main Objectives

The main objective of the study is to describe the spatial distribution of HIV cases and accessibility to treatment centers in the Sunyani Municipality.

1.3.2 Specific Objectives

The specific objectives are as follows:

- 1) To determine the spatial pattern of patients with HIV in Sunyani municipality in 2017;
- 2) To assess if there are clustering of HIV cases in Sunyani municipality; and
- 3) To assess the geographical accessibility of ART centers to the HIV patients

1.4 Scope of Study

The study covered all cases of HIV/AIDS registered by designated health facilities in the Sunyani municipal district during the period of 2017 for the treatment under the national HIV control programme (NACP) protocol. All HIV cases registered in the district for the period 2017 were studied.

1.5 Significance of Study

With respect to HIV analysis by the Municipality in Ghana, Sunyani Municipality has focused on the use of national templates and analysis requirement solely. These templates are limited to minimum sets of indicators to monitor the HIV programme in the districts and are mostly focused on performance tracking with few epidemiological extents. Much has not been done locally to explore other dynamics of the disease and its connections to populations living in the setting like Sunyani which is peri-urban and rural. Since the spatial pattern of HIV in the Sunyani area has not been studied, and in an attempt to address the HIV menace and high treatment adverse outcomes in some jurisdiction, GIS and spatial analysis will be used to determine cluster and identify locations of where the HIV cases are coming from. The results of this study will tend to benefit policymakers, surveillance efforts and the general care of the patients. This study will also help identify high-risk cluster areas

of the HIV treatment adverse outcome in the Municipality and these can be used to help target efforts (Treatment and control) and limited resources to high-risk areas and ultimately improve HIV infection control in the rural areas of the Sunyani Municipality.

1.6 Structure of the report

This practicum report is organized into six chapters. Chapter one introduces the background of the study, research questions, objectives of the study, significance, and scope of the study. Chapter two presents the theoretical and empirical review for the study. The third chapter focused on the research methods and the definition of key variables for the study. Chapter four discussed ways of data collection and methods for analyzing spatial clustering of HIV cases and the use of GIS to implement these methods. This chapter looked at sets of methods for analyzing area and point-based health information and explain the procedures and concepts that underpin the methods. Chapter five focused on the discussion of results. In the final chapter the summary of findings, recommendation and conclusion were discussed. In this chapter, the researcher presented the findings of the study and its implications and suggest the direction for future research.

CHAPTER TWO

LITERATURE REVIEW

2.1 Synopsis of HIV and AIDS

As early as 1980, HIV/AIDS was initially known and since then more and more people have been infected with the virus which keeps increasing fast worldwide (Aid for Aids: your life. Our life, 2005). HIV causes AIDS which is generally a disease condition greatly discussed as the numbers infected keep increasing day by day. The virus is transmitted through contact with blood via sex or blood transfusion as well as in the course of pregnancy, birth, and breastfeeding (UNAIDS, 2000). When the virus enters the blood, it slowly damages the immune system which becomes weak as the system loses its capability to protect itself from infections and germ for instance pneumonia and TB that attack it, and this takes a number of years. Presently HIV/AIDS has no cure although progression of the virus can be slowed by treatments to enable people infected to live relatively long and healthy lives.

Today the virus is a key worldwide health crisis that affects entirely all people in all nations resulting in deaths while causing pain to many more households. The WHO (2003) indicated that HIV/AIDS represents the main source of death to the adult population with a mortality rate that reaches 100 percent. Families are torn apart as a result of the virus which causes indescribable sorrow to many regions that are deeply burdened. In some underprivileged areas worldwide that have been hit with the virus, advances in the longevity of life recorded over the last few decades have been overturned (WHO, 2003).

HIV/AIDS energizes other diseases such as tuberculosis which is a major international concern since it results in death not only amongst HIV infected people but other members of the family and surroundings who are HIV negative. Differences exist in those affected by the virus, the treatment and preventive measures in addition to outcomes encountered by

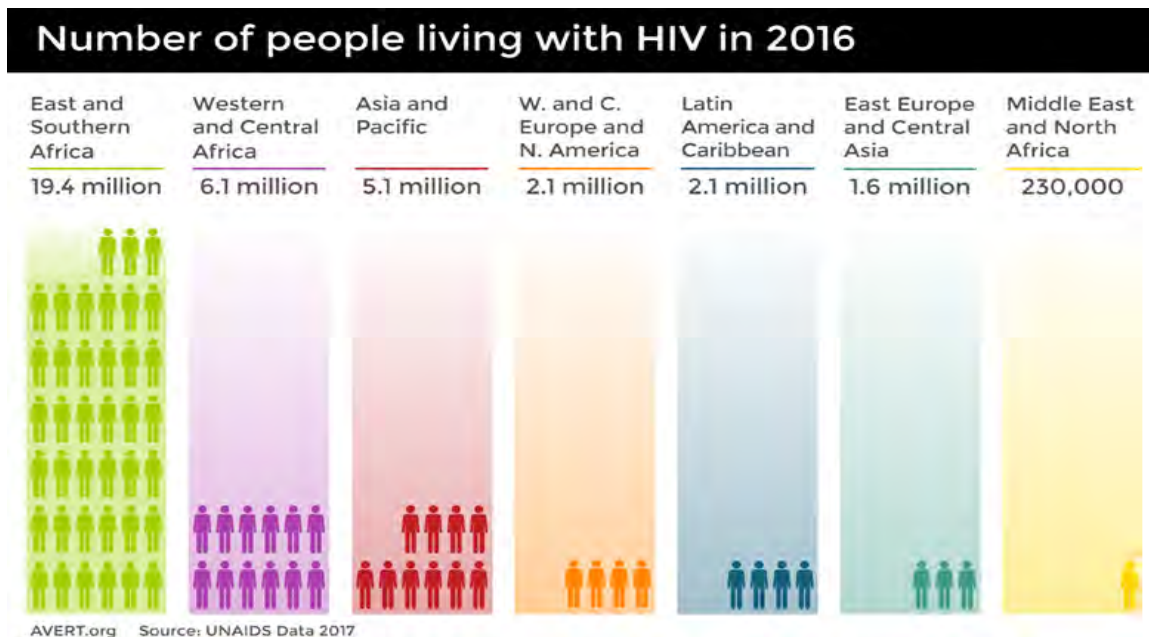
individuals infected differ extensively. However, individuals affected by the virus but receiving treatment with modern medical technology can expect to live normal. In the developed world, for example, the United States of America lots of infected people live normal lives although those in deprived areas regard the HIV/AIDS as a death decree. The disease is not managed easily in healthcare systems that are weak in particular for the disadvantaged or those living in poverty (WHO, 2003). As a result, concerns about the rights of humans become critical as an approach to fighting the menace should be directed at obligation to impartiality in the prevention and care of the disease.

2.2 HIV and AIDS Global Statistics

HIV/AIDS remains one of the major issues public health practitioner globally continues to deal with. The projected number of people living with the virus was 36.7 million as at 2016 (comprising 1.8 million that were children) and the occurrence globally stands at 0.8% among the adult population (Whiteside, 2016). According to Montaner et al. (2016), from the beginning of the virus, a probable number of infected people so far are 78 million with about relating death accounting for 35 million people.

The huge number of HIV/AIDS infected people which are projected at 25.5 million live in low and middle-income countries with about 19.4 million located in the East and Southern parts Africa ("HIV and AIDS in East and Southern Africa regional overview", 2018).

Figure 2.1 below shows the number of people living with HIV in 2016. The Statistics shows that, East and Southern Africa was 19.4, Western and CENTRAL Africa 6.1 million, Asia and Pacific 5.1million W. and C. Europe and North America 2.1million, Latin America and Caribbean also 2.1million while East Europe and Central Asia recoded 1.6million and Middle East and North Africa recoded 230,000.



Source: UNAIDS Data, 2007

Figure 2.1: Number of people with HIV in 2016

2.2.1 Emerging infections

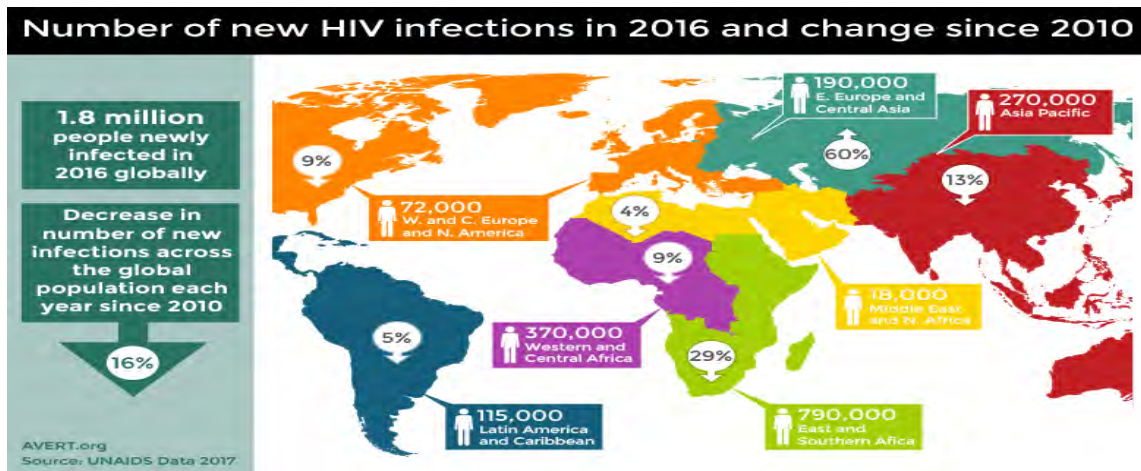
In 2016, new HIV/AIDS infections were about 1.8 million although it was a reduction from 2.1 million in 2015 (Global HIV and AIDS statistics, 2018). Although there had been an initial concern about stabilizing new adult infections yearly, rates of prevalence between 2010 and 2015 did not change much though an encouraging trend emerged whereby new adult infections were projected to have reduced in the overall population by 11 and 16 percent between 2010 and 2016, as well as decline by 8 percent between 2010 and 2015 (UNAIDS, 2018). Whereas internationally new infections declined in 2010 to 2016 from 300,000 to 160,000 respectively among children, reports specify the need to intensify knowledge on the virus while increasing testing amongst the youth (Whiteside, 2016). Evidence suggests that those at great risk are women in their youth between the ages 15-24 with 59 percent new infections.

UNAIDS warns that in spite of advances in 69 nations which saw new infection reduction, the growth of the viral infection is not declining rapidly to achieve targets globally (Kallings, 2008). Data comparison across countries showed enormous inconsistencies in the determination to slow new virus transmissions although in some countries 50 percent or higher reduction in adults' cases of new infections whereas other countries continue to experience disturbing trends in new cases (Quinn, 1996).

There is renewed concern that the annual number of new infections among adults has remained static in recent years. In 2017, there were roughly 1.8 million new HIV infections – the same as in 2016 (Fig 2.2)

Global new HIV infections have declined by just 16% in the past seven years, from 2.2 million in 2010 to 1.8 million in 2016. Although this is nearly half the number of new infections compared to the peak in 1996 (3.4 million), the decline is not quick enough to reach the target of fewer than 500,000 by 2020.

While new HIV infections among children globally have also declined, from 270,000 in 2010 to 180,000 in 2017 (35%), reports indicate that this is far less progress being made than previously thought and there is much more that needs to be done to improve knowledge of HIV and HIV testing among adolescents and young adults.



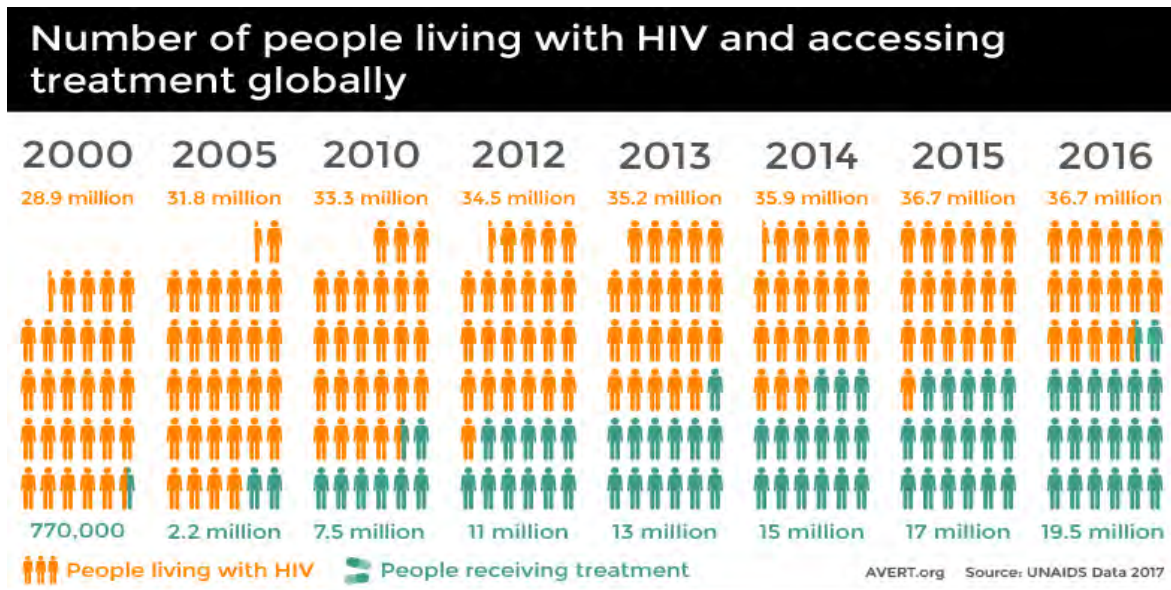
Source UNAIDS Data, 2017

Figure 2.2: Number of new HIV infections in 2016 and change since 2010

2.2.2 Treatment

Globally, efforts have been made to increase the number of infected people getting access to treatment especially in countries that are underprivileged in spite of the challenges (Montaner et al., 2006). According to UNAIDS (2018), in 2016, a key breakthrough was realized whereby it was observed that over half of the infected people 53 percent had access to treatment. Evidence from USAIDS (2018) indicates that 20.9 million infected people were getting antiretroviral treatment as of June 2017 which was an increment from 7.7 million and 17.1 million in 2010 and 2015 respectively. However, if the increase in treatment endures, by 2020, it is projected that the worldwide target of 30 million will be achieved.

Figure 2.3 below shows the Number of people living with HIV and accessing treatment globally. From the figure in 2000 number receiving treatment was 770,000 people as the number recorded in 2016 receiving treatment was 19.5 million. This has increased drastically over the years.



Source: UNAIDS Data, 2017

Figure 2.3: Number of people living with HIV and accessing treatment globally

2.3 Overview of HIV/AIDS in Africa

In Africa, 3 million people died in 2001 from HIV/AIDS and in excess of 70 percent of the 40 million infected people are located in Africa (UNAIDS, 2001). On the continent, the virus has an impact on the development of the economy and the infected people as well as their families. Although the occurrence of HIV/AIDS has been acknowledged, it is challenging to witness the epidemics effect as a whole or evaluate how it may affect the prospects of the future development of Africa (Dixon, McDonald & Roberts, 2002). Bermejo (2004) indicated that a UNAIDS report in 2003 uncovered Africa as the region with the greatest infection with a projected 26.6 million infected people representing an average 7-8 percent of the adult population and occurrence as high as 40 percent in certain countries

A disturbing occurrence for all stakeholders is the situation that approximately half of all adults with the infection worldwide are women and in Africa, of the 23 million infected adults between 15 – 49 years, 57 percent representing 13.1 million are women. UNICEF (2003) indicated that those extremely susceptible to the virus and are three times extra

probable to be infected than their male counterparts in a similar age group in for instance Zambia are women and girls between 15–24 years. Deaths attributed to HIV/AIDS in Africa in 2003 only was 2.3 million people (Bermejo, 2004). For Africa, UNAIDS has projected that by 2025, a complete array of outcomes such as stabilizing rate of infection in addition to a decrease in HIV infections.

2.4 The Impact of AIDS in Africa

The demise due to HIV/AIDS on the continent has serious implications although some parts of Africa have already felt the intensity of the infection. The lifespan of infected people are decreasing in some part with increasing rates of mortality in other cases and offers a challenge not only to the health sector but all other areas (South Africa Human Development Report, 2003).

The development expected in Africa is being obstructed by the virus which is causing a drop in crucial indicators such as social and economic while drawing back gains governments are trying to achieve (Zambia Human Development Report, 2007; Zimbabwe Human Development Report, 2003). HIV/AIDS which creates a challenge to the security of humans and development is a cause and consequence of poverty, lessening poverty alleviating strategies (Zambia Human Development Report, 2007; Kenya Human Development Report, 2006; United Nations Development Programme, 2005; Botswana Human Development Report, 2000). The virus limits human life expectancies, wearing away infected peoples sense of self-worth while instigating societal exclusion, fracturing and depriving persons, relations and entire communities with the possibility to retrograde advances in human development over the earlier years (Malawi Human Development Report, 2005; Botswana Human Development Report, 2000). The enormity of the devastation on women is been greatly underestimated and children suffer the most as their schooling are interrupted since

they have to take care of their infected parents and are sometimes orphaned with the demise of their parents. Sometimes other relatives or grandparents take care of those children who are fortunate and they are burdened with raising them (Global Issues, 2009).

2.5 HIV/AIDS in Ghana

In 1986, HIV/AIDS was detected by medical staff and the virus has diffused gradually in Ghana.

The age group infected by the virus according to the sentinel surveillance data are between 15 – 49 years and this represents 3 percent of the total population and the incidence could still be increasing (Ministry of Health, 2001)

In viewing the prevalence of HIV/AIDS in Ghana, three important facts are to be carefully looked at. Firstly, the HIV/AIDS infection is very severe and the investigation reveals that in the year 2000 approximately 350,000 individuals had the HIV/AIDS, however, this does not include infected individuals who had already died (Ministry of Health, 2001). According to the Ministry of Health (2001), new infections occur on a daily basis.

Secondly, the available information does not indicate the stabilization of the infection. Between 1994 to 2000 the Ministry of Health funded sentinel surveillance at all sites and data analyzed shows that the incidence of HIV/AIDS among the 15 – 49-year group increased from 2.7 – 3.0 percent in 1994 and 2000 respectively (Ministry of Health, 2001). With an unknown trend for the future, there is the risk that the incidence could rise as in adjoining countries due to some factors such as the global epidemic in other sexually transmitted infections.

Finally, the transmission of the virus is relatively slower in Ghana compared to several other African countries and this indicates that if the epidemic is not controlled, the incidence levels could increase (Ministry of Health, 2001).

Although the spread of the infection is slow in Ghana, it is important to realize that HIV/AIDS is a serious epidemic which could have an intense effect on the social and economic development of Ghana well into the future.

2.6 Interventions to prevent HIV/AIDS Epidemic

The global accord specifies that for those infected with the virus, care and support must be given to them and those whose families are affected must become an important part of the AIDS control programme to enable them to play a vital role in all interventions (Ministry of Health, 2001). Diverse interventions to address the diffusion mechanism should be adopted to slow the spread of HIV/AIDS. Some of the interventions include encouraging self-restraint and faithfulness, endorsing a decrease in a number of sexual partners, correct use of condoms and its availability, adolescents advised to delay sexual activity, reinforcing programmes for the control of STD as well as supporting voluntary counseling and testing. However, the principal transmission mode is by heterosexual contact and interventions in this area to limit the spread must be strengthened.

The side effects of the treatments cannot be tolerated by many people with the infection and the medications must be taken under very strict conditions and deviations from the approved pattern can make the treatment ineffective (Ministry of Health, 2001). According to Ministry of Health (2001), the treatment costs are exorbitantly high and the new combination drugs which have proven effective is expensive even in the most developed countries although these treatments can improve the HIV/AIDS infected person quality of life and delay their demise.

2.7 Application of GIS and Spatial Statistics to Diseases

GIS applications in public health planning and epidemiology as far as the 1980s was limited in use (Bracken et al., 1989). The applications increased quickly through the 1990s and the advancement persists into the 21st century (de Lepper, Cholten, & Stern, 1995; Gatrell & Loytonen, 1998). The GIS dictionary (Wade and Sommer, 2006) define spatial statistics as “the field of study concerning statistical methods that use space and spatial relationships (such as distance, area, volume, length, height, orientation, centrality and/or other spatial characteristics of data) directly in their mathematical computations. Spatial statistics are used for a variety of different types of analyses, including pattern analysis, shape analysis, surface modeling and surface prediction, spatial regression, statistical comparisons of spatial datasets, statistical modeling and prediction of spatial interaction, and more. The many types of spatial statistics include descriptive, inferential, exploratory, geostatistical, and econometric statistics.”

The widespread use of Geographical Information Systems (GIS) has significantly increased the demand for knowledge about spatial analytically techniques across a range of disciplines. As growing numbers of researchers realize they are dealing with spatial data, the demand for specialized statistical and mathematical methods designed to deal with spatial data is undergoing a rapid increase.”

The rising attention to environmental wellbeing as well as risk assessment produced some “market” for GIS applications in public health (Stockwell, Sorenson, Eckert, & Carreras, 1993). The resurgence of the infectious disease, predominantly diseases that were vector-borne in addition to efforts globally to solve health complications to help appreciate the biology of these diseases directed public health agencies towards GIS (National Science and

Technology Council, 1995). Public health professionals and epidemiologist are becoming part of the GIS community.

GIS application encompasses bringing together people to utilize a collection of computer hardware, software and spatial databases to answer questions or resolve difficulties (Kessler, 1992). A GIS application reflects at least implicitly how GIS user views the world, including what are appropriate and meaningful ways to represent reality, what are the subjects of interest, and how and by whom information will be used.

A study by Yao, Murray, and Agadjanian (2013) on access to reproductive and sexual health care was the closest to a maternal health-related study found in Africa using a gravity model. However, only quality of service and distance traveled were used as determinants in the model excluding the demand for service.

2.8 Review of Empirical Research on spatial analysis

Peng et al. (2011) undertook a study on HIV/AIDS using risk maps to determine the geographical distribution and to identify ways the virus deterrence interventions based on data of HIV/AIDS infected people from the Yunnan area in China.

They used the trend surface and spatial autocorrelation analysis to establish the geographic distribution of HIV/AIDS patient in the Yunnan region and discovered that more serious cases were in central west area whiles Kunming region showed a negative correlation (Peng et al., 2011). Peng et al (2011) assert that intervention efforts in the region should focus on the west and northeast areas which target the hotspots of the disease.

Larson and Wilson, (n.d.) investigated patterns of poverty and HIV/AIDS using publicly available county-level information from the Mississippi health sector, to explore the spatial distribution of newly reported infections. Spatial autocorrelation of county-level HIV

incidence was undertaken (Moran's I statistic) and GIS-based methods were used to identify HIV "hot spots" that considered incident cases reported in neighboring areas (Larson & Wilson, n.d). They then assessed associations of county-level HIV incidence with hypothesized county-level predictors, including population density, a proportion of African American residents, income, unemployment rates, property values, number of health facilities, and the Gini coefficient of income inequality (Larson & Wilson, n.d). Larson and Wilson, n.d found that the areas of disproportionately high reported HIV incidence were located in rural areas of the Mississippi Delta. High incidence counties were associated with higher proportions of African American residents, higher unemployment, lower median income, fewer health facilities and higher levels of income inequality. Counties with the highest reported numbers of new cases were concentrated around counties that housed larger numbers of prisoners and concluded that HIV incidence in Mississippi is associated with intense poverty, inequality and a lack of available health services.

In addition to the aforementioned Rodrigues-Júnior, Ruffino-Netto and Castilho (2014) conducted a geo-epidemiological survey on HIV/AIDS with related Tuberculosis, co-infection in addition to societal helplessness utilizing rates of prevalence as well as the human development index to generate thematic maps and a descriptive epidemiology investigation. Areas with differences in social and patterns of HIV/AIDS with its related Tuberculosis prevalence were identified from the maps. It was observed that similarities in regional differences to that by Josué de Castro, in 1940 was observed and this made them conclude that the disease prevention requires particular geographic, cultural and socioeconomic differences consideration (Rodrigues-Júnior, Ruffino-Netto & Castilho, 2014).

CHAPTER THREE

METHODOLOGY

3.1 Study Area

The Sunyani Municipality is situated in Sunyani East in the Brong Ahafo Region of Ghana. The locality was created by a government of Ghana (local government ACT: 462) and later divided along constituency lines in two, Sunyani East and Sunyani West where Sunyani East was made the Municipal capital whereas Odumase was made the Sunyani West District capital. Twenty-seven districts make up the Brong Ahafo region of which Sunyani municipality is part. The municipality was established by a legislative instrument (LI) 1473, on the 10th March 1989. This was the period Ghana adopted the District Assembly concept. Sunyani municipality has a population of about 123,224 projected from the 2010 population and housing Census and occupies an entire land capacity of 506.7 Km² (GSS, 2014)

According to GSS, (2014) in the Brong Ahafo region, the municipality is positioned between Latitudes 7° 20'N and 7° 05'N and Longitudes 2° 30'W and 2° 10'W. To the north and south, the municipality is bordered by Sunyani West and Asutifi district respectively while to the east and west by Tano North and Dormaa East District respectively.

The overall municipality's population is about, is 123,224 which represents 5.3 percent of the region's entire population (GSS, 2014). The percentages that represent males and females are 49.9 and 50.1 percent respectively with a sex ratio of 100 and over 80 percent of the populace urban (GSS, 2014).

The youth aged 15 years and above representing 62.0 percent of the populations are active economically with 38.1 percent not active. About 25.5 percent of the employed population is engaged as experienced workers in agriculture forestry and fisheries with those engaged in service and sales representing 28.1 percent, craft and trade represent 15.0 percent whereas

those engaged as managers, professionals, and technicians represent 16.2 percent (GSS, 2014). There are 34 electoral areas with 192 communities following the geographic information survey conducted in 2011. Health service to the communities in the Municipality is by Ghana Health and some few CHAG institutions.



Figure 3.1: A Map showing the study area (Sunyani Municipality)

3.2 Study Design

A cross-sectional spatial analysis method was adopted in this study. The study described and conducted spatial analysis of HIV cases and accessibility to treatment centers with data collected from the District Health Directorate HIV register. The register included patient identification (ID, age sex, residential address), etc. Patient on treatment and newly diagnosed of HIV status (testing and counseling, ART) are included in the study.

3.3 Data Collection

The data used in this study were obtained from records on HIV patient from the district register which was exported into Ms. Excel (Version 2016) template based on variables in the register. A template on MS Excel was developed to capture records (attribute data) on

HIV cases for registers of HIV in the custody of the health authorities in the district. The names of the patient were not captured. The records were checked for completeness and updated from the various health facilities in the District which was part of the data cleaning process. The district conducted a geographic survey in 2011 of all the communities and health facilities in the district.

3.4 Spatial Data

2.4.1 Geocoding patient addresses

To enable spatial analysis of HIV patterns, the locations of clients were geocoded. The 978 cases came from 44 unique communities. Due to the non-availability of reference databases for geocoding patient addresses (Dotse-Gborgbortsi, Wardrop, Adewole, Thomas & Wright, 2018)) and the Sunyani municipality count of 44 towns, manual geocoding was done in google earth using local knowledge of the terrain. Placemarks were used to extract locations, it was exported as xml and converted into geodatabase feature classes using ArcGIS conversion tools.

Although this aggregation to town level could introduce error into the analysis, Nesbitt et al., (2014) found that such error could be less in Ghana. More importantly, it addresses the more pertinent issue of confidentiality and stigma related to health data particularly infectious diseases such as HIV and Tuberculosis (Nesbitt et al., 2014).

2.4.2 Descriptive statistics

To summarize demographic characteristics and some important HIV indicators, frequencies and simple proportions were reported in tables. For numerical variables, the mean or median was reported depending on the distribution of the data.

2.4.3 Visualizing Coverages

HIV cases were visualized using graduated symbols. To give an aesthetic feel and provide context, results were overlaid on OpenStreetMap base map.

2.4.4 Spatial dependency/autocorrelation

Spatial autocorrelation statistics works on the assumption that nearer objects are more related than those farther (Tobler, 1970). The Global Moran's I is a spatial test statistic used to check for autocorrelation of objects in space; it compares an observation to nearby observations to know if they are similar. In this case, it would check if there is a clustering of the count of HIV cases based on the location of communities. The tool was run in ArcGIS 10.4 using inverse distance weighting and a straight line distance.

In the event that the Global Moran's, I show significant clustering or dispersion, a Local Moran's I would be computed to identify cluster types. The Local Indicator of Spatial Autocorrelation (LISA) is able to reveal local clusters or outliers. The clusters are either High-High, meaning a high observation with high neighbours whereas a Low-Low cluster shows a low observation with low neighbours. In contrast, there are two types of outlier which are Low-High and High-Low. The Low-High outliers are low observations with high neighbours whereas High-Low are high observations surrounded by low neighbours. Alternatively, a less robust kernel density surface would be used to interpolate the count of cases per square kilometer.

2.4.5 Distance to services

Distance to the nearest health facility and ART center were calculated using Euclidean distance. Nesbitt suggests this approach to estimating distance in Ghana when refined measures such as mechanized network distance and travel time are not available. This she said reduces cost and saves time since the Euclidean distance estimates do not affect results

much. The distance from the community to a health facility was used as a proxy to estimate the expected travel distance if ART service was provided at the nearest available health facility. Subsequently, the distance from communities to ART services was also computed. These calculations were visualized as distance decay charts showing the relationship between cases, distance traveled and type of service provided at the nearest health facility.

To evaluate if there is a significant difference between the distance to the nearest facility and ART center, a paired t-test was implemented comparing the mean distance to the nearest health facility and ART center. The aim of this t-test analysis was to validate the notion that clients travel farther to ART centers.

CHAPTER FOUR

RESULTS

4.1 Demographic Characteristics

In Table 4.1, the demographic characteristics of the HIV cases have been summarized. There were more females (77.7%) than males. Majority of the cases were married (53.2%) whereas the prevalence among separated individuals was the least (1.1%). For occupation, almost half (47%) were into full-time employment. Christians were by far the most affected at 88.5% compared to 9.2% among Muslims. Also, the results indicated that (88.96%) of the age of infected people was between 15-49 years.

Table 4.1: Demographic characteristics of HIV cases (n =978)

	Frequency	%
Age	1	0.10
0-14	870	88.96
15-49		
50+	107	10.94
Gender		
Female	760	77.7
Male	218	22.3
Marital Status		
Cohabiting	21	2.1
Divorced	106	10.8
Married	520	53.2
Not recorded	20	2.0
Separated	11	1.1
Single	241	24.6
Widow(er)	59	6.0
Occupation	460	47.0
Full time	1	.1
Full time on leave	207	21.2
On leave	84	8.6
Part-time	225	23.0
Unemployed	1	.1
Education		
JSS	380	38.9
MSLC	123	12.6
Nil	182	18.6
Primary	128	13.1
Sec tech	98	10.0
Tertiary	62	6.3
Religion		
Christian	866	88.5
Muslim	90	9.2
None	17	1.7
No response	1	.1
Traditional	3	.3

Source: Field data, 2018

4.2 Important HIV indicators

Table 4.2 shows the highest proportion of the cases were on medical insurance (93.8%) but few either paid out of pocket (4.5%) or were financed by a special project (0.4%). The cases were categorized into various HIV types. HIV type 1 (96.7%) was most prevalent compared to type 1 and 2 combined or type 2 forming below five percent of the entire number of cases. Due to morbidity of HIV and Tuberculosis, cases were tested but only 18 (1.8%) were classified as suspected Tuberculosis.

Furthermore, 13 (1.3%) of the cases have ever had ARV treatment and 866 (88.6%) were on cotrimoxazole. Also, 168 (17.2%) pregnant women were on prophylaxis to avert the virus transmission to their unborn children. Similarly, 9 (0.9%) babies who were infected by their mothers were being treated. Also, one of four cases did not divulge the status of their HIV to their sexual partners, 75.2% were sexually active, and only 8% used condoms during sex.

Table 4.2: Other HIV related characteristics of cases, N= 978

	Frequency	%
<i>Funding</i>		
Medical insurance	917	93.8
	44	4.5
Patient out of pocket		
Special project	4	.4
<i>HIV type</i>		
Hiv-1	946	96.7
Hiv-1&2	18	1.8
Hiv-2	2	.2
Cotrimoxazole	540	55.2
Tb screening	866	88.5
<i>Tuberculosis results</i>		
Not suspect	845	86.4
Suspect	18	1.8
Past ARV experience	13	1.3
Prophylaxis PMTCT	168	17.2
Baby treated	9	.9
Disclosed status to sexual partner	250	25.6
Sexually active	735	75.2
Condom use	78	8.0
Patient died	35	3.6
Admitted to hospital	27	2.8

Source; Field Data, 2018

4.3 Spatial distribution of HIV cases

Figure 4.1 shows the spatial distribution of HIV cases across the municipality. Most communities such as Fiapre, Odumase, and Abesim with a high prevalence of cases were located at the periphery of the municipality. Also, communities along New Dormaa to Chiraa stretch recorded a high number of cases compared with other roads linking the municipality.

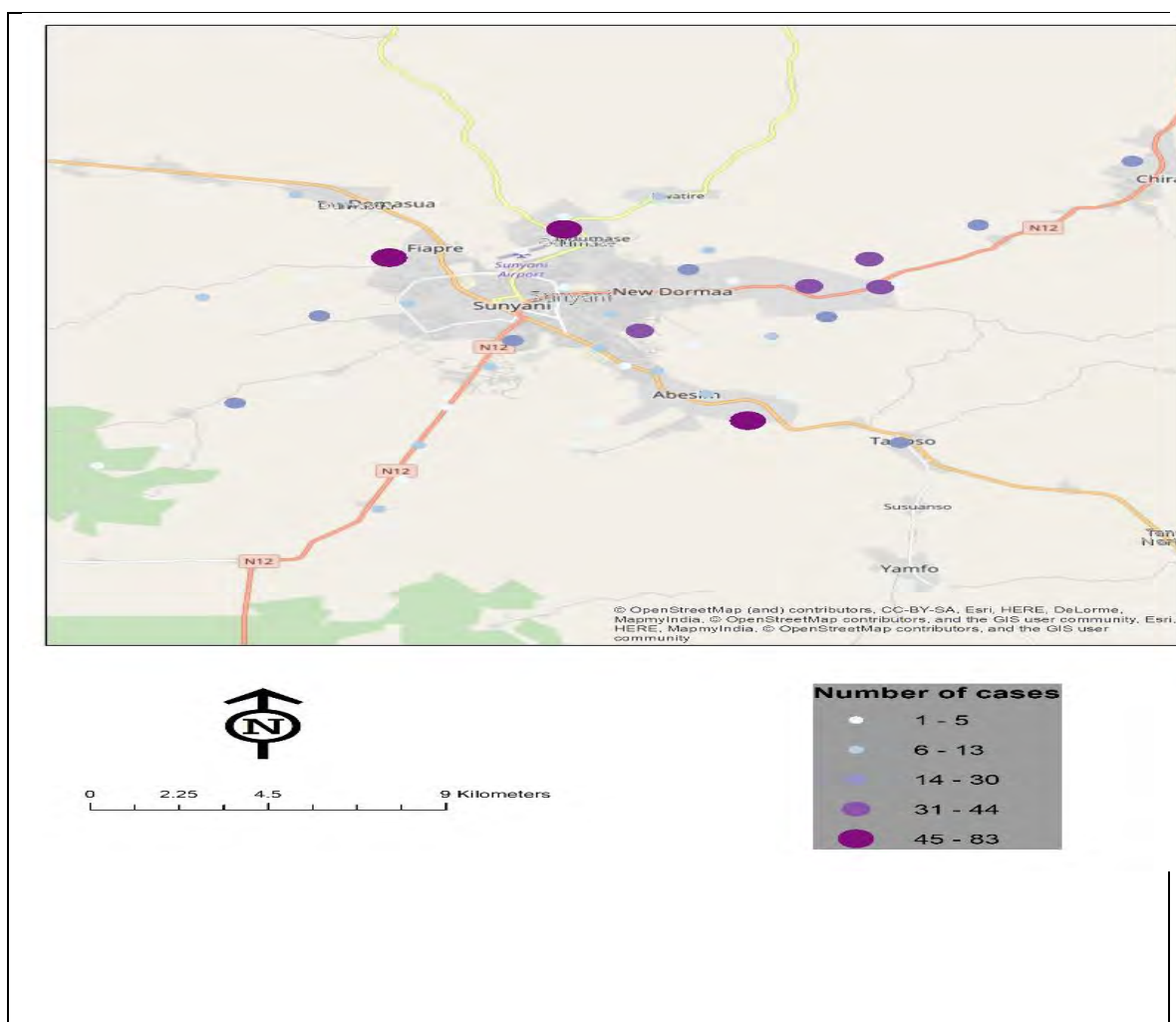


Figure 4.1: Spatial distribution of HIV cases
Source: Field Data, 2018

4.4 The density of HIV cases

The results from the density surface further highlight the high density of cases on the Sunyani, New Dormaa, Chiraa road stretch. There were fewer cases within central Sunyani itself but higher among surrounding communities. Averagely, the central portions of the municipality reported one or fewer cases per square kilometer. The highest prevalence of more than 10 cases per square kilometer was recorded between three communities (Dormaa, Kotokrom, Penkwase) within close proximity of each other.

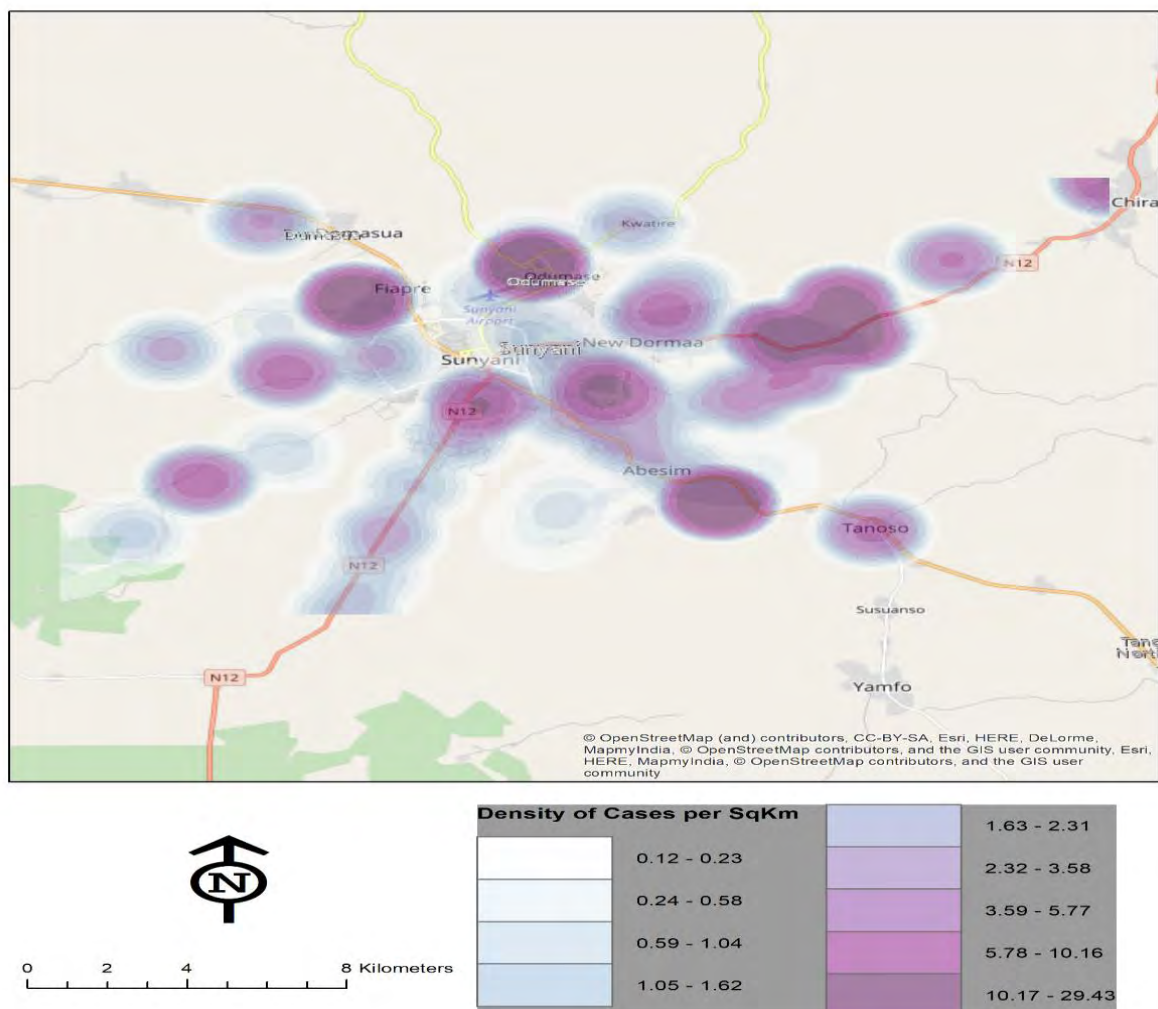


Figure 4.2: Density Surfaces
Source: Field Data, 2018

4.5 Clustering of HIV Cases

The Global Moran's I statistic was used to assess the clustering of HIV cases. Results shown in Figure 4.3 suggests HIV cases within the municipality occurred at random. Within approximately five kilometres neighbourhood of communities, using Euclidean distance and inverse distance weighting, there was no evidence of clustering of HIV cases (Moran's Index = 0.103012, Expected Index = -0.023256, Variance = 0.004539, zscore = -1.183832, p-value = 0.236479). This random distribution of cases means it was not important to further investigate the spatial autocorrelation, hot/cold spot analysis, or cluster-outlier analysis. Therefore, a simpler kernel density surface with extracted contours was used for the spatial pattern of cases assessment.

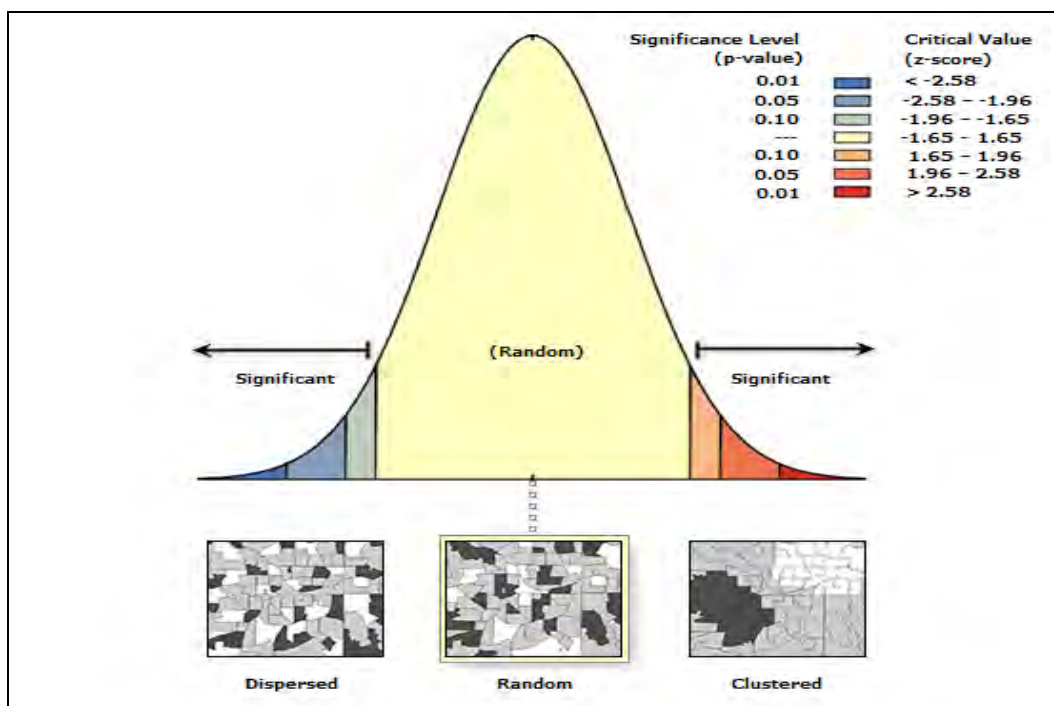


Figure 4.3: Clustering of HIV cases
Source: Field Data, 2018

4.6 Distances Travelled

Figure 4.4 shows the count of HIV cases versus distance to the nearest health facility. Most facilities closer to the communities were not providing HIV services whereas few provided PMTCT. There were three outliers relating to a number of cases and one distance outlier.

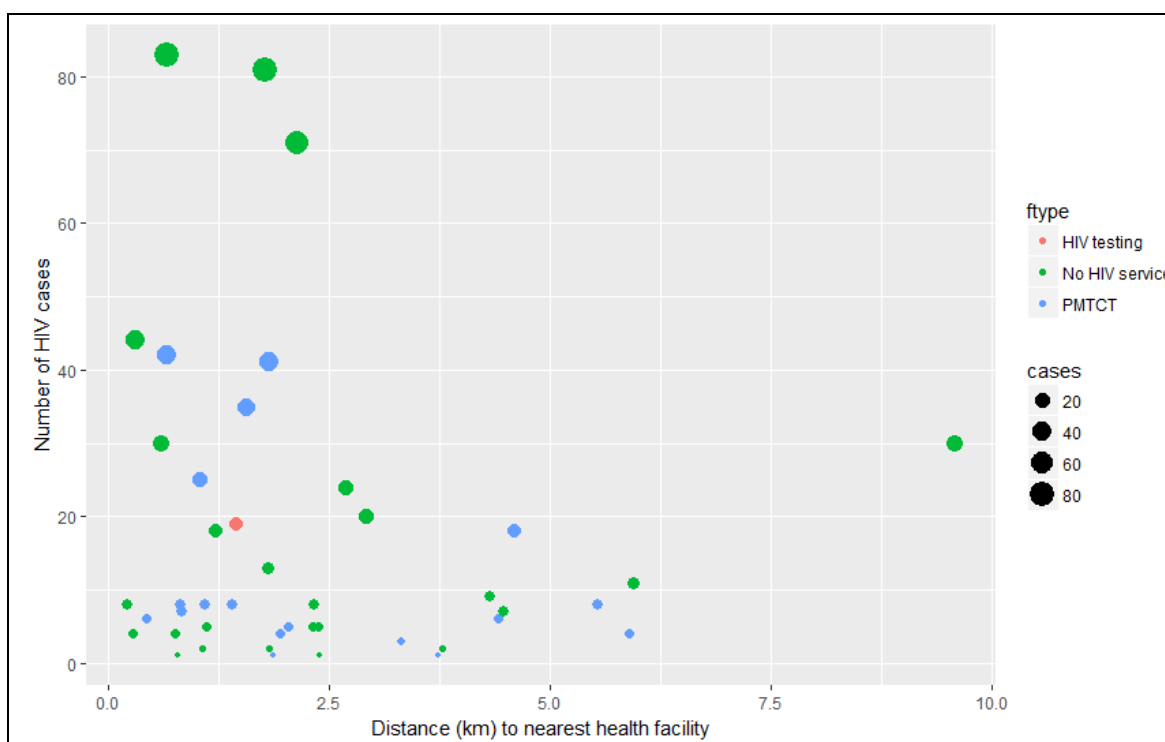


Figure 4.4: Distance to nearest health facility versus count of HIV cases

Source: Field Data, 2018

Comparatively, the distance to ART centers changed relative to the distance to the nearest health facility. More communities were farther from the ART service provision sites.

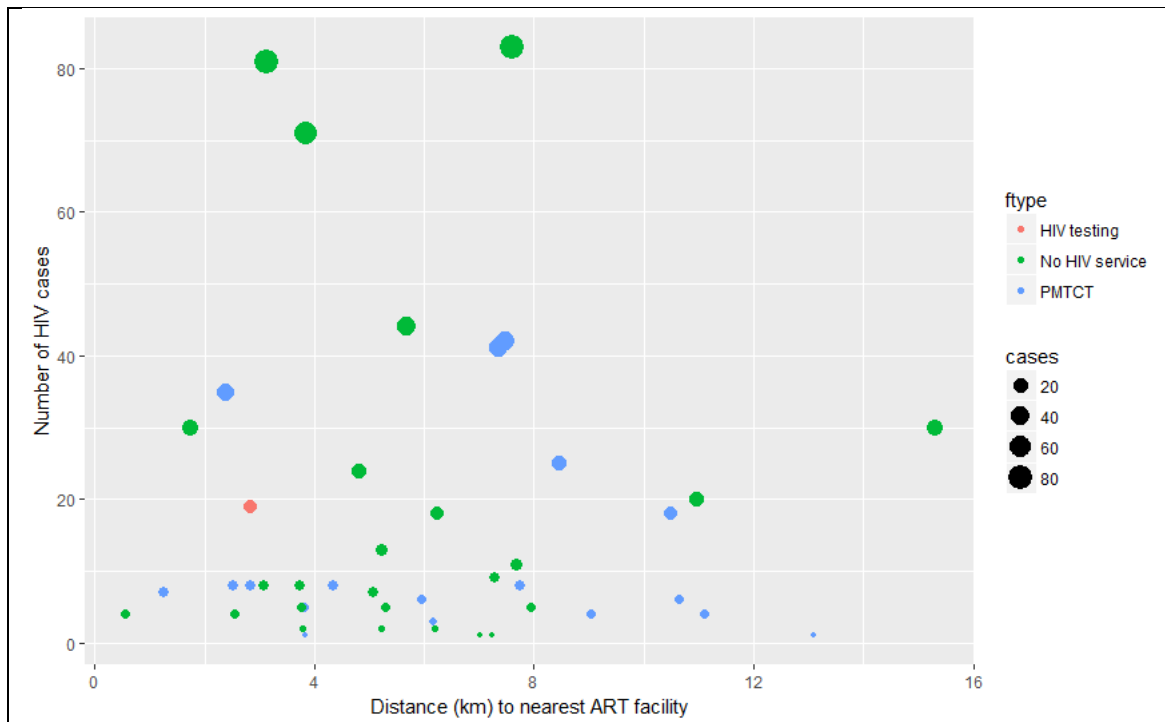


Figure 4.5: Distance to nearest ART facility versus count of HIV cases

Source: Field Data, 2018

To analyze proximity and access to ART services, the mean distance to the nearest health center and the mean distance to the ART center were compared for the 44 communities using a paired t-test. The mean distance to the nearest health facility was 2.32 km whereas the nearest ART centers were 5.96 km far from the community of clients. Results showed that access to the nearest ART center was statistically significantly higher by 3.63 km (CI: 2.87 – 4.39, $t=9.634$, $df=43$, $p\text{-value}<0.001$).

Table 4.3: Mean distance traveled in kilometers

	Mean distance in km	N	Std. Deviation	Std. Error Mean
Distance to Nearest ART	5.96	44	3.22	0.48
Distance to nearest health facility	2.32	44	1.92	0.29
Difference	3.63		2.5	0.38

Source: Field Data, 2018

CHAPTER FIVE

DISCUSSION

5.1 Demographic Characteristics

It is obvious from the study results that the greater percentage of HIV infections were women compared to men. The striking difference of the prevalence in HIV between young women and young men that have been noted elsewhere was confirmed in Walden (2007) who found out that in Africa due to cultural traditions and believe women have been found to be more vulnerable to HIV than men. This was in agreement with WHO (2009) which cited that gender inequalities arise hindering access to treatment. Poverty is identified as having an underlying connection to HIV/AIDS whereby women in less privileged areas start engaging in sex considerably earlier, without good education and empowerment (Nxumalo, Okeke, and Mammen, 2014).

Similarly, gender inequalities that encourage women to barter sex to satisfy household economic needs and reduce their ability to demand that sexual partner's use condoms have been shown to aid HIV transmission (Langen, 2005). Impoverished women, seeking to assist in meeting their children's necessities, offer sex to men who possess cash resources to buy it (Gender inequality and HIV, 2018). Wealthier men have greater freedom to move between sexual partners, thereby creating more opportunities for transmission.

Some other factors that contribute to this underlying HIV drivers have included literacy levels that are low, increased proportions of unshielded, spontaneous as well as sex that is transactional, traditional and religious factors for instance widowhood rites, low social and women's financial standing, great risk livelihoods, high immigration or freedom of movement levels, increasing frequencies of STIs and tuberculosis in addition to geographical influences largely concerning deprived access to healthcare services with

intensified risk exposure. According to NASCOP (2014), a correct understanding of HIV/AIDS including the awareness of the personal possibility of the infection are critical for making the right choices in behavior so that the risk of getting and spreading HIV/AIDS is greatly reduced.

5.2 Spatial Distribution of HIV Cases

From the analysis of the surface trends as well as the risk maps created show that the HIV/AIDS prevalence is greatest at the periphery where trading and mining activities are located. The location of Sunyani which is adjacent to Techiman a marketing town has provided an avenue through which the HIV/AIDS transmission diffuses into the municipality. Trading in addition to traveling aid the increasing numbers of individuals, identified as "floating population", continuously involved in deeds such as prostitution, smuggling of drugs, buying and selling etc. This new environment, sustained by communication which is enriched, provides the medium through which relationships are reinforced with increased drug use and sex trade thereby increasing the HIV/AIDS incidence. These areas identified in the research form the hot spots as the municipalities' key transportation route for the area which in addition to transporting merchandise increases the chances of spreading the HIV epidemic. According to Liu et al. (2005), improvement in the transportation of goods has encouraged the progress and disease transmission to the "floating population" besides as reiterated by Bao (2010) the diffusion of HIV/AIDS cases occurs along the central transportation routes into neighboring parts.

In the Sunyani municipality, economic growth may also be a contributing factor luring people not just in search of good prospects for themselves but also drawing huge multitudes of people infected with HIV who would rather stay and spread the disease than diffusing into less populous areas. Since high HIV prevalence was found at the peripheries it makes

it expensive to travel for treatment because there are no ART centers close within 1km. In South Africa, it is broadly acknowledged that spatial heterogeneity as well as processes for example, migration in circular patterns in the epidemics earlier stages caused the extensive diffusion of HIV (Williams & Gouws, 2001). Nevertheless, the epidemics' advanced stage in addition to the obvious high prevalence of the disease and lengthy infection period, expectations were that at this point a relatively even spatial distribution would be a consequence in at least a small, restricted rural populace. As such noticeable spatial variation continues, it suggests that spatial processes, complex fraternization of sexual patterns as well as effects in the communities keep impacting the changing aspects of the spread of the disease at this advanced period.

From the clustering of HIV cases, the results suggest that even though health facilities are located in and around the municipality and cases are not clustered, the cases were arbitrary distributed regarding prevalence in these communities. In spite of the phase and epidemic severity noteworthy geographical variation in the prevalence of HIV exist in this comparatively uniform population which has been open for over a decade to the HIV. According to Tanser (2009) in South Africa, solid evidence on HIV infection clustering suggests that HIV risks are linked with particular socio-geographic areas which offer opportunities for interventions that are targeted to those areas to complement already prevailing measures directed at the overall population. These outcomes defy the existing standard of universal 'generalized' rural epidemic but expose the presence of a number of epidemics that were restricted and of varying intensity that is partly confined in communities that were geographically defined. Thus, an intervention that focuses on one-size-fits-all may not produce results in such environments with noticeable disparities exist within such epidemiological and socio-geographical setting (Grassly, 2001).

5.3 Access to ART Centers

The presence of quality health care providers in certain locations vary from place to place with services that may not be readily accessible where needed greatly hence accessing healthcare is basically not an issue of evaluating the distance to health care centers but it is affected by factors such as transportation channels, socioeconomic status, cultural and social norms.

In this study, the mean distance to the nearest health facility was 2.32 km whereas the nearest ART centers were 5.96 km far from the community of clients. Results further showed that access to the nearest ART center was statistically significantly higher by 3.63km in the Municipality. Noor et al. (2006) specified that transportation between health care centers delivered a considerably improved indicator of health care access when they studied access to the Kenyan government health service. In another ongoing study on whether patients with cancer residing in countries with poor access to primary health care have a greater than average late-stage diagnosis risk, the researchers, embarked on multilevel analysis which investigated the connection among risk in late stage, demographic variables of individuals as well as background and other variables reporting the socioeconomic features of places and their spatial access to primary health care (McCaffery and Wang, 2009). The results of the study specified that high risk of late cancer identification of patients was highly concentrated among helpless people residing in districts that were economically underprivileged. Also a study Arroyo et al. (2006), in Uganda revealed a link between distance to key highways and a rise in both the disease occurrence and genetic complication of the infection with those from communities situated near the key roads two times probable to be get the infection with HIV-1 strain compared with individuals residing near a minor road.

Various parameters combined possibly account for the considerable heterogeneity detected some of which include individual, household, community, structural and geographical risk factors. Other risk factors discovered include prostitution along the transport route during initial epidemic stages, greater freedom of movement of the populace, rates of migration in populations along the main roads, clustering of the greatest groups who are sexually active living in high density geographical communities, more sexual fraternization patterns that are disassortative in the city, likelihood of other STI occurrence (linked with groups that are high risk) in certain parts and systematic geographic variations in other individual, household as well as community-level risk factors. According to Sumartojo et al. (1997) interventions for the prevention of HIV must focus equally on individuals at ultimate risk in addition to the overall public. Efforts targeted towards locations where the disease is transmitted is of utmost importance as a decline in the prevalence of the disease in such locations, greater widespread antiretroviral treatment (ART) coverage, improved awareness of status of infection, rise in use of condom as well as interventions that are venue-based may greatly impact the entire population to a large extent. In many Ghanaian rural environments with high disease prevalence, the study results call for an approach that is aligned with the location of the disease prevalence in the high-risk communities identified to complement prevention efforts directed at the overall population.

5.4 Limitations of the Study

Although this study provides evidence of the spatial patterns of HIV cases in the Sunyani Municipality, it has its limitations. The use of community centroids as the spatial unit of analysis introduces ecological fallacy (Openshaw, 1984) and possible aggregation error (Nesbitt et al., 2014). Also, a better estimate for a distance such as travel time, mechanized network distance or cost surface could be more appropriate. Furthermore, the density

surface, Morans's I and case visual analysis all used the count of cases. Calculating rates or prevalence of HIV using an appropriate population denominator would have been more acceptable than raw counts. Thus, these issues should be addressed in further research to produce polished results.

CHAPTER SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

According to the findings of this study with Sunyani been the regional capital had low HIV cases as compared to the surrounding communities like Fiapre, Odumase and Abesim. Moreover, communities like New Dormaa, Kotokrom, Chiraa also recorded high cases of HIV than the Sunyani central. This could be a result of the fact that, there is a high level of awareness of HIV cases and easy access to healthcare. Moran's I Statistics reviewed that clustering of HIV cases within the municipality occurred at random. The distance was a barrier to those periphery communities around Sunyani where cases were high and access to ART centers because the minimum distance one has to travel, was 5.96km. Whereas in Ghana, leaving in the rural communities the ideal distance one has to travel to be able to have access to health care is about 5km.

6.2 Recommendations

It was identified that distance being a barrier, the Ministry of Health should engage the non-Governmental agencies to help bring Health services to the doorsteps of the people living in the peripheries by sending mobile van clinic to render ART services and intensive health education.

The municipal Health Directorate should as part of their, policies strengthen the CHIPS system for service delivery should cover HIV care.

The Government should send more resources allocation and amenities like good road network, Health post etc

The Health Directorate in collaboration with NACP should intensify the Know your status campaign in the peripheries.

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