High incidence and prevalence rates of pulmonary TB among Nomadic Basarwa in Gantsi sub-district, Botswana

By

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September 2013

Thesis presented to the higher degree committee of Ritsumeikan Asia Pacific University in partial fulfillment of the requirements for the degree of Master of Science in International Cooperation Policy

(Public Health Management)

ACKNOWLEDGEMENT

This thesis would have not been possible without the guidance and help from several individuals who in one way or another contributed and extended their valuable assistance in the preparation and completion of this thesis;

First and foremost, I would like to express my sincere gratitude to my supervisor and advisor Prof Serik Meirmenov for the continuous support during my study, for his patience, motivation, enthusiasm, and immense knowledge. His guidance helped me throughout the research times and writing of this thesis.

It gives me a great pleasure also in acknowledging the support and help of Prof Nader Ghotbi, who gave valuable guidance and inspiration as I hurdle all the obstacles in the completion of this research work.

My thanks are also due to the Ritsumeikan Center for Asia Pacific Studies (RCAPS) for making it possible for me to collect data through provision of the research fund to finance my travel expenses, and providing a recommendation letter to seek permission to conduct the study in Botswana.

I would like to acknowledge the kind assistance from the Ministry of Health in Botswana by granting me the permission to conduct the study, Dr Idrissa Kempanju who is the head of Gantsi District Health Team and Mr Unaswi Segole district TB coordinator for the warm welcome and providing the data we needed.

Last but not least, I am thankful to my colleagues (public health management class of 2011) for the advices, encouragement and support in refining my research.

But above all, I lift up my hands with thanks giving to God almighty, for providing all the wisdom and making it possible for me to complete this thesis.

DECLARATION OF ORIGINALITY

I, VINCENT PAGIWA, hereby declare that this thesis is a true discourse of my own original investigations and any other additional sources of information have been duly cited. I declare that any internet sources, published or unpublished works from which I have quoted have been reference fully in the text and in the context list. I therefore summit this thesis to the Graduate School of Asia Pacific Studies (GSAM), Ritsumeikan Asia Pacific University, Japan for the partial fulfillment of the requirements for the acquisition of the Degree of Master of Science in International Cooperation Policy (ICP); specialization: Public Health Management (PHM).

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PAGIWA Vincent 31/May2013

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LIST OF ABBREVIATIONS

ARVT	Antiretroviral Therapy
AIDS	Acquired Immununo-Deficiency Syndrome
BNTP	Botswana National TB Programme
BOTUSA	Botswana-United States partnership on HIV/AIDS
CHBC	Community Home-Based Care
CT	Community TB
DHT	District Health Team
DOT	Directly Observed Therapy
GDP	Gross Domestic Product
HBCs	High-Burden Countries
HIV	Human Immune Virus
IPT	Isoniazid Prevention Therapy
MDR-TB	Multi-Drug Resistance Tuberculosis
MLGLH	Ministry of Local Government, Land and Housing
MOH	Ministry of Health
NDP	National Development Plan
OIs	Opportunistic Infections
PEP	Post-Exposure Prophylaxis
PHC	Primary Health Care
PMTCT	Prevention of Mother to Child Transmission
PTB	Pulmonary Tuberculosis
RADs	Remote Area Dwellers

SADC	Southern Africa Development Committee
TB	Tuberculosis
TB-IRIS	Tuberculosis-Immune Reconstitution Inflammatory Syndrome
THE	Total Health Expenditure
UK	United Kingdom
UN	United Nations
US	United Sates
USD	United States Dollar
VCT	Voluntary Counseling and Testing
WHO	World Health Organization

ABSTRACT

Tuberculosis has remained a major challenge in the world, as new cases are reported each year. The WHO reported that developing countries yield the most affliction of the disease and associated fatalities. In Africa, Southern Africa (including Botswana) is mostly affected with prevalence and incidence rates greater than that of the African average. Notification rates has more than doubled in Botswana, from 226 per 100 000 in 1990 to 494 per 100 000 in 2009, with Ghanzi district being the most afflicted. This district is dominated by the Bakgalagadi and the Basarwa tribes. The Basarwa tribe is highly mobile (nomadic), illiterate and there is a language barrier between them and the health care providers. This has lead to Basarwa tribe being linked to these high prevalence and Incidences of Pulmonary Tuberculosis in the district.

The study aims to; (i) determine the variation in Pulmonary TB incidence and prevalence rates between the nomadic Basarwa and the settled Bakgalagadi community, stratified by location of residence, (ii) identifying the trend in Pulmonary TB incidence rate between the two ethnic groups in the sub-district, and (iii) find out possible connections between nomadic lifestyle and the prevalence of pulmonary TB in Gantsi sub-district. This is a descriptive analytic study and a cross-sectional ecologic design was used. Data was analyzed statistically by descriptive and Auto Correlation Function analysis.

There were 1907 cases of pulmonary TB included in this study; 723 occurred Basarwa dominated regions and 1184 Bakgalagadi dominated region. The outcomes from this research indicated that even when the pulmonary TB incidence in Gantsi sub-district is decreasing over time, the prevalence is still high in other areas dominated by the Basarwa and the incidences were higher in those areas than the Bakgalagadi dominated region. The incidences in males (55.2%) where higher than that of females (44.8) in both regions, and the age category 25-34

years registered the highest incidence rates in both groups. Auto Correlation Function coefficients indicated the Basarwa dominated regions was positively correlated with PTB incidence during the 2^{nd} lag (r = 0.28), where else the Bakgalagadi dominated regions was negatively correlated during both 1^{st} and 2^{nd} lags (r = -0.022 and -0.174 respectively).

With these results we cannot ignore TB susceptibilities that are brought up by ethnic differences in the sub-district and this study suggests for in-depth researches both qualitative and quantitative on pulmonary TB and ethnicity in the Gantsi sub-district. Recommendations are suggested to the Botswana National TB programme to place more emphases on addressing pulmonary TB among Basarwa to reduce the rates of infection in the district.

CHAPTER ONE

1.0 INTRODUCTION

This introductory chapter provides information about the background of the study, putting emphases on the current global Pulmonary Tuberculosis (PTB) situation, in Africa, Botswana and Gantsi district which was the area of study. This chapter will in details explain the rationale for carrying out this research, based on the current problems that triggered the research questions, formulation of the research hypothesis and research objectives and lastly give details on the significance, scope and study limitations.

1.1 Background and Rationale of the study

Pulmonary Tuberculosis as a communicable disease still remains a challenge for many countries in the world despite the efforts by their health care systems. TB disease is more prevalent among men than women, and impacts commonly adults in the economically productive generation; about two thirds of TB cases are approximated to occur among people aged 15- 59 years (WHO Global TB report, 2012). Commonly, a relatively minimal proportion of people infected with Mycobacterium tuberculosis will go on to acquire TB disease; however, the possibility of developing TB is much higher among people infected with the Human Immuno-deficiency Virus (HIV) and the World Health Organization reports that new TB cases the whole world reported were 9.4 million in 2009 (WHO Global TB report, 2012). Developing countries suffer extreme burdens of the disease and associated deaths, Southern Africa being the most afflicted region. Within 15 Member States of the Southern Africa Development Community (SADC), eight (8) experience prevalence rates higher than the African average, Botswana being among them. It is

highly noticed that in many SADC Member States, the Tuberculosis growth is propelled by the HIV/AIDS and poverty (Botswana National TB Programme manual, 2007).

Tuberculosis morbidity and mortality escalated noticeably from 1990 to date in Botswana. The notification rate has more than doubled from 226 per 100 000 in 1990 to 494 per 100 000 in 2009 and the most affected age group is the 25-45 year olds males being the most affected. Linked with this higher trend in Tuberculosis cases, Botswana has experienced a rising incidence of Multi Drug Resistance Tuberculosis from 0.2 % among new smear positive patients in 1996 to 2.5 % in 2008 (Botswana National TB Programme manual, 2007) and despite the efforts made by the government of Botswana, Tuberculosis has remained a challenge as the Ghanzi District is reported as being the most TB burdened region in Botswana. The principal medical officer for Ghanzi District, Dr Kamayi Ntumba stated the district has an average of 1 100 cases per 100 000 population while the national rate is an average of 506 cases per 100 000 population. He mentioned between 2006 and May 2010, they enrolled about 2 500 TB patients in the district and they used to have an average of number of about 350 patients on treatment per year, stressing that the number may increase to 400 evaluating from the present trend (reliefweb. int, 17 May 2010). Currently there are about 25 multi drug resistant TB cases in the Ghanzi District, that being said, patients who finish the TB treatment do respond satisfactorily. Dr Ntumba mentioned that the TB rate in the district is intensifying as cases are presently identified even in locations that usually were not known as being vulnerable to TB, such as Grootlaagte."I was surprised that recently we recorded eight TB cases in Grootlaagte settlement, he said" and areas that are mostly affected are DKar, Kacgae and Bere settlements (reliefweb. int, 17 May 2010). Poor living conditions for example, crowded families and nomadic lifestyles, are said to have contributed to a higher TB prevalence in the region, as it is mostly dominated by the Basarwa ethnic tribe who

are known to be highly mobile (nomadic), illiterate and language barrier of which have made communication difficult between them and their usually Setswana-speaking health care providers. They have never been an easy group to target with health messages and information about TB or HIV/AIDS usually miss the mark completely (BOTUSA; news letter, March 2008). TB treatment is obtained by TB patients on a daily basis at the health facilities and those individuals dwelling at the farms do cease the treatment the moment they revert to the farms. Alcoholic abuse and tobacco smoking has been likewise been realized to interfere with the overall performance of the TB therapy. The number of TB defaulters in the district is reported as being high, the cure rate was reported at 11 per cent in 2008 and it has presently increased to 56 per cent (reliefweb. int, 17 May 2010). According to the World Health Organization, the national cure rate should be 85 percent on all TB registered cases, that being said, the District is aspiring to have reached out to that target by 2012 and are determined that they can, given that they are striving at 70 per cent in 2011 (reliefweb. int, 17 May 2010).

1.2 Statement of the problem

Poor lifestyle conditions for instance crowded households and nomadic lifestyles are thought to have contributed toward high TB incidence and prevalence in the region, as it is mostly dominated by the Basarwa ethnic tribe who are known to be highly mobile (nomadic), illiterate and language barrier of which have made communication difficult between them and their usually Setswana-speaking health care providers. The available TB surveillance data of the district does not reflect the geographic distribution and ethnic variation in pulmonary TB prevalence and incidence within the district and there is paucity of studies addressing this subject. However, the geographical distribution of pulmonary TB prevalence needs to be examined for ethnic variation within villages of the Ghanzi-sub-district, which is dominated by

both Basarwa and Bakgalagadi ethnic groups in order to justify association between ethnic factors with high TB prevalence.

1.3 Research questions

1. Is there a disparity in Prevalence and Incidence rates of Pulmonary Tuberculosis (marked by geographical distribution) between nomadic Basarwa community and the settled Kgalagadi community of the Gantsi sub-district, Botswana?

Sub-question

1.1 What is the trend in Pulmonary Tuberculosis incidence rates in nomadic Basarwa community and Kgalagadi community between 2006 and 2010?

1.4 Hypothesis

1. Nomadic Basarwa community shows high rates of Pulmonary Tuberculosis prevalence and incidence cases in the Gantsi sub-district, than Bakgalagadi community.

2. Nomadic Basarwa community shows a high trend of Pulmonary Tuberculosis incident rates compared to Bakgalagadi community in the Gantsi sub-district, Botswana.

1.5 Thesis objectives

The Basarwa ethnic group has been pointed out to be a difficult tribe to deal with when it comes to health issues, including Tuberculosis which is highly prevalent in the District. It is anticipated that, this has come up due to their highly mobile lifestyle, illiteracy and language barrier between them and the usual Setswana speaking health care providers. Therefore, the objective of this study will be; (i) to determine the variation in Pulmonary TB incidence and prevalence rates between the nomadic Basarwa and Kgalagadi community, stratified by location of residence, (ii)

identifying the trend in Pulmonary TB incidence rate between the two ethnic groups in the sub-district between 2006 and 2010, and (iii) find out possible connections between nomadic lifestyle and the prevalence of pulmonary TB in Gantsi sub-district.

1.6 Significance, Scope and limitations

TB has remained the second killer after AIDS in Botswana that takes hundreds of lives annually. Therefore, any kind of research pertained to TB would certainly be a subject of crucial significance in contributing to TB control programme within the country. To date, quite few researches related to TB and ethnic factors not only in Botswana but many developing countries specifically have already been conducted. In this research identifying empirically, the geographic distribution variation in pulmonary TB prevalence and the changes in TB incidence trends, the connection between nomadic Basarwa and the prevalence of tuberculosis, will strengthen or elucidate the existing body of knowledge on ethnicity factors associated Tuberculosis prevalence in the Ghanzi Sub-district of Botswana, and the strategies to address them can be formulated to improve tuberculosis control in the region. The study will benefit the Tuberculosis patients (current and future) as the findings may be used to formulate strategies to improve the quality of service delivery in the region. Ministry of Health in Botswana will as well benefit as the findings of the study can be used as a basis for further generalizable studies. In addition, recommendations could then be made to the Botswana National Tuberculosis Programme (BNTP) on how to address the mostly afflicted areas in the Ghanzi Sub-district and subsequently improve Tuberculosis control in this area.

Considering that this research is a form of ecologic study design and is carried out only in one location of the country, it might have reduced power to be generalized to areas in the country with people belonging to the Basarwa and Bakgalagadi ethnic tribes. The data for this study was

collected from the health facilities, and TB patients themselves where not interviewed to get their perceptions with regard to their cultural practices that may hinder TB control in the district. That could have given strength to the findings and the association between TB and ethnic factors. More research is needed to explore such ethnic factors and TB prevalence in the district. However, since Ghanzi district is the region where the Basarwa and the Bakgalagadi ethnic tribes are saturated, and they are highly affected by TB in Botswana, the results of this study are useful and worthy reading as the Ghanzi district contexts may not be so different from other regions with high rates of TB and comprises of similar tribes.

This chapter explained the introduction part of this research. The overview of the current global PTB situation was discussed inclusively of the situation in Botswana and Gantsi sub-district as the study area. The problem that triggered the research questions was explained following the research hypothesis, objectives and giving the significance, scope and the limitations of the study. The next chapter will introduce the literature reviews applicable to this research.

CHAPTER TWO

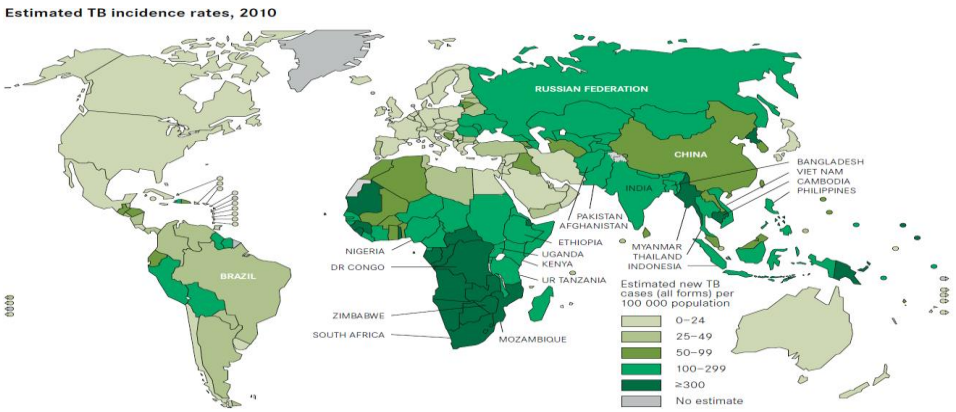
2.0 LITERATURE REVIEW

This following chapter is going to comprehensively evaluate and review previously published information on PTB distribution and burden. Firstly, it will describe the global epidemiology of PTB specifically analyzing the prevalence and incidence, following the same in Africa, Botswana and the study area Gantsi sub-district. This chapter reviews relevant literature related to the prevalence and incidence of PTB related to ethnicity.

2.1 Global Trend and distribution of TB

TB has remained a serious worldwide health challenge despite efforts put in place and the availability of effective treatment for decades. In 1993, the TB rate was estimated at 7 to 8 million cases and 1.3 to 1.6 million fatalities annually, therefore, declared at that time by WHO as a global health emergency (WHO Global TB report, 2012). Equal to 128 cases per 100 000 population deaths were reported in 2010, qualifying TB to be the second major root cause of death in the world among all infectious diseases and when TB is not treated, mortality rates are high (WHO Global TB report, 2012). Studies have shown that among sputum smear-positive cases of PTB, but HIV negative about 70% died in a period less than a decade (10 years), and cases with smear-negative but culture-positive results, 20% died within the same period of 10 years (WHO Global TB report, 2012). The development of treatment using a combination of Anti-TB drugs stated in 1940s and 1950s to reduce the mortality rates has been documented to a success rate of 90% and according to WHO, the treatment success rate has reached 87% among smear-positive cases of PTB in 2009 globally (WHO Global TB report, 2012).

Figure 2.1: Global Incidence and distribution of TB in the world, 2010



Source: (WHO report, Global TB Control, 2011)

Table 2.1: Global Estimated distribution of TB cases in 2010

Asia	59%
Africa	26%
Eastern Mediterranean	7%
European Region	5%
American Region	3%

Source: (WHO report, Global TB Control, 2011)

Asia describes the WHO regions of South-East Asia and the Western Pacific and Africa describes the WHO African Region (WHO Global TB report, 2012). HBCs (22) that have been mostly affected globally since 2000, among all estimated cases globally recorded about 81%.

Table 2.2: Five countries with largest number of incident cases in 2010

India	2.0 -2.5 million
China	0.9-1.2 million
South Africa	0.40-0.5 million
Indonesia	0.37-0.54 million
Pakistan	0.33-0.48 million

Source: (WHO report, Global TB Control, 2011)

India alone was estimated at one quarter (26%) of all TB cases globally, with China together they accounted for 38% worldwide (Table 2.2) and among 8.8 million TB cases reported in

2010, 1.2 million (12-14%) is of people co-infected with HIV (WHO Global TB report, 2012 and Ospina et al, 2012). Countries of the African region have a greater proportion of TB cases co-infected with HIV and accounted for 82% of all TB cases co-infected with HIV (WHO Global TB report, 2012).

The TB incidence rate globally has slowly declined between the year 1990 and 1997, and it was observed to be increasing around 2001(WHO Global TB report, 2012). In Africa, the rise in TB prevalence has been influenced by the HIV epidemic and these rates have declined by 1.3% per year since 2007, though a peak was estimated in 2004. Furthermore, the incident cases started to fall very slowly since 2006 in all WHO regions. Eastern Mediterranean Region has less than 1% per year decline compared to 1.8% decline rate in the African Region and 3.7% per year in the Americas Region (WHO Global TB report, 2012).

2.1.1 TB Deaths

WHO estimates that 46% of deaths were caused by TB in 2010, making TB to be the second major cause of deaths in the world after AIDS. The TB mortality improved in 2009 in most of the European and American countries in which making up just 8 % of the global TB cases (WHO Global TB report, 2012). In 2010, death rate was equivalent to 15 death per 100 000 population and 1.1 million (with a range from 0.9-1.2 million) deaths were reported among HIV-negative TB cases and among these number is women with a range 0.20 to 0.44 million (WHO Global TB report, 2012). Deaths for TB cases co-infected with HIV, data was not clearly shown as those deaths were grouped as HIV fatalities, however, deaths for TB cases that were HIV-positive were estimated to be 0.35 million (range from 0.32-0.39 million), of the total approximately 1.4

million TB cases of 2010 (range 1.2-1.5 million) who died of TB of which number of deaths was high in African countries (WHO Global TB report, 2012).

2.1.2 MDR-TB

There are more prevalent MDR-TB cases estimated than incident cases. This is because computing of the number of prevalent MDR-TB cases are more commonly comprehended than the sophisticated calculations needed to approximate the incidence rate of MDR-TB (WHO Global TB report, 2012). Among 12.0 million prevalent cases of TB, 650 000 were estimated MDR-TB cases in 2010. There is still continuous surveillance and surveys of MDR-TB and progress are not yet adequate in order to provide a definite evaluation of trends in MDR-TB worldwide and regionally. This has made it difficult to answer the question whether or not the incidences of MDR-TB cases increase, declining or stable (WHO Global TB report, 2012).

Table 2.3: Estimated proportion of MDR-TB burden countries and WHO regions

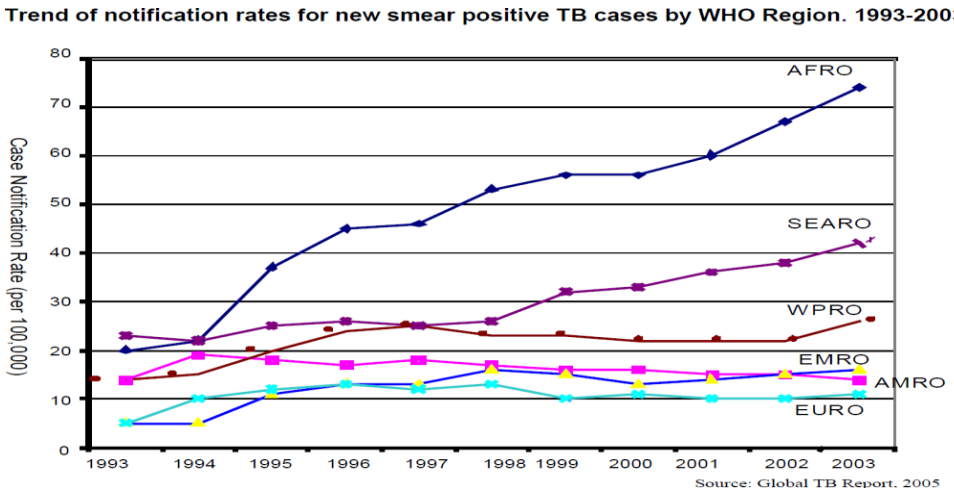
WHO REGION	**Estimated % of new TB cases with MDR-TB**
African	**1.9**
Americas	**2.1**
Eastern Mediterranean	**3.4**
Europe	**12**
South-East Asia	**2.1**
Western Pacific	**4.9**
GLOBAL	**3.4**

Source: WHO report, Global TB Control, 2011

2.2 TB Prevalence and Distribution in Africa

African Region accounts for 11% of the world's population, but contributes 27% of the total notified TB cases globally in 2003 (Update on TB Control in Africa, UN report 2006). The notification rate was 300 cases per 100 000 population in more than 34 WHO African Region countries, compared to the 15 per 100 000 population in developed countries. TB incidence has stabilized in many parts of the world, instead, Africa, South East Asia and the Western Pacific Region, the TB incidence has remained high. Among the three areas, Africa has experienced the fastest increase in TB incidence. Africa ahs the world's worst per capita burden of TB disease (Update on TB Control in Africa, UN report, 2006).

Figure 2.2: TB Notification rates for New Smear positive cases, WHO Regions, 1993-2003



Although Africa has the world's worst per capita burden of TB disease, there are variations in the burden of TB in Sub-regions of Africa. The Southern and Eastern regions of Africa are mostly afflicted and with the highest per capita burden of 400-700 cases per 100 000 population (Update on TB Control in Africa, 2006). Six out of the seven countries of the Central Africa reported between 100-200 cases per population, where else North African countries has the lowest burden

of TB of less than 65 cases per 100 000 per population (Update on TB Control in Africa, UN report, 2006).

2.2.1 TB and HIV/AIDS in Africa

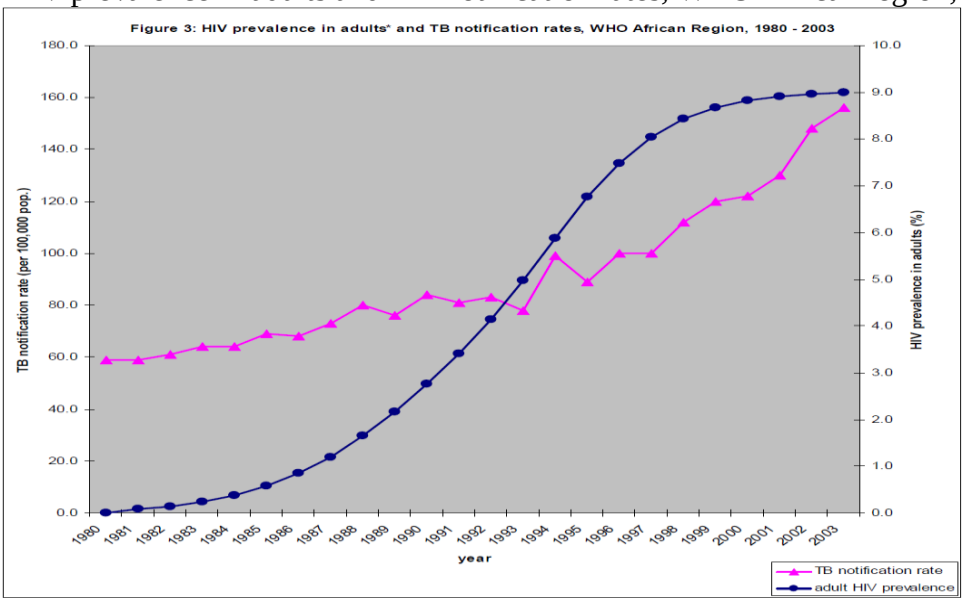
During the Abuja African Union summit in May 2006, many factors were seen to be responsible for the high prevalence of TB epidemic, such as, poor health infrastructure, organization, poverty, poor management of human resources, and weak health care systems. Besides these factors stated, HIV/AIDS epidemic is the greatest critical risk factor for TB incidences and death in Africa (Update on TB Control in Africa, UN report, 2006). Though TB itself can be cured, the presence of HIV has made the clinical management of TB to be complicated, and overloading the public health services (Update on TB Control in Africa, UN report, 2006). Stigma has increased as TB is now associated with HIV, hence making it difficult to control TB in Africa and the recurrence of TB in HIV co-infected patients is high and they tend to be more severely ill than HIV-negative patients due to immunosuppression (Update on TB Control in Africa, UN report, 2006). HIV/TB co-infected patients tend to develop side effects from treatment, causing the treatment regimen to be interrupted, hence leading to the risks of developing multi-drug resistant TB (Update on TB Control in Africa, UN report, 2006).

2.2.2 TB/HIV Co-infection in Africa

TB morbidity and mortality is mostly common among the HIV infected people and among 8% of the global dual infected people with TB and HIV, Sub-Saharan Africa accounted for approximately 35% (Update on TB Control in Africa, UN report, 2006). The young generations are the most affected group (ages 15-24), girls and young women being the mostly afflicted. HIV has been realized to cause TB more frequently and these has lead to an overloading to the health

care systems, stretching health care workers and over utilization of health facilities (Update on TB Control in Africa, UN report, 2006)

Figure 2.3: HIV prevalence in adults and TB Notification rates, WHO African region, 1980-2003



Source: (Update on TB Control in Africa, UN report, 2006, pg 4)

Africa has the largest number of deaths among TB patients resulting from high HIV epidemic hence qualifying Africa to be the world's worst burden of TB. It is estimated that every year 1 quarter million people lose their lives due to TB/HIV worldwide, and 80% of these people die in Africa (Update on TB Control in Africa, UN report, 2006). Out of 41 WHO listed countries with high TB/HIV dual infection, 29 countries are in Africa and therefore, control of both diseases in Africa has become complicated (Update on TB Control in Africa, UN report, 2006).

2.3 TB burden in Botswana

Botswana over the past 2 decades has experienced an increase in TB cases, though before 1990, initiatives in the control TB in Botswana were successful. TB notification in 1975 were 506 cases per 100 000 people and shown a decline in 1998 with a notification of 199 cases per 100

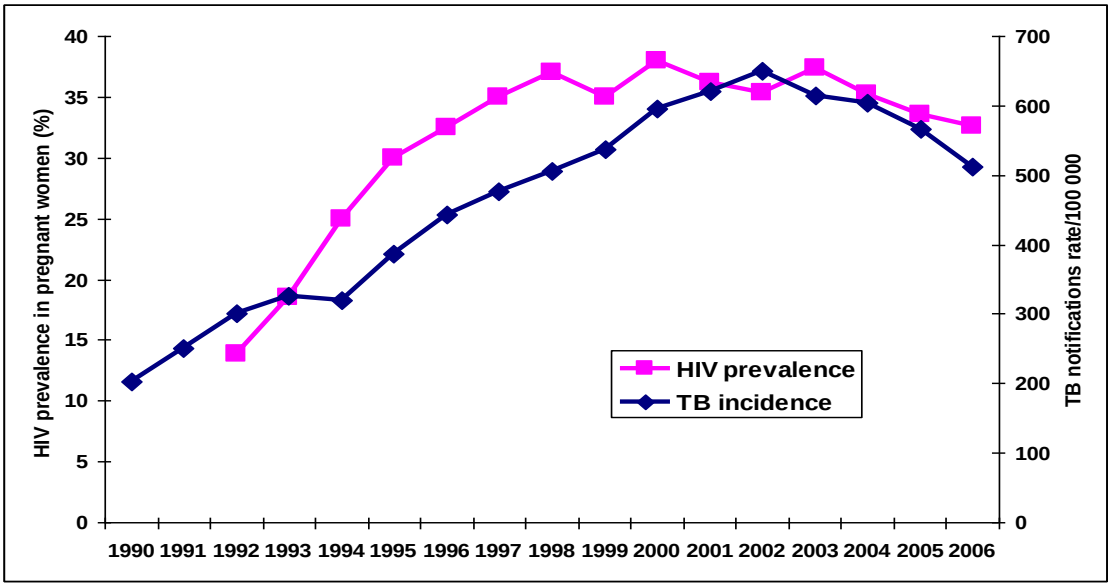
000 people (Botswana TB/HIV policy guidelines, 2011). It was in 1990 whereby the down trend of TB notification reversed and raised to 623 cases per 100 000 people in 2002, qualifying Botswana to be among the greatest TB afflicted countries globally (Botswana TB/HIV policy guidelines, 2011). In 2008, Botswana rated 536 per 100 000 people of TB cases and became the 6th highest in the world and the emerging of the MDR-TB has also posed a challenge to Botswana as the MDR-TB prevalence is increasing. The increase in new MDR-TB cases has rated from 0.2% in 1995 to 2.5% in 2008 (Botswana TB/HIV policy guidelines, 2011)

2.3.1 TB and HIV in Botswana

The proportion of TB cases among people presenting in health facilities who tested HIV positive is not yet known, though the rise in TB notification has been associated to the higher HIV cases in Botswana (Botswana TB/HIV policy guidelines, 2011). Since 1991, the increase in TB notification in Botswana reflected an increase HIV seroprevalence and people living with HIV are more susceptible to reactivated latent TB due to immunosuppression and progresses to get primary TB disease (Botswana TB/HIV policy guidelines, 2011). Researches in Botswana have revealed that 60 to 80% of TB patients are co-infected with HIV and recurrent TB has been observed to be common in people living with HIV and are normally registered as re-infection than relapse (Botswana TB/HIV policy guidelines, 2011). TB infection in Botswana has remained the major opportunistic infection to people living with HIV and major cause of TB mortality in the country (Botswana TB/HIV policy guidelines, 2011). It is estimated that among all HIV deaths, 40% is of respiratory infections and the clinical evidence of TB disease has become difficult in people living with HIV as they usually have sputum negative results (Botswana TB/HIV policy guidelines, 2011). The treatment of TB/HIV patients has also become a challenge in Botswana because of the emerging Immune Reconstitution Inflammatory

syndrome (TB-IRIS), drug interactions and toxicity, making TB/HIV posing a negative effect in the health sector in Botswana (Botswana TB/HIV policy guidelines, 2011).

Figure 2.4: TB Incidence & HIV Prevalence, Botswana, 1990-2006



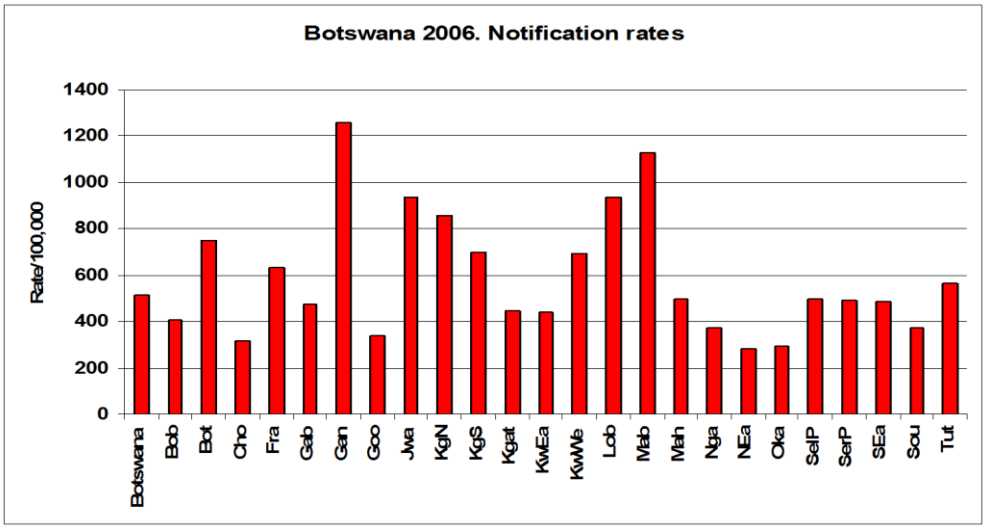
Source: Botswana National TB Programme Manual, 2007, pg 11

This graph more specifically compares trends in TB incidence with trends in HIV prevalence (among pregnant women) in Botswana. TB case rates are shown in dark blue from 1990 to 2006 with the rate per 100,000 populations represented on the right-sided y-axis. The prevalence of HIV among pregnant women attending antenatal clinics is shown in pink as a percentage on the left-sided y-axis (BNPT Manual, 2007). After the establishment of a national TB programme in 1975, TB rates declined until 1989. Since that time, they have increased simultaneously with rising rates of HIV. A recent study demonstrated that among Registered TB Patients with HIV test results the proportion of infected with HIV was 84%. This data demonstrates the effect of HIV on TB and that the rise in TB incidence is an outcome due to the escalating HIV prevalence in Botswana (BNPT Manual, 2007).

2.3.2 TB prevalence and distribution in Botswana

The increase in TB notification rate affects most of the districts in Botswana including both urban and rural. Within individual districts of Botswana there are disparities in TB notification rates within various geographical locations (BNPT Manual, 2007). Significant difference is also present in the geographical distribution of the community sub groups at a higher risk of TB, though not clearly documented in the TB surveillance data (BNPT Manual, 2007). In 2006, the TB surveillance of Botswana has shown a variation in geographical distribution of TB rates within 25 districts and sub-districts, including cities and towns. In all the districts, sub-districts, cities and towns, is dominating different tribes of Botswana, which are regarded as either major tribes or minor (ethnic tribes). Therefore, the TB notification rate and distribution vary among these tribes due to various factors that may be associated with cultural practices and lifestyle. Despite the efforts made by the government of Botswana, such as making TB treatment available and accessible for free to all patients, some districts still experience a high TB notification rate and ineffective TB control (BNPT Manual, 2007)

Figure 2.5: TB Notification proportion in Botswana, 2006



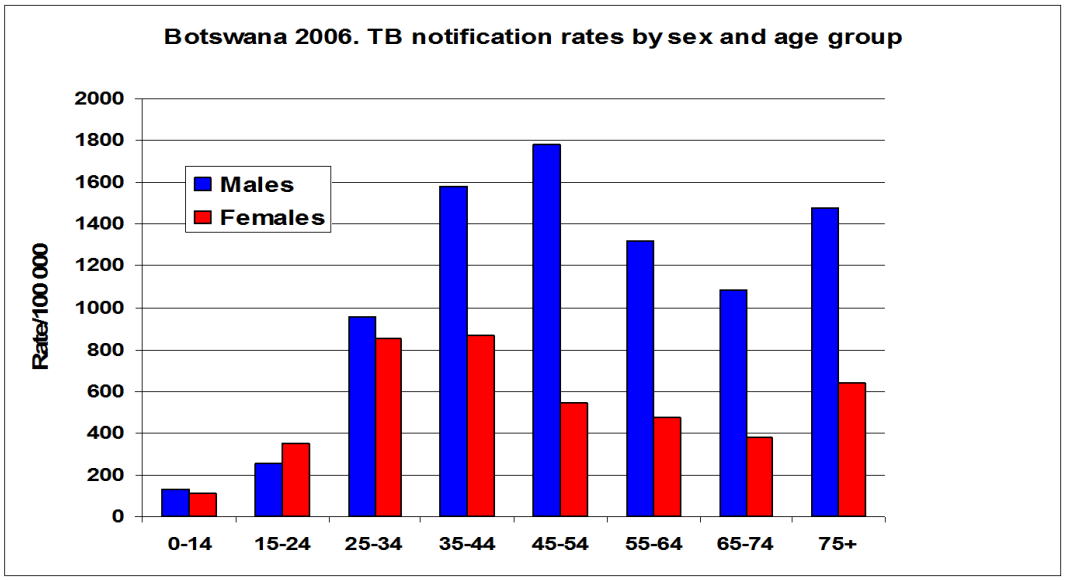
Source: (BNPT Manual, 2007, pg 12)

In 2006, Ghanzi district had a notification rate 3 times higher than the national notification rate avearage. The Ghanzi district reported more than 1 200 cases per 100 000 population more than the countries notification rate of 460 cases per 100 000 population (BNPT Manual, 2007). Ghanzi district is followed by other districts and towns which have a high TB notification rate of more than 600 cases per 100 000 population and these are Mabutsane with 1 100 cases per 100 000 people, Jwaneng town 980 cases per 100 000 people, Lobatse town 960 cases per 100 000 people, Kgatleng North sub-district 880 cases per 100 000 people, Boteti sub-district 780 cases per 100 000 people, Kgatleng South 750 cases per 100 000 people, Kweneng West sub-district 700 cases per 100 000 people and Francistown city with 640 cases per 100 000 people. Some districts, sub-districts, towns and cities, still experience lower TB notification rates less than 400 cases per 100 000 people. North East district and Okavango experienced a rate of 280 and 300 cases per 100 000 people respectively. North-East district has a TB notification 4 times less than that of Ghanzi district.

Though there are some disparities in TB notification in Botswana, studies lack to justify the cause of this disparity. A number of cultural practices, lifestyles and beliefs are associated with the differences in TB notification rates within districts of Botswana, of which are dominated by different tribes with different cultural beliefs and practices.

2.3.3 Age and sex TB notification in Botswana

Figure 2.6: TB notification by age and sex in Botswana, 2006



(BNPT Manual, 2007)

In Botswana, the highest TB case rates are among the age group 25 years and older (BNPT Manual, 2007). The TB notification rate for 2006 indicates that the rates were higher for the 45 years to 54 years in males and 35 to 44 years in females. TB in both sex groups increased at 25 years steadily to 54 years and suddenly drops until age 74. Therefore, it is observed an increase at the age of 75 years and older in both sex groups, which calls for further studies to identify factors associated with these increase in Botswana. TB notification is low in children of age 0-14 years, though there is an increase from age 15 to 24 years. The working group (mid age) is the mostly afflicted group by the TB disease. In 2006 TB notification surveillance data, males were affected than females at all age level categories. There is still need for studies to examine this disparity in age (BNPT Manual, 2007).

2.3.4 TB Control Framework in Botswana

2.3.4.1 Organization of Health Services in Botswana

The health care delivery system in Botswana is administered by the Ministry of Health (MoH) through provision of directorship on health issues, developing health policies as well as ascertaining appropriate clarification and application (BNTP manual, 2007). The framework, functionality and goals of Botswana's healthcare system are directed by the national Health policy (Abt Associates, 2000). The MoH decides the overall policies and plan of actions to be implemented, and has a direct charge over the hospital services and Primary Health Care through the ministerial departments (Abt Associates, 2000). The MoH is accountable for establishing, as well as corresponding standards for care at all department levels within the health system and supervising to guarantee that cities town councils and district health teams as well as private health care services adhere to the set guidelines (Abt Associates, 2000). City and town councils in Botswana offer targeted responsibilities on health promotion activities, fundamental medicinal services, referral when necessary as well as family health services having specific emphases on mother and child health, counseling and social welfare (Abt Associates, 2000). They need to ensure a suitable and appropriate number of health care workers at any health facility as well as support staff that includes a district communicable disease personnel concentrating on TB and HIV/AIDS (Abt Associates, 2000). Councils have the authority to determine organizational structures and framework of its District Health Team (DHT), also including the determination of heads of their teams, and all of these fundamental health services are executed in consultation with the MoH according to government policy and standards (Abt Associates, 2000).

2.4.3.2 Health Sector Finance

The government of Botswana provides a bigger portion of more than 80 % of the Total Health Expenditure for health care. Total Health Expenditure as a proportion of the Gross Domestic Product (GDP) progressively increased in 2000 from 6.4 % to 9.2 % in 2001 and to 10.5 % in 2002 (WHO Country Cooperation Strategy-Botswana, 2003-2007). Currently, studies have point out that the Botswana government's expenditures on healthcare have surpassed the 15 % aimed at the AU 2001 Abuja summit for every African country to spend on health (WHO Country Cooperation Strategy-Botswana, 2003-2007). The Government financing for health is provided through the Ministry of Health accounting for 56 %, Ministry of Local Government 7.9 %, National AIDS Coordinating Agency 9.4 % as well as the Ministry of Education 3 %, the remainder provided by the private health financing Insurance schemes, Household, NGOs and private firms (WHO Country Cooperation Strategy-Botswana, 2003-2007). A cost recovery system has currently been raised in the general public services from USD 0.40 per individual per visitation to USD 0.80 for Batswana and foreigners pay extra, depending on the kind of service they receive (WHO Country Cooperation Strategy-Botswana, 2003-2007). Health care Services like Anti-Retroviral treatment are provided free of charge, although foreigners are required to cover for such services fully. The international agencies and donors participate modestly to the developing health care system in Botswana. In 2002, a National Health Accounts Report was produced that emphasized the necessity to transform the sources of financing with regard to sustainability (WHO Country Cooperation Strategy-Botswana, 2003-2007).

2.4.3.3 Organization of the TB Control Programme (BNTP) in Botswana

The Botswana National TB Control Programme was initiated and instituted in 1975 by the MoH, through technical help and support from the WHO. After the introduction of the short-course chemotherapy treatment for TB in 1986, the "DOTs" strategy was also adopted in 1993 (BNTP manual, 2007). The BNTP is one of the MoH activities under the department of public health, which also in-cooperated the Isoniazid preventive therapy programme (IPT) (BNTP manual, 2007). TB management programme is fully integrated in to the public health care system and the services are rendered at all levels of the 24 health districts directly at district hospitals, clinics and health posts. The professional health care providers and specialists offer the services with a network of community volunteers (BNTP manual, 2007). Each district is lead by a public health specialist (PHS), who carries the whole responsibility towards TB services at district level. To each district also is attached a TB coordinator (TBC) whose responsibility is recording and reporting TB surveillance data and coordinating at the district level , activities of the TB programme (BNTP manual, 2007). Regularly, the national and district-level TB coordinators conduct regular monitoring and supervision by paying visits to all health facilities (BNTP manual, 2007). The main aim of the BNTP is to eradicate TB in Botswana, being mindful of the fiscal constraints connected to the medical services taking place in the country. They are committed to achieve this by implementing the following key areas;

1. *"Strengthening integration of TB control in to the health care system and safe guard the government commitment to TB control.*

2. *Detecting 70% of expected new cases of infectious TB and cure at least 85% of these (i.e. smear negative at the end of treatment).*

3. *Ensuring standardized short-course chemotherapy on an ambulatory basis under direct observation where never possible.*

4. *Strengthening standardized care notification based on case finding and confirmations by effective AFB smear microscopy.*

5. *Providing timely and reliable TB laboratory services with respect to microscopy and TB and HIV treatment services.*

6. *Strengthening programme supervision based on performance indicators, standardized recording and reporting and monitoring and evaluation.*

7. *Ensuring quality and client oriented TB control services.*

8. *Maintaining a reliable and regular TB drug supply and distribution*".

(BNTP manual, 2007, pg 14).

2.4.3.4 The "DOTs" Strategy

Botswana reports 100% geographical "DOTs" coverage after the adoption of the WHO recommended "DOTs" strategy in 1993. The government has continued to show total commitment in the control of TB in the country by fully financing and supporting TB programme initiatives and activities (BNTP manual, 2007). They have continually and sustainably supplied high quality TB drugs and provision of free access to TB treatment for all TB patients (BNTP manual, 2007). The government of Botswana has also entered in to long term relationship with local and international organizations for TB control in the country, such as US Centers for Disease Control (CDC), the Global Fund to fight AIDS, TB and Malaria

programme (GFATM) and the WHO (BNTP manual, 2007). The TB control in the country follows the standardized short-course treatment regimens for both children and adults, which is supervised throughout the entire treatment period with support of the community TB volunteers within the guidance of the TB control program (BNTP manual, 2007). This therapy is offered at the health facilities at each district with the support of the community TB volunteers within the guidance of the TB control program (BNTP manual, 2007). The BNTP has organized and maintained a standardized recording and reporting system from the individual patient's data. The paper registers are used at the facility level, and at district levels both paper and electronic registers are in use. On quarterly and yearly, basis data from districts is sent to the national level electronically and recorded in an electronically TB Register (ETR) (BNTP manual, 2007).

2.5 TB prevalence and distribution in Ghanzi District of Botswana

The Ghanzi district is the most TB afflicted district in Botswana and in 2010, the district reported an average of 1 100 cases per 100 000 population while the national rate is average of 506 cases per 100 000 people (reliefweb.int, 17 May 2010). Between 2006 and May 2010, the district registered 2 500 TB patients and usually the district registers an average of 350 patients on treatment per year and the number may rise to 400 judging by the current trend (reliefweb.int, 17 May 2010). The Ghanzi district registered about 25 MDR-TB cases, experienced a cure rate of 56% in 2010, and a high defaulters rate. The TB rate in the district is escalating as new cases are now detected in areas which were not known to be prone to TB (reliefweb.int, 17 May 2010).

The TB distribution within the district is not clearly explained in the surveillance data, and variation in TB notification within villages in the district have not been studied where else the disparities exists in the district.

Table 2.3: New and Re-treatment Sputum Smear Cases of Tuberculosis
Quarter 1-4 of 2010

B Cases	Pulmonary				EP	Total	%
	Smear +	Smear -	No Smear	Total			
New Cases	182	25	68	275	42	317	72.2%
Relapses	60	17	19	96	9	105	23.9%
Default	5	1	6	12	2	14	3.2%
Failure	2	-	-	2	1	3	0.7%
Total	249	43	93 *	385	54	439	100.0%
%	56.7%	9.8%	21.2%	87.7%	12.3%	100.0%	
* of which children aged 0 - 7: 18							
% smear + as proportion of Total PTB : **64.7%**							

TB Cases		0-4	5-14	15-24	25-34	35-44	45-54	55-64	≥65	Total	%
All TB Cases	M	15	11	37	59	60	38	19	16	255	58.1%
	F	10	11	34	55	35	23	5	11	184	41.9%
	Total	25	22	71	114	95	61	24	27	439	100.0%
	%	5.7%	5.0%	16.2%	26.0%	21.6%	13.9%	5.5%	6.2%	100.0%	
New Sputum Smear Positive Cases	M	-	2	26	38	25	10	9	3	113	62.1%
	F	-	4	18	23	10	9	1	4	69	37.9%
	Total	-	6	44	61	35	19	10	7	182	100.0%
	%	0.0%	3.3%	24.2%	33.5%	19.2%	10.4%	5.5%	3.8%	100.0%	
Re-Treat Sputum Smear Positive Cases	M	-	-	3	9	8	9	6	3	38	56.7%
	F	-	1	5	5	9	5	2	2	29	43.3%
	Total	-	1	8	14	17	14	8	5	67	100.0%
	%	0.0%	1.5%	11.9%	20.9%	25.4%	20.9%	11.9%	7.5%	100.0%	

$$\text{Bacteriology Coverage} = \frac{\text{Total smear pos + Total smear neg}}{\text{Total PTB minus children 0-7 yrs}} = \mathbf{79.6\%}$$

Source: BNTP TB surveillance data software, Gantsi district

2.5.1 Ghanzi District and Ethnic Distribution

The Ghanzi district is situated in the western part of Botswana, with a population of 43 370 out of 2 038 43 of the national population (Botswana Population census, 2011 August). The district consists of 2 sub-districts namely Charles Hill and Gantsi with a total of 16 villages. Two main ethnic tribes are found in the district; the Kgalagadi and the Basarwa (also known as Bushmen). The Gantsi village is the capital of the district and the mostly populated village in the district with 12 267 people. The Kagalagadi ethnic tribe is dominating the Gantsi village and the surrounding villages are dominated by the Basarwa ethnic group. By history they were the first inhabitants of the whole area though they are found in many parts of Botswana and neighboring countries. The tribe is known as one of the last nomadic hunter-gatherer tribes on earth and they speak a variety of Khoisan "click" languages (Know-Botswana website).

It is estimated that the population of the Basarwa in Ghanzi district is about 17 500 and this tribe consists of four major groups; the Gana, Gwi, Kxan ein and Naro. Lewis, in his study, divided the population per groups as follows; Gana 2 000, Gwi 2 500, Kxan ein 3 00 and The Naro being the largest group of 10 000 (Lewis, 2009). The Gantsi sub-district is the selected area where the study will take place. The sub-district has a population of 16 683 including the capital of the district, Gantsi, with a population of 14 809 (Botswana census 2011). The sub-district has 8 surrounding villages with a total of 4 698 and the Basarwa are the main dominants of these villages. The "KnowBotswana" travel guide website has reported the Ghanzi sub-district to be dominated by the Gana and the Gwi. With reference to the population estimations by Lewis in his study, the number of these two groups adds to 4 500, linking to the census results of 2011 of 4 698. The remaining 198 might be of the population of the non-Basarwa living in the area and government officers attached to work in the areas. However, most of the Basarwa people have

adapted the permanent settlements and are now non-nomads. Though they stay in these designated villages, one third is still highly mobile and stays as "squatters" (Good, 1999). It can be now be estimated that 1 500 San are still nomadic in the Gantsi sub-district. The Basarwa have never been an easy group to target with health messages compared to the Kgalagadi , because of their high mobile lifestyle, they are illiterate and communication barrier between them and their usually Setswana-speaking health care providers due to language differences. *"Messages about TB and HIV/AIDS usually miss the mark completely" (Botusa; News letter, March 2008).*The IWGIA organization report the Basarwa were traditionally seen as hunter-gatherers, but in fact, "the vast majority of them are small-scale ago pastoralists, and people with mixed economies who resides both in rural and urban areas, especially in the Kalahari desert". They further argued that the Basarwa are some of the poorest and under-privileged community in Botswana, with a high percentage of them living below the poverty line (Hitchcock et al, 2010).

There still paucity of literature in Botswana to address TB distribution and ethnic groups. However, in other countries, studies have been done to examine TB notification within ethnic groups. A similar study was carried out by Long et al, whereby they examined the epidemiology of TB within Canadian origins and foreign or ethnic groups, between 1987 and 1995. They found that, of the registered 1930 TB cases reported in 1995, 57 % of foreign-born patients (116 cases) and 14% of Status Indians (246 cases) accounted for 72 % (Long et al, 1999). The overall risk of TB was 12 times higher for people born outside Canada and 26 times higher for Status Indians than those of the 'other' Canadians and between 1987 and 1995, the rates for all ethnic groups declined between 1987 and 1995(Long et al, 1999). The TB rates for 'other' Canadians decreased nearly by 50%, where else for foreign-born people and the Status Indians decreased minimally by 8.1% respectively (Long et al, 1999). Another study examining geographical

distribution of TB with ethnicity was done in England and Wales in 1998 by Ormerod et al. They used data from National survey from 1983 to 1993. Their analyses highlighted a continuing important contribution of patients belonging to the ethnic minority to TB notification rate. They realized those of the non-whites ethnic groups contributed 56% of TB notification in both study areas, where as they constitute less in the entire UK population (6.3% of the total UK population) (Ormerd et al, 1998). An increase between 1988 and 1993 was observed as well in the non-whites ethnic groups, with an increase range of 13.6% of the total notification in Wales and 68.6% in Greater London (Ormerd et al, 1998). They further analyzed that TB rates in the ISC ethnic group is associated with place of birth and the duration of stay in the UK and within the same ethnic ISC group, those who were born in the UK have the lowest rates than those who arrived recently (less than 5 years) who had the highest rate (Ormerd et al, 1998).

2.5.2 Risk factors associated with TB prevalence in Ghanzi district of Botswana

The risk factors associated with TB in Ghanzi district were identified to be due to several factors which were grouped as social/cultural/biological and policy/institutional factors. The social/cultural/biological factors included those such as; high prevalence of HIV infection, of which HIV lowers the immune system, making a person more susceptible to TB infection and disease. Crowded living conditions and poor ventilation, mostly common in "squatter" settlements, which creates a physical environment where the bacteria can thrive. The other factor identified in the district was nomadic lifestyle, which make it difficult to contain the spread of disease or achieve cure rate set standard as treatment is interrupted when the patients are unable to return to the health facility for care. Other factors are poor treatment adherence and some occupational lung disease, especially silicosis. Policy/institutional risk factors associated with TB prevalence in the district included; inadequate integration of provision of services for HIV and

TB, human resource challenges, poor management and follow-up of cases and nosocomial transmission(BNTP, training manual 2009).

2.6 Gaps in Literature

There is paucity of published literature surrounding the evaluation of Trends in pulmonary TB and evaluating the distribution variations within ethnic groups in Botswana. Some ethnic groups, in this case, the Basarwa, have been highly associated with high prevalence of TB based on the cultural and lifestyle they are known of. However, there is less literature to evidence this argument. Additionally, some statistical complication arose following some legal and political protection on the Basarwa community and because of these, the population statistics and health records does not clearly identify them on individual bases, making it difficult to have data demarcating the individuals within villages according to tribes of the district. Therefore, in this study the tribes will discussed based on area of dominance, though the Community TB participants were useful to identify patients according to their tribes. In developing countries, literature has begun to emerge, examining the variation in TB notification between ethnic groups. These have come because the population is registered by ethnicity or status residence, and there is adequate surveillance data as health care centers register patients with the same pattern (indicating ethnicity). However, literature from developed countries still some gaps exists. The ethnic possibility of being associated with TB is challenging to interpret, in regard to establishing causality because of the possible confounding factors linked to TB prevalence that may be taken in to account, such as; poverty, overcrowding, and some socioeconomic factors (Ormerod, 1998).

This chapter has reviewed previous studies for understanding concepts in prevalence and incidence of PTB, the current situation, factors associated with the up-ward increase in PTB incidences globally, in Africa, and in Botswana. Issues related to ethnic factors were reviewed from previous studies done in other countries, which might be useful to bring an understanding in this research. The chapter that follows will introduce the methodology used in carrying out this research.

CHAPTER THREE

3.0 RESEARCH METHODOLGY

This following chapter is going to comprehensively explains in detail the procedures and methods used for data collection up to data analysis. At first, it will introduce the instrumentation, the study site characteristics, study design, study population (including inclusion and exclusion criteria) and data analysis (descriptive and statistical). Lastly, the chapter will elaborate on ethical considerations and constraints in conducting the research.

3.1 Instrumentation

The researcher used the TB surveillance data maintained by the BNTP TB registers in all health care facilities in Gantsi sub-district to conduct the study. The BNTP has developed a database register of all individuals who are contacted or were diagnosed of TB and on treatment. The demographic information of all individuals such as; age, residence status, physical address and contact details were given by the individuals during time of enrollment in TB therapy. Information on ethnicity is not provided in the database, therefore, participants were considered mainly by residence status rather than on individual bases, though Community TB participants were helpful in identifying TB patients according to their tribes.

Individuals with TB are identified in two ways in Botswana; passive and active case finding (BNTP manual, 2007). Passive case finding is when TB is diagnosed from a patient during the time he/she has attended a health facility to seek medical attention. Active case finding refers to health workers actively move around the community in search for the TB patients (BNTP

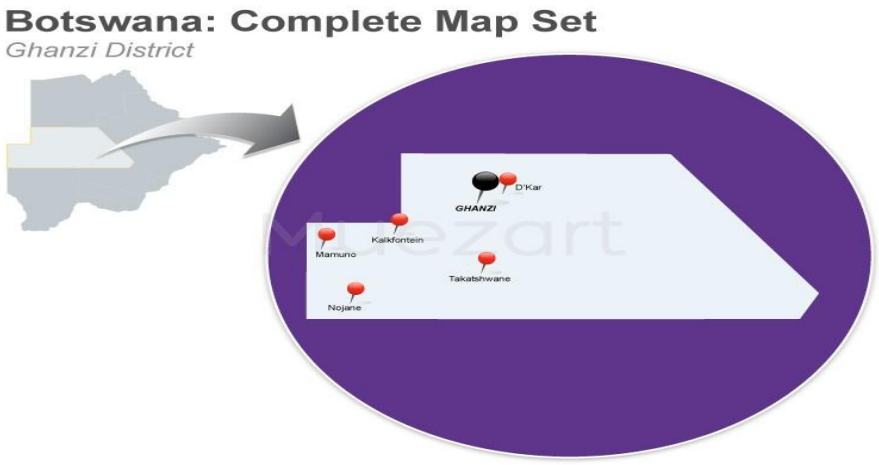
manual, 2007). The most common method used in Botswana for active case finding is contact tracing; that is; all individuals sharing the same house with the patient diagnosed are invited and/or followed for screening. In Botswana case finding is commonly done by history taking, physical examination, sputum examination, X-ray examination and Mantoux test (Tuberculin skin testing) (BNTP manual, 2007). Patients contacted either by active or passive case finding and are presenting with symptoms suggestive of TB ("TB suspect"), are recorded in a Suspect and Sputum Dispatch Register (MH 2028). Investigations will be carried out (sputum, X-ray where necessary) to rule out TB (BNTP manual, 2007). The other reason for registration is to follow the contact in case he/she does not come back for results as indicated. The register contain all suspect details including; name and serial number, gender, detailed address, phone number, date of registration and specimen collection, district/facility name and the results of the bacteriological examination. When the decision has been made whether or not the patient has TB, it will still be indicated in the Suspect and Sputum Dispatch Register. In case the patient has been confirmed to have TB, he/she is transferred to the facility TB register and allocated a treatment card (BNTP manual, 2007).

3.2 Study Site/Areas and its Characteristics

Ghanzi district, sometimes pronounced as Gantsi, is situated in the western region of Botswana, with its west side bordering Namibia and stretching east in to most of the interior of the country. The administrative center of the district is a village named after the district, Gantsi. The district has an area of 177 910 km, with a population of 43 370 as of 2010 population census results, making it less populous than any other district in Botswana. In the eastern half of the district comprises of the Central Kalahari Game Reserve. The district has two main sub-districts which include: Gantsi and Charles Hill sub-districts. The following is a list of the villages found in

Ghanzi district, listed separately in 2010 census; Gantsi sub-district covering Gantsi (capital), Bere, D'kar, East Hanahai, West Hanahai, Groote-Laagte, New Xade, Qabo, Kacgae, Kuke and Charles Hill sub-district covering Ncojane (Capital), Charles Hill, Chobokwane, Karakobis, Makunda, New Xanagas and Tsootsha. Gantsi village is the largest and the capital of Ghanzi district with a population of 12, 267 as according to the 2010 census, which is five times more than Ncojane the capital of Charles Hill sub-district which the second-largest village in Ghanzi district. This region is largely covered by the Kalahari Desert, some of which is also covered by a large seasonal wetland called the Makgadikgadi Pans. The main two tribes dominating this district are Basarwa and Bakgalagdi.

Figure 3.1: Complete map of Botswana and the study site, Gantsi District



Source: Google maps

3.3 Study design

The researcher conducted a cross-sectional ecologic study to examine the variation in geographical distribution of pulmonary TB in villages of Gantsi sub-district over 5 years (2006 to 2010). A list of complete variables which were actually made available to the researcher included; year of notification, age, gender, residence status, health facility, previous diagnosis

year (for relapse cases), treatment completion status, cure status and sputum results (initial and after 2 months). The year of diagnosis and age were used to record categorical variables and age variable was further categorized in to strata of; 0-14, 15-24, 25-34, 35-44, 45-54, 55-64 and 65+ respectively.

3.4 Study population

3.4.1 Numerator

The numerator represents the number of individuals with the risk factor and presented as the upper unit of a fraction. All individuals registered and diagnosed of pulmonary TB in the Gantsi sub-district from 2006 to 2010 were identified and presented as numerator.

3.4.1.1 Inclusion criteria

Individuals of all ages registered with pulmonary TB in Gantsi sub-district participated in the study. A full profile of total TB cases in Gantsi sub-district from 2006 to 2010 is presented in table 1 and individuals who were identified as relapses, defaulters and treatment failures were included in the study. Other studies have not included relapse, defaulters and treatment failures cases as they anticipated they would artificially inflate case rates. In his study McLeod (2007), realized the exclusion of these cases of TB could have an impact on the results. He found a great number of on off-reserves compared to on-reserves among aboriginals in Saskatchewan. He realized the inclusion of these cases may have supported the initial hypothesis that the off-reserves aboriginals are experiencing an increase in total number of TB cases over time, compared to those living on-reserve (McLeod, 2007).

Table 3.1: Summary of Pulmonary TB cases, Gantsi sub-district, 2006-2010

TB CASES	2006	2007	2008	2009	2010	Total
New Cases	355	378	305	372	245	1655
Relapses	42	38	91	79	78	328
Defaulters	19	17	27	35	19	117
Failure	4	6	5	5	4	24
Total	420	439	428	491	346	2124

3.4.1.2 Exclusion criteria

Individuals with extra pulmonary TB were excluded from the study, as the researcher believed that extra pulmonary TB may be influenced by individualized factors that may not affect the entire population. Visitors and transfer-in pulmonary TB patients did not participate in the study as their residence status may not be of Gantsi sub-district and their data may be incomplete and difficult to trace from their initial centers of diagnosis.

3.4.2 Denominator

This represents the size of the population from which the individuals were drawn and always presented as the lower unit of a fraction. The denominator can as well be a subset of the entire population and involve the measure of time in case of calculating a rate. The population from National Statistics office for Gantsi sub-district villages was very fatal to represent the denominator data. Botswana government, central statistics office, carries out a nationwide census for each 10 years which aims at collecting information from the population. Population results do not reflect the results on ethnicity and tribes, and these makes it difficult to predict the number of the population within different tribes in the country. Nevertheless, many researchers on social science studies have carried some population count among the Basarwa tribe. As a result of the

methods applied to collect data from the population, some people might be missed out as well as some may disapprove to take part leading to an underestimation about the number of people. Reliable sources were determined prior to calculation of TB cases in the Gantsi sub-district, and they were advantages and disadvantages of using those sources. The population collected by the Botswana central statistics office registration data source, produced information that was believed to be much more precise for the villages. Additionally, population statistics data carried out by other researchers also was used to support the demarcations in majority among the two tribes of Gantsi sub-district. In the eastern region of the district, which the Basarwa tribe dominate is estimated to a population of 4 500 according to a study by Lewis, (2009). The Botswana central statistics office results of the region reported 4 698, and the region consists of 4 villages namely; New xade, East Hanahai, West Hanahai, and Kacgae. The western region, there was no specific population data on Basarwa specifically, though the Basarwa tribe are dominant in the region. The villages dominated by the Basarwa in the western regions are; Kuke, Qabo, Groote Laagte, D'kar and Bere. Therefore, the population census statistics was significant to be used as a denominator in calculating the prevalence and incidence rates for the Basarwa in both regions. Gantsi village is the capital of the sub-district and though situated in the western region of the sub-district, it is mainly dominated by the Bakgalagadi tribe. The tribe has never been associated with nomadic lifestyle, making it cluster in one area with a large population. The population of Gantsi village according to Botswana central statistics office results is 14 809, and the number of Basarwa residing in the village is unknown even though they are present. The village has three regions acting as catchment areas for health access and the areas were as follows; Gantsi clinic, Gantsi primary Hospital and SHAA clinic. Due to the nature of the study (ecologic study), the population statistics from Botswana central statistics office results was used

in calculating the rates for the tribes. The application of the numerator and denominator in this research assisted in answering the research questions and gave results in numbers that were discussed to bring out conclusions in geographical distribution variations of pulmonary TB notification versus ethnic tribes of Gantsi sub-district.

3.5 Data Analysis

3.5.1 Descriptive analysis

This is a descriptive analytic study; therefore descriptive analysis was used to analyze frequency of pulmonary TB cases in Gantsi sub-district by year of diagnosis, location of residence (Basarwa and Bakgalagadi), age categories and sex respectively. There were large numbers of TB cases; therefore all ages could lead to stable estimates. Besides, for easy analysis it was decided to categorize the age in the following manner; 0-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64, 65+ respectively. Prevalence and incidence rates were calculated for both Basarwa and Bakgalagadi located regions using census statistics and presented as number of cases per percentage for the prevalence and number of cases per 1, 000 people per population for the incidences (objective 1). Prevalence was obtained using the following formula;

$$\frac{\text{number of existing cases of a disease during time period}}{\text{Total population during time period}} \times 100$$

The incidence rates were calculated and expressed as cases per 1, 000 population using the following formula;

$$\frac{\text{number of new cases of a disease during time period}}{\text{Population at risk during time period}} \times \text{Constant}$$

The constant used in this study was 1, 000 people per population.

The results were presented in tables, graphs and charts for comparing and description. Statistical assessments to get trends in incidence between 2006 and 2010 were not carried out as predictions of rates were not part of the study objectives, rather the trends were evaluated by observing incidences over time for comparing and formed part of the descriptive analysis.

3.5.2 Statistical Analysis

The Auto correlation Function was used to primarily examine whether or not adjacent observations are auto-correlated; meaning, whether in a series of observations there is correlation (the measure of time series of events over time in a particular place). This is a measure of association between two variables that have been measured on internal or ration scales and determines the direction and strength at which two variables are linearly correlated (Easton and Mc Coll, 1997). Auto correlation function analysis was performed to identify the significance of variables possibly connected with the incidence of pulmonary TB and denoted by *"r"* (Easton and Mc Coll, 1997). When *"r"* is close to +1, it is denoted that variables x and y are correlated positively, if close to -1 the correlation is negative, and when *"r"* is at 0, then there is no relationship between the two variables (Easton and Mc Coll, 1997). In this case the relationship between pulmonary TB incidence and location of residence (Basarwa dominated regions and Bakgalagadi dominated region) with time (between 2006 and 2010). Variables with significance to TB incidence in Gantsi sub-district were selected for inclusion into the Auto Correlation Function and variables that qualified for inclusion are the Incidence rate, year of diagnosis, and location of residence (Basarwa dominated and Bakgalagadi dominated). Inclusion in to the major impact model was decided on from the mentioned above variable's statistical significance with the incidence of pulmonary TB ($P<0.05$).

3.6 Ethical Considerations

Permission to collect data and conducting the study has been granted by both the Ritsumeikan Center for Asia Pacific Studies (RCAPS) and the government of Botswana through the Ministry of Health, health research unit. See appendix for letters of approval.

3.7 Constraints in Conducting Research

There were several constraints in conducting this research, more especially during the data collection process. The data collection process was delayed by 9 days, as the Ministry of Health in Botswana delayed in issuing the approval letter. The delays were caused by the fact that, the research team did not approve the research title as they believed it pinpoint a certain minority group that has a strong protection from the government and internationally. The fear was the publication of this study might work against the government in relation to vulnerable ethnic groups like Basarwa. The villages included in the study were dispersed and the roads were sandy, which lead to our car getting stuck hence affecting data collection schedule. There was poor and/no network coverage in most villages and no lodging facilities, which lead to us commuting from Gantsi villages on daily bases making the data collection process costly and tiresome.

This chapter has in detail provided an explanation of how this study was carried out by describing it to three stages of field work, namely; the procedure before the field work, the process during field work and data analysis after the field work, and the procedures and methods used for data collection. Lastly, the methods and process of data analysis were elaborated. The next chapter will introduce the results and findings after the data analysis.

CHAPTER FOUR

4.0 FINDINGS AND RESULTS

This chapter will present the results and data interpretation. Firstly, the data proportion of PTB in Gantsi sub-district, 2006-2010 is summarized and presented in a table. The prevalence results were calculated and presented in a bar graph. The incidence results are also presented in tables and graphs and further stratified in to regions within Gantsi sub-district for easy comparison. The statistical results from the Pearson analysis are also presented in tables.

4.1 Descriptive Results

The total number of pulmonary TB was 2 377 reported to the Botswana National TB programme in the Gantsi sub-district between 2006 and 2010 and 470 cases were excluded from the study as they failed to meet the selection criteria (i.e. cases registered as extra pulmonary TB and transfer in from other district as well as the prison clinic data of 35 cases was also excluded in the study). The remaining cases of 1 907 met the selection criteria and finally included in the study analysis yielding the following variables presented in the proportion of pulmonary TB cases table 4.1.

Table 4.1: Proportion of Pulmonary TB, Gantsi sub-district, 2006-2010

	Frequency	**Percentage%**	**Incidence per 1, 000 population**
Sex			
Male	1 166	54.8	21.1
Female	958	45.2	18.3
Age			
0-4	185	8.5	3.1
5-14	176	7.8	2.8
15-24	346	16.8	6.1
25-34	531	26.3	9.6
35-44	418	20.2	7.4
45-54	240	11.3	4.1
55-64	111	4.5	1.6
65+	117	4.8	1.7
Residence status			
Basarwa Dominated regions	705	33.2	90.3

Bakgalagadi Dominated region	1 419	66.8	32
Sex x Residence			
Males			
Basarwa Dominated regions	402	19.7	48.2
Bakgalagadi Dominated region	764	35.5	15.2
Females			
Basarwa Dominated region	368	18.2	44.4
Bakgalagadi Dominated region	590	26.6	11.4
New cases			
Basarwa Dominated regions	573	34.6	73.4
Males	307	53.6	39.3
Females	266	46.4	34.1
Bakgalagadi Dominated regions	1 082	65.4	24.4
Males	619	57.2	14
Females	463	42.8	10.4
Defaulters			
Basarwa Dominated regions	14	11.2	1.7
Males	11	78.6	1.4
Females	3	21.4	0.4
Bakgalagadi Dominated region	103	88.8	2.3
Males	69	67	1.6
Females	34	33	0.8
Relapses			
Basarwa Dominated regions	113	34.5	14.5
Males	55	49	7.0
Females	58	51	1.3
Bakgalagadi Dominated region	215	65.5	4.8
Males	111	52	14.2
Females	104	48	2.3
Treatment failures			
Basarwa Dominated regions	5	14.3	0.4
Males	1	20	0.1
Females	4	80	0.5
Bakgalagadi Dominated region	19	85.7	0.4
Males	11	58	0.24
Females	8	42	0.2

Among the 1 907 pulmonary TB cases in the Gantsi sub-district, 1 052 (55.2%) are males leading females cases of 855 (44.8%). The ages were stratified in to 8 categories as; 0-4, 5-14, 15-24, 25-34, 35-44, 45-54, 55-64 and 65+ respectively. Age category 25-34 had the highest rates with 501 (26.3%) followed by 35-44 age category with 385 cases (20.2%) and in that order

15-24 with 320 cases (16.8%), 45-54 213 cases (11.3%), 0-4 162 cases (8.5%), 5-14 148 cases (7.8%), 65+ 91 cases (4.8%) and with least cases 55-64 with 85 cases (4.5%). The Bakgalagadi dominated region had the largest number of pulmonary TB notification of 1 184 (62.1%) against Basarwa dominated regions with 723 cases (37.9%). As discussed earlier in chapter two, Bakgalagadi dominated region is more populated than the Basarwa dominated regions hence there high notification rates in Bakgalagadi dominated region. In both regions, male's rates are higher than those of females. The Gantsi sub-district registered 1 655 new cases between 2006 an 2010. Basarwa dominated regions registered 573 (34.6%) new cases while Bakgalagadi dominated region recorded 1 082 (65.4%) of new cases. Defaulters were 116 in the sub-district, 103 (88.8%) registered under Bakagalagadi dominated region and 13 (11.2%) registered from Basarwa dominated regions. The relapse cases surpassed the defaulter's rates with 328 cases, 215 (65.5%) cases registered from Bakgalagadi dominated region and 13 (34.5%) cases from Basarwa dominated regions. There were very few cases recorded as treatment failures of 21 cases. 18 (85.7%) were of Bakgalagadi dominated region and only 3 (14.3%) cases were registered from Basarwa dominated regions.

4.1.1 Prevalence Results

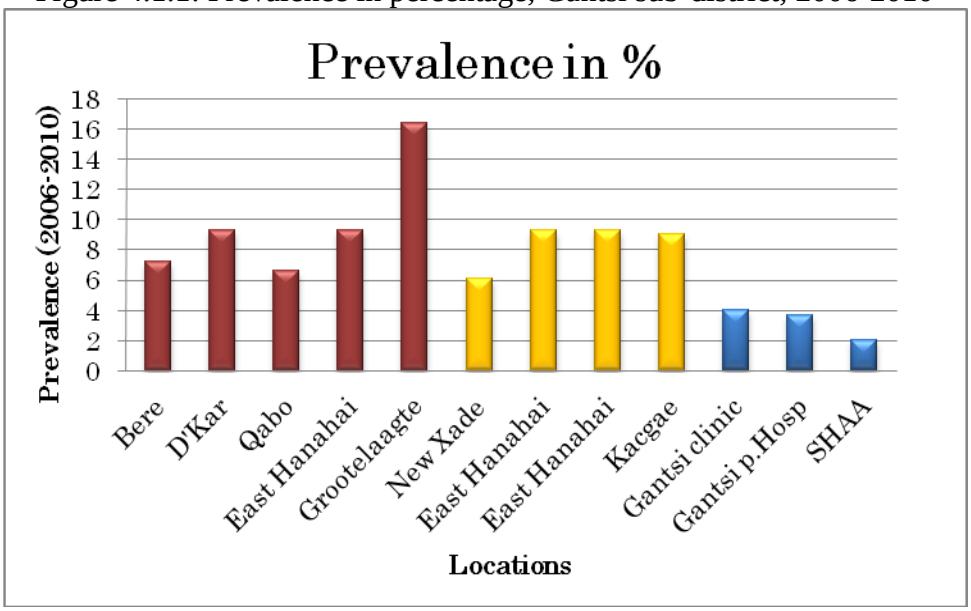
Viewing the results from the proportion table above, it seemed the Bakgalagadi dominated region is highly afflicted than the other regions dominated by the Basarwa. The prevalence rates were calculated using the formula and expressed as percentage. The table and bar graph below shows the prevalence rates.

Table 4.1.1: Prevalence in percentage, Gantsi sub-district, 2006-2010

Year	Bere	D'Kar	Qabo	Kuke	Groote-Laagte	Kacgae	Eeast-Hanahai	West-Hanahai	New Xade	Gantsi Clinic	Gantsi Hosp	Shha
2006	1.43	1.68	1.7	2.2	1.88	1.5	0.9	1.42	0.9	0.8	0.8	0.4
2007	0.72	1.86	1.3	1.7	2.4	3.4	1.1	2.28	1.34	0.7	1	0.3
2008	2	2	0.5	1.7	3.1	2.1	0.9	1.85	0.9	1	0.85	0.5
2009	1.43	1.92	1.7	3.8	0.58	0.94	0.9	1.85	1.4	0.9	0.6	0.54
2010	1.61	1.86	1.3	2.5	3.3	1.1	1.3	2.71	1.5	0.6	0.5	0.24
Total	**7.2**	**9.3**	**6.6**	**11.3**	**16.4**	**9**	**9.3**	**10.1**	**6.1**	**4**	**3.7**	**2**

Key;
- Eastern region, Basarwa dominated
- Western region, Bakgalagadi dominated
- Western region, Basarwa dominated

Figure 4.1.1: Prevalence in percentage, Gantsi sub-district, 2006-2010



Analyzing the table and bar graph above, it is evident that though the Basarwa dominated regions had less pulmonary TB cases notification rate, they are all highly prevalent than the Bakgalagadi dominated region. Groote-Laagte has the highest prevalent rates of about 16.4%, followed by Kuke with 11.3%, West Hanahai 10.1%, East-Hanahai and D'kar with equal rates of 9.3%, Kacgae with 9%, Bere 7.2%, Qabo 6.6% and New Xade with 6.1%. Bakgalagadi region all registered 45 and below, Gantsi clinic with 4%, Gantsi primary hospital 3.8% and the least with only 2% is SHAA clinic.

4.1.2 Incidence Results

Incidence rates were calculated using the incidence formula choosing 1, 000 people per population as a constant between 2006 and 2010. The incidence rates were also expressed as percentage in a pie chart to explore the differences between regions.

Table 4.1.2: Incidence rate per 1, 000 populations, Gantsi sub-district, 2006-2010

Year	Bere	D'Kar	Qabo	Kuke	Groote-Laagte	Kacgae	Eeast-Hanahai	West-Hanahai	New Xade	Gantsi Clinic	Gantsi Hosp	Shha
2006	7.3	10.4	16	9.8	3.6	8	3.8	2.9	3.2	3.8	8.2	1.8
2007	7.2	9.8	9.3	20.8	15.6	24.3	11.4	24.8	6.4	2.2	10	1.6
2008	20	12.2	5.3	7.3	24.3	9.6	3.8	8.7	8	5.1	8.7	3.3
2009	7.3	16.5	14.7	31.2	51.3	8	3.8	17.4	12.8	5	5.8	4.5
2010	16.4	16.5	12	19.7	31.7	8	13.3	17.6	12.8	4.1	4.6	2.2
Total	**53.9**	**70.7**	**60.4**	**97.4**	**36.6**	**61.4**	**37.7**	**87.2**	**45.3**	**20.9**	**38.4**	**13.6**

Key;
- Eastern region, Basarwa dominated
- Western region, Bakgalagadi dominated
- Western region, Basarwa dominated

Figure 4.1.2: Incidence rate per 1, 000 populations, Gantsi-sub district, 2006-2010

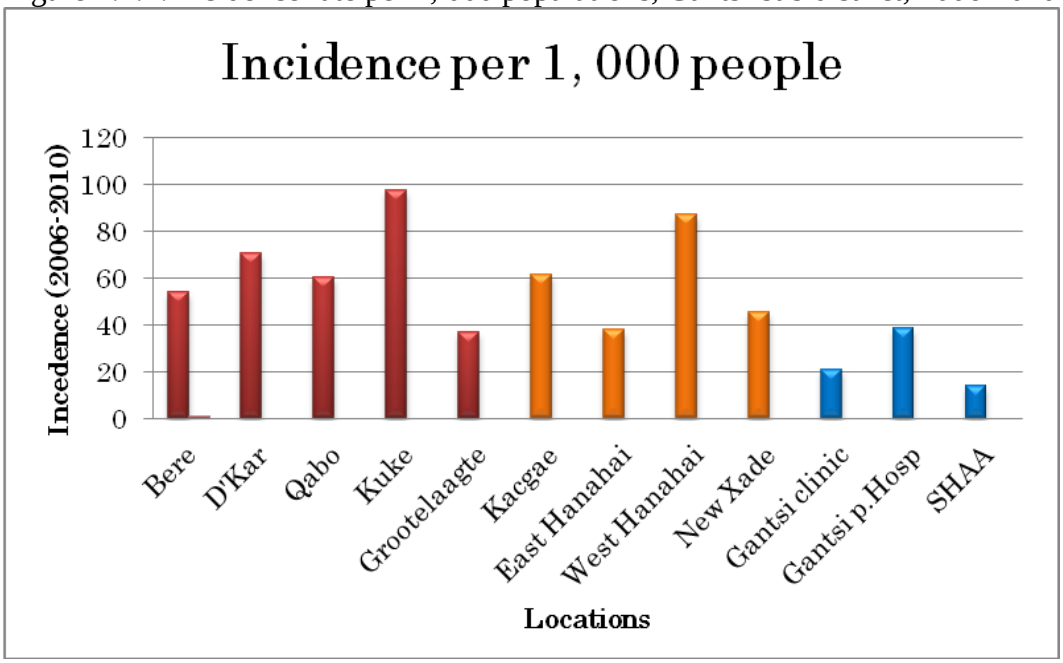
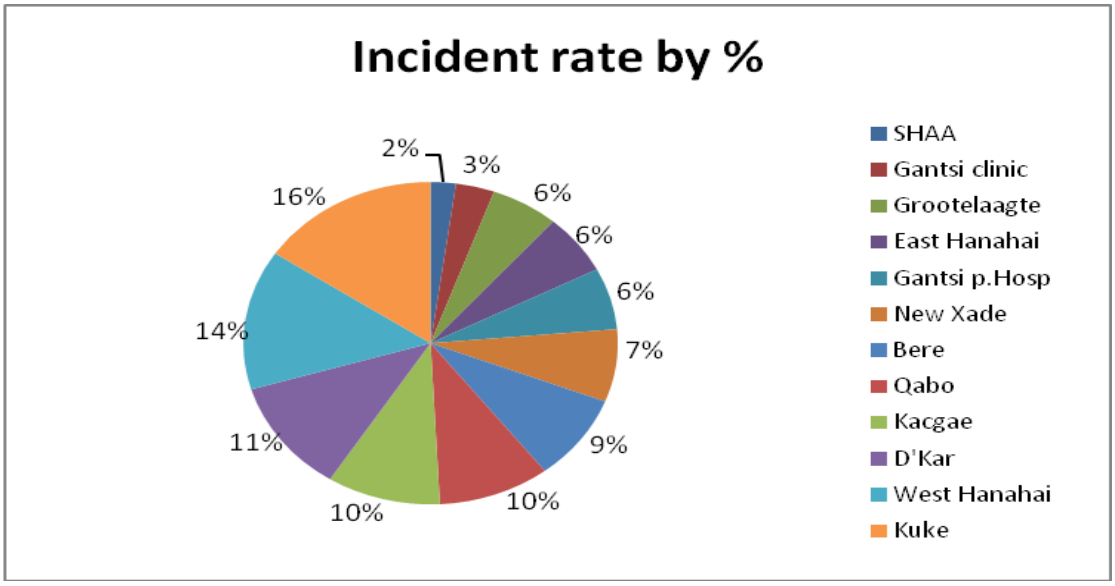


Figure 4.1.3: Incidence rate by percentage, Gansti-sub district, 2006-2010



It also became evident that Basarwa dominate regions had high incident rate than the region dominated by the Bakgalagadi tribe. Table 4 and Figure 2 reflect Kuke having the highest incident rate of 97.4 people per 1, 000 population, followed by West Hanahai with 87.2 people per 1, 000 population, D'kar 70.7 people per 1, 000 population, Kacgae 61.4 people per 1, 000 population, Qabo 60.4 people per 1, 000 population, Bere 53.9 people per 1, 000 population, New Xade 45.3 people per 1, 000 population, Gantsi primary hospital 38.4 people per 1, 000 population, East hanahai 37.7 people per 1, 000 population, Groorte-Laagte 36.6 people per 1, 000 populations, Gantsi clinic 20.9 people per 1, 000 populations and SHAA clinic with least rates of 13.6 people per 1, 000 populations. Expressing the incidence rates as percentage, the pie chart (figure 3) indicates Kuke as the highest with 16% of all rates and SHHA clinic as the lowest with 2% of incidence rates. Gantsi primary hospital recorded higher than the East Hanahai and Groote-Laagte, instead when expressed as percentage all the 3 areas had an equal incident rate qualifying them to be in the third position and linking Gantsi primary hospital to the other last 2 least incident areas of the Bakgalagadi dominated areas.

4.1.3 Trends in Incidence rates, 2006-2010

Trends in incidence rates for each year were analyzed. The line and bar graphs below illustrates those trends for all the villages over 5 years. Due to the complexity of the line graph (figure 4.1.3.1), it was decided that the regions be broken even according to regions; east and west, representing the villages found within each region.

Figure 4.1.3.1: Trend in Incidence rates, Gantsi sub-district, 2006-2010

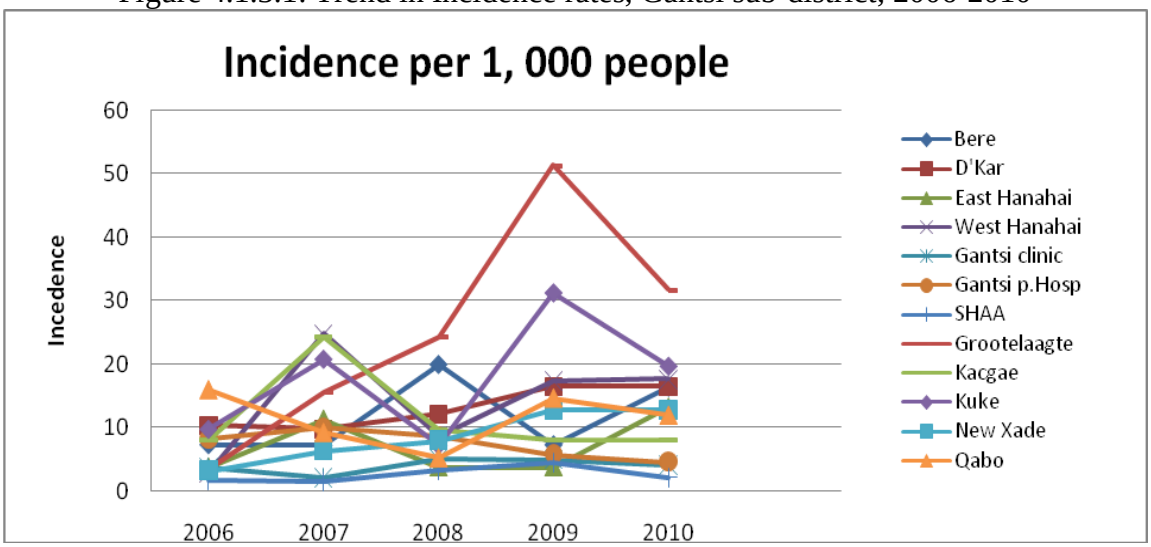
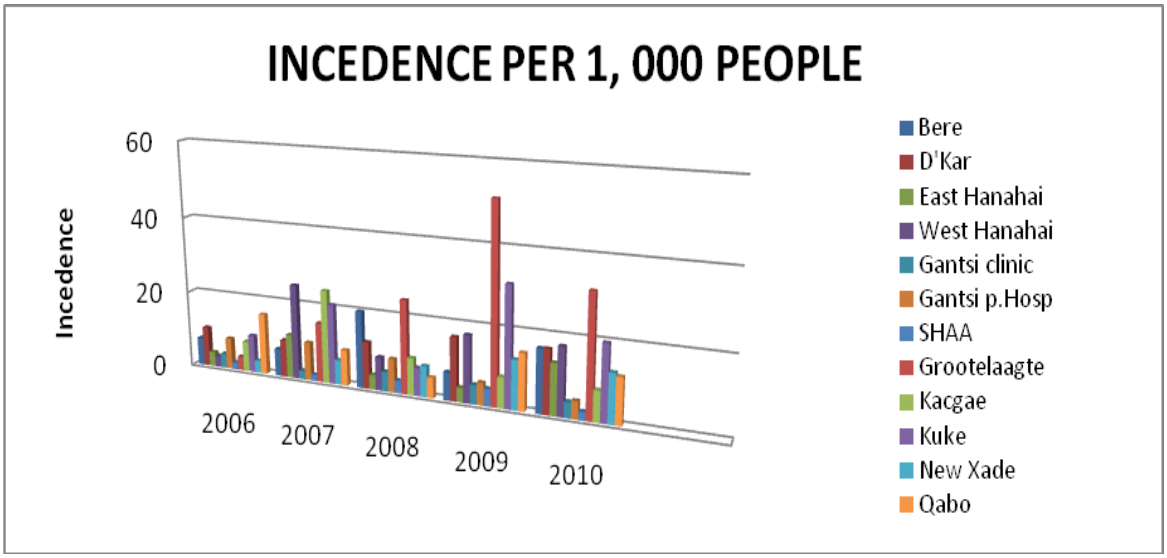


Figure 4.1.3.2: Trend in Incidence rates, Gantsi sub-district, 2006-2010



The line graph above is a bit complex, but it shows the trends in incidence rates for all the villages in Gantsi sub-district. The lower bar graph (figure 4.1.3.2) also reflects the trends in incidence similarly to the line graph.

Figure 4.1.3.3: Summary, Average in incidence rates, Gantsi sub-district, 2006-2010

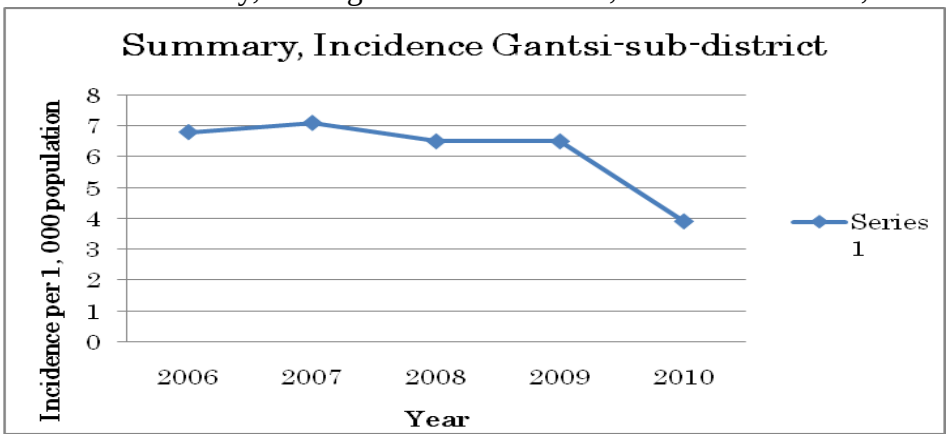
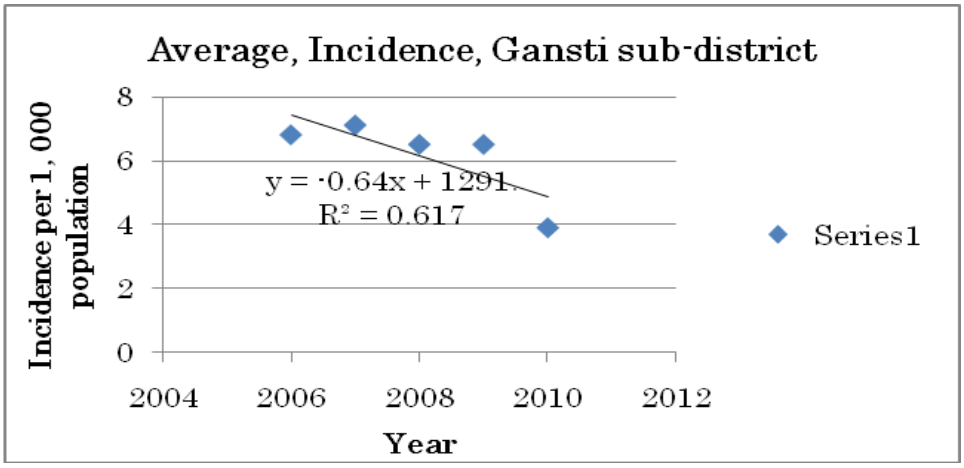


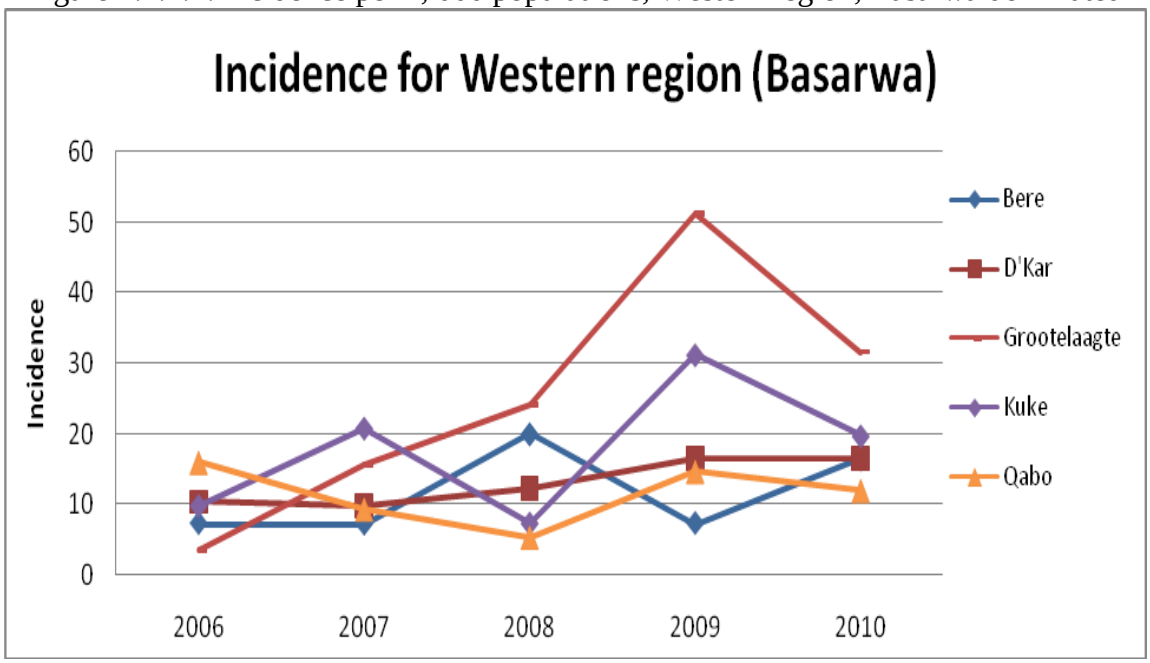
Figure 4.1.3.4: Summary, Average in incidence rates (line of best fit), Gantsi sub-district, 2006-2010



The incidence rates between 2006 and 2010 for the Gantsi sub-district was summarized (figure 4.1.3.3), and looking at the trend of incidence each year, there was a steady decrease for the whole period of 5 years, followed by a sharp drop between 2009 and 2010. The average therefore, gives us results that there is a decrease in the sub-district, as shown by the line of best fit (figure 4.1.3.4).

4.1.4 Incidence, Western region (Basarwa Dominated)

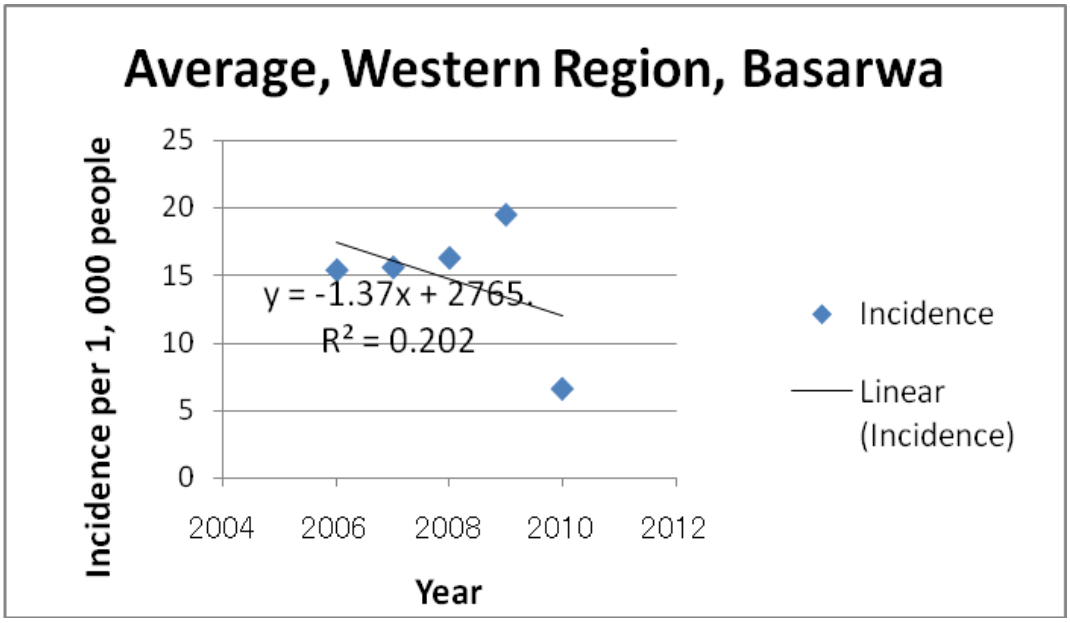
Figure 4.1.4.1: Incidence per 1, 000 populations, Western region, Basarwa dominated



Looking at the trends in incidence for the western region (figure 4.1.4.1), which is dominated by the Basarwa, Groote-Laagte had a very steady increase between 2006 and 2008 by 10 people per 1, 000 population. In 2008, the incidence almost doubled increasing with 20 people per 1, 000 population. Between 2008 and 2009, there was a sudden rise of about 36 people per 1, 000 population, followed by a sudden steep drop between 2009 and 2010 of about 19 people per 1, 000 population. Kuke had a similar trend between 2006 and 2007, but dropped by 18 people per 1, 000 populations between 2007 and 2008. In 2008, it followed a similar pattern with Groote-Laagte and increased steadily by 22 people per 1, 000 population. We observed a sudden drop as well between 2009 and 2010, the drop was about the rate of 10 people per 1, 000 populations. D'kar acted differently. There was a steady increase from 2006 to 2009 and then maintained a constant trend between 2009 and 2010. Looking at Bere, there was a constant trend between 2006 and 2007 then an increase with Groote-Laagte between 2007 and 2008 by 12 people per 1,

000 populations, suddenly dropping by 12 people per 1, 000 populations between 2008 and 2009. Bere experienced an increase of 8 people per 1, 000 populations between 2009 and 2010. Village Qabo from 2006 to 2008 maintained a steady decrease. Between 2008 and 2009 there was a sudden increase of about 10 people per 1, 000 populations and then a drop between 2009 and 2010 by half (5 people per 1, 000 populations).

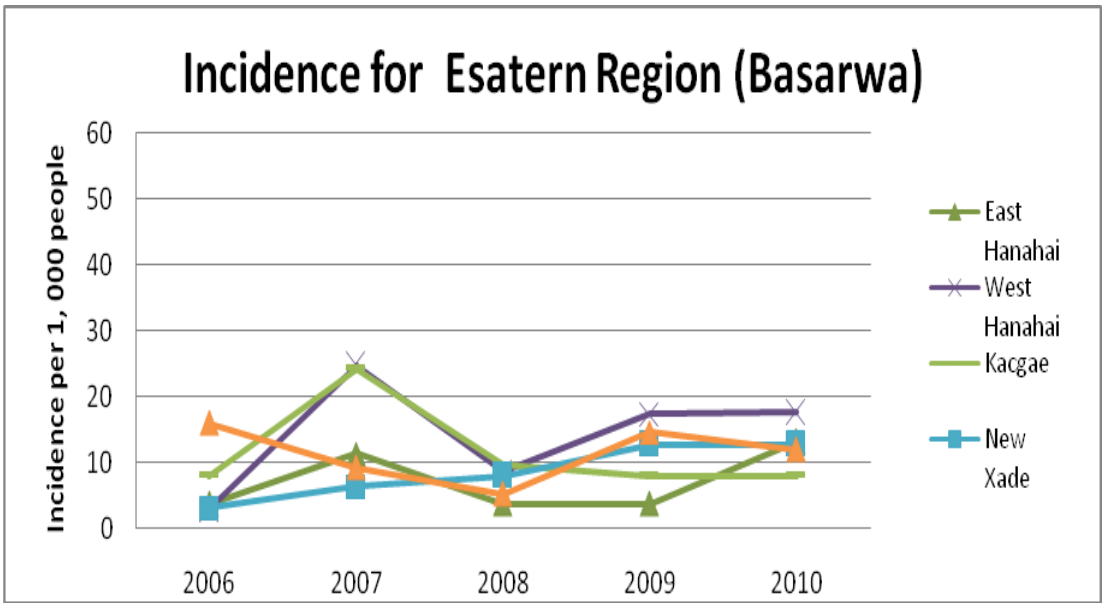
Figure 4.1.4.2: Average, Incidence per 1, 000 populations, Western region, Basarwa dominated



Averagely this area shows a decrease in incidence rates between 2006 and 2010. This is shown by the line of best fit above.

4.1.5 Incidence, Eastern region, Basarwa dominated

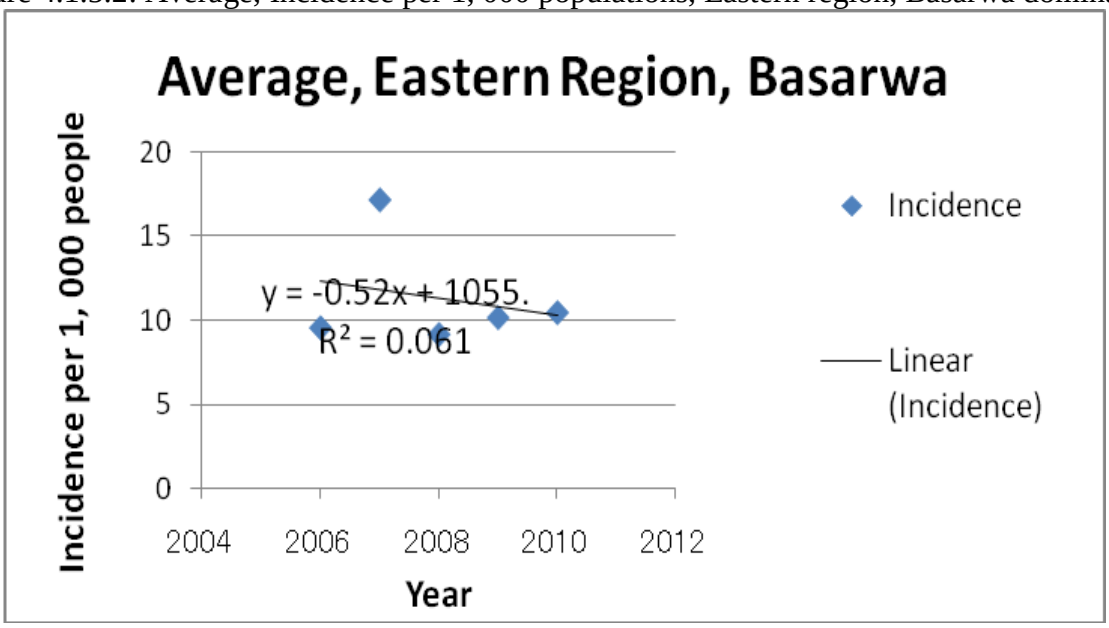
Figure 4.1.5.1: Incidence per 1, 000 populations, Eastern region, Basarwa dominated



The eastern region, dominated by the Basarwa tribe had some differences and similarities as compared to the western region. Village Kacgae experienced an increase in incidence rates between 2006 and 2007 with about 17 people per 1, 000 populations, and a sharp drop between 2007 and 2008 (decreased by almost 100%). Between 2008 and 2009 there was a slight decrease and ultimately became constant between 2009 and 2010. Likewise, West Hanahai experienced a sudden increase of about 21 people per 1, 000 populations between 2006 and 2007, and then suddenly dropped by 17 people per 1, 000 populations between 2007 and 2008. There was a slight rise of about 10 people per 1, 000 population between 2008 and 2009, and then maintained a constant rate of about 18 people per 1, 000 populations between 2009 and 2010. New Xade increased in incidence rates steadily between 2006 and 2009. The rates almost doubled each year, and then maintained a constant rate of about 14 people per 1, 000 populations between 2009 and 2010. East Hanahai was different even though like other villages experienced an increase of about 7 people per 1, 000 populations between 2006 and 2007. There was a sudden drop between

2007 and 2008 by almost the same number of 7 people per 1, 000 populations, and then maintained a constant level between 2008 and 2009 at 4 people per 1, 000 populations. Between 2009 and 2010, there was sudden increase acting differently against other villages, increasing by almost 9 people per 1, 000 populations from 4 people per 1,000 populations.

Figure 4.1.5.2: Average, Incidence per 1, 000 populations, Eastern region, Basarwa dominated

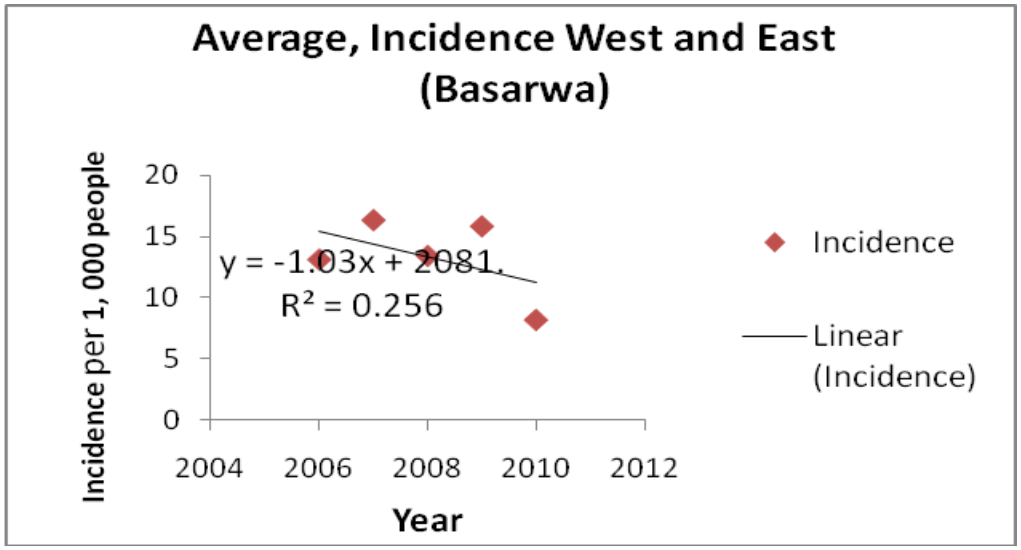


The graph above indicates the average for the incidence in the eastern region of which the incidence rates were unstable throughout the 5 years. Averagely the line of best fit indicates there is a decrease in incidence rates in this region. Contrary, plotting the points in the graph will indicate an increase between 2009 and 2010. The average results might be affected by a sharp drop between 2007 and 2008, and then followed by a steady increase between 2008 and 2010.

Table 4.1.5.1: Average incidence rates per 1, 000 populations, Basarwa dominated regions

YEAR	2006	2007	2008	2009	2010
Incidence	13.1	16.3	13.4	15.8	8.2

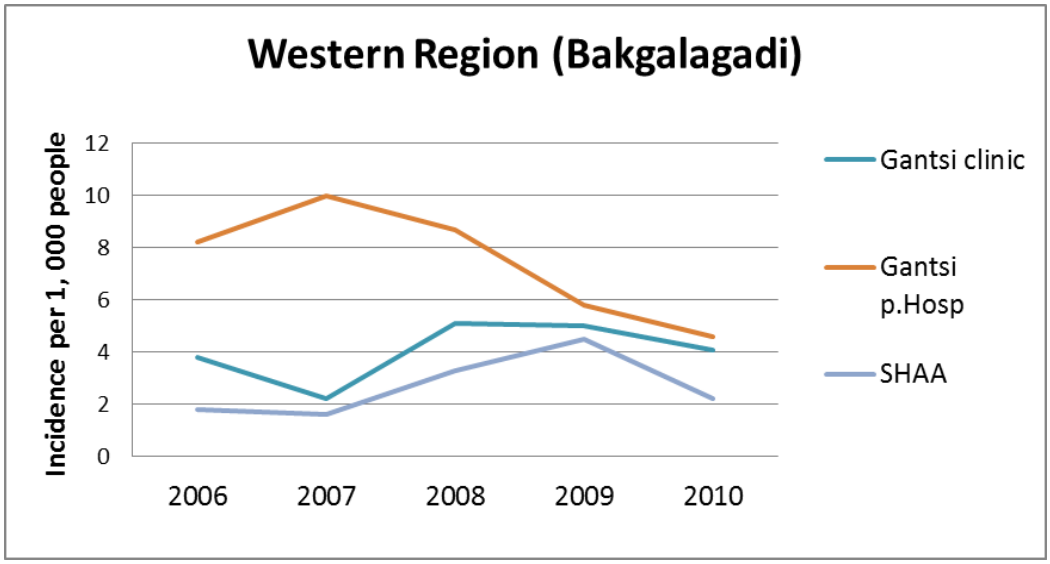
Figure 4.4.5.3: Average, Incidence per 1, 000 populations, Western and Eastern region, Basarwa dominated



Averagely, there is a decrease in incidence rates between 2006 and 2010 in these 2 regions dominated by the Basarwa, repersented by a line of best fit (figure 2.10). Looking closely to the dotted line, there has been a multi-modal curve in incidences between 2006 and 2010, therefore it is very difficult to predict the future of the incidence in these areas as the current trend has been unstable yearly. The trends started with an increase between 2006 and 2007 of about 3.2 people per 1, 000 population, followed by a decline between 2007 and 2008 of the same number of the increase experienced in the previous year of about 2.9 people per 1, 000 population. Another increase was observed the following year between 2008 and 2009 of about 2.4 people per 1, 000 population. Between 2009 and 2010, the two regions experienced a major decline of about 7.6 people per 1, 000 population. More investigations and studies are needed to folllow up with the trends in the following years and at this time we could not conclude if incidences are decreasing based on the current average.

4.1.6 Incidence Western region (Bakgalagadi dominated)

Figure 4.1.6.1 Incidence per 1, 000 populations, Western region, Bakgalagadi dominated



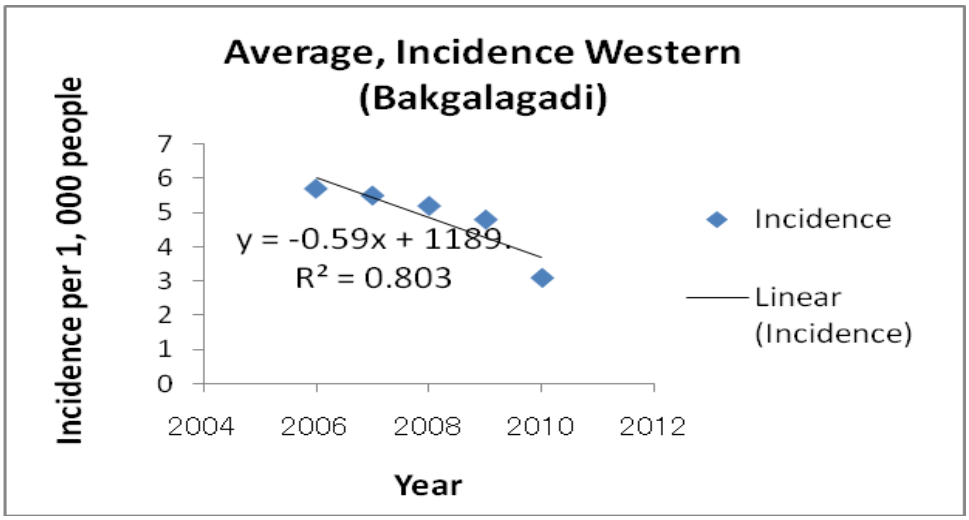
There were 3 main health facilities representing the main areas of Gantsi village dominated by the Bakgalagadi tribe. The areas represented are referred to as health facilities catchment areas. Gantsi primary hospital catchment area experienced an increase between 2006 and 2007 of 2 people per 1, 000 populations and then a sudden drop by 1.8 people per 1, 000 populations between 2007 and 2008. There was a steep decrease following 2008 and 2009 and continued to drop between 2009 and 2010. There was almost a total of 5.8 people per 1, 000 population decrease from 2006 to 20101. Gantsi clinic between 2006 and 2007 experienced a drop in incident rates of 1.8 people per 1, 000 population. Suddenly there was an increase between 2007 and 2008 of about 2.5 people per 1, 000 population. Between 2008 and 2009 the rates started to drop and ultimately continued to drop again between 2009 and 2010. There was a steady drop of about 1.0 people per 1, 000 populations between 2008 and 2010. Similarly, between 2006 and 2007, SHAA clinic catchments area experienced a slight drop followed by a sudden steady increase between 2007 and 2009, increasing by 2.4 people per 1, 000 population. The rates were

more than doubled between 2007 and 2009. The area experienced another sharp drop of about 2 people per 1, 000 populations between 2009 and 2010.

Table 4.1.6.1Average, incidence rates per 1, 000 populations, Bakgalagadi dominated region

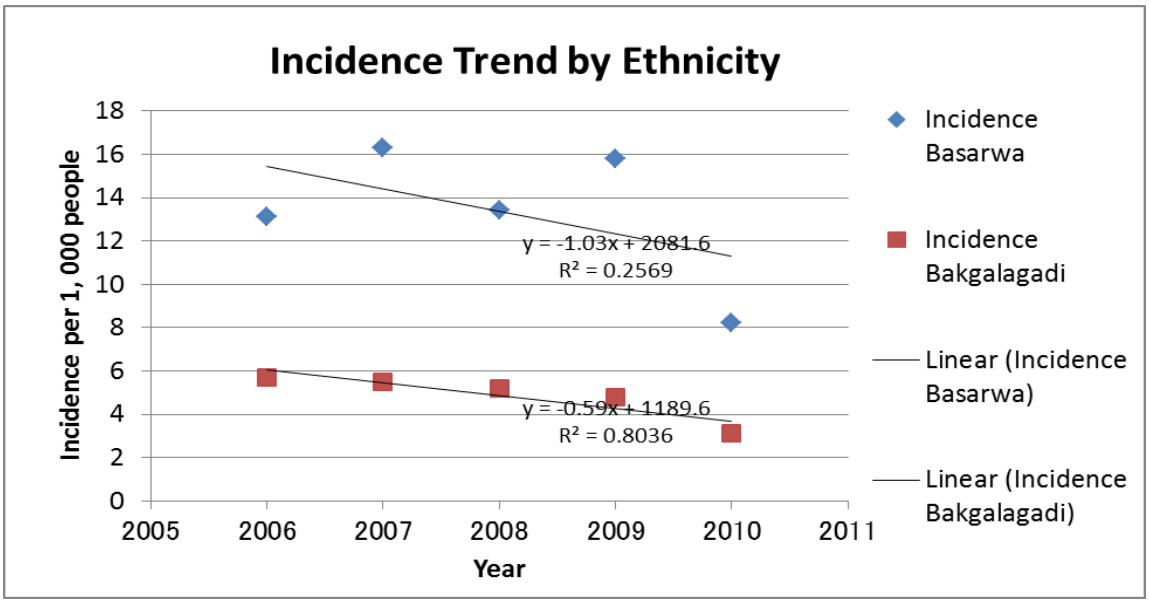
YEAR	2006	2007	2008	2009	2010
Incidence	5.7	5.5	5.2	4.8	3.1

Figure 4.1.6.2 Average, Incidence per 1, 000 populations, Western region, Bakgalagadi dominated



The trend in incidence rates for the western region which is dominated by the Bakgalagadi has shown a steady decrease from 2006 to 2010. Averagely, the region has shown a decline throughout the 5 years of study (between 2006 and 2010) as follows; between 2006 and 2007 there was a decline of 0.2 people per 1, 000 population, between 2007 and 2008 a decline of .03 people per 1, 000 population, between 2008 and 2009 a decline of 0.4 people per 1, 000 population, and a decline of 1.7 people per 1, 000 population between 2009 and 2010. The future of this region can be predicted and a decrease is estimated to continue in the following years based on the above results.

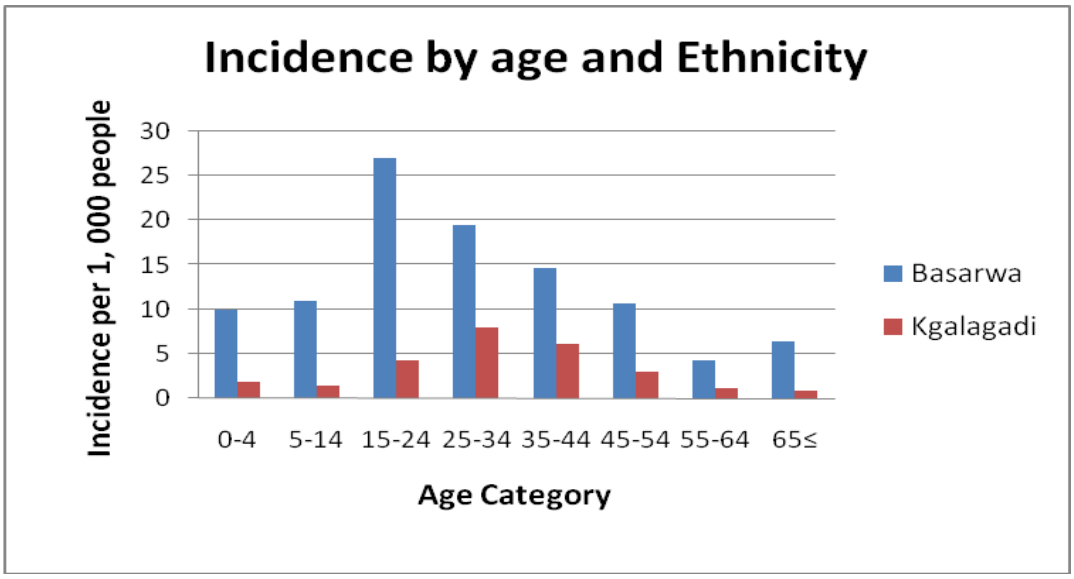
Figure 4.1.3.5 Incidence summary by location of residence (Basarwa and Kgalagadi)



The line graph above (figure 4.13.5) displays the average in PTB incidence rates comparing the two study areas (Basarwa dominated and Bakgalagadi dominated). It is very clear that generally the Bakgalagadi dominated region have lower incidence rates than of the Basarwa dominated regions. In 2006 the rate for the Bakgalagadi dominated region was 5.7 compared to 13.1 reported by the Basarwa dominated regions, declining to 5.5 while the Basarwa dominated region experienced an increase to 16.3 in 2007, 2008 declining to 5.2 and Basarwa dominated region experincing a decline to 13.4, 2009 further declining to 4.8 while the Basarwa dominated regions experinced an increase to 15.8 and lastly declining to 3.1 with Basarwa dominated regions decling to 8.2. While in 2010 there was an decline in PTB incidence rates in both regions, the notification rates remains high for Basarwa dominated regions at 8.2 per 1 000 population against a 3.1 per 1 000 population of the Bakgalagadi dominated regions. Further observation is required to follow the pattern of trend after 2010 in both two regions.

4.1.7 Incidence by Age

Figure 4.1.7.1 Incidence per 1, 000 populations by age and location of residence, Gansti sub-district, 2006-2010



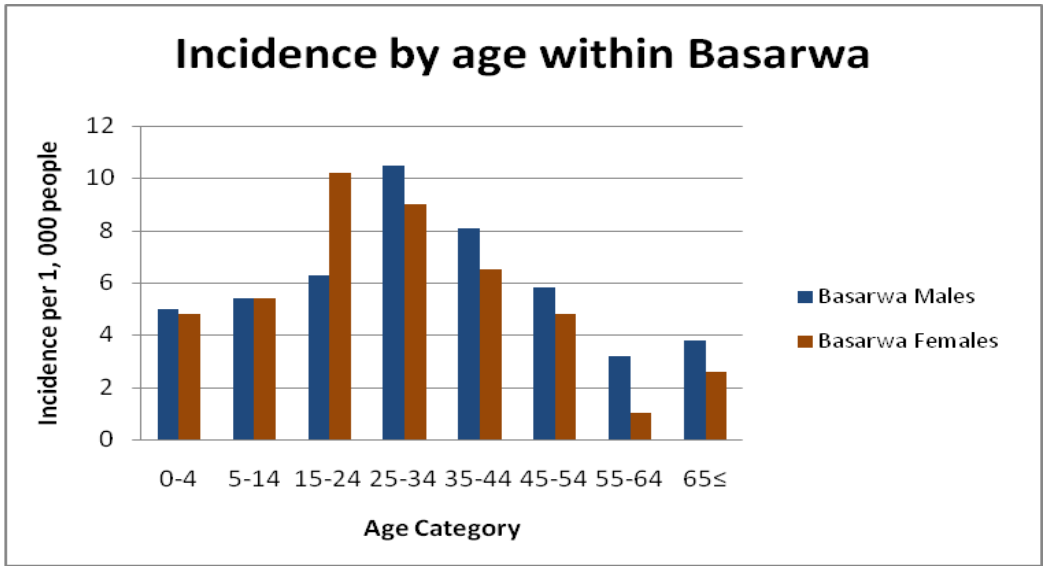
In all age groups, Basarwa dominated regions were more affected that Bakgalagadi dominated region over 5 years of study (between 2006 and 2010). Age category 15-24 was leading among the Basarwa dominated regions by an incidence of 27 people per 1, 000 population, followed by age age category 25-34 reporting 19.5 people per 1, 000 population, thirdly age category 35-44 with an incidence of 14.6 people per 1, 000 population. Age category 5-14 years was fouth reporting 11 people per 1, 000 population, fifth being ages 45-54 with an incidence of 10.6 people per 1, 000 population, and ages 0-4 years reporting 10 people per 1, 000 population. The age groups reported less rates were age categpry 65+ with an incidence of 6.4 people per 1, 000 population and lastly being ages 55-64 with 4.2 people per 1, 000 population.

The Bakgalagadi dominated region reported differently from Basarwa regions. The leading age category instead was 25-34 with an incidence of 7.9 people per 1, 000 population, followed by ages 35-44 reporting an incidence of 6.1 people per 1, 000 population, thirdly ages 15-24 with

4.3 people per 1, 000 population. Ages 45-44 was fourth with an incidence of 3 people per 1, 000 population, ages 0-4 fifth with 1.9 people per 1, 000 population and ages 5-14 years sixth with 1.4 people per 1, 000 populaion. The least groups were age 55-64 with 1.2 people per 1, 000 population and 65+ last with less than 1 person per 1, 000 population.

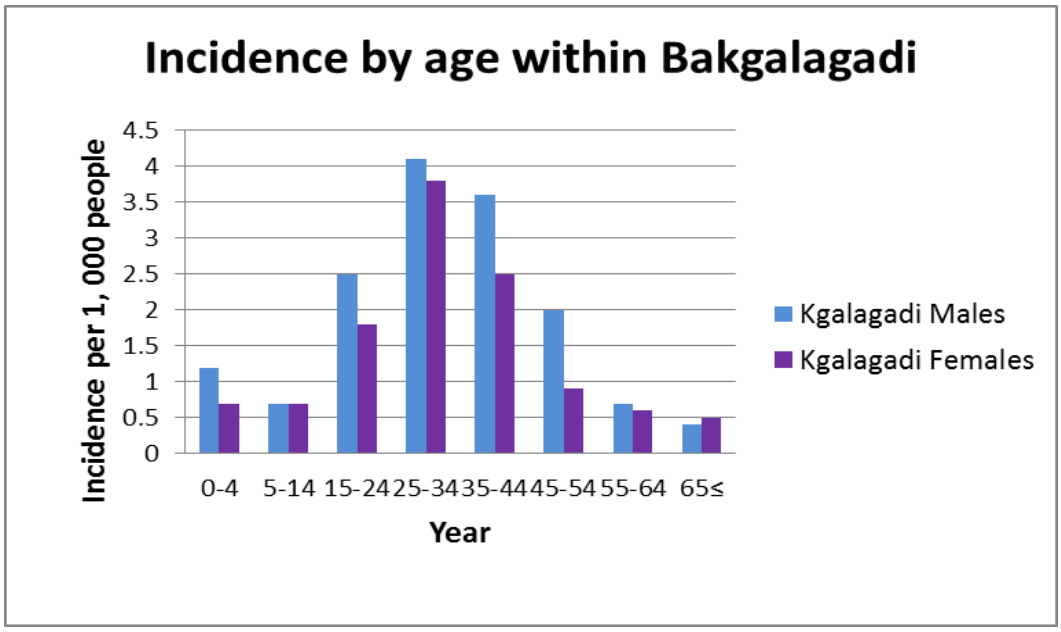
4.1.8 Incidence by Age and Gender

Figure 4.1.8.1 Incidence per 1, 000 populations by age, Basarwa dominated, 2006-2010



Basarwa pulmonaryTB incidences among men were higher than that of women throughout all age categories in the regions dominated by the Basarwa, except for ages 15-24 where female rates were higher than that of males and ages 5-14 whereby rates were equal for both genders. The incidence among men were hihghest in ages 25-34, followed by 35-44, 15-24, 45-54, 5-14, 0-4, 65+ and 55-64 respectively. Females were different, ages 15-24 leading and followed by 25-34, 35-44, 4-14, 0-4, 65+ and 55-64 reporting least rates.

Figure 4.1.8.2 Incidence per 1, 000 populations by age, Bakgalagadi dominated, 2006-2010



Bakgalagadi region showed a similar case with males rates higher than those of females, but differently age 65+ females rates were giher than of men with ages 5-14 having equal rates for both genders. The males had age category 25-34 leading, followed by 35-44, 15-24, 45-54, 0-4, 55-64, 5-14 and 65+ respectively, wherelse the females had almost similar trend except for age category 0-4 and 5-14 which had almost equal rates.

4.2 Statistical Analysis

The tables below presents the results of the Auto Correlation Function. Main necessary variables were included for analysis which are location of residence (Basarwa and Kgalagadi dominated regions) and year of diagnosis with the incidence of pulmonary TB ($P<0.05$).

Table 4.2.1 Autocorrelation Function, Incidence per 1 000 population and location of residence over 5 years

Case Processing Summary

		Incidence per 1000 population in Basarwa Dominated regions	Incidence per 1000 population in Bakgalagadi Dominated region
Series Length		5	5
Number of Missing Values	Negative or Zero	0	0
	Before Log Transform		
	User-Missing	0	0
	System-Missing	0	0
Number of Valid Values		5	5
Number of Values Lost Due to Differencing		1	1
Number of Computable First Lags After Differencing		3	3

Table 4.2.2 Incidence per 1000 population in Basarwa Dominated regions

Autocorrelations

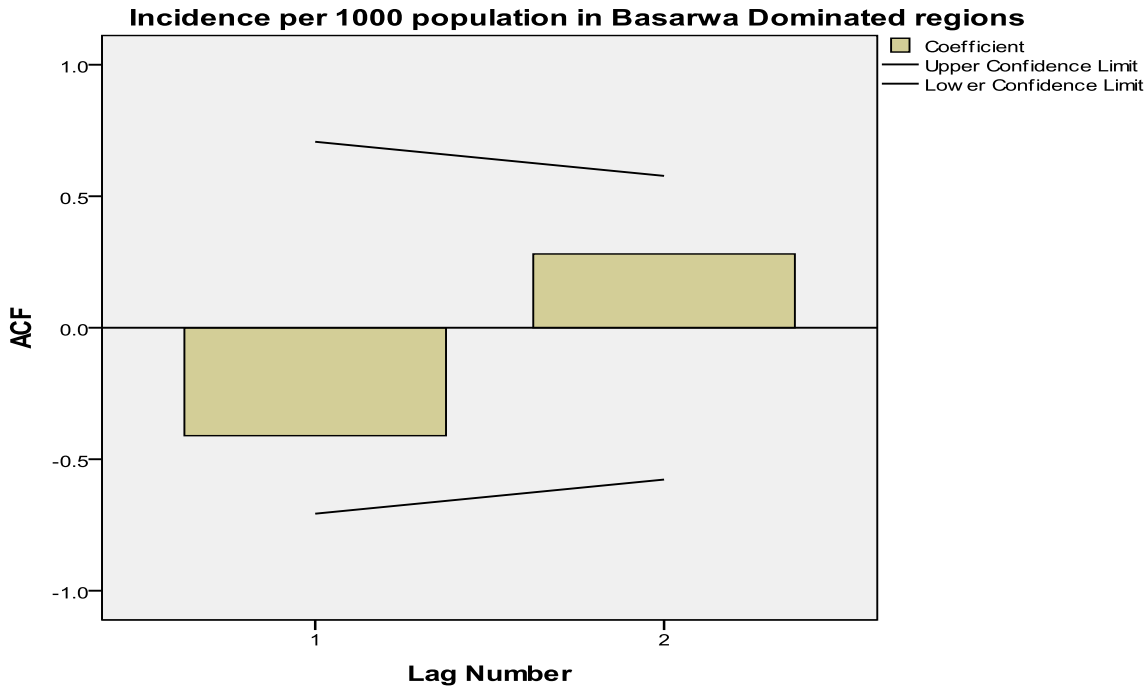
Series: Incidence per 1000 population in Basarwa Dominated Regions

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.410	.354	1.347	1	.246
2	.281	.289	2.292	2	.318

a. The underlying process assumed is independence (white noise).

b. Based on the asymptotic chi-square approximation.

Figure 4.2.1 Autocorrelation Function, lagged series, Basarwa dominated regions



P<0.05 (1-tailed), 95% CI

Observing the above results in figure 4.2.1, Basarwa dominated region, there was a statistical negative correlation presented by year of diagnosis 2006 and 2007 lagged 1, with the incidence of pulmonary TB shown by *r* of -0.41. An increase is observed beginning of lag 2, where is a statistical positive correlation between years of diagnosis with the incidence of PTB represented by *r* of 0.28. Judging from the above results, it can be concluded that there is an increase in the incidence of PTB in the region with time.

Table 4.2.3 Incidence per 1000 population in Bakgalagadi Dominated region

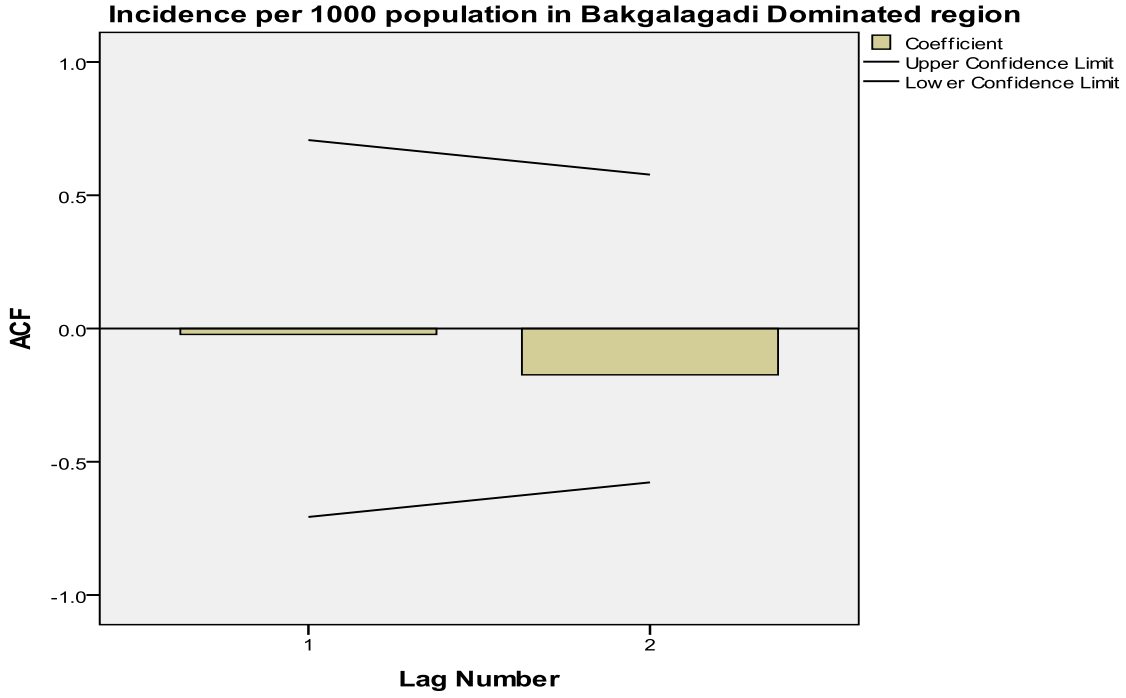
Autocorrelations

Series: Incidence per 1000 population in Bakgalagadi Dominated region

Lag	Autocorrelation	Std. Error[a]	Box-Ljung Statistic		
			Value	df	Sig.[b]
1	-.022	.354	.004	1	.950
2	-.174	.289	.366	2	.833

a. The underlying process assumed is independence (white noise).
b. Based on the asymptotic chi-square approximation.

Figure 4.2.2 Autocorrelation Function, lagged series, Bakgalagadi dominated regions



The Auto Correlation Function coefficient results (figure 4.2.2) showed some negative trend of the incidence of pulmonary TB between lag 1 and 2 for the Bakgalagadi dominated region. During lag 1, there was a statistical negative correlation represented by *r* of -0.022, very close to 0 and with time there was a further increasing negative correlation in lag 2 with an *r* value of -1.74. This trend shows us that in this area, there is an ongoing decrease of PTB incidence with time, as shown by an increasing negative correlation.

The descriptive and statistical results which were obtained and interpreted from the data analysis were presented in graphs and tables this chapter. This opens for further discusion of the findings andthis will be done in the next chapter.

CHAPTER FIVE

5.0 DISCUSSION

This study's main objective was to determine variation in pulmonary TB incidence and prevalence rates in the Gantsi sub-district, which is dominated by the Basarwa and the Bakgakalagdi tribes, between 2006 and 2010. Furthermore, trends in incidence rates were determined during the course of the study with differences between the 2 regions. This particular study is a relatively new area of research in the country, although nomadic Basarwa has been in existence for decades. The general results obtained out of this research were actually in consistent, along with some other research findings carried out. This chapter will be discussing the results in comparing with other researches.

5.1 Descriptive Results

5.1.1 TB and Location Residence

The distribution of pulmonary TB in Gantsi sub-district is actually becoming progressively uneven, with majority of villages with higher incidence rates and increasing trends over years, average and below average rates for few areas. The analysis of this study results also highlights the going on important contribution of patients being connected to certain settlements to TB notification rates. Analysis by location of residence shows that the rate of pulmonary TB averagely decreased in all regions of the sub-district between 2006 and 2010, and whilst the decline was progressive in all regions, there was an increase in certain villages between 2009 and 2010. In the western region dominated by the Basarwa, Bere village experienced an increase of 9.1 people per 1, 000 populations against other villages and D'kar remained with constant rates. Observing the trends for the eastern region dominated by the Basarwa tribe, almost all villages remained with constant rates between 2009 and 2010, except for East Hanahai village

experiencing a high increase more than all trends it has ever acquired since 2006. In average, even though these two regions dominated by the Basarwa tribe are experiencing a decline, there has been an increasing unevenness in incidence rates between 2006 and 2010. The trends started with an increase between 2006 and 2007 of about 3.2 people per 1, 000 population, followed by a decline between 2007 and 2008 of the same number of the increase experienced in the previous year of about 2.9 people per 1, 000 population. Another increase was observed the following year between 2008 and 2009 of about 2.4 people per 1, 000 population. Between 2009 and 2010, the two regions experienced a decline of about 7.6 people per 1, 000 population. Therefore, analyzing this trend in notification rates, it is very difficult to predict the future for these regions, and further observation is needed in order to follow the trends after 2010. Despite the fact that the notification rates declined between 2006 and 2010 in these two regions, the prevalence still remains high. It is difficult to analyze the rates at which the region declined between 2006 and 2010 due to uneven trends yearly, except for 2009 and 2010 where the regions experienced a 48% decline.

The data for the Gantsi village (western region) dominated by the Bakgalagadi tribe, shows a decline in notification rates between 2006 and 2010, even though 2 areas (Gantsi clinic and SHAA clinic) experienced an increase between 2007 and 2009. Averagely, the region has shown a decline throughout the 5 years (between 2006 and 2010) as follows; between 2006 and 2007 there was a decline of 0.2 people per 1, 000 popualtion, between 2007 and 2008 a decline of about 0.3 people per 1, 000 population, between 2008 and 2009 a decline of 0.4 people per 1, 000 population, and a decline of 1.7 people per 1, 000 population between 2009 and 2010. The future trend for this region can be predicted as notification rates decline every year and the prevalence is low compared to the regions dominated by the Basarwa.

Analyzing stated differences between groups, some would question whether pulmonary TB notification rates have an association with location of residence. Observing the results, it is clear that location of residence has an association with pulmonary TB notification rates, despite other similar factors both regions might experience commonly such as; TB/HIV co-infection, poverty, alcoholism and low socio-economic status. Although Basarwa and Bakgalagadi reside in the same district, the Basarwa residential settlements are in the periphery, far and out of reach for development. The settlements are scattered across from the south western part to the eastern part of the sub-district. The eye catching feature of the settlement is the heavy sand, scanty grass, bushes and scattered trees (Tshireletso, 1997). The majority of the villages we collected data; the modern and well-constructed buildings are the tribal administration office, primary school and a clinic, of which all are situated at the entrance of the settlement. The village resident's homes are noticeably away from each other and one needs to walk a bearable distance from one to the next dweller in the heavy sand. Basarwa constitute 70% of the Remote Area Dwellers in the country and are poor with limited access to financial opportunities and many continue without access to essential services like health facilities, emergency services, clean water and school (Tshireletso, 1997). Tshireletso (1997) in his study further explained that Basarwa as nomadic people have very little regard for permanent and well built shelters or household furniture and utensils. There are always out of reach for essential services and lack access to productive resources. As a result Allison (1981) quoted by Tshireletso believes that it is insufficient just to offer access to education and health services to the Basarwa due to their lifestyle (Tshireletso, 1997).

Health care workers expressed experience during our data collection that Basarwa do consult to the health facilities when experiencing symptoms. The sputum will be collected and the transported to Gantsi primary hospital for analysis. They explained the policy allows them to

initiate patients on anti-TB treatment even without sputum and X-ray results as long as signs and symptoms qualify for TB. Normally Basarwa experience such procedure as they do not normally return for results and some will opt to seek for traditional treatments thinking the health facilities have failed to address their sickness. Due to their high mobility, Basarwa highly default treatment and their location of residence makes it difficult for tracing by the health care providers. Contact tracing procedures also have become not easy if not impossible to conduct in Basarwa dominated areas due to sandy roads, dispersed households and nomadic lifestyle. We also determined thorugh a closer observation that although the number of relapses cases are prevalent in the Gantsi primary hospital, the majority of the cases, about 53% are of Basarwa who are referred form periphery villages for hospitalization. Therefore, all these location factors might have contributed to the upward trends of pulmonary TB in the Gantsi sub-district.

Bakgalagadi are the most populated group in the sub-district and are settled with access to developments. Gantsi village is situated in the western region of the sub-district and the sub-district is named after it. The village has essential services such as water, electricity, schools; primary, junior and senior secondary, vocational training center, primary hospital and clinics. Although the area also have some people relatively poor, residents are not limited to economic opportunities and have access to valuable resources such as land, capital and tools. Pulmonary TB in this region has been well controlled over 5 years of study, as people have access to health facilities. In his study McLeod, (2001), explained that even though DOT strategy is used for treatment of TB holistically, those residing in developed centers would gain more chance to access to health services compared to those who reside in more remote areas (McLeod, 2001). Previous studies have shown that TB can be associated with socio-economic status, even those in

the urban areas, the homeless, those with mental illness and substance abuse and further confirm that TB reflects the underlying social conditions of inequality and poverty (Munch et al, 2003).

The pulmonary TB rates in Gantsi sub-district remain very strongly associated with location of residence as those residing in the remote (Basarwa), have highest rates while those located in a modern area has lower rates. Munch et al (2008) made a recommendation from their study that measures to reduce TB transmission should be based on locations rather than on personal contacts (Munch et al, 2003). They carried out an ecological study that described the relationship between the frequency of TB and the distance of residence from the shebeen (Munch et al, 2003). As the place of residence where exposure is measured is based on the probability that transmission takes place in the home, while in reality there may be exposure to infected individuals elsewhere, the associations being belonging to enumerator area. They suggested that the "hot spots" be used as first target groups (Munch et al, 2003). This disparity opens for further research on location based factors contributing to high notification rates in the Gantsi sub-district.

5.1.2 TB and Ethnicity

The topics on ethnicity have been covered on several studies from different countries in the context of various health issues, not limited to TB, discrepancies between ethnic groups. In Botswana the issue of ethnicity in health has not yet become common to researchers. The concept of ethnicity could be very strongly associated with identity, a notion which had a significant influence on the lives of Batswana in various ethnic groups. However, there has been a major argument over the accurate status of specific minority groups in the country. The issues around ethnicity and minority lead to lack of statistical information for the distinct populations and research in to demographics and/or population health is restricted by inaccurate, incomplete

or complete lack of data or the inability to extrapolate from sample data sources (McLeod, 2001). However, due to inadequacy of ethnicity population data, this ecological study was carried out with the unit of analysis being a group of people in a similar area than at individual level. The analysis of this study also emphasizes a going on important contribution of patients connected to ethnic groups to pulmonary TB notification rates. The results of this study have shown some disparities between the Basarwa and the Bakgalagadi ethnic groups based on the location of residence. The regions dominated by the Basarwa has over the years (between 2006 and 2010) experienced high notification rates and still remains with high prevalence rates compared to a region dominated by the Bakgalagadi ethnic group, which has experienced low notification rates and the current trends indicates a decline. These discrepancies may trigger a question if ethnicity factor has an influence on pulmonary TB transmission.

Basarwa like any other ethnic group portrays some characteristics that distinguish them from others. They are known as nomadic hunter-gatherer tribe, even though some have become semi-nomadic some completely sedentary. According to Good (1999) one third is still highly mobile and stays as "squatters" (Good, 1999). They speak a variety of khoi-San click language and have never been an easy group to target with health messages due to their high mobility, illiterate and language barrier between them and the Setswana usually speaking health care providers. Messages about TB/HIV usually miss the mark totally ((BOTUSA; news letter, March 2008). Basarwa as nomadic people has very little regard to permanent and well built shelters. There is not a single descent house inhabited by the Basarwa in the settlement and they live in makeshift shelters of loose sticks as roof (Tshireletso, 1997,). Tshireletso, (1997), also identified on his study that it was noticeable in all households was the absence of households utensils and furniture except for an opened tin as a cooking pot. There was also very little woolen bedding

evident in the households except for animal skins which were dominating. The home environment for Basarwa mostly consists of crowded family shelters exposed to the elements of weather and is not conducive for their health (Tshireletso, 1997).

Basarwa as a tribe has certain perceptions that might have also contributed to their delay in their transition from nomadic lifestyle to sedentary life. As noted by Tshireletso, (1997) in his study, Basarwa are not enthusiastic for education and it has been taken note of that in most times their enrolled children are usually removed from school at earlier stages to follow their parents in their hunting and gathering excursions (Tshireletso, 1997). It was not surprising that 89% of Basarwa parents indicated they have never attended school at all, and 11% had only done some primary schooling (Tshireletso, 1997). Further exploring the 11% who were literate was Bakgalagadi who had moved in to those settlements. Interviewing Basarwa parents, it became clear they were less informed about importance of education as they viewed school as a place where young ones can have a meal for a day (Tshireletso, 1997).

This factor has a great impact on the health issues as most of the information is passed through by the health workers who are non-Basarwa on the other hand Basarwa being reluctant to receive the messages. Basarwa people who have been relocated in to sedentary settlements refrain from working and improving their lives. As interviewed by Tshireletso (1997) they uttered the words to say,

"Government brought us in to this settlement and promised us good life, we are prohibited from hunting and there is nothing we can do about ourselves the government has to take care of us…"

(Tshireletso, 1997, pg 179).

A number of studies on TB and ethnicity have been carried out in other countries. Though the related associated factors may differ from findings in this study, there has been some ethinic

disparities observed in those studies. In an ecological study carried out by Michael, et al (1998) in the US, recognized TB rates amongst racial/ethnic minorities were 5-10 times more than those in whites from 1987-1993. Regardless of the longstanding attributes of the evidence dominating the increased TB risk among racial/ethnic minorities in the US, they discussed that there is presently no sufficient explanation for those identified variations (Michael, et al, 1998). Nevertheless, the higher prevalence of several understood risk factors for TB among young blacks residing in congested conditions, such as being homeless, alcohol dependency, imprisonment, intravenous substance abuse and infection with human immuno-deficiency virus (HIV), mostly likely accounted for much of the accentuated effect of crowding in this population (Michael, et al, 1998). Additionally adjustment and crowding in the final model further increased the proportion of TB risk accounted for by low socio-economic status especially among US born blacks (Michael, et al, 1998). Another finding by Nahid et al (2011) in US identified racial differences in the reported rate of TB infection in young black and white adults. Their findings suggested that factors other than co-morbid conditions and socio-economic status may contribute to the racial disparity seen in US (Nahid, et al, 2011). Whether this disparity are due to unmeasured factors related to race as a social construct or due to biologic susceptibility factors, is still subject to debate (Nahid, et al, 2011).

However, a lot of differences may be seen in many studies and countries due to the uniqueness and differences in cultures. The discrepancy in notification rates in the Gantsi sub-district may be driven by the different in ethnicity related factors within the region. The Basarwa were identified to be problematic when it comes to health issues as they are illiterate, highly mobile and language barriers that make it difficult to communicate with the usually Setswana speaking health care providers. This is in comparing to the Bakgalagadi ethnic group which has been

settled, have access to education and speak a similar Setswana language common to the health care providers. This finding allows for further research in exploring other ethnicity based factors associated with TB transmission, not limited to finding out knowledge, perceptions, and attitudes about TB in both groups.

5.1.3 TB and Gender

Gender and TB has been a neglected aspect of TB in research, though recent studies are in progress relatively to explore in this area. This discussion will also bring forward publications on gender and TB, indicating how gender has an impact on pulmonary TB and its control. Worldwide, the ration of male and female reported cased is approximately 1.5-2:1 (Diwan, et al, 1999). Results from our study were a bit different from the above approximation by WHO. There were not much of a difference in ratio between males and females even though males were high. The ration of males to female was 1.2: 1 males to females for the sub-district. The gender ratio for specific groups reported 1.1:1 males to females for regions dominated by the Basarwa and 1.3:1 males to females for the regions dominated by the Bakgalagadi. The results showed high rates of pulmonary TB incidences among men in both ethnic groups and age except for age category 15-24 for the regions dominated by the Basarwa and age 65+ of the regions dominated by the Bakgalagadi which had rates of females higher than that of males. Age category 5-14 in both regions for both males and females reported equal incidence rates. Such differences will be discussed below with similar findings from other researches.

A conclusion of a recent research on gender and TB was that a combination of biological factors, socio-economic and cultural factors and health care system factors are responsible for these differences. The immune response to TB may also be closely related to differences between males and females in type and concentration of non-sex steroids and sex-steroid hormones

secreted (Diwan, et al, 1999). Pulmonary TB higher rates among men are somewhat clarified by the local transmission dynamics, especially in crowded, improperly ventilated or nosocomial settings (Jimenez-Corona, et al, 2006). Male pulmonary TB patients are more likely to report risk factors that have been linked with exposure to TB such as prior residence in a shelter, or imprisonment (Jimenez-Corona, et al, 2006). Men are reported of much more constant use of alcoholic beverages and use of tobacco, habits that may influence the rate at which TB infection advances to active disease. Examination of male gender and alcohol by logistic regression analysis and Cox models by Jimenez-Corona et al in their study revealed that men with TB are at higher risk of a poor treatment outcome, independent of alcohol use (Jimenez-Corona, et al, 2006).

Evaluating gender and alcohol consumption in the Gantsi sub-district, men consume alcohol more than females even though Basarwa females are mostly highly alcoholic dependent. Social drinking and smoking might have increased the transmission rates among men at the bars and shebeens. There were significant noticeable variations in the outcome of anti-tuberculosis treatment between men and females based on our results. The defaulter's rates were high among men than females in both groups with men about 72.8% and female 27.2%. The relapse rates males reported 50.5% while female with 49.5% between 2006 and 2010. Treatment failures in the sub-district were about 24 cases with 39% being males and 61% being females. The results above indicates man have poor treatment outcome than females indicating females to have a high compliance to anti-tuberculosis treatment than men. However, some factors have been discussed by researchers to be contributing to these variations.

Basing on the standards of the WHO Global TB Control, the best important suggestive symptom of pulmonary TB is a prolonged cough of over} 3 weeks, and a community-based study in

Vietnam mentioned that prevalence of lengthy periods of cough is not substantially varying between females and males by 1.5 and 1.3 percent respectively (Thorson, et al, 1999). A research in Japan discovered doctor's delay was much longer for women than for men, and this variation was mainly attributed by inadequate medical check-ups such as delay in chest X-ray examination or ordering no sputum examination despite recognition of abnormal shadows on the chest X-ray (Sasaki et al, 1996; 2000). An additional study in Japan by Matsushita indicates that the stage and the degree of lung lesions are less advanced among females than among male TB patients and that there are immunological and biological evidence showing that men may have more infectious TB (smear-positive pulmonary TB) than women (Thorson, et al, 1999). Geographic access can also be a factor for these differences. A research in Vietnam reported that even though there is no considerable variation between males and females in relations to geographical proximity from their homes to TB facilities and hospital, the travel time to these health facilities to seek medical attention is significantly longer for women than men because of their pooper access to any mode of transportation such as motorcycle (Thorson, et al, 1999). Mostly women in rural areas can be restricted to house chores in their homes, like taking care of children child and preparation of daily meals and all these can hinder women in finding time to visit the hospital for examination, and not seeking health care to advanced health care providers when referred to by the local clinic e.g. referral hospitals which are distant from their homes (Thorson, et al, 1999). In Tanzania a study by Wandwalo quoted by Thorson A, reported that patients delay is greatly longer in remote places for patients with low education levels, for those who first consulted with a traditional healer and for patients who were less informed on TB before the clinical diagnosis. Therefore, mostly, women are likely to encounter these aspects more commonly than men (Thorson, et al, 1999).

The results of our study indicated females in the age category 15-24 form the region dominated by the Basarwa to be higher that of men. This difference have been discussed by Jimenez-Corona, et al, 2006 in their study that in the progression rate, which is the tendency to develop TB disease after infection with M. bacterium may be higher in women of child bearing age than in men of the same age, of which men have higher rates of progression when older (Jimenez-Corona, et al, 2006). They further clarified that co-morbid contributions like HIV infection cirrhosis and diabetes could alter the rate at which TB develops and their prevalence could differ by gender (Jimenez-Corona, et al, 2006). In this case TB/HIV co-infection might have been the cause to this trend as in sub-Saharan Africa females are highly infected by HIV than men. A study by Holmes et al (1998) reported the overall peak HIV prevalence levels among TB patients in their study were found in women aged 15-24 0r 34 (Holmes et al, 1998).

There were no ethnic correlation between TB and gender in Gantsi sub-district, based on the fact that in both regions males were highly prevalent than females. Therefore, this subject is still an area of a great need for further researches to explore factors in the sub-district that might have influenced such disparities in gender.

5.1.4 TB and Age

The overall findings of our study, the notification rates were different among age categories and in gender between 2006 and 2010. The younger and middle aged experienced higher rates than the older ages in all regions of Gantsi sub-district. In all age categories, the Basarwa dominated regions experienced higher rates than the Bakgalagadi dominated regions. Age category 15-24 was the highest in Basarwa dominated regions where as for the Bakgalagadi region the highest was age category 25-34. The lowest age for the Basarwa dominated region was 55-64 while for the Bakgalagadi the lowest age category were 65+. These differences in notification rates on age

between the 2 groups open for further investigations to explore ethnic factors that might be associated with pulmonary TB and age. Despite the above age differences, childhood pulmonary were also noticeable in both regions. The notification rates were high in ages 0-4 and 5-14 than of ages 45-54, 55-64 and 65+.

Our findings were almost parallel to other various studies from different countries. McLeod, (2001) in his study explained that younger patients are determined quite often during screening before having active TB disease which is active detection, while the older patients fall under passive detection as they are found because they present with symptoms when they are sick (McLeod, 2001), meaning that, if the person diagnosed is older, the method of detection is passive. In a study in South Africa on childhood TB by A van Rie, 1998, the results showed high TB case notification rate of 3588/100 000/year in young children 0-5 years old, which was 3.5 times higher than the case notification rate in adults. They explained that children under at the age of 5 years are a susceptible group and could be viewed as a virgin population group with greater risk of infection and disease (A van Rie, 1998). Due to the fact that every TB case in a child was a consequence of a recent infection, the high childhood case load was an evidence of going on transmission of the disease in the community and of partial failure of the TB control program (A van Rie, 1998).

The results of this study indicated the working age 15-44 to be highly affected than children and elderly people. This is not different from other findings from various researches. It is anticipated that the working age are the mostly infected with HIV in Southern Africa. The mode of HIV transmission in Southern Africa is heterosexual and these age groups are mostly active sexually. Studies have shown that co-morbid conditions such as HIV infection, Cirrhosis and diabetes could also influence the rate at which TB occurs (Jimenez-Corona M.E, et al, 2006). A study by

Thomas et al (2002) explained that poverty brings up inadequate diet, psychological and physical stress and drug abuse, which are elements that damage immnunocompetence and thus increase TB susceptibility (Kistemann, et al, 2002). Basarwa particularly, constitute 70% of the Rural Area Dwellers (RADs) in Botswana and one of the poorest ethnic tribes in the country (Tshireletso, 1997), therefore, the potential outcomes from poverty mentioned by Thomas qualifies them to easily develop TB. Furthermore, Botswana as one of the countries highly afflicted by HIV/AIDS pandemic, and the Gantsi sub-district is not an exception. The HIV/AIDS pandemic also could have lead to high TB rates among these age groups in the sub-district. Further studies can be then be carried out to explore the relationship between HIV, poverty and TB in the sub-district. TB in elderly is generally assumed to largely reflect endogenous reactivation of an earlier disease and the relative weight of endogenous reactivation are enhanced by a population growing older and decade-lasting reduction of TB incidence. Diminishing immune-competence concerning this group linked with aging could be thought to trigger the majority of the TB cases of the senior people by response echoing (Kistemann, et al, 2002)

5.2 Statistical Analysis

The purpose of the Auto Correlation Function analysis was to statistically examine the association between pulmonary TB incidence and location of residence in Gantsi sub-district, in combination with other factors of interest across the study period, 2006 to 2010.

The results from the Auto Correlation Function analysis indicated that there is a statistical association between location of residence and the incidence of pulmonary TB in Gantsi sub-district, either positively or negatively. The disparity in pulmonary TB incidence and location of residence has been shown by the Auto Correlation Function coefficients results. The coefficients showed the Basarwa dominated regions statistically correlated positively with the incidence of

pulmonary TB during the 2nd lag (r = 0.28), while Bakgalagadi dominated region was negatively correlated with incidence in pulmonary TB during both lag 1 and lag 2 *(*r = -0.022 and -0.174 respectively). There was a positive correlation between locations of residence for Basarwa with the incidence of pulmonary TB on the 2nd lag, though during the first lag there was a negative association and these results support the findings in chapter 4, showing that there has been an uneven trend of PTB notification in the Basarwa dominated regions between 2006 and 2010 (figure 4.2.3.5 in chapter 4). Therefore it is difficult to predict the future trend of PTB notification in these regions and more follow up investigation is required for a larger time series. The Bakgalagadi dominated region has experienced a negative correlation in PTB incidence between 2006 and 2010 (both first and second lag). These results are clearly indicated by figure 4.2.3.5, showing a steep decline in pulmonary TB incidence rate between 2006 and 2010 on Bakgalagadi dominated region. Therefore, in this region it is clear to predict the future burden of PTB and there is an indication PTB is controlled well. A similar analysis was carried out by a group of researchers in Spain, with a focus to assess annual seasonal patterns of PTB between 1971and 1997. The Auto Correlation Function results showed some seasonal fluctuations annual in PTB incidences, during the lags, with mostly increasing cases between February and end of June recording between 0.1 and 1 and lower number of cases between coefficients -0.1 and -1 from July to January (Rios et al, 2000).

CHAPTER SIX

6.0 CONCLUSION AND RECOMMENDATIONS

This following chapter is presenting the study conclusions with summary of the findings illustrated in chapter 5. The reviews of the findings are compared to the objectives of the study which were pointed out in chapter 1. This chapter also seeks to provide recommendations and suggestions on PTB control among the nomadic Basarwa and suggestion for further studies.

6.1 Summary and Conclusion

Outcomes from this research reveal that even when the incidence of pulmonary TB in Gantsi sub-district is decreasing over time, the prevalence is still high in other areas. The regions dominated by the Bakgalagadi ethnic tribe has shown a steady decline over 5 years of study and the prevalence has also declined over time, whereas the regions dominated by the Basarwa incidences have slowly declined and prevalence remaining high. The incidence rates for the regions dominated by the Basarwa have been uneven over the 5 years of study; there has been an increase between 2006 and 2007, followed by a decrease between 2007 and 2008, then suddenly a sharp increase between 2008 and 2009 and then lastly a decrease between 2009 and 2010. Observing this trend in incidence, it is very difficult to predict the future of pulmonary TB incidence burden in the regions and more follow up have to be made.

The results indicated a strong positive association between pulmonary TB incidence and location of residence within the sub-district. With these results we cannot ignore TB susceptibilities that are brought up by ethnic differences in the sub-district and our study suggests that factors other than socio-economic disparities exist as noted by different pulmonary TB incidence between ethnic groups in the Gantsi sub-district.

Further research is needed as this study has allowed for more in-depth follow-up studies, both qualitative and quantitative on pulmonary TB and ethnicity in the district. Future research should address the relationship between pulmonary TB and other suspected factors such as HIV, poverty, education, gender and age. Knowledge, attitude and perception study should also be carried out to explore the level of understanding on the disease between the 2 tribes.

6.2 Recommendations

6.2.1 Recommendations for policy implications

More recommendations are suggested for a better TB control in Gantsi sub-district district.

- Health education by the Botswana National TB programme is highly emphasized more especially to the nomadic Basarwa regarding pulmonary TB. Due to the fact that this group is illiterate, health information should be disseminated through video and audio translated to their language. The videos should be animated in order to attract the attention of the viewers. The community-based TB programme participants should be encouraged to educate patients on daily bases and emphasize the need for DOT.
- Compensation strategy should be endorsed in to the BNTB programme by the government of Botswana for TB patients in the form of money grants or food parcels. This might encourage patients to stay on DOT and complete treatment, as some the reason for mobility is in search for jobs in the farms and food. This strategy has been implemented in South Africa by allocating grants to TB patients enrolled on treatment for the whole 6 months.
- As nomadic lifestyle might be difficult to control, nomads should be encouraged by the health care providers and community-TB based programme volunteers to report immediately to a nearby health facility with their treatment cards to be enrolled at those facilities for

continuation of the DOT therapy, as it is free and accessible to every citizen throughout the country.

- The development of the RADs, Basarwa in particular, should be among the prioities of the Botswana government policies in order to foster care through education, access to health care and poverty eradication.

6.2.2 Suggestions for further researches

The results of this study have opened for further generalizable studies on pulmonary and ethnicity in the district. Researches on health and ethnicity, HIV/TB in particular, should not be ignored as there are covered issues regarding these health endemics and ethnic practices.

7.0 LIST OF REFERENCE

Botswana National TB Programme Manual. (2007). Retrieved August 05, 2012, from WHO international website: http://www.who.int/hiv/pub/guidelines/botswana_tb.pdf

Botswana TB/HIV Policy guideline-TB Online. (2011). Retrieved 05 August 2012. www.tbonline.info/media/uploads/.../botswana_tb-hiv_polcy_2011.pdf

Cantwell, M. F., McKENNA, M. T., McCRAY, E. U. G. E. N. E., & Onorato, I. M. (1998). Tuberculosis and Race/Ethnicity in the United States Impact of Socioeconomic Status. American Journal of Respiratory and Critical Care Medicine, 157(4), 1016-1020.

Diwan, V. K., & Thorson, A. (1999). Sex, gender, and tuberculosis. LANCET-LONDON-, 1000-1000. Retrieved February 05, 2013, The Lancent website: http://www.hawaii.edu/hivandaids/Sex,%20Gender,%20and%20Tuberculosis.pdf

Holmes, C.B., H. Hausler, & P. Nunn. (1998). A review of sex differences in the epidemiology of tuberculosis. The International Journal of Tuberculosis and Lung Disease, 2(2), 96–104.

Good, K. (1999a). The state and extreme poverty in Botswana: the San and destitutes. The Journal of Modern African Studies, 37(02), 185–205.

Good, K. (1999b). The State and Extreme Poverty in Botswana: The San and Destitutes. The Journal of Modern African Studies, 37(2), 185–205. doi:10.2307/161845

Hasselbring Sue. (2000). A sociolinguistic survey of the languages of Botswana. SIL International. Retrieved May 22, 2013, from http://www.sil.org/resources/archives/36521

Hitchcock, R. K. (2002). “We are the First People”: Land, Natural Resources and Identity in the Central Kalahari, Botswana. Journal of Southern African Studies, 28(4), 797–824. doi:10.1080/0305707022000043520

Jiménez-Corona, M.-E., García-García, L., DeRiemer, K., Ferreyra-Reyes, L., Bobadilla-del-Valle, M., Cano-Arellano, B., Ponce-de-León, A. (2006). Gender differentials of pulmonary tuberculosis transmission and reactivation in an endemic area. Thorax, 61(4), 348–353. doi:10.1136/thx.2005.049452

Kistemann, T., Munzinger, A., & Dangendorf, F. (2002). Spatial patterns of tuberculosis incidence in Cologne (Germany). Social Science & Medicine, 55(1), 7–19. doi:10.1016/S0277-9536(01)00216-7

Know Botswana magazine. (2011). Basarwa and Bakgalagadi communities. knowbotswana.com. Retrieved May 22, 2013, from http://www.knowbotswana.com/basarwa-and-bakgalagadi.html

Lewis, M. Paul, Gary F. Simons, and Charles D. Fennig (eds.). 2013. Ethnologue: Languages of the World, Seventeenth edition. Dallas, Texas: SIL International. Online version: http://www.ethnologue.com.

Munch Z., Van Lill S. W. P., Booysen C. N., Zietsman H. L., Enarson D. A., & Beyers N. (2003). Tuberculosis transmission patterns in a high-incidence area: a spatial analysis. The International Journal of Tuberculosis and Lung Disease, 7(3), 271–277.

Nahid, P., Horne, D. J., Jarlsberg, L. G., Reiner, A. P., Osmond, D., Hopewell, P. C., & Bibbins-Domingo, K. (2011). Racial Differences in Tuberculosis Infection in United States Communities:

The Coronary Artery Risk Development in Young Adults Study. Clinical Infectious Diseases, 53(3), 291–294. doi:10.1093/cid/cir378

Ormerod, L. P., Charlett, A., Gilham, C., Darbyshire, J. H., & Watson, J. M. (1998). Geographical distribution of tuberculosis notifications in national surveys of England and Wales in 1988 and 1993: report of the Public Health Laboratory Service/British Thoracic Society/Department of Health Collaborative Group. Thorax, 53(3), 176–181. doi:10.1136/thx.53.3.176

Ospina, J. E., Orcau, À., Millet, J.-P., Sánchez, F., Casals, M., & Caylà, J. A. (2012). Community health workers improve contact tracing among immigrants with tuberculosis in Barcelona. BMC Public Health, 12(1), 158. doi:10.1186/1471-2458-12-158

Public Health Wales Health Protection Division. (2013a, April 9). Tuberculosis. lechyd Cyhoeddus Cymru Public Health Wales. Retrieved May 14, 2013, from http://www.wales.nhs.uk/sites3/page.cfm?orgId=457&pid=27952

Rie, A. van, Beyers, N., Gie, R. P., Kunneke, M., Zietsman, L., & Donald, P. R. (1999). Childhood tuberculosis in an urban population in South Africa: burden and risk factor. Archives of Disease in Childhood, 80(5), 433–437. doi:10.1136/adc.80.5.433

Ríos, M., García, J. M., Sánchez, J. A., & Pérez, D. (2000). A statistical analysis of the seasonality in pulmonary tuberculosis. *European Journal of Epidemiology*, *16*(5), 483–488. doi:10.1023/A:1007653329972

Stead, W. W., Senner, J. W., Reddick, W. T., & Lofgren, J. P. (1990). Racial Differences in Susceptibility to Infection by Mycobacterium tuberculosis. New England Journal of Medicine, 322(7), 422–427. doi:10.1056/NEJM199002153220702

Tshireletso, L. (1997). "They are the government"s children'. School and community relations in a Remote Area Dweller (Basarwa) settlement in Kweneng District, Botswana. International Journal of Educational Development, 17(2), 173–188. doi:10.1016/S0738-0593(96)00044-2

United States-Botswana. (2008, March 17). BOTUSA News - March 2008 - Home Page. BOTUSA news. Retrieved May 22, 2013, from http://www.cdc.gov/botusa/news/0308/

World Health Organization. (2013b, February 11). WHO | Global tuberculosis report 2012. WHO. Retrieved May 14, 2013, from http://www.who.int/tb/publications/global_report/en/

8. APPENDICES

Appendix A

APU

立ア大リサーチ 12－024

26 June 2012

Head of Health Research Unit
Ministry of Health
Private Bag 0038
Botswana

Dear Head of Health Research Unit,

Mr PAGIWA Vincent is a bona fide Master's student at Ritsumeikan Asia Pacific University (APU), and has been selected as a Master's Student Field Research Support Program recipient for Spring 2012. Mr PAGIWA would like to conduct a field research at your organisation to collect data from 6 August 2012 to 5 October 2012 on the theme of "Nomadic Basarwa community shows a high incidence and prevalence of Pulmonary Tuberculosis in the Gantsi sub-district of Botswana." APU will partially subsidize his trip.

APU has already given him clearance to make this trip, and we kindly request your cooperation with all of the necessary documentation to ensure that the data collection can be carried out as planned.

Thank you very much for your consideration with this matter, and if you have any questions, please do not hesitate to contact me at the number below.

Sincerely,

片岡龍之

Tatsuyuki KATAOKA (Mr.)
Administrative Manager
Research Office
Ritsumeikan Asia Pacific University (APU)
TEL: +81-977-78-1134 (Direct)
FAX: +81-977-78-1135

Ritsumeikan Asia Pacific University
1-1 Jumonjibaru, Beppu-shi, Oita 874-8577 Japan TEL +81-977-78-1134 FAX +81-977-78-1135
〒874-8577 大分県別府市十文字原1丁目1番 TEL 0977-78-1134 FAX 0977-78-1135

Appendix B

APU

June 5, 2012

Name: PAGIWA Vincent
Student ID: 51211624
Application No: 12-S10

AY2012 Spring Semester
Master's Student Field Research Support Program
Acceptance Notice

I am pleased to inform you that your application for the above research support program was approved as follows:

Research Title: "Nomadic Basarwa Community Shows a High Incidence and Prevalence of Pulmonary Tuberculosis in the Gantsi sub-district of Botswana"

Awarded Amount : Up to 75,000 yen (AY2012)
*However, we will only reimburse the actual expenses based on the Guidelines.

Ghotbi, Nader
Director, Ritsumeikan Center for Asia Pacific Studies (RCAPS)
Ritsumeikan Asia Pacific University

Ritsumeikan Asia Pacific University
1-1 Jumonjibaru, Beppu-shi, Oita 874-8577 Japan TEL +81-977-78-1134 FAX +81-977-78-1135
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Appendix C

Telephone: (267) 363200
FAX (267) 353100
TELEGRAMS: RABONGAKA
TELEX: 2818 CARE BD

MINISTRY OF HEALTH
PRIVATE BAG 0038
GABORONE

REPUBLIC OF BOTSWANA

REFERENCE NO: PPME 13/18/1 PS VOL V (237) 23 August 2012

Health Research and Development Division
Notification of IRB Review: New Application

Mr Vincent Pagiwa
Ritsumeikan Asia Pacific University
AP House 1,W224, 1-1 Jumonjibaru

Dear Mr Pagiwa

PERMIT: PREVALENCE AND INCIDENCE OF PULMONARY TUBECULOSIS IN THE GHANZI SUB-DISTRICT

Your application for a research permit for the above stated research protocol refers. We note that your proposal has been reviewed and approved by the University of Botswana Research Ethics Committee.

Permission is therefore granted to conduct the above mentioned study. This approval is valid for a period of 1 year effective 23 August 2012.

This permit does not however give you authority to collect data from the selected sites without prior approval from the management. Consent from the identified individuals should be obtained at all times.

The research should be conducted as outlined in the approved proposal. Any changes to the approved proposal must be submitted to the Health Research and Development Division in the Ministry of Health for consideration and approval.

Furthermore, you are requested to submit at least one hardcopy and an electronic copy of the report to the Health Research, Ministry of Health within 3 months of completion of the study. Approval is for academic fulfillment only. Copies should also be submitted to all other relevant authorities.

Yours sincerely

P. Khulumani
For Permanent Secretary

MINISTRY OF HEALTH
DEPT. OF POLICY PLANNING, MONITORING AND EVALUATION
2 3 AUG 2012
P/BAG 0038
GABORONE
REPUBLIC OF BOTSWANA

1

Appendix D

SAVINGRAM

MINISTRY of HEALTH
REPUBLIC OF BOTSWANA

From: Public Health Specialist
Ghanzi DHMT
P.O. Box 7
Ghanzi

Dr.Idrissa Kempanju (MD, MPH)

Tel: 6596114
Fax: 6596420

To: Vincent Pafiwa
Post Graduate Student
Health Research and Development Division
Ritsumeikan Asia Pacific University
Japan

29th August 2012

REF: PREVALENCE AND INCIDENCE OF PULMNARY TUBERCULOSIS IN GHANZI SUB-DISTRICT

Please refer the above heading and your letter of 27/08/2012 on the same. Your hereby approved to conduct a research on the Prevalence and Incidence of Pulmonary Tuberculosis in Ghantsi sub-district Botswana as per letter Ref: No: PPME/13/18/1 PS VOL V (237) of 223rd August 2012 from Health Research and Development Division – Ministry of Health. Please contact facilities In Charge and our TB office at DHMT for data collection in Ghantsi Sub-District.

Thank you

Appendix E

Ritsumeikan Asia Pacific University
AP House 1, W224
1-1 Jumonjibaru, 874-8577
Beppu-City, Oita-Prefecture
Japan

05/07/2012

Head of Health Research Unit
Ministry of Health
Private Bag 0038
Botswana

R.E: HEALTH RESEARCH APPROVAL APPLICATION AND CONSENT

This letter serves to seek an approval and as a consent for carrying a health research. The study will form part of the requirements for attaining a Master's degree in Public Health Management with the above mentioned university, of which I am currently studying. I am an employee of the Ministry of Health of Botswana, serving as a lecturer at Lobatse-IHS and currently on study leave as a World Bank scholar. Therefore, I would like to carry out a study in Botswana in the Gantsi sub-district.

My research topic is; **Nomadic Basarwa shows a high prevalence and incidence rates of Pulmonary Tuberculosis in the Gantsi sub-district of Botswana.**
The study will determine the geographic variation in the prevalence and incidence rates of pulmonary Tuberculosis within the Basarwa and Bakgalagadi of Gantsi sub-district in Botswana, stratified by location of residence. The research will be a cross sectional ecologic study, using surveillance data from 2007 to 2011, collected from TB registers in health facilities.
I therefore guarantee total confidentiality of information and will report only information that is in public domain and written within the law. When I intend to use the information that is in anyway sensitive, I will seek the permission of the health research unit before using it. There will also be total confidentiality as names of patients will not be used as part of variables of the study.

I will be grateful for this approval and for your support in carrying out this research.

Yours faithfully,

PAGIWA Vincent

Appendix F

ETHICAL STATEMENT

I, Vincent Pagiwa, promise that, while carrying out this research, I will observe the highest possible ethical standards. I will maintain the highest integrity at all times regarding data gathering. I will only report information that is in public domain and within the law. I will avoid plagiarism and fully acknowledge the work of others to which I have referred in my work. My findings will be reported honestly and truthfully, and I consider the research worthwhile and of benefit to the Botswana National TB Programme in Ghanzi district.

The following ethical protocols will be observed;

- The permission of the District Health Team manager of Ghanzi district will be obtained prior to data collection being carried out.
- The permission of the district TB coordinator and health facilities heads will be obtained prior to data collection.
- Health care providers and facility heads will be made aware regularly that data collection is going on.
- At no time will data collection process detract the normal work schedule of health facilities.
- Strict confidentiality will be adhered to. No names will be included in the written report.

PAGIWA Vincent **DATE:** 05/07/2012