PATTERNS, PERCEPTIONS AND MANAGEMENT OF CEREBRO-SPINAL MENINGITIS IN THE KASSENA-NANKANA EAST AND WEST DISTRICTS

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is my own work produced from research undertaken under supervision and that no part of it has been submitted for another degree or qualification in this institution or elsewhere.

Candidate's Name: APWAH FREDERICK

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Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis was supervised in accordance with the guidelines on supervision of thesis laid down by the University of Ghana, Legon.

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ABSTRACT

Cerebrospinal Meningitis (CSM) has been a long-standing health concern especially in tropical West Africa. CSM has been studied extensively especially in its immunological and clinical aspects in the study area in particular and the northern part of Ghana in general. However, begging questions and gaps remain in its comprehensive assessment in local-specific contexts. Consequently, the objective of the study was to gain better insight into its patterns, perceptions and management in the Kassena-Nankana East and West Districts within the broader context of the Meningitis Belt of Africa.

Guided by Meade's human ecological triangle, a Geographical Information System's Approach was used to generate a rate map to show magnitude and spatial patterns. Charts were also used to show seasonality and demographic patterns. A comprehensive approach was also adopted in assessing views on the issues of perceptions and management. A sample size of 250 respondents was drawn from the general public and 100 respondents comprising people who have experienced the disease before in the last two years was also considered.

The study revealed that, meningitis is still an issue to reckon with in the study area, as it portrays rates higher than the national average and falling within the hyper endemic zone of the Meningitis Belt of Africa. Besides, marked spatial variations have also been observed in relation to sub zones, as well as with demographic categorisations (age and sex) and seasonality. The study showed that, majority of the people have knowledge about the disease, however, both naturalistic and supernatural attributions are made for causes of meningitis.

With the variations observed in relation to the spatial, seasonal as well as demographic patterns, it was concluded that a holistic and strategic approach is required in dealing with the specifics, while recommending further research into the causes and extent of these observations.

DEDICATION

To my dear mother, Madam Ann Doris Balunu Apwah.

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CDC	Centre for Disease Control
CSM	Cerebrospinal Meningitis
DHD	District Health Directorate
DHMT	District Health Management Team
GIS	Geographic Information System
HIV/AIDS	Human Immuno Virus/Acquired Immuned Deficiency Syndrome
KNED	Kassena-Nankana East District
KNWD	Kassena-Nankana West District
MCM	Meningococcal meningitis
MOH	Ministry of Health
NDSS	Navrongo Demographic Surveillance System
NHRC	Navrongo Health Research Centre
PCM	Pneumococcal meningitis
UNEP	United Nations Environmental Programme
WHO	World Health Organization

CHAPTER ONE

INTRODUCTION

1.1 Introduction to the study

Cerebro-spinal Meningitis (CSM) is a dangerous epidemic and endemic disease. CSM is characterised by inflammation of the protective membranes covering the brain and spinal cord known as the *meninges*, giving rise to complex forms of symptoms including severe headache, sudden onset of fever, stiff neck, tenderness of the back, permanent damage to the brain and ultimately death (Welch, & Nadel, 2003; Ministry of Health [MOH], 2010). There are four main types of meningitis; bacterial, viral, fungal and parasitic or amoebic and a fifth type which is non infectious. Bacterial meningitis is the main cause of major epidemic outbreaks in Africa and will be the focus of this paper. Bacterial meningitis is now among the top 10 infectious causes of death worldwide (Grimwood et al., 2000).

Having been described as far back as 1805, Meningitis has come to stay as a global health concern, with different regions experiencing different incidence rates at various seasons. The incidence of CSM, as it manifests itself in spatial and temporal patterns can be attributed to a constellation of factors. Among these factors are the characteristics of the infecting organism, the resistance of the host, and, the environment (physical and social) (Sultan et al., 2005). It is further noted that CSM is one disease that is closely linked to climate as, evidenced by its spatial and temporal patterns throughout the world

(McMichael, 2004; McMichael, et al., 2006; Sultan et al., 2005; Harrison et al., 2009). Given compelling evidence of global climate change with climatologist estimating upwards trends in global temperatures to up to 2^{o}C by the year 2100, regional and local patterns of CSM must be closely monitored (Patz et al., 1996).

Equally important to the study are considerations pertaining to critical socio-cultural conditions, dynamics and outlooks, such as attitudes and perceptions. Various studies have shown that the socio-cultural orientation of a people could also inform their overall perception on the incidence of diseases and management efforts (Furnham et al., 1999; Green, 1999; Madge, 1998). These constitute a critical component in the overall effort to appreciate the existence, patterns as well as trends of health related issues in a given population. Thus, people perceive the incidences of health phenomena variously depending to a significant extent on their socio-cultural context and orientation.

An observation of the global and regional distribution and patterns of meningitis indicate that CSM is very much a function of space and time. Thus, CSM like many other diseases does not occur at the same time, with uniform patterns globally, but with marked intraregional and regional variations (Manchanda et al., 2006). According to Grimwood et al. (2000), there have been some major outbreaks in Asia (China 1979, and 1980, Vietnam, 1977, Mongolia 1973-1974 and 1994-1995, Saudi Arabia 1987, Yemen 1988). Five common types (serogroups)—(A, B, C, Y and W135) are responsible for over 90% of global infections, with serogroup Y and w135 on the rise mostly associated with Hajj pilgrims and also common in Burkina Faso (Manchanda, et al., 2006). In temperate regions the number of cases increases in winter and spring. Serogroups B and C together account for a large majority of cases in Europe and the Americas e.g. (Spain 1995-97 and Canada and US 1992-93).

The African continent has been experiencing epidemic meningitis for over a decade. In the geographical region known as the "Meningitis Belt" incidence occurs in irregular cycles (5-12 years) and affects millions of people, with a case fatality rate of between 10-50%. Epidemics in Africa are associated with bacterial *N. Meningitides* and mostly occur in the dry season (Integrated Disease Surveillance and Response [IDSR], 2003; WHO, 2012).

Meningitis represents a main health challenge in the meningitis belt which stretches from Senegal in the West to Ethiopia in the East and covers most parts of northern Ghana (GHS, 2011). It ranks 51st amongst the 60 diseases reported by the Ghana Health Services (GHS, 2004). Meningitis was among the top ten causes of deaths of all ages— national for 2009— ranking 9th (a mortality rate of 2.3 percent), the first eight being; malaria (13.4%), HIV/AIDS related conditions (7.4%), Anaemia (7.3%), Cerebro-vascular accidents (6.4%), Pneumonia (6.2%), Septicaemia (5.1%), Hypertension (4.1%) and Cardiac diseases (4.0%). Diarrhoeal diseases occupied the tenth spot with a mortality rate of 2.3%, with all other causes being 41.5% (GHS, 2009).

Periodic outbreaks of cerebrospinal meningitis occur, particularly in the northern regions of the country and widespread epidemics remain a public health threat (WHO Country Cooperation Strategy, 2008-2011, for Ghana). In 2012, the Upper East and Northern regions of Ghana recorded over 230 total reported cases of cerebro-spinal meningitis (CSM) in just two months−January and February (*Africa Report* Posted on Thursday, 23 February 2012 13:33). Recent developments indicate that the rest of the country lies effectively within the risks zone of the disease aside the three regions of the north, as evidence point to the fact that the Meningitis Belt is pushing towards the south of the country—all regions of the country have reported of meningitis at least in the last five years (GHS, 2013).

1.2 Problem statement

CSM continues to occupy its place as one of the major threats to human health and socio-economic structures of communities in especially most parts of tropical Africa (Heymann, 2003; Frasch, 2005; & Roberts, 2008). Evidence of change in mean climatic (dry-hot) conditions accompanied by agent mutation and resistance together with diverse human risks behaviour and deposition have combined effectively to ensure that CSM remains a major public health issue especially in the Meningitis Belt of Africa and adjoining regions (Sultan et al., 2005). It is therefore increasingly clear that this phenomenon represents a worrying source of concern, for communities, health practitioners and policy makers since everybody is at risk in these endemic areas, with high poverty levels and already overburdened health care systems.

In the Kassena-Nankana East and West Districts which lie in the northern part of the country and within the Meningitis Belt of Africa, CSM continues to be a public health burden. During the 1996/97 major outbreak, the War Memorial Hospital in Navrongo was overwhelmed by meningitis cases. The Kassena-

Nankana District recorded 1,396 cases with 69 deaths (Enos, 1997). CSM has since continued to hit the area in its endemic and sporadic forms. Recent evidence indicates that the study area is leading in the whole of the Upper East region and represents one of the highest rates nationally (DHMT-KNWD, 2012; DHMT-KNED, 2012; GHS, 2013).

The worrying phenomenon of meningitis has prompted expansive studies on especially the study area and the northern parts of the Ghana. While most of these studies have basically explained the clinical, immunological and some other aspects of its epidemiology, (Gagneux et al., 2000; 2002; Hodgson et al., 2002; Forgor et al., 2005), there is scant and incomprehensive literature on the spatial distribution and patterns as well as the seasonal trends of meningitis in the study area. Further, local perceptions on the phenomenon have not also been adequately dealt with. Hence, there is little geographical and social means of analysing and appreciating the distribution patterns for policy formulation and implementation to help manage and control meningitis in the study area. Mead and Emch (2010) assert that for the comprehensive and holistic analysis and appreciation of a health related concern on a population in a given area, there is the imperative need to pay attention to the local contexts pertaining to the critical interactive issues of population, habitat and behaviour.

It is against this background that the study seeks to examine the spatial patterns, seasonality and to as well assess the knowledge and perceptions on CSM. Further, the study seeks to assess the management dimensions and socioeconomic implications of meningitis as a health concern in the area, in the hope that this perspective would add to literature that would help in the better appreciation and management of the disease in the area.

1.3 Research objectives

The general objective of the study is to evaluate and assess the patterns, perceptions and management of meningitis in the Kassena-Nankana East and West Districts.

The specific objectives of the study are to:

- describe the magnitude, spatial patterns and seasonality of meningitis in the study area,
- assess the level of knowledge and perceptions of the people about meningitis in the area,
- assess the management and socioeconomic implications of meningitis in the study area,
- make recommendations for the management of meningitis in the study area.

1.4 Research questions

- What are the patterns of Cerebrospinal meningitis in the study area?
- How is meningitis perceived in the study area?
- How is meningitis being managed?
- What are some of the socioeconomic implications associated with the meningitis scourge?

1.5 Rationale for the study

Considering the fact that, habitat, behavioural and other socio-demographic characteristics as well as agent type and mutation drive meningitis, it is only instructive that a study be made to assess the patterns and associations between the various critical factors noted above. The significance of the study further ties in well with local, national and international efforts aimed at understanding all aspects of the disease, and to garner efforts to halt and reverse its infections.

1.6 Scope of the study

The study pays attention to three dimensions of scope—Geographical, content and time. Geographically, the study focuses on the Kassena-Nankana East and West Districts of the Upper East Region of Ghana. The study further narrows down to five zones covering both districts that the Navrongo Health Research Centre (NHRC) uses for surveillance and monitoring health programmes−East, West, Central, North and South zones. Content wise, the study covered magnitude, patterns, attitudes, perceptions management and socio-economic implications of meningitis. Focus was on responses from people who have survived the meningitis scourge, the general public and health personal in charge of meningitis programmes in the study area. Regarding the scope of time, the study covered a five year period−assessing data from 2008-2012 for the study area. All these have been considered in relation to the national situation within the broader context of the Meningitis Belt of West Africa.

1.7 Organisation of the study

The study is made up of six chapters. Chapter one looks at the introduction to the study, problem statement, research objectives, research questions, rational for the study, the scope of the study and the organisation of the thesis. Chapter two focuses on the review of related literature. Chapter three covers the study area and research methodology. Chapter four describes the magnitude and patterns of meningitis in the study area. Chapter five discusses the knowledge, perception and management of meningitis. Finally, presented in Chapter six are the summary of findings, conclusion and recommendations of the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter starts with a discussion on issues pertaining to the nature and epidemiology of meningitis. The chapter proceeds with a brief definition of medical geography as a discipline, and the review of relevant medical geographical perspectives and approaches (supernatural theory of disease causation, the germ theory and the disease ecology approach). The chapter then looks at the patterns and trends of diseases in medical geography and the multidimensional perspectives of the concept of health. Valuable empirical studies germane to the study have also been reviewed. A conceptual framework for the study concludes the chapter.

2.2 The nature and epidemiology of meningitis

2.2.1 A brief history of meningitis

Hippocrates (c.460 BC-370 BC) described conditions central to meningitis as far back as ancient Greece. In the 16th Century A.D., Robert Whytt (1714 to1766) described in a posthumous report a ‘‘dropsy of the brain’’ (now known as tuberculosis meningitis), however, no link was established between that condition and any agent that causes it (Hippocrates, 1988). In the same vein, Anton Weichselbaum (1845-1920) an Australian bacteriologist is purported to have found the agent of meningitis; bacteria which he termed *meningococcus* in 1887. It appears the first recorded major outbreak occurred in Geneva, Switzerland in 1805, given by Vieusseux (as cited in Leimkugel et al., 2009). A year later, meningitis is said to have occurred in New England. And throughout the 19th century across Europe and North America epidemics occurred and also in Africa (Greenwood, 1999).

According to Waddy (1957), Ghana (then Gold Coast) recorded its first outbreak of meningitis in Cape Coast in 1900. This incidence was reported to have occurred among labour from East Africa brought in by the British to assist in their campaign against the Ashanti. Subsequently, there have been major outbreaks of epidemics notably in 1906, 1919/21, 1944/45, and 1948/50. Major outbreaks were also reported to have occurred in 1960/61 and 1972/73. The 1996/97 outbreak is considered the biggest in the history of the country (Woods et al., 2000). In recent times, meningitis in Ghana is more prevalent in the northern parts of the country, even though the southern parts especially the forest belt have been recording sporadic incidences.

2.2.2 Types and causes of meningitis

Meningitis may develop in response to a number of causes. Bacteria, virus, protozoa and fungi are the main causal microorganisms. Meningitis may also be caused by non infectious factors such as physical injury, cancer or certain drugs (Ryan et al., 2004; MOH, 2010). Mention can also be made of

Different types of bacteria cause bacterial meningitis. Three types commonly identified are: *Neisseria meningitides, Haemophilus influenzae,* and S*treptococcus pneumonia*). *Neisseria meningitides:* are bacteria that can cause illness in people of any age. At any time, about 5-15% of people have these bacteria in their throats or noses without getting sick. The bacteria are spread through saliva (spit) during kissing, sharing of food, drinks or cigarettes, and by close contact with infected people who are sneezing or coughing. People who have come in close contact with the saliva of a person with meningitis from this type of bacteria may have to get antibiotics (medicine) for protection. Meningitis caused by these bacteria is called “meningococcal.” There are vaccines, which can be used to help prevent this kind of meningitis (Ryan et al., 2004; Trotter et al., 2005; MOH, 2010). Different common serogroups have also been identified. These are: A, B, C, Y and W135 (Manchanda, et al., 2006).

Haemophilus influenza: type b bacteria, also called Hib, can also cause meningitis. There is a vaccine called “Hib vaccine” that could prevent infants and young children from getting Hib disease. Most adults are resistant to this type of meningitis, and thanks to the vaccine, most children under 5 years of age are protected. Certain people who have come in close contact with the saliva of a person with meningitis from this type of bacteria may have to get an antibiotic for protection.

Streptococcus pneumonia: are bacteria that cause lung and ear infections but can also cause “pneumococcal” meningitis. These bacteria are usually found in the throat. Usually, most people who have these bacteria in their throats stay healthy. However, people having chronic medical problems or with weakened immune systems, and those who are very young or very old, are at higher risk for getting pneumococcal meningitis. Meningitis caused by *Streptococcus* *pneumoniae* is not spread from person-to-person. People in close contact with someone who has pneumococcal meningitis do not need to get antibiotics.

Other bacteria can also cause meningitis, but meningitis from these other bacteria is much less common and usually not contagious (Massachusetts Department of Public Health, 2011). Bacterial meningitis is the main cause of meningitis outbreak in the Meningitis Belt of Sub Saharan Africa.

A second type of meningitis is viral meningitis, also known as aseptic or nonpurulent meningitis. Different viruses can cause meningitis. Viral meningitis is less severe than bacterial meningitis. Examples of viruses that can lead to meningitis include *mumps* and viruses that spread through mosquitoes and other insects *(arboviruses).*

Rare but more deadly is the third type; - fungal meningitis. High risk people include those with HIV/AIDS, leukaemia, or other forms of immunodeficiency and immunosuppression. Examples of fungal causing meningitis are *Cryptococcus* and *Candida*. Protozoa is another cause of meningitis, even though very rare as compared to the other main causes**.** One main example is *toxoplasma* in HIV/AIDS (MOH, 2010).

Aside the traditional infectious causes of meningitis discussed above, there are also other non-infectious causes that may cause inflammation of the *meningis* of the brain and cause meningitis. Examples of these non infectious causes are; cancers, certain drugs that weaken the body immune system, head and brain injury and diabetes. These non infectious causes are also very rare.

2.2.3 Symptoms and complications of meningitis

Complex forms of symptoms are associated with meningitis. With children of less than one year old, symptoms include; fever, irritability, refusal to eat, poor suckling, vomiting, drowsiness and weak cry, bulging fontanel etc. With adults and older children, symptoms include; fever, neck pains severe headaches, photophobia, coma, convulsion, vomiting and so forth (Welch, & Nadel, 2003; MOH, 2010).

2.2.4 Health determinants and risk factors of meningitis

With respect to CSM, just like many other health concerns, certain conditions may predispose one to its contraction. These are the determinants and risks factors. Health determinants are generally defined as the underlying social, economic, cultural and environmental factors that are responsible for health and disease, most of which are outside the health sector (Last, 2001; Lee, 2005; Marmot, 2005; Irwin et al., 2006).

A risk factor refers to an aspect of personal habits or an environmental exposure that is associated with an increased probability of occurrence of a disease. Since risk factors can usually be modified, intervening to alter them in a favourable direction can reduce the probability of occurrence of disease (Bonita et al., 2006). While all the risk factors for meningococcal outbreaks in Africa are not understood, several conditions have been identified as having some association with the development of epidemics in the meningitis belt. They include: Medical conditions (immunological susceptibility of the population), demographic conditions (travel and large population displacements), socioeconomic conditions (poor living conditions and overcrowded housing), and climatic conditions (temperature, drought and dust storms) (CDC. *website www.cdc.gov).*

2.2.5 The Meningitis Belt of Africa

The Meningitis Belt throws more light on another concept in geography—patterns. The basic premise or general assumption would always be that all things being equal health effects should show a uniform pattern among a population in a given locality. However, certain complex, overlapping and ever-changing constellatory factors always ensure that patterns of health concerns would vary given the conditions in a given location or area (Sultan et al., 2005). Surely, other health concerns like malaria, onchocerciasis, and tuberculosis in Africa may show different patterns.

Meningitis is not distributed evenly but occurs in clusters throughout the world. The African continent has been reporting epidemics since 1909 (WHO, 2011), and has become the major host to this disease. But of critical concern is an area in Sub-Saharan Africa known as the "Meningitis Belt", which accounts for a hugely disproportionate percentage of meningitis occurrences throughout the world. The "Meningitis Belt" is an area roughly circumscribed to the bio geophysical Sahelo-Sudanian band, which stretches from Senegal in the West to Ethiopia in the East. Outbreaks of meningitis occur yearly in 25 countries in this region. Africa has 80% of the disease burden, with epidemics usually occurring in irregular cycles of every 5-12 years, especially in the dry season (December-June) and dying out in the intervening rainy season (Sultan et al., 2005).

Further, 25 countries and over 300 million people are at risk, 700,000 cases were recorded, with a case fatality rate of 10-50% in the 2009 (WHO, 2010). The typical coincidence with periods of low humidity, high temperatures and dusty conditions subsidence and disappearance of it give the indication that, environmentally these are critical factors that may play an important role in the occurrence of meningitis incidence. The definable frontier being the junction of the savannah belt and the forest zone- where there are sever alterations between humid and dry season conditions, with epidemics really being reported in the forest and coastal zones (Waddy, 1958; Moore, 1992; Cheesbrough et al., 1995; Greenwood, 1999; Molesworth, 2002).

2.3 The Concept of health and disease: Attributions, beliefs, practices and management

According to the WHO (1948), as a concept, "Health is the state of complete physical, mental, and social well-being and not merely the absence of disease and infirmity". In relation to this, the concept "wellness" has been defined as: "an approach to personal life that emphasizes individual responsibility for well-being through the health-promoting life behaviours" Hurley & Schlaadt, 1992 (as cited in Edlin et al., 2000). Drawing on this, six dimensions of health and wellness have been identified to the inclusion of: emotional, intellectual, spiritual, occupational, social and physical. The underlying assumption in this context is holism since these dimensions are interrelated and interlinked in defining one's health and wellbeing. (Edlin et al., 2000)

Central to health and health behaviour like any other behaviour is attribution. Thus, the causal and explanatory line of thought employed to aid in the understanding of happenings in the world. The concept of attribution has long been recognised as playing a critical role in decision making among alternative courses of actions (Kelley, 1973; Anderson, 1983).

In the same vein, it is also stated that people with culturally diverse background most often make varied attributions to illness, health, disease, symptoms and treatment. It is further, noted that these cultural differences in health attributions have critical implications for the understanding and management of health concerns, since over time attributions would play an important role in the formation of beliefs concerning health and illness. An element of reciprocity is introduced, as health beliefs constitute a cognitive and psychomotor schema that shape the way people make attributions (Furnham et al., 1999; Murguía et al., 2003).

In their study on cultural health attributions, Murguía et al. (2000) note that, even though Latino populations are diverse, collectively and as a whole they are much likely to believe in attributional equity as a primary cause of illness (e.g. a just retribution from God for ones behaviour). They are therefore predisposed to the utilisation of ethnomedical approaches to healthcare such as *Santeros* (practitioners/priests of Santeria who combine indigenous rituals with the saints of the Catholic Church), *herbalista* (herbalists) and folk remedies.

In a similar study, Madge (1998) pointed out much earlier on that African patients may be more likely to attribute illness to a spiritual or social cause rather than a physiological or scientific cause. Thus, depending on the particular condition, remedies or management could include both material (e.g. herbal remedy), and spiritual (e.g. amulets) explanations and techniques (Chipfakacha, 1994; Madge, 1998). For instance in Ethiopia, Mulatu (1999) found that most Ethiopians were more likely to attribute mental illness to cosmic or supernatural causes, including curses or possessions.

It has further been noted that not all diseases have mutually exclusive causes. Thus, circumstances may allow for a naturalistic interpretation in a given episode and personalistic (witchcraft) explanation at another time or with a different patient. Yet, at both, interpretation may hold relevance and apply at a given situation (Green, 1999). A very illustrative example is given that, in most of Africa today most people are in the known that STDs and HIV spread primarily through sex contact. “However, human agency — manifested as a desire to send a harmful “message” to someone— may be the ultimate explanation of why the virus victimised a particular person” (Green, 1999, p. 468).

These bases definitely influence people’s perceptions, choices of seeking healthcare and disease management in different ways given their socio-cultural context and orientation. This underscores the fact that local perceptions are a critical component in the broader efforts to appreciate the nature of a particular health related concern in given locality.

2.4 Disease Patterns and trends: The spatial, seasonal and demographic dimensions

Essentially, the study of geographic patterns of disease is seen as falling within the ambit of the classic triad in descriptive epidemiology of "time, person, and place". Following this, place represents a platform for the mix of behavioural, environmental, and possibly genetic factors that may underlie variations in rates of disease across populations. Here, the primary focus is both to describe such variations and to identify possible causes that could explain them. Thus the exploration of regional or local variations for patterns could be done by either one or a combination of the following approaches: Qualitative description, mapping, and graphical and tabular presentation of variables of interest (Rothman et al., 2008).

In relation to seasonality and patterns of infectious diseases, Rothman, et al. (2008, p. 607) further identified cyclical patterns as a major type under a broader time patterns category. They stated that; "cyclical patterns are not surprising, given the known cycles in the size and activity of vector populations, the change in physical environment that influences exposure, and in many human setting, the physiological functions and behaviours". By this assertion, Rothman et al. (2008) argue for a closer examination of the complex interplay of underlying factors such as vector, the physical environment and the socio-cultural context within which cyclical patterns of health concerns are manifested.

From the view point of variation and seasonal trends in diseases, descriptive observations could be made at both international and local levels. Thus, international patterns could give clues to local patterns, while local patterns could show further variations.

Drawing on the assertion above, the difficulty that arises is the identification of the appropriate scale of analysis on the interaction between levels of susceptibility and variations of underlying environmental factors. Thus, while certain patterns may be visible at a wider scale or at the international level same may not be through at the local (small-area) level. Besides, apparent geographic variations in disease rates and patterns may be less real due to problems associated with the enumeration of cases (numerator) or the population (denominator) at risk or both. Given this assertion on the possible limitations to the otherwise obvious variations, great care is required in any interpretation. Critically required in these instances would be the clear and unambiguous definition of one's scope (study area). Besides, such a study should also strive for accurate or good data from the appropriate sources.

According to Pascual and Dobson (2005, p. 18); "meningitis in western Africa shows recurrent seasonal patterns every year. Epidemics typically start at the beginning of February and last until May". Pascual and Dobson (2005) further noted that explanations of observed infectious disease patterns on the basis of some seasonally varying environmental factors such as temperature, humidity, and rainfall come together as a critical pathway for appreciating the effect of climate change on disease dynamics. There may however be marked local variations in "uniform" patterns within larger scales.

2.5 Theoretical Perspectives and Epidemiological Approaches to Medical Geography

2.5.1 Medical Geography

Much earlier on, Hippocrates (c.460-377 B.C.) demonstrated familiarity with the importance of cultural-environmental interactions for disease observation— more than 2,000 years ago. The study of these interactions, which are important to disease etiology, health promotion, and health service promotion alike, continues to this day as medical geography.

Following Brown, McLafferty and Moon (2010, pp. 327-328) "Geography has been able to make an important contribution to understanding how the spatial and temporal proximity of human populations to infectious agents in the physical environment contribute to risk of infectious diseases". According to Meade and Emch (2010), medical geography employs concepts and methodologies from the disciplines of geography to investigate health related concerns. Health/medical geography is an integrative, multi stranded sub discipline that has room within its broad scope for a wide range of specialist contributions. Medical geography is seen as both an ancient perspective and a new specialization.

2.5.2 The supernatural theory of disease causation

Proponents of the theory make attributions of diseases and illness to supernatural and unseen forces. The notion that disease is supernatural in origin has a very long history. However, its origins cannot be attributed to the intellectual credit of any one or group of scholars as its dimensions and forms vary markedly across cultures and time. It gained its distinction from the observations of common causal dispositions of diseases among and across cultures.

At the heart of this theory is superstition, which can be defined as the irrational belief in the existence of unseen forces (frequently thought of as evil spirits) controlling peoples fate or the outcomes of events, usually with negative effects, unless particular actions are taken to prevent the ill effects or to produce the desired good effects; this may involve a person's behaviours and actions, avoidance of actions, places, etc., or the use of amulets amongst other things. Superstition according to Dawkins (as cited in Beck & Fortsmeier, 2007) is defined as a wrong idea about external reality.

Murdock (1980, p.17) further puts the supernatural theory into categorizations: *Mystical causation*—which accounts for the impairment of health as the automatic consequence of some act or experience of the victim mediated by some putative impersonal causal relationship rather than by the invention of a human or supernatural being; *animistic causation*— ascribes the impairment of health to the behaviour of some personalized supernatural entity-a soul, ghost, spirit or god; and *magical causation*—simply produced by magic.

Even though, it is as old as humanity, this theory seems not to have lost its relevance in contemporary times even in the face of qualitative refinements of alternative theories of disease causation such as the germ theory and the ecological theory. It may be erroneous for the assumption to be made that this theory finds inordinate followers only in remote rural settings and among illiterate folks (simple societies). It is a truism that, even many well educated and intelligent people hold on to various superstitions under the euphemistic banner of cherished traditions of some sort.

The supernatural theory of disease causation does not show empirically the grounds on which cause and effect meet and unite. One other criticism is that, some people find in the supernatural theory of disease causality a handy way to castigate their enemies. Yet, because health concerns like epidemics took a greater toll on the poor than the rich in most societies, the rich could employ the supernatural theory as a justification for scolding the poor for their sinful behaviour (Tesh, 1988).

The relevance of this theoretical review would help place into perspective people's perceptions about meningitis in the study area. As noted, perceptions about diseases are varied and culture specific.

2.5.3 The germ theory of disease causation

The origins of the germ theory of diseases causation (also known as the Pathogenic theory of medicine) could trace back into ancient times, but its modern incipient forms dates to 1862 in the publications of the Viennese physician Dr. M. A. Plenciz. The emergence of the Germ theory in its even more crystallized forms is widely attributed to the works of the French Chemist—Louis Pasteur (1822-1895) —a century later in 1864. Other key proponents of the germ theory include two German Physicians namely; Robert Koch (1843-1910) and Friedrich Gustav Jakob Henle (1809-1885).

A main assumption of the Germ theory is that a diseased condition arises as a result of the main invasion by specific micro-organisms. Thus, illness is caused by bacteria, virus and other micro-organisms. The theory further posits that a specific germ is responsible for each disease. Also, these micro-organisms are capable of reproduction and transportation outside of the body.

One of the strengths of the theory lies in the fact that, it introduces another dimension to the understanding of disease causation. Up to the time that the theory was propounded, causation of illness and disease had rested on ancient Shamanism, superstition and religion, of invading entities and spirits (Baker, 2005).

Also, the emergence of the germ theory initiated a forward drive in medicine that resulted in massive advancements and developments in antiseptics, antibiotics, and the better understanding and appreciation of microbiology and pathology—laying the foundation of modern science.

However, the germ theory at the earlier stages of its evolution and even in contemporary times runs into criticisms. The assertion is that it shifts personal responsibility for health and well-being onto the sole sphere of the medical profession who possessed the knowledge to get rid of those germs (Baker, 2005). Thus, given this line of thought, the “germ era” contributed in no small measure to the decline of public hygienic health in the 19th century in especially the west, were it started and had multitudes of ardent and inordinate disciples.

It is also argued that, the Germ theory failed to answer some few important observations: For instance, why is it that not everyone who is exposed to a bacteria or virus falls ill? For example, medical doctors in general practice typically come into close contact with scores of flu sufferers every day. Yet, they do not generally get the flu. Also, how is it possible to avoid illness without avoiding contact with bacteria and viruses? Unless we live in isolation in a sterile environment, it is impossible to avoid contact with bacteria and viruses. Yet again, by changing our diet, getting enough physical activity and rest, taking nutritional or herbal supplements, etc, we can avoid falling ill so often (Seah, 2013).

Finally, why is it that certain treatments, like Homeopathy, and Traditional Chinese medicine, prove effective against infectious diseases when they do not directly target the bacteria and virus? Besides, why is it that other therapies like osteopathy and chiropractic which involves manipulation of the body's skeletal structure have high success rates, for instance in helping sufferers recover from flu (Seah, 2013).

It is found that the germ theory of disease, while it seems to make sense and has a lot to offer, does not totally prove that germs "cause" diseases. Could it well be the other way around? - That once a person is sick (due to whatever other reasons), that person's body allows germs to thrive? Furthermore, evidence is mounting that the fight of disease with antibiotics, vaccinations and pasteurization on the basis of the germ theory comes serious side effects.

The review of the germ theory in this context it was hoped would help broaden the scope of the study to cover various attributions made to the causation of the prevalence of disease in a given locality. This apparently helped put people's knowledge, perceptions, beliefs, practices and even management choices in context, assisting in the explanations of such outlooks in given circumstances.

2.5.4 The disease ecology approach

The ecological theory, as first proposed by early epidemiologists such as Hippocrates, forms the basis for this study. Ecology is a branch of biology concerned with complex relationships between organisms and their environment (Hawley, 1950). Disease ecology examines the relationship between population and the changing environment, it further shows how processes of population interactions support or discourage disease.

As noted earlier, Hippocrates is the first epidemiologist who advised to search the environment for the causes of diseases. Hippocrates was born on the Greek island of Cos around 460 B.C. A body of medical writing was produced by him and his disciples. The Hippocratic approach to medicine, as interpreted by Galen and others, dominated European medical thought well into the nineteenth century (Thagard, 1997). Hippocrates argued that, whoever wishes to investigate a health related phenomenon properly should proceed in the first place to give due consideration to the seasons of the year and what effects each produces (Meade & Erickson, 2000).

The concept of ecology changed within biology as it matured from an emphasis on organism to an emphasis on relations and functions of the system. The foundational biological concepts and processes, however entered in the 1960s into cultural ecology into both anthropology and geography and thus into the sub disciplines of medical anthropology and medical geography

(Meade & Emch, 2010). The concepts of cultural-environmental interactions in systems became more useful for understanding the basis of infections and parasitic diseases. Brown et al. (2010, p. 37) noted that; "disease ecology has been commonly understood to include features of the environment, population and culture in the explanation of patterns of diseases". Brown et al. (2010) further stated that the core questions it seeks to address are: "why is this disease here", or why is this disease in places like this?" —where places are set of locations with common attributes.

2.5.5 The triangle of human ecology (the disease ecologic approach/model)

The disease ecology comes in as one of the tremendously powerful and useful approaches in the study and analysis of health concerns (diseases) in the context of human—environment interaction. Meade et al. (2000; 2010) and others have built on the disease ecology model as originally articulated by May (as cited in Mayer, 1996). Essentially, the disease ecologic approach seeks the understanding of the interactive and evolving processes of humanity (including, culture, society, and behaviour); the physical (e.g. topography, vegetation and climate); and biology (including, vector and pathogen ecology) in producing a disease foci.

This approach represents an attempt at portraying the critical concept of holism which is central in geographical studies. Further, it comes in strongly as a potent means of explaining the distribution of disease foci among a population. The approach further places the sport light on the material aspects of culture in the complexities of health concerns.

The disease ecology approach has a lot to offer, however it has been mainly criticised as being overly ambitious-attempting to capture everything under the sun, as it seeks explanations to concerned phenomena. Thus, in such an over elaborate endeavour, detail may be sacrificed for superficial and general patterns and trends.

The geographical study of health and disease in general and meningitis in particular, could best be conducted by adopting the ecological approach as presented by the diagram below. The diagram focuses on three main categories of factors that affect the state of human health: population, behaviour, and habitat.

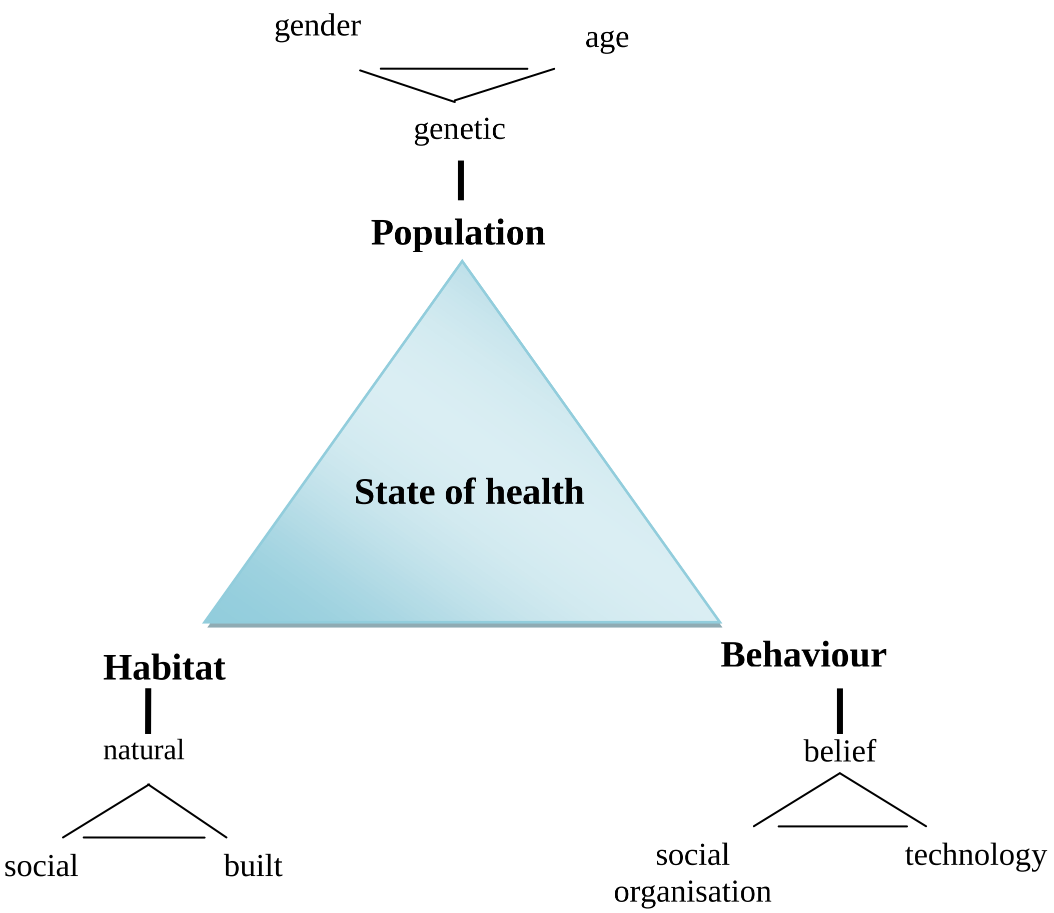

Figure 2.1: The triangle of human ecology

Source: Mead and Emch, (2010).

Population: **-** This makes reference to biological organisms (in this instance humankind) that may carry and host disease. For instance, Population characteristics such as genetic susceptibility, age, and gender could determine whether or not a host can physically and emotionally cope with infection. It is further presumed that, this host−disease interaction could partly determine the sort of health outcome and pattern that would be generated in a specific locality at a given period.

Habitat: **-** It constitutes part of the environment or context within which people live, that which may directly or indirectly affect them as they engage in their daily routine. The habitat is usually put into three categories or types: - Natural habitat; which includes, topography, land cover, land use, climate and weather patterns. The social habitat constitutes the second category; this includes family, friends, culture and spiritual influence (the social environment consists of the groups, relations, and societies within which people live). The third as shown by the diagram is the built habitat or environment, which includes, the building or settlement types we live in, work at, and travel within during our daily routines (construction materials, sanitation and waste disposal, water sources, building designs, air flows and lighting, health care facilities and transportation).

Behaviour: **-** This refers to the observable aspects of culture. It emanates from cultural precepts, economic constraints, social norms and individual orientation, outlook and psychology. Mobility, roles cultural practices and technological interventions are covered here. According to Glanz et al. (2002), health behaviour is influenced and determined to a significant extent by individual or personal believe or perceptions. Thus, a wide range of intrapersonal factors such as age, sex, ethnicity, personality socioeconomic knowledge and self-efficacy could affect health behaviour.

This characterization of the distribution of health-related states or events is one broad aspect of epidemiology called descriptive epidemiology. Descriptive epidemiology provides the "*What*, *Who*, *When*, and *Where"* of health-related events. In the same vein, several ecological processes have been noted to have the potential of resulting in strong spatial patterns of risks or incidence (Ostfeld, et al., 2005). According to Pavlovsky (as cited in Ostfeld et al., 2005), the concept of landscape epidemiology consists of three observations/assumptions. First, diseases and health concerns tend to be limited geographically. Secondly, this spatial variation arises from underlying variation in the physical and/or biological conditions that support the pathogen and its vectors and reservoirs. Thirdly, if those abiotic and biotic conditions can be delimited on maps, then both contemporaneous risks and future changes in risk patterns and trends should be predictable.

The relevance of the human ecological theory lies in the fact that, *the agent, host* and *habit* components and interconnectedness have been adapted and used in the conceptual framework. It is considered that, the *where, when, who,* and *how much* questions which are central to Geography, would also prove useful for the contextual examination of meningitis in the study area. Thus, the approach is very critical for targeting disease in space and time and epidemiological maps can be generated (Ostfeld et al., 2005). This would help explain the patterns and perception of meningitis in the study area. This model also meets the demands of the multifactorial causation theory and the general systems theory as they propose a multi-perspective analysis of geographic phenomena.

2.5.6 Empirical studies on meningitis concerns

The incidence of meningitis has been studied from many different perspectives as part of the efforts to contribute to its understanding and management at various localities at different times. Whereas some scholars focused their investigation on its clinical and immunological dimensions, others studied some aspects of its epidemiology. Thus, the various approaches and methodologies adopted were apparently to address specific research needs in given contexts. For the purpose of this study, a number of related empirical studies have been reviewed to help draw on some of the applied conceptual and methodological insights that hold relevance to and provide valuable grounds for the study.

Hodgson et al. (2001) investigated the survival and sequelae of meningococcal meningitis in the Kassena-Nankana District of the Upper East Region of Ghana. A background information to the study noted that bacterial meningitis, remains an important cause of mortality and morbidity in the area.

For the survival and disability studies, a list of all clinically or laboratory diagnosed meningitis cases at the district during the 1997 epidemic was compiled from the hospital records. A Geographical Information System (GIS) was used to locate the nearest eligible controls to the home of the case. The Navrongo Demographic Health System (NDSS) was used to determine dates of deaths or migration of patients and controls. The sampling procedure for the disability study involved a simple random sample of survivors of the epidemic who could be traced. Conclusions were that, excess deaths occurred during the first thirty (30) days after the onset of meningitis. Hearing impairments was also noted as the major sequel. Similar studies (Heymann, 2003; Frasch, 2005; & Roberts, 2008) also hint on the devastating implications of meningitis in the meningitis belt of Africa.

Greene et al. (2005) studied Michigan's high viral meningitis incidence rates from 1993-2001. Cases were analysed for standard epidemiological indices, geographical distribution and spatio-temporal clusters.

Surveillance data was collected on all diagnoses of reportable disease or conditions, as defined by the Michigan Public Health Code. For the statistical analyses, cumulative indices and relative risks were calculated using SAS for windows v8. The disease incidence mapping was done using Arc View GIS v3. Time series analysis techniques were also applied to the data using R v1.

Results were thematised as; demographics of cases (cases ranged in age categories), temporal trends (seasonal distribution), and spatial trends. Generally, the results confirm the existence of certain high-risk groups and disease clustering in both space and time within the study area. The study also supported several findings from previous studies of viral meningitis including risk factors related to seasonality, age, race, and crowding. Thus, the age specific analysis indicated that youth is considered a predisposing factor for meningitis

The study recommended that, the identification of spatial and temporal clusters in the investigation should encourage further research aimed at identifying local and socio-demographic influences on infectious disease agent transmission.

Forgor et al. (2005) investigated the influence of climatic factors on the incidence of Meningococcal meningitis (MCM) and Pneumococcal meningitis (PCM) in the Kassena-Nankana District of northern Ghana. Epidemiological data (meningitis cases) was gathered from health facilities in the district between January 1998 and December 2004. Meteorological data (humidity, temperature, sunshine, dusty hazy days, and wind speed) was gathered from the Navrongo meteorological station.

Statistical analysis were run for weekly and monthly aggregates of meningitis cases and corresponding meteorological data, which were double entered using visual FoxPro. Negative binomial regression in Stata software version 9.0 was used to determine the lag period in the environmental variable that best predicted the incidence of meningitis.

Results of the study showed that, concurrent weekly increase in temperature and concurrent weakly decrease in total rainfall significantly influenced the risk of MCM and a concurrent weekly decrease in rainfall significantly influenced the risk of PCM.

Conclusions were that, climatic factors that trigger MCM and PCM are similar, not always the same and often result in different timing of outbreaks of the two diseases. The duration of preceding absence of rainfall appears to be the best predictor of both MCM and PCM.

Baffoe-Bonnie et al. (2006) assessed human health vulnerability and public health adaptation to climate change: risks and responses in Ghana. The main purpose of the study was to strengthen the knowledge base at national level, on vulnerability and adaptation to climate change in areas such as human health and agriculture.

A background to the assessment revealed that, climate change is projected to increase threats to human health, either directly or indirectly, particularly in lower income populations within tropical and subtropical countries. Meningococcal meningitis was cited as one of the air-borne diseases driven by climate change.

The assessments were done in the Ashanti and Upper West Regions of Ghana. The methodology of the study involved time series projections based on the following: health variables (monthly outpatient morbidity data was broken down by age and sex and year for incidences of selected diseases), climate variables (rainfall, mean air temperature, mean relative humidity and rainfall amount), analysis of the health data against their seasonal changes, disease incidence by different age groups and the estimation of the socio-economic burden of diseases.

Findings indicate that, climate change and variability would adversely affect vulnerable groups with diseases such as meningitis and diarrhea likely to rise. While health systems and their responsiveness to changing climate are to be monitored, recommendations included education, adaptation and resource mobilization for a concerted attack against especially air-borne and other diseases.

Colombini et al. (2009), in a study in Burkina Faso looked at costs for households and community perceptions of meningitis epidemics. Districts for the study were selected on the bases of experiencing an on-going epidemic. Meningitis cases were selected using lists of patience recorded in medical registers at health centres. Community members were also selected to give a representative sample of social characteristics such as: age, sex, socioeconomic status, occupation and village of residence.

The study revealed that, environmental (including sun, wind and the Harmattan season) and supernatural causes (activities of sorcerers or soul eaters) were noted as the main causes of meningitis. Respondents reported that, people who have contracted meningitis due to environmental causes could respond to modern medical care and survive. However, those afflicted by a sorcerer would not. These imputed causes according to the study, affected preventive as well as therapeutic approaches individuals and groups adopt, which included a mix or a combination of interventions offered by soothsayers, traditional healers and modern health workers.

The study concluded that, even though, modern concepts of disease and health seeking have made significant penetration, beliefs and care seeking behaviour with regard to meningitis in Burkina Faso remain influenced by traditional thinking. The study also concluded that, meningitis epidemics have a very high economic cost for families and societies.

Vaughn et al. (2009) set out to look at the general issue of health management in differentiated communities. The primary aim was to assess the role of cultural differences and how those differences affect treatment decisions and the need for medical educators, health practitioners and other stake holders to appreciate this for effective health management.

Specifically, the study touched on the following thematised areas: 1) health attributions and the effects of different cultures on those health attributions; 2) models of common cultural beliefs; 3) cultural practices of health and healing; 4) cultural-bound syndromes; 5) effects of immigration and other socio-cultural factors on health; 6) assessment of cultural background through treatment and therapy approaches; and 7) cultural considerations in medical education.

The findings and conclusions were that, considering the increasing diversity, complexity and pervasiveness of cultural health attributions, beliefs and practices, it is pertinent that due attention is given to such factors in the overall appreciation and management of specific health concerns in given localities.

The review of the above empirical studies is of enduring relevance to the study in that, critical contextual, methodological and conceptual issues have been gleaned out that helped guide the study. First, meningitis has been noted as important cause of mortality and morbidity especially in northern Ghana. Secondly, there are strong indications of some association between climate and meningitis. It has been noted that, there are wide variations in terms of spatial, seasonal, and socio-demographic dimensions of meningitis. Besides, beliefs and perceptions about health concerns have all been shown. Finally, it has also been deduced that, meningitis incidence mapping could prove critical to the comprehensive study of the disease.

2.5.7 Conceptual framework

A number of conceptual frameworks have been developed to explain the incidence of certain diseases—deriving from many theoretical perspectives. The Meningitis patterns framework has been developed drawing on relevant concepts, principles and linkages from the conceptual approaches reviewed– the ecological theory, the human ecological triangle and the empirical studies. The frame ultimately considers population/host, habitat and behaviour, as the vertices of the triangulate system. The multivariate nature of CSM as a geographically related health concern should be considered by paying attention to the significance of the various individual influencing factors (population/host, habitat and behaviour) in their unique perspectives and in relation to each other as a system. This would help address the core issues of the study.

The population or host, in the conceptual framework covers the nature of the population and its composition and considers variables such as age and sex distribution and patterns as they relate to the incidence of meningitis. These are variables that would help to explain the patterns of meningitis in the study area.

Next to be considered on the conceptual framework is the habitat as a critical component and one of the vertices of the triangle. Here, it is considered that, physical or environmental conditions and human organisational context have some association with the patterns of CSM. Environmental or physical conditions such as seasonal variations in especially temperature and rainfall have been shown to have some influences on disease patterns in peculiar localities with varying outcomes.

The third and last vertex on the triangular framework represents behaviour. Thus, the concept of behaviour in specific terms of attitude and perceptions that a people hold towards a disease could have an effect on patterns of that health condition in that particular locality. For instance, the perceptions a people or a section of a population hold about the causes and treatment of disease could help explain the state of that disease in that particular society.

The combinations of these factors- population, habitat and behaviour, in the conceptual framework offered good conceptual grounds to situate the research in the study area. Particularly, it pays attention to the need for the consideration of the geographical concepts of space, time, patterns and holism—as a system, bearing enduring relevance to the study of spatial and temporal phenomenon (Bertalanffy, 1950; 1968).

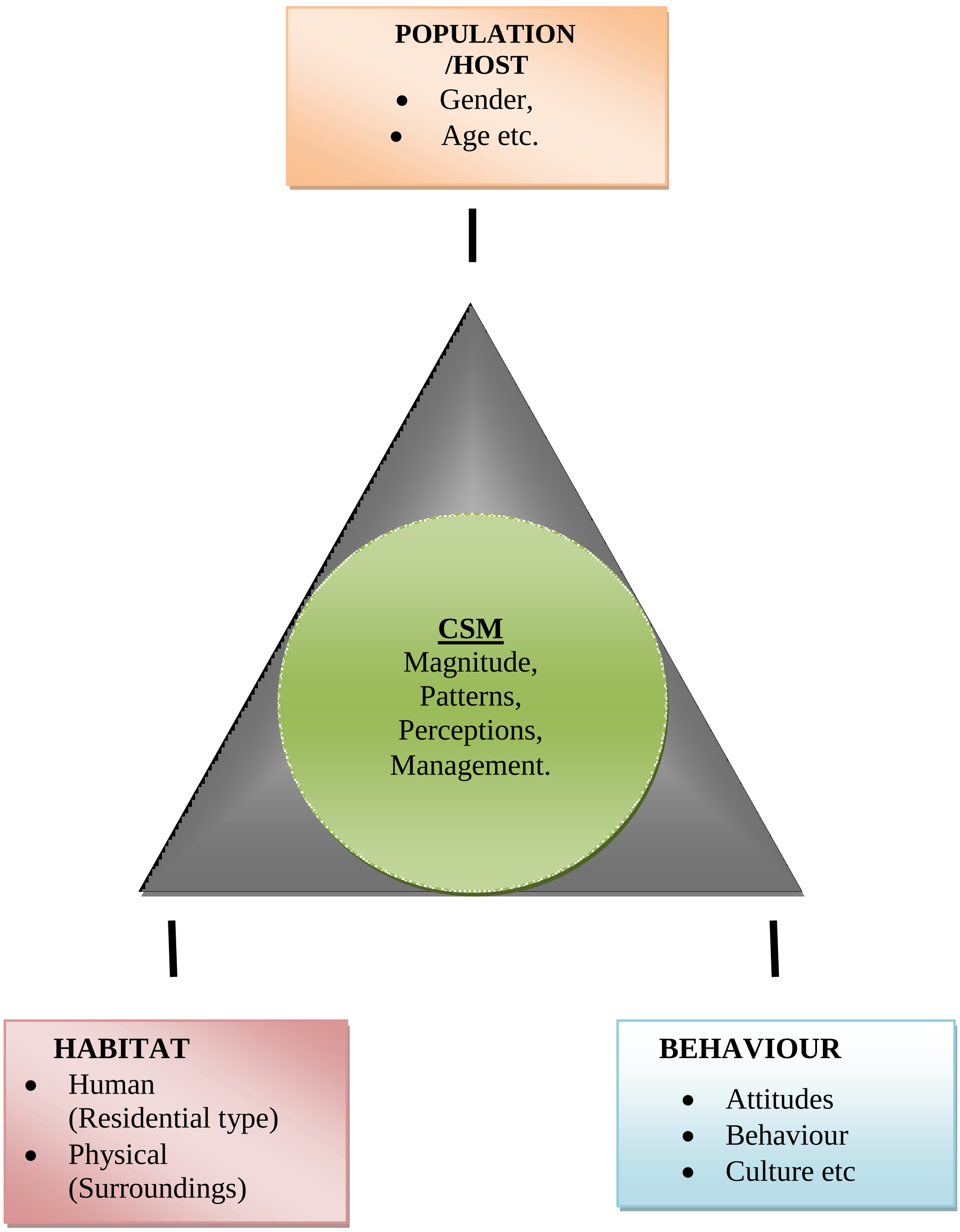

Figure 2.2: Meningitis patterns framework

Source: Adaptation of the triangle of human ecology (Meade & Emch, 2010).

CHAPTER THREE

THE STUDY AREA AND RESEARCH METHODOLOGY

3.1 Introduction

This chapter focuses on the study area and the methodology. The location and physical characteristic, socio-demographic characteristics and economic features of the study area have been looked at. The methodology coverers issues such as, study design, sources of data, research instruments and target population, sampling procedure and sample size, data analysis and presentation, ethical clearance and data limitation concerns.

3.2 The study area

3.2.1 Location and physical characteristics

The Kassena-Nankana East and West Districts lie within the Guinea Savannah woodlands. The districts fall approximately between latitude 11°10’ and 10°3’ North and longitude 10°1’ West. The Districts have a total land area of about 1,674 sq.km and stretch about 55km North-South and 53km East-West. The Districts share boundaries to the North with Burkina Faso, to the East with Bongo and Bolgatanga Districts, West with the Builsa District and Sissala District (in the Upper West Region) and South with West Mamprusi District (in the Northern Region). The districts were hitherto one entity known as the Kassena-Nankana District but separated only in 2008 into the Kassena-

Nankana East and Kassena-Nankana West Districts, with the district capitals being Navrongo and Paga respectively (KNEDA, 2012).

The vegetation of the district is of the Sudan and savannah type with grassland separating deciduous trees. The District is covered mainly by the Sahel and Sudan-Savannah types of vegetations; comprising open savannah with fire-swept grassland and deciduous trees. Some of the most densely vegetated parts of the District can be found along river basins and forest reserves. Examples are the Sissili and Asibelika basins, Kologo and Naaga forest reserves. However, the activities of man over the years have affected the original (virgin) vegetation cover. Common trees found are dawadawa, baobab, sheanut and mangos.

The climate conditions of the district are characterized by the dry and wet seasons, which are influenced mainly by two (2) air masses – the North-East Trade winds and the South-Westerlies (Tropical Maritime). The area falls within the Tropical Continental climatic zone as classified by Dickson and Benneh (cited in Yaro, 2004). The Harmattan air mass (North-East Trade Winds) is usually dry and dusty as it originates from the Sahara Desert. During such periods, rainfall is virtually absent due to low relative humidity, which rarely exceeds 20 per cent and low vapour pressure less than 10mb. Day temperatures are high recording 42° Celsius (especially February and March) and night temperatures are as low as 18° Celsius. The District experiences the tropical maritime air mass between May and October. This brings rainfall averaging 950mm per annum. There is a Meteorological Services Department at Navrongo, which records the weather situation in the area.

3.2.2 Socio-demographic structure

According to the 2010 Population and Housing Census, the Kassena-Nankana East has a total population of 109,944, with a male proportion of 53,676 and a female proportion of 56,268. The Kassena-Nankana West District has a total population of 70,667 with a male proportion being 34,747 and a female proportion of 35, 920 (GSS, 2012). Thus the total population for the study area stands at 180611.

The sex composition favours female. Together, the two districts would give a total population of 180,611, with a combine male proportion of 88,423 (49%) and that of the female being 92,188 (51%). The District recorded a population density of 91 persons per sq.km. This is higher than the national density of 7.97 persons per sq. Km but below the regional density of 104.1 persons per sq. Km.

On settlement structure, aside Navrongo and Paga—the two District capitals, and a few other settlements that records population of over 5,000 residents, most areas of the District live in rural settlements. Type of dwelling:- households in the Districts are mainly compound houses, followed by separate and semi-detached houses. Modern flats and apartments constitute a very small percent of dwelling type (0.8%).

The health system in the KND is modelled along the district health care concept. The Navrongo War Memorial Hospital serves as the main referral centre to all health centres and clinics in the two districts. The Navrongo Health Research Centre (NHRC) also conducts high quality demographic and health research in the area to inform policy. The District health Management

Directorate also ensures that, health education activities ranging from public address systems to talks with individuals are organised. This is paramount in ensuring the course of work performance of health institutions through durbars, community meetings and promotional health talks at service points. Communities are sensitised to report early for treatment. School health activities are also carried out in the districts.

3.2.3 Economic features

The major occupations in the Districts are Agriculture, employing about (68%) of the total labour force; production/transport and labourers constitute (10.4%); Sales workers (9.2%); Service workers (5.6%); Administration/Managerial workers (0.1%); Professional technical workers (3.5%); and others (0.1%). In terms of its contribution towards the Gross Domestic Product and labour employment, the primary sector activities which are dominated by agricultural practices contribute about 68.6 percent.

The secondary sector's performance, dominated by small-scale enterprise activities contribute about 3 percent to the Gross Domestic Product and about 2 percent exclusively to labour employment, thus excluding those who are engaged in direct primary agricultural activities. The tertiary sector whose contribution comes mainly from informal private individual economic activities, records about 11 percent to the district's local economy in terms of her Gross Domestic Product (GDP) and also accounts for about 30 percent to the labour employment figure. For further information on the profile of the study area and study sites (See Ghana Districts.com; UNDP, 2010 and Figure 4.5).

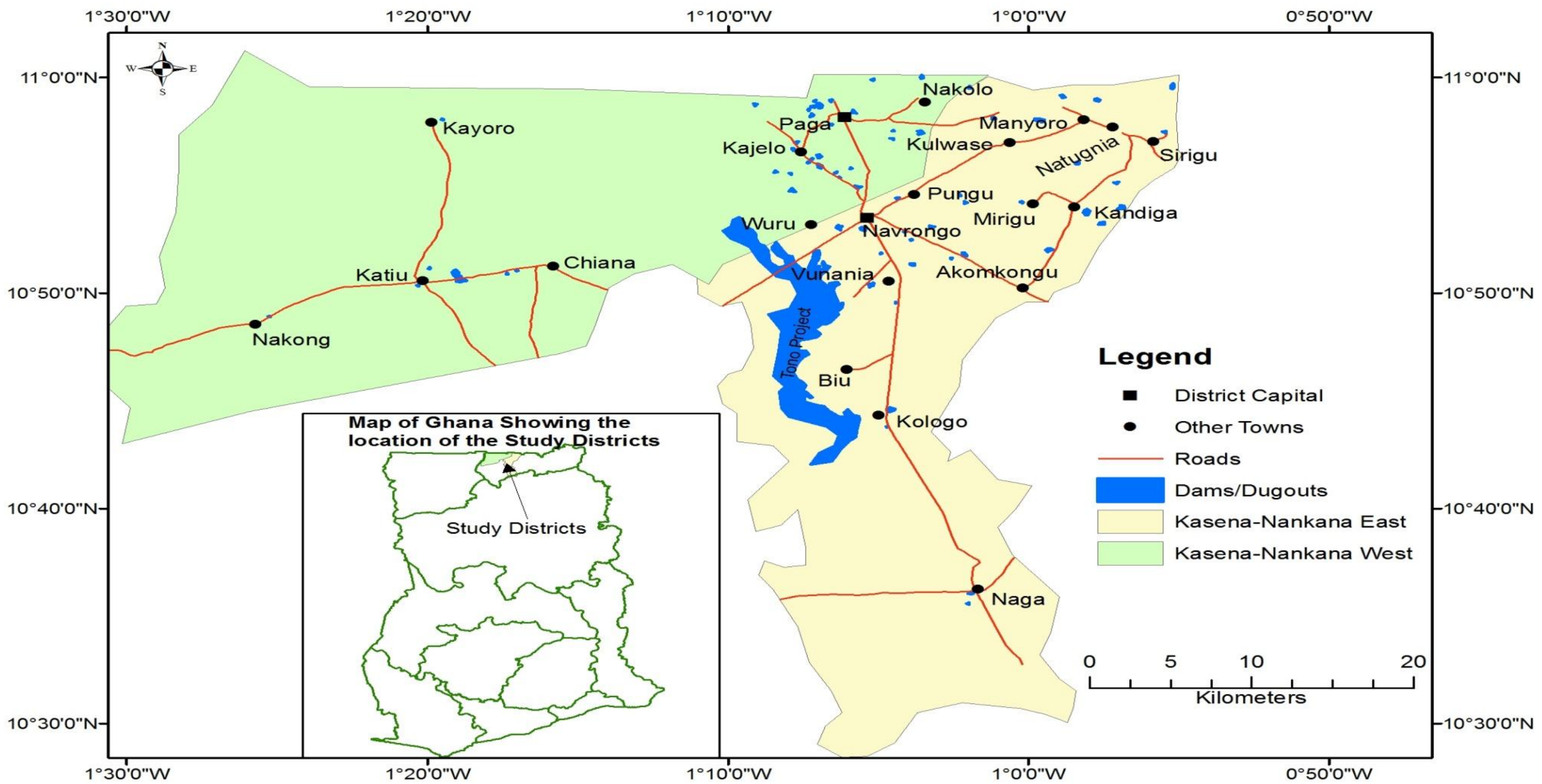

Figure 3.1: A map of Ghana showing the location of the study districts (Kassena-Nankana East and West Districts)

Source: Field work, (2013). GIS generated.

3.3 Research methodology

3.3.1 Study design

A study design serves critical research needs. It among other things provides a guide that offers order and clarity in the process of study (Sarantakos, 2005; Kumekpor, 2006; Panneersevam, 2010). For this study, the approach is the mixed method. Thus, the mixed method deals with the collection and analysis of both quantitative and qualitative data (Creswell, 2009). The mixed method approach was used because the study relied on both quantitative and qualitative information to adequately address the research questions and objectives. This way, the figures would help establish the patterns while the voices of people would help give meaning to the figures behind the patterns. This, it was hoped would aid in the comprehensive understanding of the issues of concern.

Specifically, the cross sectional epidemiological study design was used. The cross sectional study is analytical, and comes under observational study under the broader epidemiological study design (Figure 3.2). A cross sectional study takes place at a single point in time and provides room for the researcher to look at numerous things at once (age, occupation, gender etc). It is often used to look at the prevalence of something in a given population (Bonita et al., 2006). Data from cross sectional studies provide useful indications of trends, due to its inherent descriptive and analytical qualities (Bonita et al., 2003; Tolonen et al., 2006). The cross sectional design was preferred because the study sought to assess the patterns, seasonality, perception management, and socioeconomic implications of CSM in the study area.

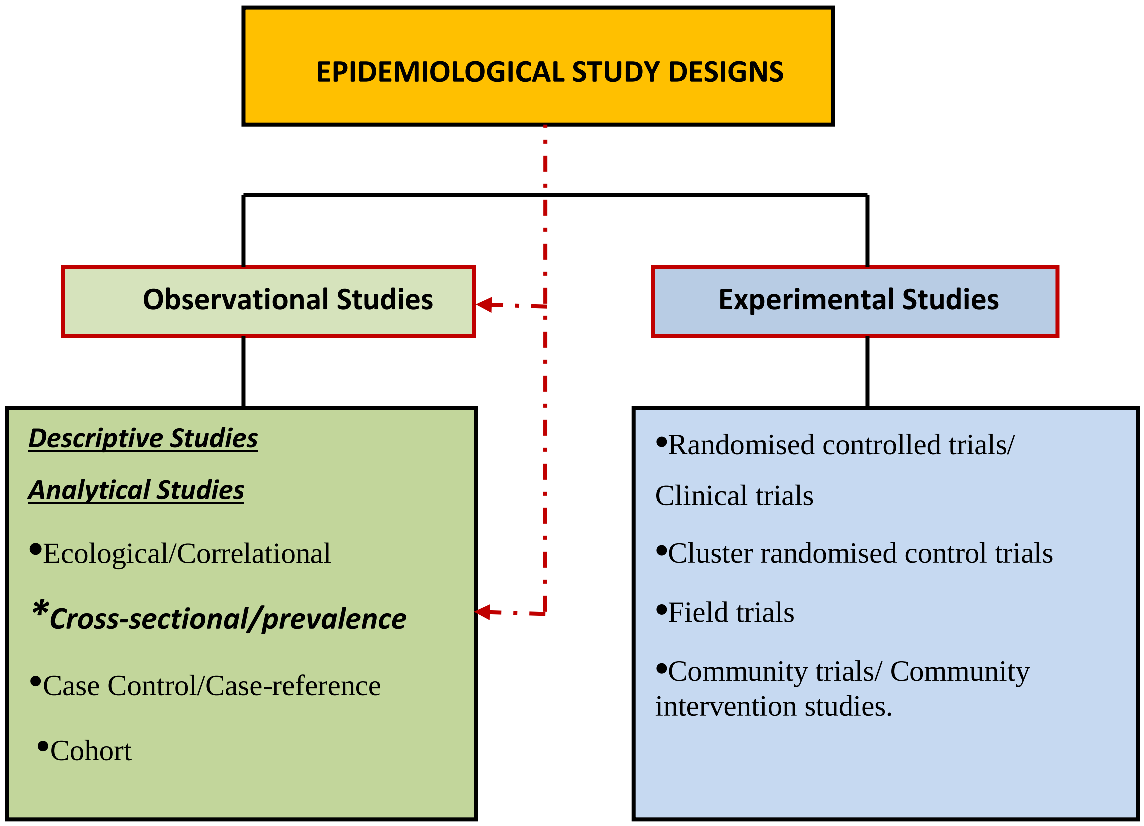

Figure 3.2: Epidemiological study designs. Note: *Cross-sectional/prevalence design used.

Source: Bonita et al., (2006).

3.3.2. Sources of data

Data for the study were obtained from two main sources—primary and secondary. The primary data was drawn from the general public, people who have experienced meningitis before in the last two or three years, and health personnel. The secondary data were obtained from records of health institutions in the area such as the Navrongo War Memorial Hospital, the Navrongo Health Research Centre (NHRC), the District Health Directorates (DHDs) from the two districts, the Ghana Health Service Disease Surveillance Unit, Korle-Bu—Accra, as well as other published books and articles from internet search and other relevant sources. Meteorological data was also obtained from the synoptic weather station in Navrongo.

3.3.3 Data collection

For the collection of data, both quantitative and qualitative methods were used. As indicated in the sources of data section, meningitis statistics were obtained from both the districts and national health records. Also, the main research instrument for gathering the primary data from the survey respondents (the general public and those with immediate past experience of the disease) was the semi-structured questionnaire. People who have experienced the meningitis scourge were targeted because they are the ones who have experienced the disease and could offer practical information for the study. The general public was also of interest because they are the potential victims of the disease.

Qualitative information was also gathered from Health personnel working with meningitis units and programmes in the district using in-depth interviews schedules. This was because they possess relevant information about the disease. This was to give more meaning to give more meaning to the figures.

To ensure that issues of validity and reliability were adequately catered for, a number of measures were employed. Three trained field assistants were employed and instruments pre-tested. The instruments were also developed drawing from similar works by early researches. For the questionnaire and interview schedule administration, the same set and order of questions were employed. Also, to cater for threats such as history, maturation and mortality, the survived meningitis case frame (people who experienced meningitis before) was limited to two years. This served the purpose of enabling respondents to have a vivid remembrance of experiences with the disease and to give relevant information.

3.3.4 Sampling procedure for questionnaire

For the study, as noted above, the target population was made up of three categories of respondents. These are the “general public”, people who have experienced meningitis before in the last two years and health personnel with a meningitis programmes in the study area.

Selection of the general public was based on the communities. This was done using the quota sampling technique because quotas were taken from each of the five zones within the district. The district has been demarcated into five zones based on the geographical position of the district. They are the North, South, East, West and Central zones. The South zone has 74 communities, East 52 communities, West 49 communities, North 49 communities and Central 21 communities, giving a total of 245 communities. Within the five zones, 20% of the communities were selected for the study because the communities within each zone have similar characteristics and it is hoped that this percentage ensured a fair and proportional representation of the communities within each zone. This gave a total of 49 communities comprising 15 communities for the South zone, 10 for West, 10 for North, 10 for East and 4 Central zones. According to Sarandakos (2005), one of the cardinal principles of sample size determination is the homogeneity of the target population. The more homogenous the target population the smaller the sample size can be and vice versa.

The lottery method was employed to select the communities within the zones. Here, the names of the communities within each zone were written out and picked randomly till they required number of communities per zone was obtained. This technique ensured equal chances of each community being selected and also eliminated any biases in the selection process.

The study units were then selected from households from the selected communities. Because of time and budgetary constraints, 250 respondents were selected in all from the sampled communities. Proportionately, 77 from the south zone, 51 each from the north, west and zones, and 20 from the central zone. This method ensured an even selection of respondents from the communities as well as reduced biases (Table 3. 1).

Table 3.1: Categories of zone, selection procedure and sample size.

Zone	Name of zone	Number of communities in zone	Number of communities sampled	Number of respondents per each zone
1	South	74	15	77
2	North	49	10	51
3	West	49	10	51
4	East	52	10	51
5	Central	21	4	20
Total	**5**	**245**	**49**	**250**

Source: Field work, (2013).

For those who have experienced meningitis before, a sampling frame of survived meningitis cases was created based on the records from the health institutions. To get a fair representation of cases for the interview, the simple random sampling method was employed to generate the sample. With the simple random sampling, each unit of all the population has an equal chance of being selected. It is both the easiest random sample to understand, and the one on which other types are modelled (Neuman, 2003; Nadar, 2005; Pannerselvam, 2010). Because it is a cross sectional study and in order that threats to validity is minimised, sampling was limited to two years of recorded meningitis cases as noted early on. Based on the two year period data availability, a sample size of 100 was randomly generated. The survived meningitis cases constituted a suitable target unit because, as victims they had better information to offer about their experience with meningitis.

Health personnel working with meningitis programme in the study area was purposively selected. The health personnel were seen as suitable target units because of their direct involvement in the treatment and management of the disease.

3.3.5 Ethical considerations and clearance

The purpose of the research was made very clear to the major actors in the research process and their consents and views taken on board. These included the outfits from which meningitis data was acquired and the respondents .This was deemed necessarily due to the fact that the study is health related and respondents needed to be fully aware of its purpose, in order that doubts were not invoked in their minds that could affect the outcome of the research. It is believed this greatly enhanced the execution of the whole exercise even though several limitations were encountered.

3.3.6 Data limitations

A number of issue emerged at various stages of the research that proved daunting and threatened to limit a comprehensive and more efficient execution of the study. First and foremost were financial constraints which limited the researcher in trying to cover more grounds in terms of selecting a higher sample that would have been more representative. However, with a thorough sampling procedure, it was hoped that the issue of representativeness was addressed.

Additionally, health personnel were a little bit hesitant in giving in-depth information about the disease. The purpose of the research, as being purely an academic exercise and the assurance of confidentiality had to be consistently appealed to in order to attain the needed information despite prior notification during pre-study visitations. It was also very hectic to trace and locate especially people who have experienced meningitis before. Those sampled from the health records were scattered all over the two districts and on a number of times, visits of more than once had to be embarked upon before target respondents could be reached.

It was also the desire of the researcher to have covered a much longer period, for the study area in order to show trends, but had to finally settle for a five year (2008-2012) period due to fragmented records on meningitis cases. In addition, in trying to generate the rate map of meningitis for the study area, a number of difficulties were encountered. For instance, the zones into which the study area has been put by the NHRC were too arbitrary and running into each other. It was with the assistance of an expert that more geographically meaningful demarcations were made.

3.3.7 Data analysis and presentation

Data was analysed, using both qualitative and quantitative methods. For the quantitative analysis, SPSS version 16.0 was employed. Specifically, simple descriptive statistics such as frequency tables, bar charts, and line graphs were used to show patterns and trends pertaining to the questionnaire and interview schedules. Maps were also used to show patterns for continental (meningitis belt) and national rates. A rate map was also generated using Geographical Information Systems (GIS) —for the study area. Specifically, ArcGIS version 9 was used to generate the rate map. Regarding the rate map, different geographical areas or zones were shaded in different colours according to the differences of case values— employing pattern matching. For the qualitative data content analysis and simple descriptive narrative were used for the analyses and presentation of the key findings.

CHAPTER FOUR

THE MAGNITUDE, PATTERNS AND SEASONALITY OF MENINGITIS

4.1 Introduction

This chapter presents information on the dimensions of meningitis in the context of the Meningitis Belt of Africa. It then proceeds to analyse data sought on the magnitude, spatial patterns and seasonality of meningitis. Information on the demographic distribution of meningitis in the study area is also presented.

4.2 The Context of the Meningitis Belt of Africa

Discussion and analysis of the Meningitis Belt of Africa are presented in this section. This comes in critically as a background context for the analysis of meningitis in Ghana and ultimately the study area. As noted earlier, meningitis magnitudes are strikingly high in this “belt”. Thus, meningitis remains a major public health challenge in the "meningitis belt" which stretches from Senegal in the West to Ethiopia in the East of Africa and covers the northern parts of Ghana (GHS, 2011). Figure 4.1 gives information on the Meningitis Belt of Africa.

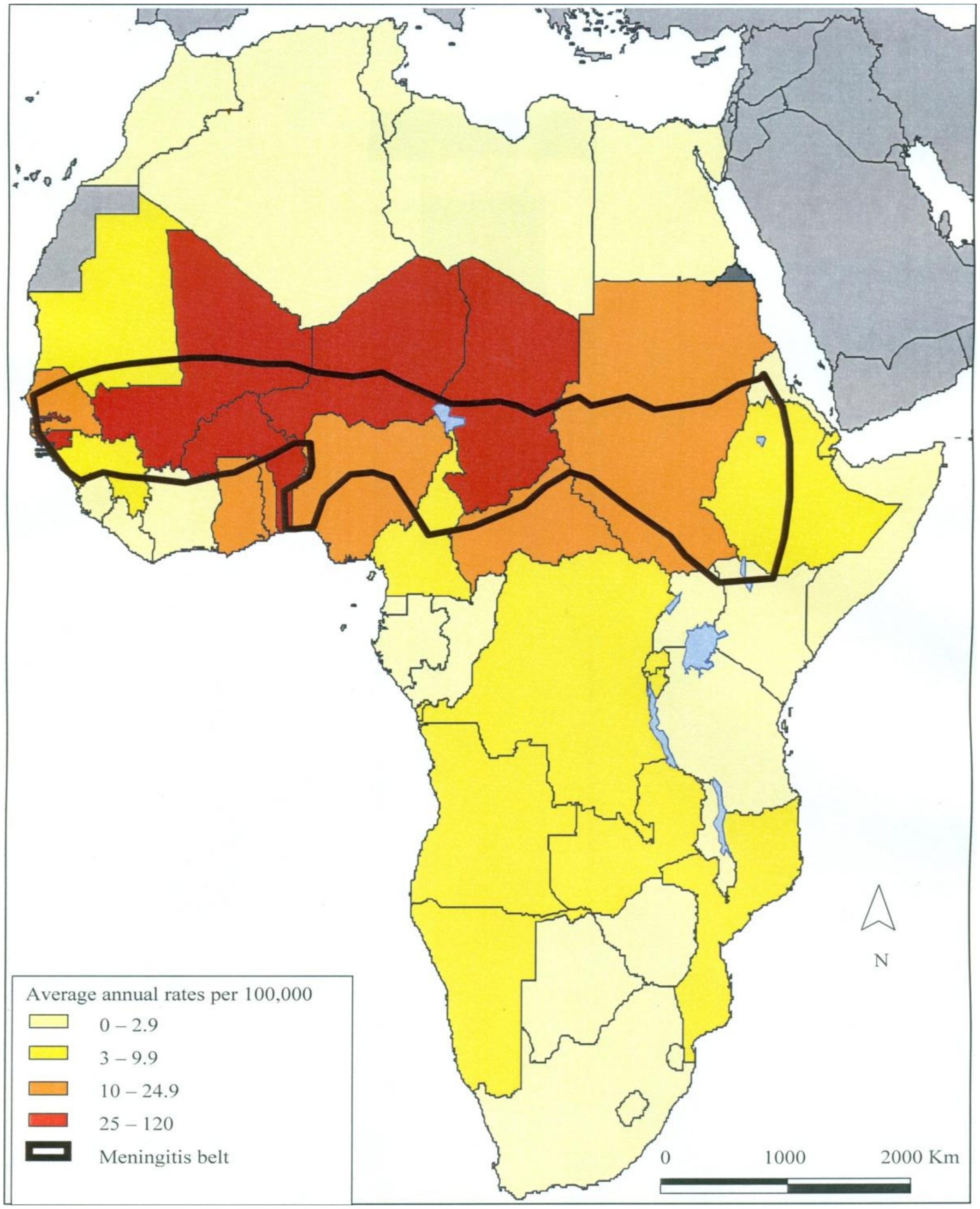

Figure 4.1: The meningitis belt of Africa showing average annual rates per 100,000

Source: Konde et al. (2007).

From Figure 4.1 it is seen that the hyper endemic countries include Burkina Faso, Mali, Niger and Chad, with average annual rates of 25-120 per 100,000 population. Figure 4.1 further indicates that, the adjoining region of Ghana falls well within the epidemic zone with annual average rates per 100,000 population being 10-24.9.

The indication is that, despite ongoing efforts to enhance disease surveillance and response, many countries face challenges in accurately identifying, diagnosing and reporting infectious diseases due to the remoteness of communities, lack of transport and a communication infrastructure, and shortage of skilled health-care workers and laboratory facilities to ensure accurate diagnosis.

Some of the underlying reasons for the observed patterns as indicated by figures in this section could be attributable to the fact that, this sahelo-sudanian region constitutes a suitable frontier (environmental and socio-cultural constellatory factors) that makes its inhabitants susceptible to the disease as noted by (Moore, 1992; Greenwood, 1999; Molesworth, 2002; Cheesbrough et., 1995).

Besides, within this broader context of the Meningitis Belt of Africa, marked variations are bound to occur due to corresponding variations in local conditions. The Meade's human ecological model excels at bringing us to the clear understanding of the unique combinations in differentiated local contexts within the broader band of this meningitis belt resulting in these possible wider local variations.

4.3. The context of Ghana

Information was also sought on the incidence of meningitis at the national level. Figure 4.2 presents data on the annual reported cases of meningitis in Ghana for the five year time span (2008-2012).

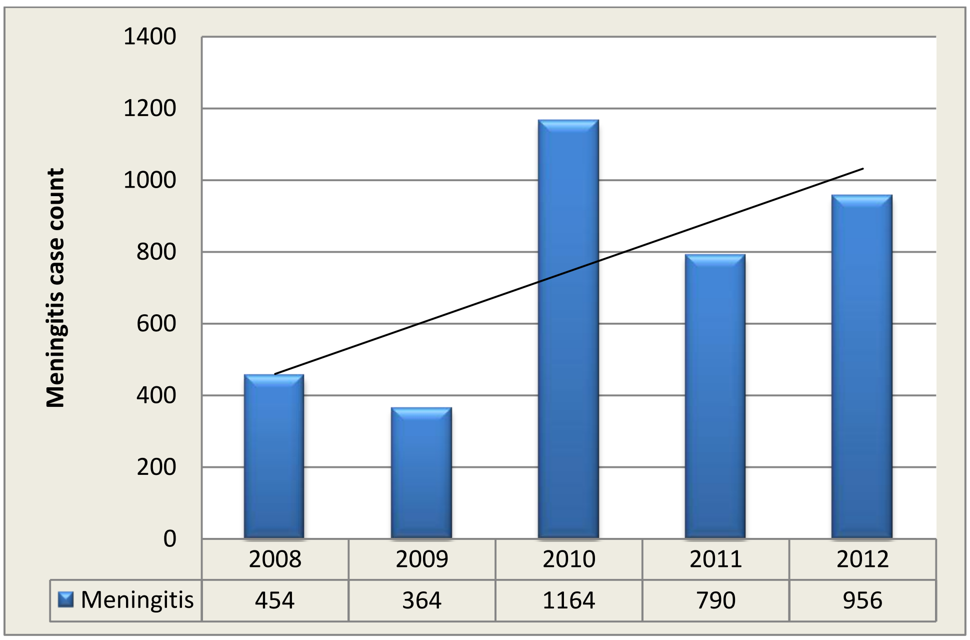

Figure 4.2: Number of reported meningitis cases in Ghana (2008-2012)
Source: GHS, (2013).

Information from Figure 4.2 shows that meningitis has always affected the country at different rates with marked difference. In the year 2008, the annual figure of 454 reported cases (rate of attack, 2.0) drops to an absolute figure of 364 (rate of attack 1.6). However, in 2010 reported cases rose remarkably to 1164 (rate of attack 4.5) and drops to 790 (rate of attack 3.2). Figures again shot up to 956 (rate of attack 3.9). This trend cannot be explained by one single factor as a complex combination of factors result in such variations. Besides, as noted by the

WHO (2010), meningitis could hit sporadically and in irregular intervals. The underlying issue from this information is however that, meningitis constitutes a major threat to health in Ghana.

Table 4.1 further presents information on the annual meningitis case count and annual rates in Ghana (2008-2012).

Table 4.1: Annual meningitis reported cases, rates of attack, reported deaths and (CFR %) in Ghana from (2008-2012)

Year	**2008**	**2009**	**2010**	**2011**	**2012**
Reported cases	454	364	1164	790	956
Annual attack rates	2.0	1.6	4.5	3.2	3.9
Deaths	97	68	128	104	90
Case Fatality Rate (CFR %)	21.4	18.7	11.0	13.2	9.4

Source: Calculations from the Ghana Health Service Annual Records (2008-2012).

The information from Table 4.1 indicate that the last two years show higher rates — 3.2 for 2011 and 3.9 for 2012 than the first two years—2.0 for 2008 and 1.6 for 2009 respectively, with 2010 recording even a higher rate. The number of reported deaths for the five year period averaged 97, while the case fatality rate for the five year period averaged 12.7%. Obviously, these represent worrying trends. The observation, especially of the 2010 higher figure could be explained by the occurrence of the irregular cylices of 5-12 of epidemic incidences in the Meningitis Belt as noted by WHO (2010).

Table 4.2 gives further information on the calculations on attack rates and case fatality rates for the national and regional averages for the current complete year of 2012.

Table 4.2: Regional and national averages of attack rates and case fatality rates for the year 2012

Region	Number of Reported Cases	Population At Risk	Attack Rates	No. of Deaths	CFR (%)
Upper East	298	1,046,545	28.5	37	12.4
Upper West	179	702,110	25.5	24	13.4
Northern	191	2,479,461	7.7	18	9.4
Brong-Ahafo	39	2,310,983	1.7	5	12.8
Ashanti	206	4,780,380	4.3	2	1.0
Volta	0	2,118,252	0.0	0	0.0
Eastern	33	2,633,154	1.6	4	12.1
Western	0	2,376,021	0.0	0	0.0
Central	2	2,201,863	0.1	0	0.0
Greater Accra	8	4,010,054	1.2	0	0.0
National	**956**	**24,658,823**	**3.9**	**90**	**9.4**

Source: Fieldwork, (2013) Calculations based on Ghana Health Service Records (2013) and 2010 Population and Housing Census (GSS, 2012). NB: CFR (%) = Case Fatality Rate.

From Table 4.2, the fourth column named **"Population at risk"** indicates the regional and national populations. Column five named **"Attack rates"** for both regional and national averages (this is gotten by dividing the number of reported cases in column three by the population at risk multiplied by a 100,000 population). Further, the Case fatality rate (CFR %) as captured in the last column is also gotten by striking the number of reported deaths as a percentage of the reported meningitis cases.

Figure 4.3 is a map of Ghana drawing from Table 4.2 and illustrating the national and regional averages for the year 2012. The figure shows a national annual attack rate of 3.9. The three regions of the north all have figures well above the national average (3.9) — Upper East Region 28.5, Upper West Region 25.5 and the Northern Region 7.7. Thus, figures from the Upper East (28.5) and Upper West (25.5) regions fall within the hyper endemic bracket (25-120 average annual rate per 100,000) as indicated in Figure 4.1 (the meningitis belt map). Another interesting observation is the Ashanti Region with a figure of 4.3, with the Kumasi Metropolis alone having recorded 180 reported cases (GHS, 2013). It is also noted that the Volta and Western Regions did not record any cases in 2012. However, it is instructive to note that all regions have at least recorded some cases within the last five years, an indication that indeed the meningitis belt in Ghana is pushing southwards.

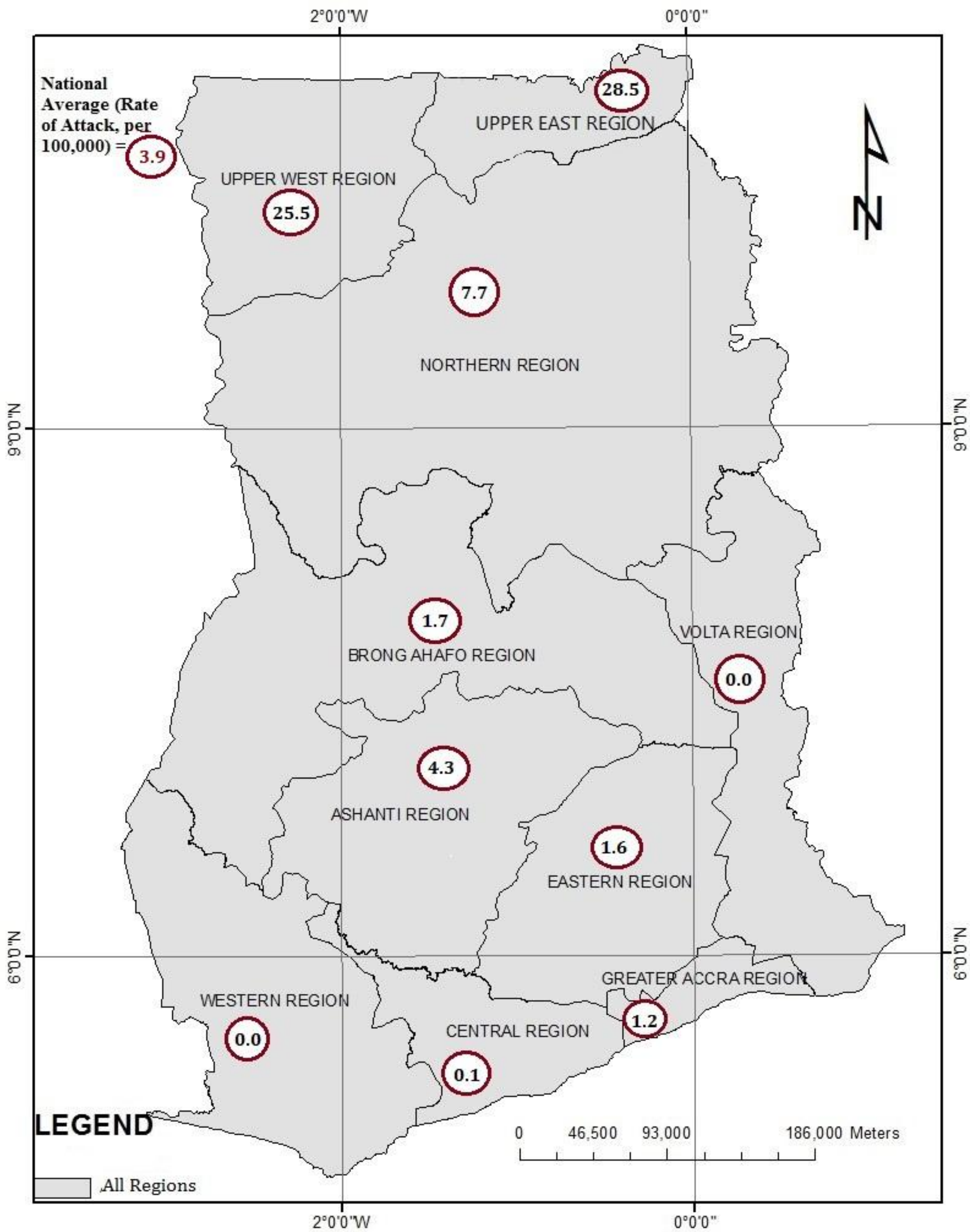

Figure 4.3: A map of Ghana showing the national and regional averages of reported meningitis cases for the year 2012.

Sources: Fieldwork, (2013). Calculations from GHS Annual Records (2013) and GSS, (2013).

Relating the information in Figure 4.3 to that of Figure 4.1 (the meningitis belt), it is noted that the national figure of 3.9 for the year 2012 falls within the risk bracket of 3-9.9.

4.4 Magnitude and patterns of meningitis in the study area

This section starts with analysis of the spatial distribution and patterns of meningitis in the study. First information is presented on each one of the individual districts (the East and West Districts), and then the two districts are put together as one entity (on the basis of zones) since they share a lot in common in respect of issues such as history, ethnicity and geography and were only separated in 2008 for administrative purposes. Then the annual seasonal distribution and trends are presented, followed by observed demographic (sex and age) distributional patterns of meningitis in the study area.

4.4.1 The magnitude and spatial patterns of meningitis

Before focusing on the spatial patterns of meningitis in the study area, it is important to pay attention to its magnitude in respect of reported cases, deaths, attack rates and case fatality rates.

Table 4.3 gives information in respect of the vital statistics of the disease in the study districts for the period 2008-2012.

Table 4.3: Vital reported CSM statistics from the study districts (2008-2012)

Year	Study district	Cases	Deaths	Attack Rate	CFR (%)
2008	Kassena-Nankana*	69	14	-	30.3
2009	Kassena-Nankana East	13	2	-	15.7
	Kassena-Nankana West	9	1	-	11.1
	Total	**22**	**3**	-	**13.6**
2010	Kassena-Nankana East	53	17	48.2	32.0
	Kassena-Nankana West	35	7	49.2	20.0
	Total	**88**	**24**	**48.7**	**27.3**
2011	Kassena-Nankana East	66	11	81.3	16.7
	Kassena-Nankana West	28	4	32.7	14.3
	Total	**94**	**15**	**52.5**	**16.0**
2012	Kassena-Nankana East	66	8	60.1	12.1
	Kassena-Nankana West	32	3	45.3	9.4
	Total	**98**	**11**	**54.3**	**11.2**

Source: GHS, (2013). NB: Kassena-Nankana* (Even though the Kassena-Nankana District was split into East and West in 2008, data was presented for the district as one entity in that year). CFR =Case Fatality Rate (%).

The information presented in Table 4.3 indicates considerably higher case fatality rates (CFR). For the two districts put together, an average of 19.7% case fatality rate is recorded for the five year period under study (2008-2012). However, the East district registered a case fatality average of 19.1% and 13.7% for the West district for the period 2009-2012 since the year 2008 did not have separate records for the individual districts. In the year 2011, both districts recorded very high case fatality rates—32.0 and 20.0 for the East and West districts respectively. This trend indicates the seriousness of the disease in the study area.

Information is further presented in Table 4.4 on the study area in comparison with the host region (Upper East Region) and the national statistics for the current complete year of 2012.

Table 4.4: The magnitude of meningitis in the study districts in relation to the regional and annual figures for 2012

Study Entity	Cases	Deaths	Attack Rate	CFR (%)
Study Districts	98	11	54.3	11.2
Upper East Region	298	37	28.5	12.4
National	965	90	3.9	9.4

Source: Field work (2013).

Information from Table 4.4 and Figure 4.4 makes the picture clearer, as it is noted that attack rate in the study stands at 54.3, which is way bigger than the regional and national attack rates of 28.5 and 3.9 respectively. On the case fatality rates, it is also observed that the study area figure of 11.2% is far more than the national average of 9.4%, though slightly lower than the regional rate of 12.4%.

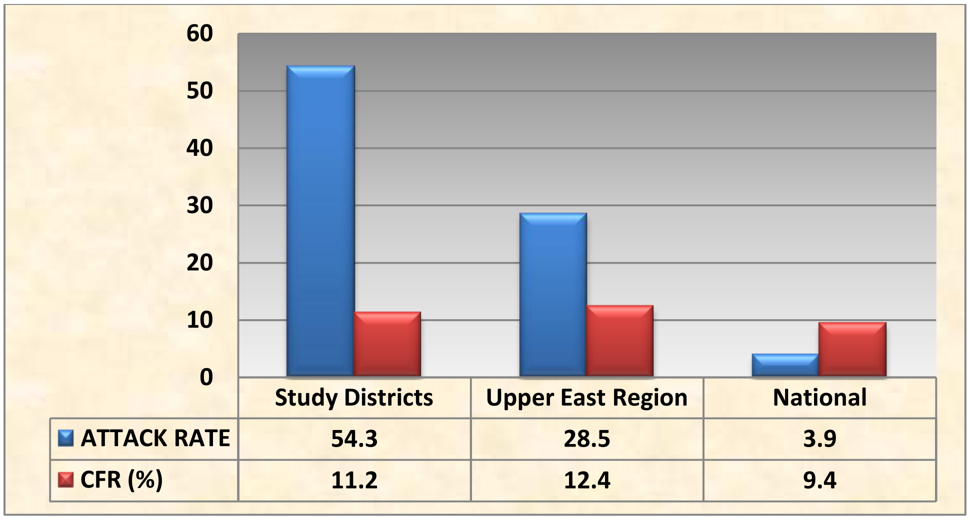

Figure 4.4: The study districts, the host region (Upper East Region) and national attack and case fatality rates for 2012.

Source: Fieldwork, (2013).

The information illustrates very high rates of attack for the study area. Especially the last two years—2011 (52.0) and 2012 (54.3) rates of attack are phenomenally high (See Figure 4.3). When this is compared with Figure 4.1 (with rates ranging from 24-120 per a 100,000 population for high risk zones), the study area falls effectively within the hyper endemic zone. It is realized that indeed findings in the study keep a close affinity to the magnitude of the disease as portrayed by the WHO for the African Meningitis Belt.

On the question on the magnitude of meningitis from the view point of a health personnel, the following response was given:

> Meningitis occurs in this district mostly in the period between March to May. It occurs in the rainy season as well but not usually high as compared to the dry

season. Its peek is always in March. CSM is seasonal and so is not as serious as other diseases such as malaria, HIV, typhoid fever and others.

From this position, meningitis in the study area may not be as serious as other tropical diseases such as malaria, but in relative terms within the Meningitis Belt, its magnitude is seen to be very high.

Further, it is observed from the rate map—Figure 4.5 that, the pattern of meningitis in the study area shows considerable spatial variations. Thus, meningitis is not evenly distributed throughout the study but varies per the zones. This is supported by literature that, meningitis varies greatly in its spatial pattern throughout the world and in differentiated localities. For the period 2008-2012, the North zone shows the highest absolute average rate (20.4). This observation is corroborated by findings from the in-depth interview that indeed the North zone has always been of particular concern. The East and West zones follow (each showing a figure of 13.2), then 16.8 and 10.6 for the Central and West zones respectively.

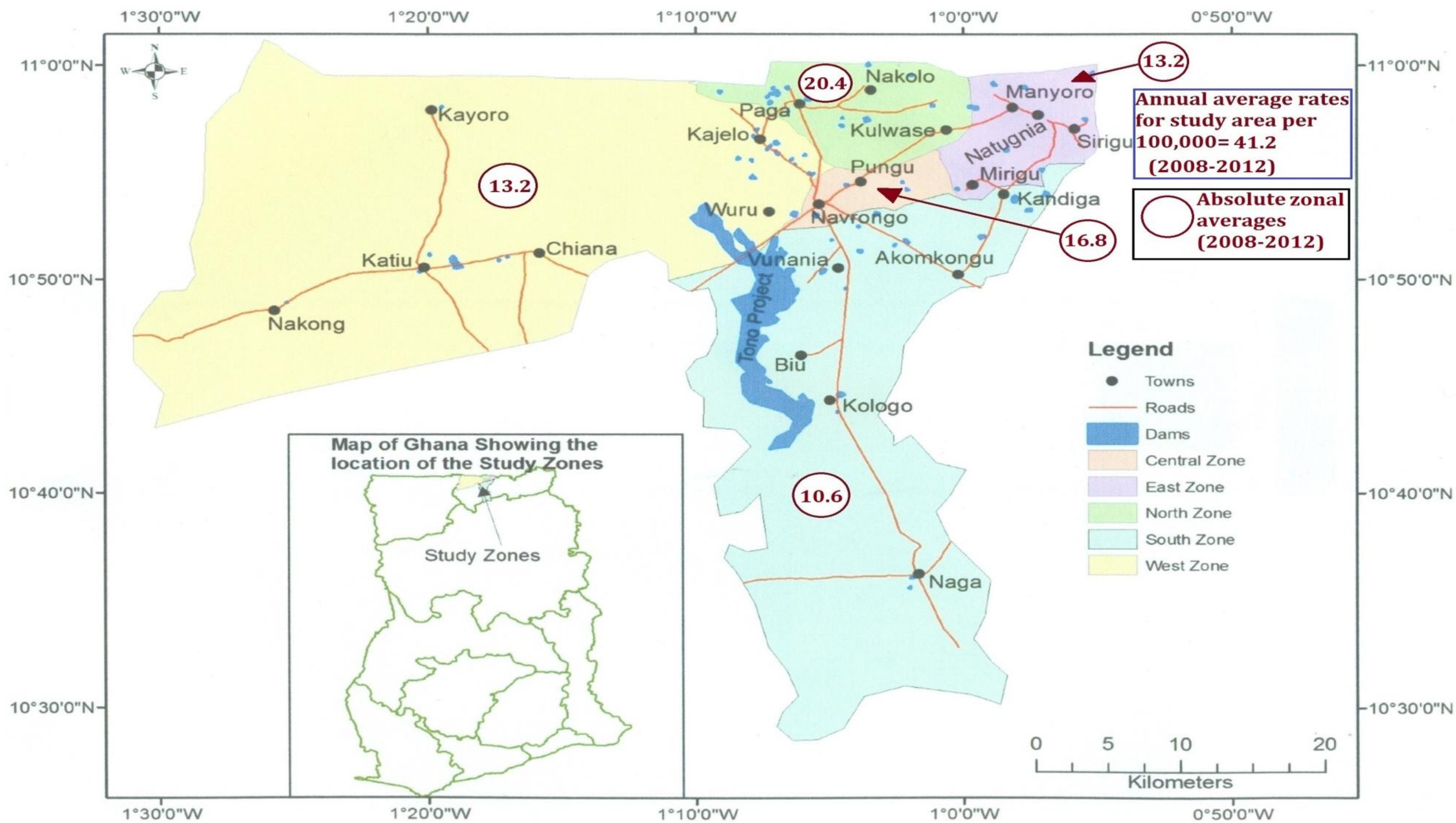

Figure 4.5: A map of the study area illustrating zones and spatial distribution of reported meningitis cases (2008-2012)

Source: Fieldwork, (2013). GIS generated.

Figure 4.6 also shows data on the annual spatial (zonal) magnitude and distribution of the incidence of meningitis in the study area for the five year period.

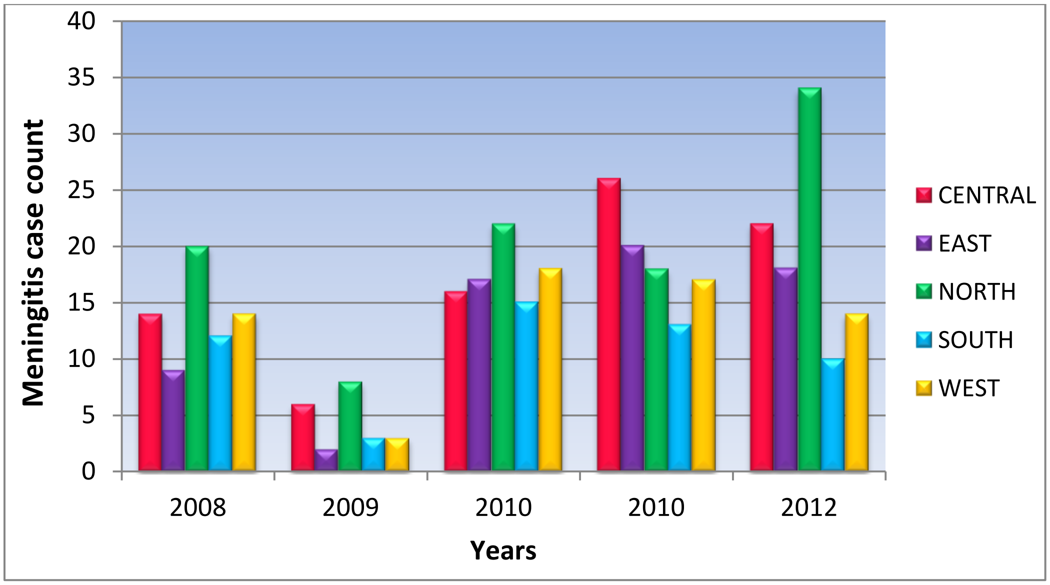

Figure 4.6: Annual spatial (zonal) distribution of reported meningitis cases in the study area (2008-012)

Source: Fieldwork, (2013).

The information in Figure 4.6 indicates that, for the five year period under consideration, the North zone has always represented the highest figures except for 2011 when it came second only to the East zone.

It also came to light from the in-depth interview of the health personnel on the issues of spatial variations that the rates of meningitis in the north zone are particularly high because of the proximity of that sub ecological zone to Burkina Faso which is a hyper endemic country. Basically, conditions in this sub ecological zone are relatively harsh (hot-dry). It is also illustrative from Figure 4.6

that the East and West zones also show high rates These two zones lie adjacent to the North zone, and together, all three zones lie astride (from west to east) to the heart of the Meningitis Belt.

4.4.2 Seasonal distribution and trends in meningitis

Aside the annual sums and spatial patterns, the study further sought to examine the seasonality of the incidence of meningitis by looking at the monthly distributions of this phenomenon. Figure 4.7 gives information on the annual and monthly distribution of meningitis.

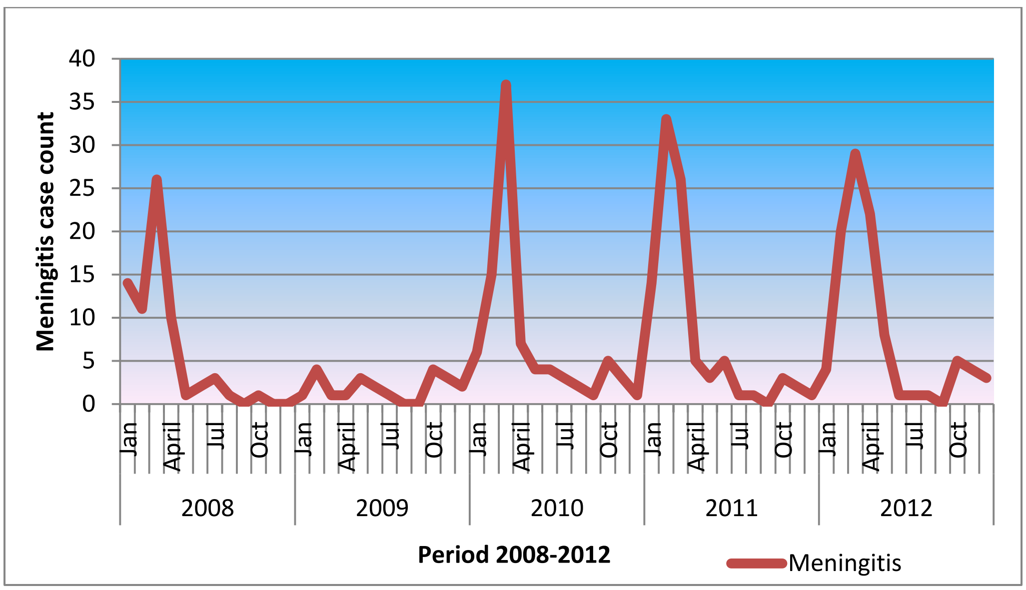

Figure 4.7: Seasonality (monthly distribution) of reported meningitis cases in the study area (2008-2012)

Source: Fieldwork, (2013).

From Figure 4.7 the indication is that the incidence of the disease is particularly high in the months of January, February, March, and April for each of the five years running. These observations agree with previous findings that meningitis has a strong correlation with seasons of the year. The need of the organisms for an ideal temperature and humidity that prevails during the dry season partly accounts for the disease incidence (GHS, 2004 as cited in Baffoe-Bonnie et al., 2006). The information also confirms findings by Pascual and Dobson (2005) that, meningitis in western Africa shows recurrent seasonal patterns every year- typically starting at the beginning of February, peaking up in March and April, decreasing and eventually dying off at wetter and colder periods.

Tying these observations to the conceptual framework, it fits in well with the natural habitat vertex; which basically posits that climate, weather patterns and seasonality significantly drive the onset and prevalence of diseases, in this context, meningitis. Besides, the trend lends credence to the assertion that hot dry conditions coupled with poor ventilation favour the occurrence of meningitis cases. Baffoe-Bonnie et al. (2006, p.58) noted that; "the range of months suitable for high incidence of meningitis cases are on the increase and the nation stands a risk of high meningitis cases".

On the same question of seasonality of the disease, again the in-depth interview shows that, harsh environmental or climatological conditions such as low rainfall and high temperatures could be underlying factors in the spread of the disease. This came at the back of the fact that most of the cases are being reported in the hot dry seasons of the year, especially around the hot periods of the month of March.

The study further sought to assess the association of meningitis and three critical climatic parameters (rainfall, temperature & humidity). Information was gathered on each one of them for a five year period. Pascual and Dobson (2005) further assert that, environmental factors such as rainfall, temperature and humidity are critical in appreciating the seasonality of infectious diseases.

Figure 4.8 presents information on mean rainfall distribution and average meningitis case counts.

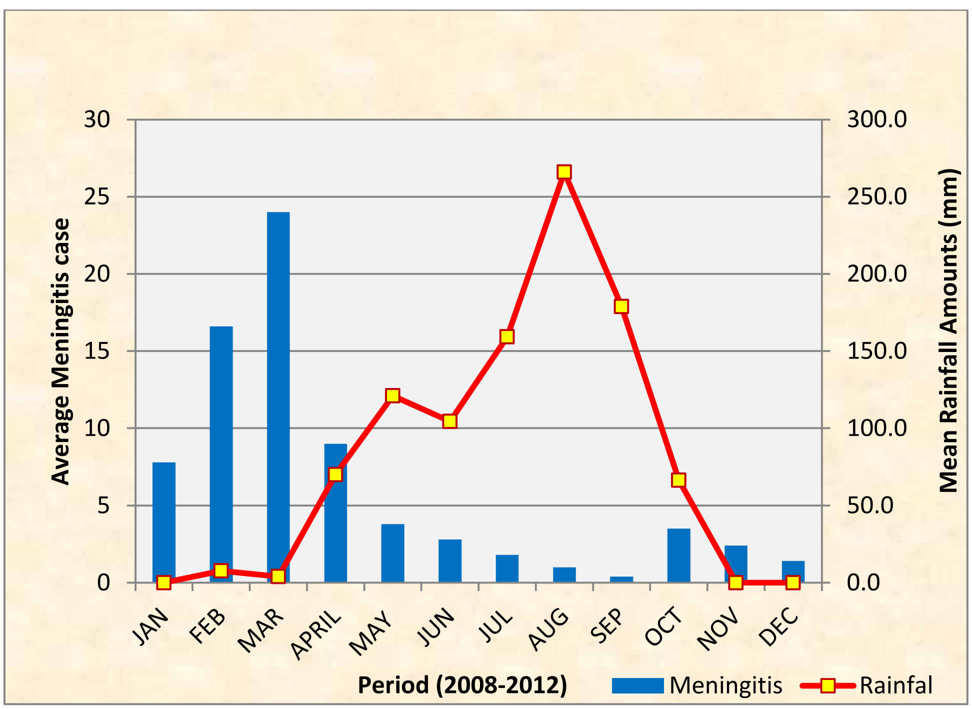

Figure 4.8: Distribution of number of reported meningitis cases (monthly averages) for 2008-2012 and monthly mean rainfall amounts

Source: Fieldwork, (2013).

Figure 4.8 shows that high meningitis cases counts occur at periods of low rainfall amounts, which could be said to be dry periods. Thus, data indicates that from the first three months where rainfall has been relatively low, meningitis has been relatively high. Conversely, between the months of May and June, it is observed that with higher rainfalls, the incidence of meningitis correspondingly drops.

This information seems to confirm findings by Sultan et al. (2005), that meningitis is closely related to climate as evidenced by its temporal patterns all over the world, and one of the critical parameters being rainfall distribution. Again, the conceptual framework makes a case for weather parameters such as rainfall being one of the determinant factors in the distribution of diseases.

One other climatic parameter that information was gathered on and compared to meningitis case counts is mean air temperature. Figure 4.9 presents information on the meningitis temperature nexus.

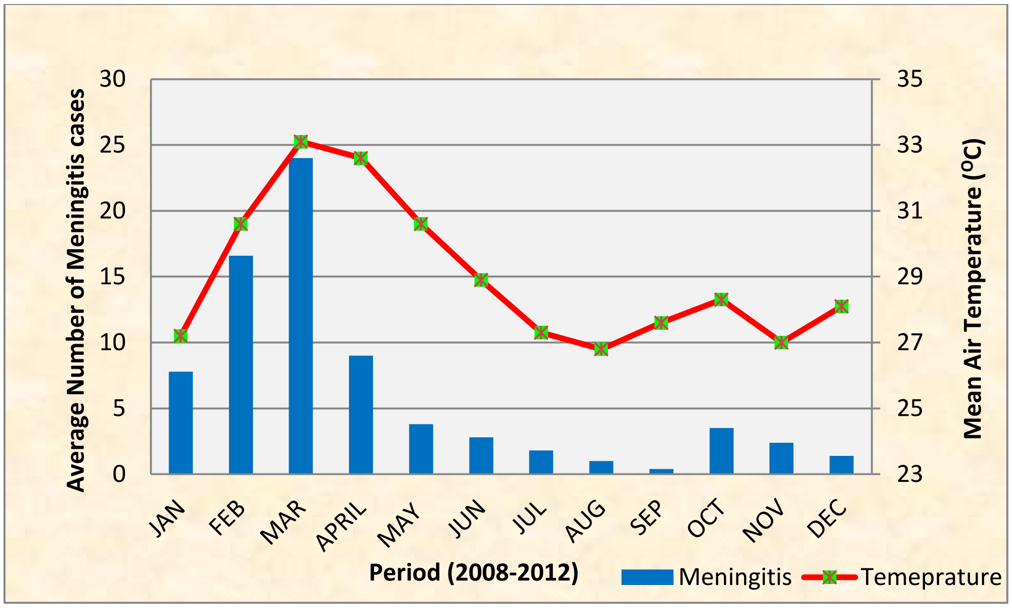

Figure 4.9: Distribution of number of reported meningitis cases (monthly averages) for 2008-2012 and monthly mean air temperature

Source: Fieldwork, (2013).

Within the time frame under consideration, high cases of meningitis occurred between particularly January and June. Very high figures are recorded in February, March and April with a mean air temperature of over 30°C which are hot months. Again it is also observed from the data that lower cases of meningitis cases occurred at a mean air temperature of around 27°C which are cold months.

Data was also collected on mean relative humidity for comparison with meningitis cases to see patterns. Information gathered on this has been presented in Figure 4.10.

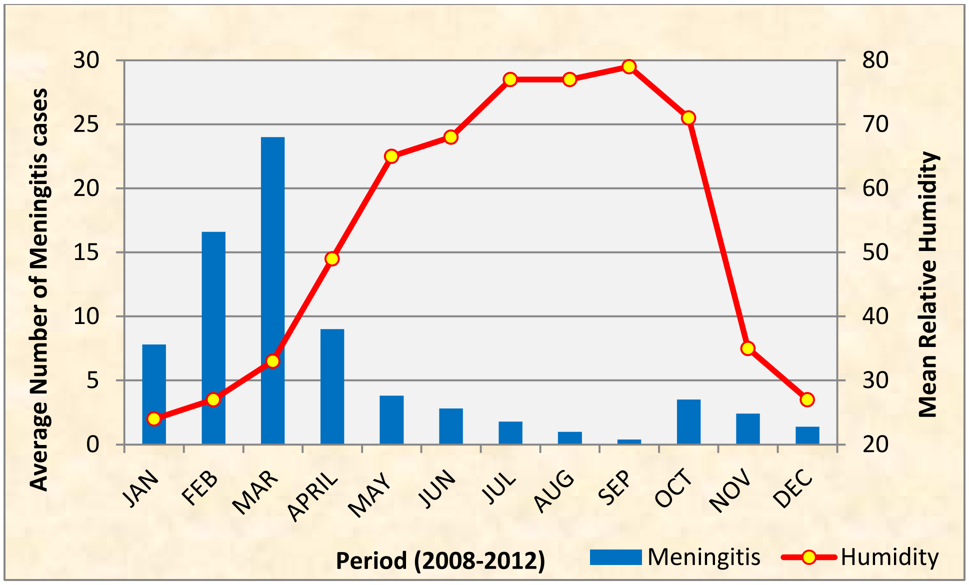

Figure 4.10: Distribution of number of reported meningitis cases (monthly averages) for 2008-2012 and monthly mean relative humidity

Source: Fieldwork, (2013).

The data gives an observed general trend of humid months (from April to October) recording very low meningitis cases as compared to drier or less humid months like the first three months of the year which recorded relatively lower cases. This information again falls in line with finding by Sultan et al. (2005) that meningitis occurrence among other things have a close affinity to the climate of a particular locality. The human ecological triangle in the same vein considers climate as an important determinant factor in the incidence of especially communicable diseases.

Views on the seasonality of the disease were also sought from the in-depth interview of which the information is provided below:

It is mostly in the dry season and it is the dry winds that come from the Saharan countries like Mali and Niger through Burkina Faso then to Ghana. Apparently, dry-hot conditions are effective drivers of meningitis. Hence, it peaks during such times.

3.4.3 Meningitis and observed demographic patterns

Information was also gathered to assess the demographic distribution of meningitis. This was done by considering two demographic variables—age and sex. Figure 4.11 shows the distribution of meningitis among various age categorizations for the study area from 2008 to 2012.

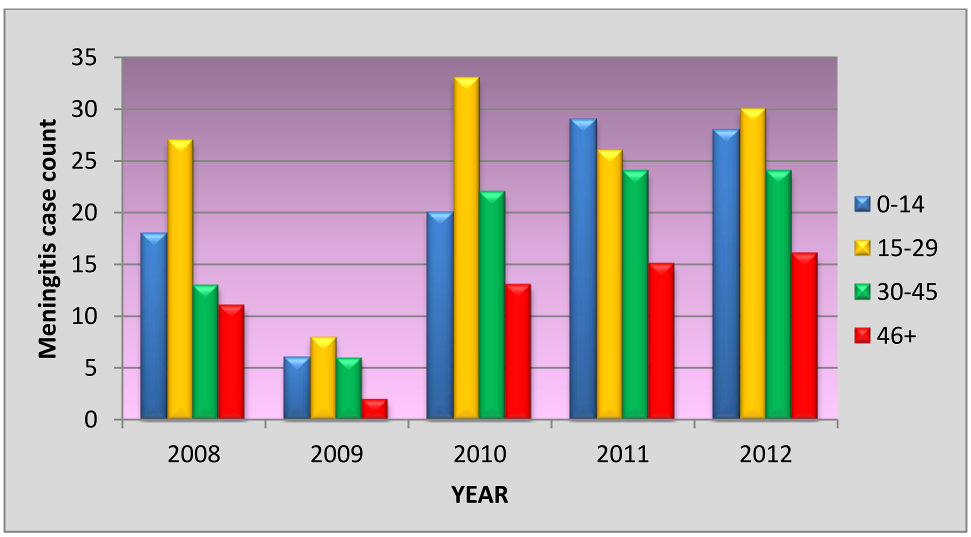

Figure 4.11: Annual distribution of reported meningitis cases by age

Source: Fieldwork, (2013).

The data indicates that meningitis varies greatly among the age groups. Particularly, it is seen that rates are high among the 0-14 and 15-29 age groups. This observation could be explained by the fact that these age groups are the most active and could easily engage in activities that would predispose them to the disease. Again, as indicated by the human ecological model by (Mead and Emch, 2010), age could come in as a significant determinant in the distribution of a health concern among a population in a given locality even though there are other factors. The implication thereof is that attention is required in the area of age in the appreciating CSM in the study area.

In respect of the age categories at most risk, the in-depth interview seems to confirm the findings of the study. It was noted that the most active age groups are more predisposed to the disease per their activities. As noted by a health worker:

> One of the reasons is that most people of these age groups (0-14 and 15-29) are of school going age. CSM is air borne through sneeze and cough and the more you are expose to crowd the higher your risk of getting infested with the disease.

On the demographic patterns of meningitis, the study gathered information on the distribution of the disease by sex. The data is presented in Figure 4.12.

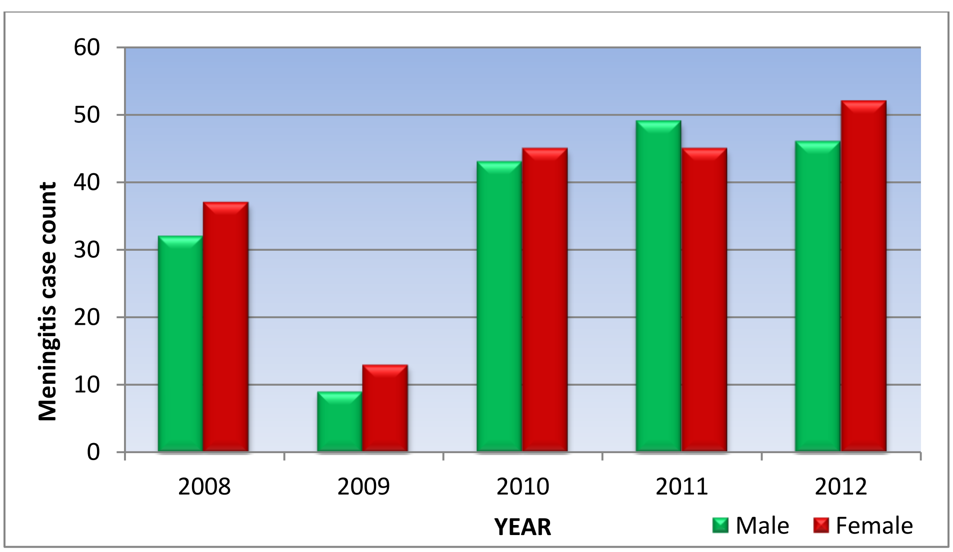

Figure 4.12: Annual distribution of reported meningitis cases by sex

Source: Fieldwork, (2013).

Information from the in-depth interview shed more light on the observation in Figure 4.12. One in-depth interviewee remarked that:

> Both male and female are of equal risk. Women are of the risk because they are exposed to smoke during cooking. Men are also of the same risk because many men smoke. These are aspects of individual level situations that can predispose one (by means of sex) to the disease aside the broader environmental drivers of the disease.

Figure 4.12 examines the distribution of meningitis by sex. There are considerable differences between the sexes. The distribution shows higher rates for female than male for the five year running. This can partly be explained by the fact that, the population ratio favours female (51%) (GSS, 2012). Again, Mead and Emch (2010) in their human ecological model posit that, physiological predisposition such as gender could determine the incidence of a disease among gender. The implication is that, the distributional pattern of meningitis among gender should be given greater attention since this might not just occur by happenstance but due to other underlying factors which could be either, environmental, sociological and physiological or a combination of all. The essence of bringing in this geographical perspective is to show patterns.

4.5 Conclusion

The chapter discuses issues on meningitis bordering on magnitude, spatial patterns and seasonal trends. Observations and information from the data gathered indicate that CSM constitutes a major health threat in the study area and the

Upper East region within the broader context of the Africa Meningitis Belt. The study further found that there are marked variations; spatially, seasonally and demographically (sex and age). The chapter therefore suggests that any efforts at understanding, appreciating and managing the disease in the study area should give due consideration to these observed variations.

CHAPTER FIVE

KNOWLEDGE, PERCEPTIONS AND MANAGEMENT OF MENINGITIS

5.1 Introduction

This chapter first examines the biographic data of the respondents and then presents their level of knowledge and perceptions about meningitis. The chapter also presents information on the socioeconomic implications of having meningitis and how it is managed in the study area. The study presents the results from the perspectives of those who have suffered the disease in the last two years or so, the general public and health workers.

5.2 Socio-demographic characteristics of respondents

This section presents the background characteristics of the survey respondents who are put into two categories—general respondents and those who experienced the incidence of meningitis in the recent past. The section presents results on sex, age, education, religion, occupation and the residence type as illustrated in Table 5.1.

For this section, first, much attention was placed on respondents with recent experience with meningitis to assess their biographic characteristics and the subsequent presentation incorporated the background characteristics of both.

Table 5.1: Background characteristics of respondents

Variable		Respondents (general public)		Respondents with recent experience with Meningitis	
		Freq.	**(%)**	**Freq.**	**(%)**
Sex	Male	124	49.8	44	44
	Female	125	50.2	56	56
	Total	**249**	**100.0**	**100**	**100.0**
Age	15-25 *(0-25)	39	15.7	18	18
	26-35	87	34.9	28	28
	36-45	60	24.1	21	21
	46-55	41	16.5	16	16
	56-65	9	3.6	10	10
	66+	13	5.2	7	7
	Total	**249**	**100.0**	**100**	**100**
Education	No Formal education	40	16.1	8	8
	Primary	44	17.7	15	15
	JSS/Middle	86	34.5	35	35
	Secondary	52	20.9	32	32
	Tertiary	27	10.8	10	10
	Total	**249**	**100.0**	**100**	**100**
Religion	Christian	125	50.2	65	65
	Muslim	55	22.1	16	16
	Traditional	69	27.7	19	19
	Total	**249**	**100.0**	**100**	**100**
Occupation	Student	53	21.3	25	25
	Trade/merchant	45	18.1	22	22
	Trades persons/Artisans	42	16.9	18	18
	Farming	61	24.5	27	27
	Civil/Public servants	29	11.6	8	8
	Unemployed	19	7.6	0	0
	Total	**249**	**100.0**	**100**	**100**
Residential types	Hut	22	8.8	8	8
	Separate/single House	76	30.5	29	29
	Compound. House	144	57.8	54	54
	Semi-detached	7	2.8	9	9
	Flat/Apartment	0	0	0	0
	Total	**249**	**100.0**	**100**	**100**

Source: Field work, (2013). Note: * (0-25) first age bracket for respondents with recent experience of Meningitis—different from the first age bracket (15-25) for other respondents.

For the sex distribution of the sample of those who have suffered meningitis in the recent past as indicated in Table 5.1, 44 (44%) of the respondents were males and 56 (56%) were female. These observations could be understood better when assessed in relation to findings in Figure 4.12 (annual distribution of meningitis by sex for the entire five year period 2008-2012), where higher rates are skewed towards female. As noted by Meads and Emch (2010) the characteristics of the host such as sex counts very much when it comes to comprehensive assessment and understanding of a health issue among a people in a particular locality.

The results in Table 5.1 also show the distribution of the respondents across ages—for respondents who have suffered the disease in the recent past. The result indicates that, 49% of the respondents were between the ages of 0 and 35. Those who were between 36-55 year bracket were 37%. For the age range of 56 and above, respondents were 17 percent. The results presented show that majority of the population of the study area are youth and likely to engage in active work and meetings which may expose them to risk factors of having the meningitis. This observation about age like the sex characteristic noted earlier represents the host vertex in Meade human ecological theory.

Results on the educational background on the respondents are presented in Table 5.1. The results show that 8% of the respondents have not had any formal class room education. Those who had up to the primary school level were 15% while middle school or Junior High School levels were 35%. For secondary education, 32% of the respondents fall within educational category. Only a few of the respondents (10%) had tertiary education.

The religious background of the respondents was investigated. Most of the respondents were Christians 65 (65%). Moslems were 16 (16%) and Traditional religion were 19 (19%) of the total respondents. These observations could be explained by the fact that in the study area 58.9% of the population are Christians, 8.7% Muslims and 31.3% representing Traditional religion (UNDP, 2010). Thus, the findings reflect the respective percentages of the three main religions and a particular religion cannot therefore be pointed out to have any particular affinity to incidences of meningitis in the study area.

The occupational status of the respondents was examined. The result shows a very high meningitis rates— 27 percent for farmers, 25 percent for students followed by 22 percent for those engaged in trading activities. The high rates of reported cases among farmers as a group could be attributable to the fact, the bacteria that causes meningitis is found in the soil and is air borne. Hence by the longer exposure on the field they are much predisposed to the disease. With regard to students, the 25 percent could be explained by over crowdedness (such as dormitory conditions) and other group activities. Apparently, the reasons for the high figures among the traders too could be pointed at the direction of over-crowdedness, and possible trips to hyper endemic zones such as Burkina Faso which shares borders with the study area. As noted by Waddy (1957) human movement in terms of labour and trade have been major drivers of meningitis. Also, as provided for by the Meade's human ecological triangle, some aspects of behavioural and organizational structure could influence the health outcomes among a people given the particular health subject at issue.

To know the type of residence that the respondents use, question was asked on this subject. The responds are presented in Table 5.1. From the results, majority of the respondents 54 (54%) were staying in compound houses. Those who stayed in separate/single houses were 29 (29%) of the total respondents. Only 8 (8%) were staying in huts. The remaining 9%, respondents stay in semi-detached and none of the respondents stayed in a flat/apartment. Even though the results show that majority of the respondents stay in compound houses, it cannot be definitely concluded that this type of residence drives meningitis, since it is the commonest in the area. However, these observations could be tied to the human built habitat vertex of the Meade human ecological theory which forms the conceptual basis of this study.

5.3 Awareness of meningitis

This section presents results on the awareness level of the survey respondents. Firstly, this section presents result on the sources of information on meningitis and then moves on to present the perceived causes of meningitis.

The question was asked if the respondents have heard some information or have had any education on meningitis. The response to this question was that all the respondents had some idea about meningitis. The results thus, indicate a high level of knowledge about the disease among individuals in the study area.

For the source of information as presented in Table 5.2, 45.5% of the respondents said that the information about CSM was gained from electronic media. 34.5 percent of them said community durbars constituted one of the means by which they obtained information on CSM. Still on Table 5.2 (for respondents with past experience with the disease), higher observations of 38.7% and 39.2% were recorded for the electronic media and community durbars respectively. The other sources of information on CSM were the print media, community durbar and other source apart from the ones listed. Thus, the electronic media and community durbars constitute tremendously powerful conduits for relaying information on meningitis to the people in the study area. These findings are in line with suggested strategies to combat epidemic diseases (including CSM) in the Upper East Region (GHS, 2008).

Table 5.2: Source of information on meningitis

	Respondents (General public)		**Those with recent past experience with Meningitis**	
Source of information	**Frequency**	**Percent**	**Frequency**	**Percent**
Electronic Media	223	45.5	86	38.7
Print media	69	14	34	15.3
Community Durbar	169	34.5	87	39.2
Other source	29	6	15	6.8

Source: Field work, (2013).

Note:*****multiple responses hence more than sample. Attention therefore on the percentages.

5.4 Perceived causes or drivers of meningitis

Table 5.3 presents the results of the examined perceptions on some of the causes or drivers of meningitis in the study area. The results indicate that some of the drivers of meningitis are environmental, social and cultural as well as spiritual causes (supernatural).

Table 5.3 Perceived Causes/Drivers of Meningitis

Causes/drivers	**SA** Freq.(%)	**A** Freq.(%)	**N S** Freq.(%)	**D** Freq.(%)	**SD** Freq.(%)
Environmental causes	183(73.5)	53(21.3)	2(0.8)	6(2.4)	5(2)
Social causes	100(40)	15(6)	23(9)	35(14)	76(31)
Community gathering	79(32)	92(37)	62(25)	6(2)	10(4)
Supernatural	32(12.9)	22(8.8)	96(38.5)	69(27.7)	30(12)

Source: Field work, (2013).

Key: SA (Strongly Agree); A (Agree); NS (Not Sure); D (Disagree); SD (Strongly Disagree)

From Table 5.3, 73.5 percent of the respondents strongly agreed that meningitis is caused by some environmental factors, 21.3 percent agreed that environmental factors (such as mean temperature levels, Harmattan, humidly and dust) could possibly contribute to meningitis, and 4.4 percent said that they disagreed or strongly disagreed to environment as a factor that causes meningitis. Only two of the respondents (0.8%) were not sure. This result supports the theoretical proposition by Meade and Emch (2010) which argues that the environment in which one lives to a significant degree affect his/her health status. In the same manner, the finding that could be deduced from this is that the environmental habitat is influential. This is also in line with Pavlovsky's (as cited in Ostfeld et al., 2005) argument that environmental conditions may propel the growth of certain bacteria or provide a more conducive condition for incubation. Again, Forgor et al. (2005) found that climatic factors which are part of the environmental conditions increases the risk of having the disease.

One of the findings of Forgor et al. (2005) is that the seasonal effect of the diseases cannot be disputed. Thus, there are variations in the incidence of the disease due to seasonal changes. This he attributed to the wind, mean temperature and others. Colombini et al. (2009) also argue that harmattan season plays a crucial role. This means that a dry weather is a cardinal factor which may lead to increase or decrease in the meningitis cases. Despite these facts in the literature, the study moved on to find out whether the respondents perceive these seasonal factors as contributing to increase reported cases in the disease. For the most part of the responses, the respondents strongly agreed that dry weather, in other word a very less humid wind and hot temperatures which are characteristics of Harmattan is one of the factors that lead to meningitis cases in the district.

Similarly, question was asked whether social factors could cause or expose one to meningitis. The responses to this question indicate that 46 percent of the respondents suggested that they strongly agreed or agreed with that statement.

This result is similar to that of MoH (2010) findings on the causes of meningitis. Again this finding is not out of place. Considering the conceptual framework adopted for this study, social habitat also forms part of the factors that affect an individual health state. In line with this it can be concluded that the social life of the individual may increase the risk of getting the disease. It is also noted that social conditions, like travel, poor living conditions and overcrowded houses constitute risk factors for the outbreak of meningitis (CDC. website www.cdc.gov).

Community gathering (e.g. markets and funeral grounds) is considered one factor that could lead to increase incidence in Meningitis cases. This is because community gathering brings much more people together. Overcrowding increases the chance of getting the disease and it spreading faster. To this effect, respondents were asked if they agree to the community gathering like church, funerals and other social gathering as factor that may increase their chances contracting the disease. The respondents who strongly agreed or agreed to the statement were 69 percent. Twenty-six percent of them were not sure if community gathering could lead to increased susceptibility to meningitis. Only six percent strongly disagreed or agreed. This result showed that many consider community gathering as meningitis prone factor. However, the 32 percent who were either not sure or strongly disagreed or disagreed is an indication that much remains to be done on education on the disease.

On the question of the attribution of causes of meningitis to supernatural forces, interesting results were shown. This study found per the results presented that 21.7 percent either agreed strongly or agreed that meningitis could arise as a result of supernatural causes. However, 39.7 percent of the respondents either strongly disagreed or disagreed that the incidence of meningitis could be attributable to supernatural causes. A whopping 38.5 percent were not sure.

On the perceived causes of meningitis, one survey respondent remarked interestingly in this manner:

> There is no question about the fact that this disease called CSM is caused by supernatural causes. Either than that how can one just suddenly have a stiff neck and proceed to die like that? And you call it CSM! This is ridiculous!

These findings tie in well with the supernatural theory of disease causation and the diverse conceptions of health which are cultural specific. As noted by (Anderson, 1983; Kelly, 1973) the concept of attribution has long been seen as a critical factor in decision making among alternative courses of actions (Anderson, 1983; Kelly, 1973). In the same vein, Chipfakacha, 1994; Madge, 1998 also noted that it is a common phenomenon in Africa for attribution to illness to be made to spiritual and or social causes rather than physiological or naturalistic causes. Besides, the findings also falls in line with Mead and Emch (2010) conceptualization that, the socio-cultural context counts very much in the overall assessment of health related concerns.

According to Colombini et al. (2009) supernatural causes have been cited as one of the main causes of meningitis as noted in their study in Burkina Faso. Thus, the result confirms Colombini et al. (2009) study. The implication is that, even though in the study area the majority does not consider that the ailment results from any unseen supernatural forces, a significant number (54) of the respondents representing (21%) still are of the opinion that supernatural forces could count as an underlying and remote cause of the incidence of meningitis. In the same vein, the finding falls in line with Murdock (1980) assertion of the *animistic causation*— ascribing the impairment of health to the behaviour of some personalized supernatural entity.

It worth noting that the multiple options provided and the corresponding multiple responses fall in line with the assumptions of the conceptual framework (adopted from Mead and Emch, 2010). Here, emphasis on the multifactorial causation proposition upon which the conceptual model was built. This clearly shares common grounds with the assertion of Green (1999) that, not all diseases have mutually exclusive causes.

5.5 Knowledge of symptoms of meningitis

Being aware of the symptoms of a disease is a first step to managing it. In the light of this, respondents were asked to identify the symptoms associated with meningitis. The results are presented in Table 5.4. From the results, 87 percent of the respondents strongly agreed that fever is a sign that an individual may have contracted meningitis. Also, a whopping 92 percent of them strongly agreed or agreed to the fact that neck pain could be a symptom of meningitis.

Table 5.4: Symptoms of meningitis

Responses	Strongly Agree Freq. (%)	Agree Freq. (%)	Not sure Freq. (%)	Disagree Freq. (%)	Strongly Disagree Freq. (%)
Neck pains	169 (68)	59(24)	13(5)	8(3)	-
Fever	210(87)	21(9)	-	4(2)	4(2)
Severe headache	69(28)	59(24)	23(9)	40(16)	58(23)
Vomiting	79(32)	92(38)	62(25)	2(0.8)	10(4.1)

Source: Field work, (2013).

The above results are in line with the research report by the MoH (2010) which mentioned neck pain as one of the symptoms associated with meningitis. Fever is another symptom that was mentioned in the report of the Ministry of Health. The respondents seemed to have divergent views on the basic symptoms as could be seen spread across the scale. Generally, it could be said that respondents have considerable knowledge on the symptoms of the disease which could be a good starting point to effectively tackling it.

5.6 Management of meningitis

This section presents the results on the question pertaining to the management of meningitis (Table 5.5). The information was sought from the three category of respondents—the general public, those with recent past experience with the disease and health workers. For the first group, 30 percent of the respondents were of the view that individuals are to seek spiritual help when a person suffers from meningitis. Also, 17.6% of the respondents reported that meningitis could be managed by avoiding overcrowded places. This would ensure that the spread of the diseases is limited. Again, vaccination is deemed to play a major role as 41 percent of them were in favour of this.

Table 5.5: Measures to control meningitis

	Respondents (general public)		**Those experienced disease in recent past**	
Responses	***Frequency***	***Percentage***	***Frequency***	***Percentage***
Seek spiritual help	140	30	3	3
Avoid overcrowded place	85	17.6	35	35
Vaccination	198	41	50	50
Ventilated room	60	12.4	12	12

Source: Fieldwork, (2013).

For those who have experienced the ailment before (in the past two years or so), three percent sought (or combined) spiritual help to cure the ailment. Thirty-five percent acknowledged that avoiding overcrowded place is best way to avoid contracting the disease. Among all these factors, vaccination was top, with 50 percent of the respondent saying that vaccination reduces the possibility of having the disease.

The in-depth interview of a health personnel revealed that vaccination is the safest management option. It was also acknowledged that people have different views about management of meningitis outside the formal health system. As highlighted in the interview:

> Some people do not report their cases on time. Others don't even know the symptoms and so they report when the situation is almost out of hand. However management is done at the hospitals. So, it is usually through durbars that information is disseminated. This mode is very effective because it is expected that at least one person will represent a compound during durbars in the communities

The management processes identified supports earlier studies. Example, MoH (2010) suggests that one way to prevent meningitis is to ensure that vaccines are taken or made available to individuals. Lee (2005) suggests that most factors that affect health are outside health sector. This is shown when some of the respondents advocated for spiritual assistance. That is the social environment and cultural factors could affect the management of the disease.

Also, Bonita et al. (2006) noted that risk factors could be modified, so interventions are necessary to reduce the occurrence of diseases. This means that, vaccination could help to immune individuals against the probability of getting the diseases. The implication of these findings is that as people perceived the disease to be caused by different factors, the same direction would their management options go. This calls for thorough education on the real causes and best management options to effectively deal with the disease.

The effectiveness of vaccination to combat the disease was further explored.

Individuals who have suffered from the meningitis were asked whether they have vaccinated themselves against the disease. The results show that 90 percent of the respondents have not vaccinated themselves before contracting the disease. And even the 10 percent who have vaccinated before has done so for a long time before the current ailment.

On the reason why people do not vaccinate, it was found out that generally individual have perceived that the vaccination was not necessary or needed to fight or protect themselves against the disease. Individuals in this category were 35(39%) Similarly, 40 of them (44%) did not consider it serious. Meanwhile, 17 percent of them thought they were too young to have the diseases attack them.

Table 5.6 Vaccination, time of vaccination and reason for not vaccinating

	Responses	**Frequency**	**Percent**
Vaccinated before ailment	Yes	10	10
	No	90	90
	Total	**100**	**100**
Reasons not vaccinating	Though it is not needed	35	39
	It was not serious	40	44
	Was not old enough	15	17
	Total	**90**	**100**
Last vaccination	Long time	10	10

Source: Field work, (2013).

This shows that there is the need for more education on the importance of vaccinating one's self against the disease. Even though, it is clear from earlier responses that, vaccination is one of the effective ways of managing meningitis, it seemed to be a problem. Perhaps people do not take it seriously or would not go for it because it is not solely a matter of one being vaccinated or not (as different perspectives have been shown on its causes). However, as noted earlier on interventions in the form of vaccination is an effective option to dealing with the disease. This finding supports Bonita, et al. (2006) that interventions help alter and reduce the probability of contracting diseases.

5.7 Socioeconomic implication of meningitis

The study also sought information on the socio-economic implications of the disease from the view point of the general public, those with recent history of meningitis and health personnel. The results are presented in Table 5.7.

Table 5.7: Socio-economic effect of meningitis

Effect	General Respondents		Suffered the disease before	
	Frequency	Percent	Frequency	Percent
Cause paralysis	186	30	10	5.4
Deafness	169	28	12	6.5
Death	193	32	17	9.2
Affect daily activity	63	10	100	54.3
Stigmatisation	-	-	45	24.6

Source: Field work, (2013). Note: Multiple responses.

For the general public, the results showed that, 30 percent of the respondents suggested that meningitis could cause paralysis, 28 percent said it could cause deafness, 32 percent indicated that it could result to death and 10 percent indicated that it could affect ones daily round of activities.

The same question was posed to those who have suffered the disease before on some of the socio economic effect of the disease. The results are also presented in Table 5.7. Generally, the entire 100 respondents argued that it affected their active participation in economic and social life.

The views of those who have suffered the disease before can be summarised by what one of them remarked:

> The disease is so devastating; apart from the health implications on you, it can also disrupt one's daily socio-economic activities. When I contracted it, it took quite a long time before I came back fully to my normal self. That really affected my daily round of activities.

On the same question, the in-depth interview of the health personnel generally captured the issues highlighted in Table 5.7 as the main socioeconomic implications of the incidence of meningitis. He remarked in this manner:

> The disease can be very devastating. Thus, apart from the fact that it can lead to death, it can also leave victim with severe health implications such as hearing impairment and paralyses. Aside this, it can also affect the socio-economic activities of victims as they may be constraint for a long time.

This implies that individuals who suffered the sickness also suffer socially and economically. These responses confirm findings by Hodgson et al. (2001) that meningitis remains an important cause of mortality and morbidity in the area in the study area with other socio-economic implications. Aside, Heymann, 2003; Frasch, 2005; & Roberts, 2008 also highlighted the devastating nature of the disease within the meningitis belt of Africa.

5.8 Conclusion

This chapter presents the results on the knowledge and perception about meningitis. From the study, it could be concluded that the respondents have general knowledge about meningitis. The people are aware of the possible causes of meningitis. Majority of them said community gathering and overcrowded environment are contributory factors to meningitis problem. However, some argued that supernatural forces cause meningitis. This brings to the fore the role of superstition in meningitis problem and if such ideas are not managed, it may hinder clinical solution to the problem. Thus a multiplicity and overlapping attribution to meningitis causation is noted. Also, individuals seem to be aware of the symptoms that are associated with meningitis. Except that few individual were not sure whether fever and vomiting are symptoms of meningitis. Thus the study found that on the average, individuals are aware of the causes and symptom of the disease showing their level of knowledge.

The chapter also presented the results on the implications of meningitis and their management. It could be derived from the results presented that, vaccination and hospital attendance are major source of managing the disease. It was also clear that spiritual assistance were sought for by sick persons. Concerns of stigmatization, death as well as the retardation of daily round of activities were identified as some of the socio economic effects of the disease.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This is the final chapter of the study. The chapter gives a brief overview and summary of key findings of the study. The chapter then presents the conclusion and moves on to make recommendations for management policy and further research.

6.2 Summary

Meningitis, being a serious health concern in the northern part of Ghana, the study set out to examine the magnitude, patterns and seasonal trends in the study area within the context of the Meningitis Melt of Africa. The study further sought to unravel the individual knowledge and perceptions about the disease as well as the management and socio economic implications. The study employed the mix method and used both questionnaire and secondary data.

The study showed that within the meningitis belt of Africa, the study area records considerably higher rates—greater than the national average and ranging among the highest in the meningitis belt region. Also, the study showed remarkable variations in spatial patterns and seasonality of the disease. Still, on the seasonality and possible influence by the climate, the study found that rainfall, temperature and humidity appear to influence reported cases or meningitis. However, this relationship cannot be said to be definite since other factors could also account for this. It is further shown that there are considerable differences in the disease distributions among the sexes and age categorizations, with female usually affected more than the male. Also, the age categorization show that the age groups of 0-14 and 15-29 years records marked higher trends than the other age groups for the five year period under consideration.

The study also found out that, the individuals in the study area have high level of knowledge of the disease. This is demonstrated by the fact that majority of them cited socio-cultural contexts like over crowdedness and less ventilated conditions (such as funeral and other community gathering) as possible triggers to meningitis. Besides, environmental conditions such as dry and hot weather conditions were cited as other possible risk factors. Besides, some demonstrated correctly the knowledge on some of the basic symptoms that come with meningitis. However, the cultural beliefs of individual affect the people on their perception on the causes of meningitis. It came out from the study that, some individuals believe that meningitis is caused by supernatural forces beyond the natural. Yet others did not know some of the basic symptoms that come with meningitis.

The study also showed that vaccination and hospital attendance are the major sources of managing the disease. The study further demonstrated that, spiritual assistance was a viable management option. It was also realized that social stigmatization, death, deafness and paralysis have been identified as some of the socioeconomic implication of meningitis in the study area.

6.3 Conclusions

Based on the summary of findings, the following conclusions were made:

- While cerebrospinal meningitis is likely (for now) to continue to be a critical public health concern for the people of the study area (as trends are way above national averages), its spatial patterns, seasonal trends and demographic distribution have portrayed a varied and interesting picture. As shown by the conceptual framework, the population/host, behaviour and habitat have combined to produce the sort of observed variations in these patterns and trends.

- On knowledge and awareness, it can also be concluded that even though individuals have considerable knowledge of the disease, both naturalistic and supernatural (traditional and superstitious thinking) attributions were made for the causes of meningitis in the study area. The implication is that, these two strands of attribution—naturalistic and supernatural—could influence health seeking behaviour in relation to the incidence of meningitis. Hence, sources of information such as the electronic media (television and the radio) could prove very crucial in keeping people abreast with the incidence of the disease.

- It could further be concluded that meningitis have a very high and multiple health and socio-economic implications. This implies that in an area were development is relatively low, with high poverty levels the disease could retard development efforts if not well checked.

6.4 Recommendations

6.4.1 Understanding and managing meningitis

It is amply clear from the findings and conclusion of the study that a holistic and continues approach is required to study, understand, manage and document cerebrospinal meningitis in the study area. In view of this, the following recommendations are made:

- First, on the spatial patterns of meningitis, the whole of the study area shows rates that reflect hyper endemic figures. Particularly, the North zone and the adjoining West and East zones recorded phenomenally higher figures. More attention should therefore be given there.

- Besides on the seasonal variations, particular attention should be paid to the hot dry months, which are the first four month of the year.

- It is also recommended that, more attention be given to the age category of

0-35 which showed relatively higher rates. It is further recommended that, for occupational and group-based categorizations, particular attention be paid to farmers, traders and students who based on the sample selection seem to be the most vulnerable.

- On the knowledge and perception of the disease, it is recommended that more education on the disease be intensified using such outlets like the radio and community durbars, since traditional thinking and superstition still rule the minds of a section of the population regarding causes of meningitis. The need to take vaccination seriously and the avoidance of overcrowded conditions and less ventilated conditions are also recommended.

- In the same vein, on the management and socioeconomic implication, the high burden of the disease could be lessened by more intensive education and strategic vaccination, targeting high risks zones, seasons and high risk demographic categories.

6.4.2 Issues for further research

However, since time and resource constraints did not allow for a bigger sample and a more extended time frame, the study recommends that further studies be done into these variations to see whether reporting rates among the various zones among other factors could result in similar patterns.

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APPENDICES

Appendix A:

The University Of Ghana

Department of Geography and Resource Development, Legon

Questionnaire for general public

The exercise is in partial fulfillment for the award of Master of Philosophy in degree in Geography and Resource Development. The topic is "Patterns, perceptions and management of meningitis in the Kassena-Nankana East and West Districts". This is purely an academic exercise. All information provided by respondents will be treated with utmost care and confidentiality and used solely for the stated purpose.

Section A: Socio-Demographic Characteristics

1. Sex 0.1 Male [ ] 0.2 Female [ ]
2. Age……………………………………
3. Main occupation…………………………………………
4. Educational status

   0.1 No formal education [ ] 0.2 Primary [ ]

   0.3 JSS/Middle [ ] 0.4 Secondary [ ]

   0.4 Tertiary [ ] 0.6 Others [ ]
5. Religion

   0.1 Christianity [ ] 0.2 Muslim [ ]

   0.3 Traditional [ ] 0.4 Others [ ]

6. Types of Household/occupancy dwelling at the time of incidence of case.

   0.1 Huts [ ] 0.2 Separate/single house [ ]

   0.3 Compound house [ ] 0.4 Semi-detached [ ]

   0.5 Flat/Apartment [ ]

   0.6 Kiosk/Container/Attached to SHOPS [ ]

Section B: Awareness about Meningitis

9. Have you heard about meningitis before?

0.1 Yes [ ] 0.2 No [ ]

10. If yes, where did you get the information from?

(Mark the appropriate box)

Source of information	
a) Electronic media (TV, Radio, internet etc)	
b) Print media (News papers etc)	
c) Community durbars/district health outreach programmes	
d) Others	

Others (Specific) ………………………………………...

11. To what extent do you agree with the following as possible environmental and social determinants/causes of meningitis in the area? *(Mark the appropriate box)*

Drivers/determinants	**(1) Strongly agree**	**(2) Agree**	**(3) Not sure**	**(3) Disagree**	**(3) Strongly disagree**
a). Overcrowded/poorly ventilated rooms					
b). Dry weather conditions					
c). Community gathering (e.g. market centres & funeral grounds)					
d). Supernatural causes					
e). Others					

Others (Specify)……………………………………………………………

12. What is your view on the following conditions/symptoms as being commonly associated with meningitis?

Option	**(1) Yes**	**(2) Not sure**	**(3) No**
a). Severe headache			
b). Fever			
c). Neck pains			
e). Others			

Others (Specify)…………………………………………………………………..

Section C: Management and socioeconomic implications

13. Can you mention some of the implications that meningitis has on your daily life and socioeconomic activities?

………………………………………………………………………………

………………………………………………………………………………

14. Can you mention some of the things you are doing or one could do avoid contracting meningitis?

………………………………………………………………………………

……………………………………………………………………………..

Appendix B:

University Of Ghana

Department of Geography and Resource Development, Legon.

Questionnaire and Interview Schedule for Survived Meningitis Cases

The exercise is in partial fulfillment for the award of Master of Philosophy degree in Geography and Resource Development. The topic is "Patterns, perceptions and management of meningitis in the Kassena-Nankana East and West Districts". This is purely an academic exercise. All information provided by respondents will be treated with utmost care and confidentiality and used only for the stated purpose.

Section A: Socio-Demographic Characteristics

1. Sex 0.1 Male [ ] 0.2 Female [ ]
2. Age……………………………………
3. Main occupation………………………
4. Educational status

   0.1 No formal education [ ] 0.2 Primary [ ]

   0.3 JSS/Middle [ ] 0.4 Secondary [ ]

   0.5 Tertiary [ ] 0.6 Others [ ]

5. Religion

   0.1 Christianity [ ] 0.2 Muslim [ ]

   0.3Traditional [ ] 0.4 Others [ ]

6. Types of Household/occupancy dwelling at the time of incidence of case.

   0.1 Huts [ ] 0.2 Separate/single house [ ]

   0.3 Compound house [ ] 0.4 Semi-detached [ ]

   0.5 Flat/Apartment [ ] 0.6 Kiosk/Container/Attached to SHOPS [ ]

Section B: Awareness about Meningitis

7. Before your recent infection, have you ever suffered any previous infection? 0.1 Yes [ ] 0.2 No [ ]

8. What was your first point of call when you started feeling on well?

0.1 Hospital [ ] 0.2 Pastor [ ] 0.3 Malam [ ]
0.4 Fetish Priest [ ] 0.5 Others …………………………..

9. Did you know you had meningitis before you were diagnosed at the health facility?0.1 Yes [ ] 0.2 No [ ]

10. Tell me about your experience with the disease.

……………………………………………………………………

……………………………………………………………………

……………………………………………………………………

11. To what extent do you agree with the following as possible environmental and social determinants/causes of meningitis in the area? *(Mark the appropriate box)*

Drivers/determinants	**(1) Strongly Disagree**	**(2) Disagree**	**(3) Not sure**	**(4) Agree**	**(5) Strongly agree**
a). Overcrowded/poorly ventilated rooms					
b) Dry weather conditions					
c) Community gathering (e.g. market centres & funeral grounds)					
e) Supernatural causes					
f) Others					

Others (Specify) ………………………………………………………………

12. What do you remember, or know about the following conditions/symptoms as being commonly associated with meningitis?

(Mark the appropriate box)

Symptoms	**(1) Yes**	**(2) Not Sure**	**(3) No**
a). Severe headache			
b). Fever			
c). Neck pains			
e). Others			

Others (specify):……………………………………………………………

Section C: Management and socioeconomic implications

13. Can you mention some of the implications that meningitis had on your life and daily socioeconomic activities at the time of incidence?

……………………………………………………………………………………

……………………………………………………………………………………

……………………………………………………………………………………

14. Can you mention some of the things you are doing or one could do avoid contracting meningitis? ....

Appendix C:

The University Of Ghana
Department of Geography and Resource Development, Legon
In-Depth Interview Schedule for Key Informant (Health Personnel)

The exercise is in partial fulfillment for the award of Master of Philosophy degree in Geography and Resource Development. The topic is "Patterns, perceptions and management of meningitis in the Kassena-Nankana East and West Districts". This is purely an academic exercise. All information provided by respondents will be treated with utmost care and confidentiality and used solely for the stated purpose.

1. How would you describe the state of meningitis in the district?
2. Would you attribute the incidence of meningitis in the district to any particular factor(s)?
3. Can you say something about the geographical distribution of meningitis in the district?
4. Which season of the year does meningitis strike the most?
5. Which categories of people are most susceptible to the contraction of meningitis?
6. What are some of the socio-economic implications associated with meningitis?
7. What programs are there in place for the management of the disease?
8. What are some of the difficulties encountered in management efforts?
9. How in your view can meningitis be effectively managed in the district?

Appendix D:

Navrongo Demographic Surveillance Systems' Clusters and Their Localities (Zones)

The Navrongo Demographic Surveillance System (NDSS) of the Navrongo Health Research Centre (NHRC) for the purposes of studying and monitoring health related issues have demarcated the Kassena-Nankana District prior to it being split in 2008 into the East and the West Districts into five zones based on clusters. These are the ***North, West, South, East,*** and ***Central zones.*** *Even after the district was split in 2008, these zones effectively remained in place. It is on the bases of these zones that the study was carried out.*

The North Zone:

NO.	CLUSTER CODE	LOCATION/SECTION	VILLAGE
1	NAA	ZENGA	PAGA
2	NAB	ZENGA	PAGA
3	NAC	KAKUNGU/NYANIA	PAGA
4	NAD	BAWIO	PUNGU
5	NAE	NYANGUA	PUNGU
6	NAF	WUSUNGU	PUNGU
7	NBA	PUNYORO	PUNGU
8	NBB	PUNYORO/MANYORO	PUNGU
9	NBC	PUNYORO/YITONIA	PUNGU
10	NBD	TEKURU	PUNGU
11	NBE	DIMBASINIA	PUNGU
12	NBF	DIMBASINIA	PUNGU
13	NBG	DIMBASINIA	PUNGU
14	NCA	CHANIA	PAGA
15	NCB	SAKAA/BANYONO	PAGA
16	NCC	BWANIA	NAKOLO
17	NCD	BUGANIA	NAKOLO
18	NCE	SAVIO	NAKOLO
19	NCF	PEDAA	NAKOLO
20	NCG	KASILI	NAKOLO
21	NDA	NAVIO CENTRAL	NAVIO
22	NDB	BADUNU	PAGA
23	NDC	BADUNU	PAGA

24	NDD	SAMWU	NAVIO
25	NDE	KAZUGU	NAVIO
26	NDF	TAZIKA/BAGTUA	PAGA
27	NDG	TAZIKA/BAGTUA	PAGA
28	NEA	KWANIA	PUNGU
29	NEB	TELANIA	PUNGU
30	NEC	TELANIA	PUNGU
31	NED	TELANIA/MANCHORO	PUNGU
32	NEE	TELANIA	PUNGU
33	NEF	TEKURU	PUNGU
34	NEG	BAVUGNIA/WUSUNGU	PUNGU
35	NFA	KULIYAA	MANYORO
36	NFB	KUPELLA	MANYORO
37	NFC	CHILLA	MANYORO
38	NFD	YAGANI/WURA	MANYORO
39	NFE	DEMBISI	MANYORO
40	NFF	WANJAGNIA	MANYORO
41	NFG	SAFORO	MANYORO
42	NGA/NGK	NANIA	PAGA
43	NGB/NGI	GWARI	PAGA
44	NGC	GWARI	PAGA
45	NGD	NANIA	PAGA
46	NGE/NGJ	KAKUNGU/NANIA/BABILI	PAGA
47	NGF	BABILI/KAYULU	PAGA
48	NGG	KAKUNGU	PAGA
49	NGH	PINDAA	PINDAA

The West Zone

NO.	CLUSTER CODE	LOCATION/SECTION	VILLAGE
1	WAA	ASAASONG	KATIU
2	WAB	ACHINIA/SABORO	KATIU
3	WAC	BINANIA/ ZAZONA/BAYAO	KATIU
4	WAD	ASASONG/ADABANIA	KATIU
5	WAE	SAA	KATIU
6	WAF	SAA	KATIU
7	WAG	NAKONG	NAKONG
8	WBA	YIDANIA/WURUNIA	CHIANA
9	WBB	WURUNIA	CHIANA
10	WBC	ASUNIA/PIMLOLA	CHIANA
11	WBD	ASUNIA	CHIANA
12	WBE	VOGNIA	CHIANA
13	WBF	ASUNIA	CHIANA
14	WCA	KAFANIA/SABORO	CHIANA
15	WCB	KALVIO	CHIANA

16	WCC	SABORO	CHIANA
17	WCD	KALVIO/GUGURO	CHIANA
18	WCE	GWENIA	CHIANA
19	WCF	KALVIO-GUGU/NAYEMIA	CHIANA
20	WDA	ABULU	CHIANA
21	WDB	KALVIO/GWENIA	CHIANA
22	WDC	GWENIA/KORANIA/WURU	CHIANA
23	WBE	NYANGNIA	CHIANA
24	WDF	NYANGNIA	CHIANA
25	WDG	NYANGNIA	CHIANA
26	WDX	GWENIA	CHIANA
27	WDY	KANANIA	CHIANA
28	WDZ	ABULU/KANANIA	CHIANA
29	WEA	NANGWAO	GIA
30	WEB	BANBANIA/KWOSONGO	GIA
31	WEC	NANGWAO	GIA
32	WED	WURU	NAVRONGO
33	WEE	NAWOGNIA/WURU	NAVRONGO
34	WEF/WEI	NAMOLO/NOGSINIA/NAWOGNIA	NAVRONGO
35	WEG	WURU/NAKALKINIA	NAVRONGO
36	WFA	NANGWAO/BALOO/KAYILO	KAJELO
37	WFB	KAJELO CENTRAL	KAJELO
38	WFC	NABIO	KAJELO
39	WFD	JAMANGBIA	GIA
40	WFE	SABORO	SABORO/NAVRONGO
41	WFF	SABORO	SABORO/NAVRONGO
42	WFG/WFH	BANIU	NAMOLO
43	WGA	SABORO/AKANIA	KAYORO
44	WGB	BALIU	KAYORO
45	WGC	KADANIA/KANANIA	WURU/KAYORO
46	WGD	WOMBIO	WURU/KAYORO
47	TBA/TBD	BONIA	NAVRONGO
48	TBB	BONIA	NAVRONGO
49	TBC	YOGIBANIA/YIGUANIA	NAVRONGO

South Zone

NO.	CLUSTER	LOCALITY/SECTION	VILLAGE
1	SAA	NYANGA-DOONE/GINGABNIA	DOBA
2	SAB/SAN	NAMOLAGABISI	VUNANIA
3	SAC	JANANIA	JANANIA/VUNANIA
4	SAD	MOMOLIGO	JANANIA/VUNANIA
5	SAE	OSAAGO	VUNANIA/JANANIA
6	SAF	LOWER GAANI	GAANI
7	SAG	UPPER AND LOWER GAANI	GAANI
8	SAH	MOMOLOGA/AZIAYIRE	VUNANIA/GAANI
9	SAJ	TANKUNA	KUGWANIA
10	SAK	TANKUNA	NAYAGNIA
11	SBA	BADANIA	NAYAGNIA

12	SBB	KARANIA/BADANIA	NAYAGNIA
13	SBC	KORINGO	DOBA
14	SBD	BADANIA	NAYAGNIA
15	SBE	BADANIA	DOBA
16	SBF	KANSAA	DOBA
17	SBG	BUNGUM/KANSAA	DOBA
18	SBH	BUNGUM	DOBA
19	SCA	GOORU/KANSAA	DOBA
20	SCB	GOORU	DOBA
21	SCC	AZAASI/AKURUGU-DABOO	DOBA
22	SCD	ATOSALE/NKWANTA	KANDIGA
23	SCE	GINGABNIA	DOBA
24	SCF	APEMPINGO	KANDIGA
25	SCG	ATABAABA	KANDIGA
26	SCH	APEMPINGO/ATABAABA	KANDIGA
27	SDA	AZAASI	KANDIGA
28	SDB	AZAASI	KANDIGA
29	SDC	KAASI	KANDIGA
30	SDD	AKAAMO AKAASI	KANDIGA
31	SDE	AKAAMO	KANDIGA
32	SDF	ATIYORO	KANDIGA
33	SDG	ATIYORO	KANDIGA
34	SDH	AKUNKONGO/NKWANTA	KANDIGA
35	SDI	AKUNCONGO	KANDIGA
36	SEA	GUNWO/BEMBISI	SIRIGU/KANDIGA
37	SEB	BEMBISI	KANDIGA
38	SEC	BEMBISI	KANDIGA
39	SED	LONGO	KANDIGA
40	SEE	LONGO	KANDIGA
41	SEF	LONGO	KANDIGA
42	SEG	TIBABISI	KANDIGA
43	SHE	LONGO/ZEADUMA	KANDIGA
44	SEI	GUMWOKO	KANDIGA
45	SFA	KURUGU	KANDIGA
46	SFB	KURUGU	KANDIGA
47	SFC	AZEADUMA/AKANDAA	KANDIGA
48	SFD	AGANDAA	KANDIGA
49	SFE	AZEADUMA	KANDIGA
50	SFF	AZEADUMA/KURUGU	KANDIGA
51	SFG	KURUGU	KANDIGA
52	SFH	KURUGU	KANDIGA
53	SGJ	BIU/DIGONGO	BIU/DIGONGO
54	SGK	KODEMA/DONGSIEDEMA	BIU
55	SGL	KODEMA	BIU
56	SGM	TEMPOLA/GAANI	GAANI
57	SGN/SGU	GONGNIA/BUNDUNIA	GONGNIA/BUNDUNIA
58	SGP	TINDEMA	GONGNIA
59	SGQ	KASINNIA	KORANIA
60	SGR/SGW	KURISI	KORANIA

61	SGS	UPPER AND LOWER NANKALKINIA	NANGALIKINIA
62	SGT	UPPER NANGALIKINIA	NANGALKIA/NOGSENIA
63	SHA	ZUO-WINGO	KOLOGO
64	SHB	NAYIRE	KOLOGO
65	SHC	WINGO-NAYIRI	KOLOGO
66	SHD	TINDAAGO-TUO	KOLOGO
67	SHE	DIGOOGO	KOLOGO
68	SHF/SHJ	TUO-KULEMGO	KOLOGO
69	SHG	DIGONGO-BIU	BIUKOLOGO
70	SHH	BIU	BIU
71	SJA	NAGA	NAGA
72	SJB	NAGA	NAGA
73	SJC	NAGA	NAGA
74	SJD	CHAABA	NAGA

East Zone

NO.	CLUSTER CODE	LOCALITY/SECTION	VILLAGE
1	EAA	GOMONGO	MANYORO
2	EAB	MANYORO/GOMONGO	MANYORO/GOMONGO
3	EAC	GOMONGO/NATUGNIA	MANYORO/NATUGNIA
4	EAD	APOA-DOONE	NATUGNIA
5	EAE	AKUMBISI/SABISI	NATUGNIA
6	EAF	AKUMBISI/DAZONGO	NATUGNIA
7	EAG	DAZONGO/GERIBISI	SIRIGU/NATUGNIA
8	EBA	GUMONGO	MANYYORO/NABANGO
9	EBB	APIA-GOMONGO/WOLONGO	MIRIGU
10	EBC	GONUM	MIRIGU
11	EBD	GONUM/CHENGO	MIRIGU
12	EBE	WOLONGO	MIRIGU
13	EBF	ZAMPENGO	NABANGO
14	EBG	WOLONGO/PINGO	MIRIGU/NABAMGO
15	EBH	APIIBISI	NABANGO
16	ECA	CHENGO/GONUM	MIRIGU
17	ECB	NAYIRE/KASALINGO	MIRIGU
18	ECC	NATURE/GAYINGO	MIRIGU
19	ECD	DOOSUM	MIRIGU
20	ECE	KANSAA/PUNBISI	MIRIGU
21	ECF	KASAA/ACHULIGOBISI	MIRIGU
22	ECG	KUMBUSINGO/LONGO	MIRIGU/KANDIGA
23	EDA	ABUGUZIO DOONE	NABANGO
24	EDB	GONUM/WOLINGO	MIRIGU
25	EDC	NYONGO	NABANGO
26	EDD	TINTUMSISI	NABANGO
27	EDE	TIKONGO	NABANGO
28	EDF	TINKONGO	NABANGO
29	EDG	NYONGO/BEMBISI	NABANGO
30	EDH	NYONGO/TANGASINIA	NABANGO

31	EEA	ANYOGSI/AMUNTANGA	NATUGNIA
32	EEB	SABISI/ANYOGSI	NATUGNIA
33	EEC	SABISI/GERIBISI/DAZONGO	NATUGNIA
34	EED	MUNTANGA/KOBGO/BOKUM	SIRIGU/NATUGNIA
35	EEE	ZIKADOONE/DAZONGO	SIRIGU
36	EEF	NYANGOLIGO	SIRIGU
37	EEG	NYANGOLIGO/BUGSONGO	SIRIGU
38	EFA	ABILLATIO/TANGASIA	SIRIGU
39	EFB	BUGSONGO/MARKET	SIRIGU
40	EFC	GUNWOKO/MARKET	SIRIGU
41	EFD	GUNWOKO	SIRIGU
42	EFE	TINGINE	SIRIGU
43	EFF	BUSONGO/YORIGO	SIRIGU
44	EFG	WUNGINGO/BASENGO	SIRIGU
45	EFH	BASENGO	SIRIGU
46	EGA	TARIBISI	YUA
47	EGB	TARIBISI/BUSONGO	YUA/SIRIGU
48	EGC	TARIBISI	YUA
49	EGD	AFARIGABISI/YOROGO	YUA/SIRIGU
50	EGE	AFARIGABISI/GINGINGO	YUA
51	EGF	AFARIGIBISI	YUA
52	EGG	GINGINGO	YUA

Central Zone

NO	CLUSTER CODE	LOCALITY SECTION	VILLAGE
1	CAA	BAGWENIA	NOGSENIA
2	CAB/CBD	APIABIA	NOGSENIA
3	CAC/CBB	KABASNIA	NOGSENIA
4	CAD	NIABAWIABIA	NOGSENIA
5	CAE	KABAGNIA	NOGSENIA
6	CAF/CAX	YIPUGNIA	NOGSENIA
7	CAG	NAMOLO ZONGO	NAMOLO
8	CAH	NAMOLO ZONGO	NAMOLO
9	CAI/CAZ	BALOBIA	NOGSENIA
10	CAJ	ICOUR TOWNSHIP 3	NAMOLO
11	CAK/CBE	KUSINGU	NOGSINIA
12	CAL/CAY	NAMOLO PONGO	NAMOLO
13	CAM/CBA	SEBAGNABIA	NOSENIA
14	CAN	NAMOLO PONGO	NAMOLO
15	CAP	APIABIA	NOGSENIA
16	CAQ	BAWIABIA	NOGSENIA
17	CAR	NAVASCO	JANANIA
18	CAS	TONO TOWNSHIP 1	GIA
19	CAT	SABORO LOW COST	SABORO
20	CAU	APIABIA	NOGSENIA
21	CAV/CAW	BAGWEBIA	NOGSENIA

Source: Navrongo Health Research Centre, (2012).