KNOWLEDGE, PERCEPTION AND PRACTICE OF MOTHERS OF UNDER FIVE ON CEREBROSPINAL MENINGITIS IN YOLA NORTH LOCAL GOVERNMENT AREA OF ADAMAWA STATE

BY

Yadika Shapu CHARLES

B.Sc HUMAN ANATOMY, MHPM (UNIVERSITY OF MAIDUGURI)

MATRIC NO: 174217

A PROJECT SUBMITTED TO THE
DEPARTMENT OF HEALTH PROMOTION AND EDUCATION,
FACULTY OF PUBLIC HEALTH, COLLEGE OF MEDICINE,
UNIVERSITY OF IBADAN IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF PUBLIC HEALTH
(HEALTH PROMOTION AND EDUCATION)
OF THE
UNIVERSITY OF IBADAN

APRIL, 2015

DEDICATION

I dedicate this work to God Almighty, for seeing me through the MPH programme. I know that if it wasn't for God, I wouldn't have come this far.

Thank You Jesus!!!

ACKNOWLEDGEMENT

My gratitude first and foremost goes to God, the King of Kings and the Lord of Lords for the grace and strength that he has bestowed upon me all through life and all through my MPH programme. I really wouldn't have been able to make it without Him. Thank You so much Father for always hearing and answering me when I pray! My gratitude also goes to my family for the enormous support they have shown me all through this programme, for the constant words of encouragement and prayer backings, I say thank you. I particularly celebrate my parents, Mr. and Mrs. Charles Shapu for their care and support. I also appreciate my brothers and sisters; Ruth, Bitrus, Serah, Samson, and Daniel, you guys are just the best ever. I pray that God almighty will continue to strengthen the bond of love amongst us.

I would like to appreciate my project supervisor, Dr. Frederick O. Oshiname, who is not only a supervisor, but a father and a good man; thank you sir for your profound investment into this research work. I also greatly appreciate all the lecturers and staff of the Department of Health Promotion and Education, starting from the Head of Department, Prof O. Oladepo, to the other lecturers in the department: Prof A.J. Ajuwon, Dr (Mrs.) O.S Arulogun, Dr O.E Oyewole, Mrs.A.T Desmenu, Mrs. M.M Oluwasaanu, Mr. M.A. Titiloye, and Mr. F. Dipeolu. I also thank Baba 'Egbayi', Uncle Lanre, Uncle Yemi, Mr .O.O Bello and MR P. Ayeni. Thank you all so very much for your kind investment of time and energy. I especially thank Mr. J. Imaledo, for his substantial professional advice and constant support he gave me throughout the period of this program.

I celebrate my love, the mother of my unborn kids Barr (in view) Jemimah Ahmadu Msheliza for your support, encouragements, prayers, love and understanding you have shown to me from the day I set my eyes on you. I pray that the good God will keep us and grant us a happy matrimonial home in Jesus name Amen. My heart of Thanks goes to all my friends; I most appreciate the likes of Linkx, Cybug, Ziros, IB-hena, Nathan, John, Benji, Akila. You guys are just too wonderful. I thank God for using you guys to make me achieve this dream.

To all my classmates and colleagues, it was very enriching and exciting meeting you. The likes of Kefe, Yetunde, Tobi, Anu, I have taken a whole lot from the experience and I have learnt a whole lot more from you all and for that I am very grateful.

To the world…watch out for us!!!

ABSTRACT

Cerebrospinal Meningitis (CSM) epidemics mostly affect under-5 children and contribute significantly to under-five mortality rate in Nigeria. There is little study conducted in Northern Nigeria to ascertain the knowledge, practice and perception of mothers of Under-5 on CSM. This study was conducted to explore knowledge, perception and practice of mothers of under-five on cerebral spinal meningitis in Yola North Local Government Area (LGA) of Adamawa state.

The study was cross-sectional in design. A three-stage sampling technique which involve random selection of 6 ward out of the 10wards in the local government, proportionate selection of 10 communities from the six wards, and random sampling of 401 consenting respondents. Mothers were interviewed using a validated interviewer-administered semi-structured questionnaire to collect information on knowledge, perception and practice. Knowledge was assessed on a 29-point scale and score >19 was categorized as good, (15-19) categorized as fair while scores <15 was categorized as poor. Data from the questionnaire were analyzed using descriptive statistics, chi-square test and multivariate analyses at p=0.05.

Respondents' age was 31.23±10.37 and majority (70.3%) of the respondents was ≤35 years. Predominantly 72.5% of the respondents were Muslims. Few (30%) of the respondents had tertiary education, 28.4% had secondary education, while those that had primary education and no formal education were of almost equal proportion (20.9%). Majority of the respondents (82.0%) knew that overcrowding, may lead to transmission and spread of CSM in a community. Mean Knowledge score was 13.5±4.9 categorized as good, fair and poor with 7.7%, 39.9% and 52.4% respectively. Marital status, religion, educational status and monthly income of respondents had significant association between levels of knowledge of respondents about CSM. Respondents' perception on the possibility of their children getting CSM showed that only 3.6% felt it was highly possible while those that felt the possibility was low were 21.8%, 17.2% felt "Never" and 57.4% "Didn't know". There was an almost equal perception among respondents who agreed (46.3%) and those who disagreed (43.7%) that malaria is more serious compared to CSM, although majority (81.2%) agreed that CSM is deadly. Few respondents (14.4%) agreed that it is witches and wizards that determine who gets CSM. Few (23.7%) of the respondents agreed that CSM immunization is against their religious doctrines, 48.3% disagreed and 28%

were undecided. Respondents who reported that their children had ever received immunization against CSM accounted for (54.4%) while only (37.3%) reported that their children had immunization 6-7 months preceding this study with the majority (86.0%) receiving CSM vaccine from government owned hospitals, only 59.6% mothers had ever received immunization against CSM.

Mothers of Under-5 children had poor knowledge of CSM, very few of the mothers perceived they were susceptible to the disease and the practice of immunization against CSM for children less than 5 years was poor. Therefore, the need to implement a preventive behavioral communication change programme aimed at increasing knowledge and improving best preventive practices that will reduce future occurrences of outbreak is recommended.

Keywords: Cerebrospinal meningitis, Knowledge, Perception, Adamawa and Mothers of under-5

Word count: 487

CERTIFICATION

This is to certify that this study was carried out by **CHARLES,** Yadika Shapu of the Department of Health Promotion and Education, Faulty of Public Health, College of Medicine, University of Ibadan, Nigeria.

SUPERVISOR

Dr. Frederick O. Oshiname

B.Ed, (Benin), MPH, (Ibadan), M.A. (CWRU, Cleveland), PhD, (Ibadan)

Senior Lecturer

Department of Health Promotion and Education,

Faculty of Public Health, College of Medicine,

University of Ibadan

TABLE OF CONTENTS

Page

CHAPTER THREE: METHODOLOGY

CHAPTER FOUR: RESULTS

CHAPTER FIVE: DISCUSSION, CONCLUSION, RECOMMENDATIONS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ABM	Acute Bacterial Meningitis
AIDS	Acquired Immuno-Deficiency Syndrome
CDC	Centre for Disease Control
CFR	Case Fatality Rate
CSM	Cerebrospinal Meningitis
CSF	Cerebrospinal Fluid
FGD	Focus Group Discussion
HIV	Human Immunodeficiency Virus
PCR	Polymerase Chain Reaction
RA	Research Assistant
SSA	Sub Saharan Africa
SPSS	Statistical Package for Social Sciences
U-5	Under Five
WHO	World Health Organization
YN	Yola North

OPERATIONAL DEFINITION OF TERMS

Knowledge: This can be defined as fact of knowing about something i.e. general understanding or familiarity with a subject, place, situation etc

Perception: the way in which something is regarded, understood or interpreted

Practice: the application or use of ideas, beliefs, theories or methods

Mothers of Under-five: Women of child bearing age who have child/children aged less than five years.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Cerebrospinal Meningitis (CSM) is an acute medical emergency and an important health problem in Nigeria. Epidemics of meningitis occur periodically in Northern parts of Nigeria (Rabasa, et al., 2003). Many researchers have however, reported sporadic outbreaks of meningitis in different parts of the country. High incidence of meningitis occurs during the hot, dry season; this is the usual period of epidemics in Northern Nigeria (Rabasa et al., 2003). Greenwood et al. (1979) reported meningococcal epidemics in Zaire in 1977. The report by Rabasa et al. (2003) in Maiduguri on epidemic meningococcal meningitis showed that the peak incidence of infection was in March, which was the peak of the dry season. Reports from Zaria and Maiduguri support the fact that meningococcal epidemics in Northern Nigeria usually occurs during the hot dry season (Rabasa et al., 2003). The low humidity experienced during dry season promotes breaches in the nasal mucosa thus creating a portal of entry for microorganisms into the blood stream (Odedina and Emumwen, 2008).

Meningitis is an important cause of morbidity and mortality especially in low-resource settings and many parts of the world (Theodoridou, 2007). In sub-Saharan Africa, the meningitis belt (areas with frequent epidemics of meningococcal meningitis) has been characterized by high and seasonal incidences of bacterial meningitis (Micheal et al., 2012). Despite the progress being made in treating the condition, the mortality rates continue to be high, ranging between 2% and 30% globally (Chavez-Bueno and McCracken, 2005). In Ghana, the mortality rate of meningitis has been estimated to range from 36% to 50% (Holliman, 2007).At least 1.2 million cases of meningitis are estimated to occur with estimated annual deaths of 170,000 (WHO, 2011). Complications such as epilepsy, mental retardation, deafness and other related neurological defects have been observed in 10% to 20% of those who survive (Edmond, 2010). According to Edmond (2010), the estimated median risk of at least one major or minor sequel from bacterial meningitis after discharge from the hospital is 19.9% (range = 12.3–35.3%). In middle and low-income countries, acute bacterial meningitis remains the fourth leading cause of disability (Edmond, 2010). The prevalence of bacterial meningitis in these countries is higher compared to the figures in developed countries (Edmond, 2010).

Bacterial meningitis is caused by a number of organisms but beyond the neonatal period, over 90% of infections are caused by Streptococcus pneumoniae (S. pneumoniae), Haemophilus influenza (H. influenza) and Neisseria meningitidis (N. meningitidis) ((Edmond, 2010)). Over the last two decades however, the causative agents of meningitis has changed with the introduction of new highly effective vaccines (Renner, 2007). Haemophilus influenzae type b (Hib) used to be a common cause of bacterial meningitis worldwide before the Hib vaccines (Martin, 2004). However more recently, S. pneumoniae and N. meningitidis have become the major organisms causing meningitis. In countries with high HIV prevalence, Cryptococcus neoformans could also be significant causative agent. In many African countries including Nigeria which lie within the meningitis belt, epidemic cases of acute bacterial meningitis caused by different subtypes of N. meningitidis and S. pneumoniae have been reported (WHO, 2011). Cerebrospinal meningitis has a strong relationship with certain factors which are categorised into socioeconomic factors, social behaviour, climate and environmental factors, demography, respiratory tract disease and geographical localization. In some countries of the world there are sporadic occurrences of the disease (WHO, 2012), which implies that the meningococcal bacteria is endemic there but at low level. There is an area that spans through sub-Saharan Africa called the "meningitis belt" where large epidemics occur regularly (WHO, 2012).

Communicable diseases including CSM are significant causes of morbidity and it is generally accepted that immunization against common specific infections represent a significant breakthrough in the control and eventual eradication of these infections world-wide (Ogunmekan, 2007). Experience has shown that routine immunization remains the cheapest, most cost effective, efficient and sustainable way to reduce child morbidity and mortality. Active immunization of infants and children against vaccine preventable diseases has therefore been regarded as an effective means of disease prevention and health maintenance (Omotara et al., 2012). Alto (2006) in her study of polio immunization in Nigeria, remarked that Muslim leaders believed that the vaccine contained contraceptive agents and other contaminants with which the Western world hoped to control population growth. Babalola and Aina (2004) also pointed out that inequitable access to routine immunization in Nigeria has been attributed to fear and confusion about the intent and purpose of immunization.

Figure 1.1 Map: showing African Meningitis Belt

According to Singh and Yadav, (2001), 13 million people die from infectious diseases every year worldwide and over half of these people are children under the age of five. Most of the deaths could be prevented with routine immunization. The 20th century witnessed dramatic decline in under-five mortality in almost all countries of the world, regardless of initial levels, socio-economic circumstances and development strategies. However, more than 10.8 million children younger than 5 years die every year mostly from preventable causes (Black et al., 2003). According to Ahmed et al., (2000) six countries accounted for 50% of worldwide deaths in children younger than five and 42 countries accounted for 90 %. Child mortality varies among world regions, and these differences are becoming wide. In 2000, there were 175 deaths per 1000 live births in Sub-Saharan Africa and only 6 per 1000 in the industrialized countries, which are a 29 fold difference (Ahmed et al., 2000 and Black et al., 2003).

In 2000, as part of the millennium development goals for health, nations pledged to ensure a two-third reduction in child mortality by 2015, from the base year 1990 (United Nations, 2001). This includes a reduction in mortality due to CSM. It is important to note that diphtheria, poliomyelitis, measles, pertursis, tetanus, tuberculosis, hepatitis B, yellow fever and cerebrospinal meningitis which constitute the "Vaccine preventable diseases" are amongst the many causes of high infant mortality rate (Ogunmekan, 2007). Obionu (2001) has opined that they are indicators of the low socio-economic and health status of the countries where they occur.

Cerebrospinal Meningitis is a contagious respiratory disease. Clinical CSM disease was first described by Vieusseux in 1805 in Geneva, Switzerland while the causative agent, *Neisseria meningitidis* was identified by Austrian bacteriologist Anton Weichselbaum in 1887 (WHO, 1998). Since then, the disease has occurred in epidemic proportions in other parts of the world including China, Vietnam, Mongolia, Saudi Arabia and Yemen, Europe and the Americas (WHO, 2003). The first report of a meningitis epidemic in Africa occurred in 1840. African epidemics thereafter became much more common in the 20th century in the African meningitis belt (Greenwood, 2006). In Ghana, CSM cases have been recorded in all its regions, with the Northern region recording the highest cases (Micheal et al., 2012).

Bacterial meningitis is an infection or inflammation of the protective membranes covering the brain. Several different bacteria are however said to possess the potential to cause bacterial meningitis and *Neisseria meningitidis* is one of the most important because of its potential to cause epidemics (WHO, 2003). The other bacteria, that can cause bacterial meningitis include S. pneumoniae and H. influenzae type b. Bacterial meningitis is now said to be among the top 10 infections that cause death worldwide (Grimwood et al., 2000). Twelve subtypes or serogroups of N. meningitidis have been identified and four (N. meningitidis A, B, C and W135) are recognized to cause epidemics (Moore, 1992).

The bacteria causing CSM have been identified to be transmitted from person to person through droplets of respiratory or throat secretions (WHO, 2003). The bacteria can be carried in the pharynx and it overwhelms the body's defenses. This allows infection to spread through the bloodstream and to the brain. Conditions that favor transmission of the bacteria are densely populated rooms with inadequate ventilation, overcrowding at public events including worship centres and markets, as well as population movements during pilgrimages (Molesworth et al., 2002). Incubation period ranges from two to ten days with an average of 4 days, and *N. meningitidis* does not infect animals but only humans (WHO, 1998). Climatic conditions characterised by dry winds, dust storms, low humidity and cold nights considerably diminishes the local immunity of the pharynx thereby increasing the risk of occurrence of meningitis (Akande and Olu, 1998).

Cerebrospinal Meningitis has varying symptoms and the most common ones are stiff neck, high fever, sensitivity to light, convulsion, headaches and vomiting (WHO, 1998). Even when the disease is diagnosed early and adequate therapy instituted, 5% to 10% of patients still die, typically within 24–48 h of onset of symptoms (WHO, 2003). In the event that a person survives, bacterial meningitis may result in brain damage, hearing loss or learning disability in 10% to 20% of survivors (WHO, 2003).

In 1996, Africa experienced the major recorded outbreak of epidemic meningitis in history, with over 250,000 cases and 25,000 deaths registered. Between that crisis and 2002, 223,000 new cases were reported to the World Health Organization (WHO, 2000 and WHO, 2005). The countries most affected during this period were been Burkina Faso, Chad, Ethiopia and Niger.

In 2002, the outbreaks which occured in Burkina Faso, Ethiopia and Niger were said to have accounted for about 65% of the total cases reported on the African continent. Furthermore, the meningitis belt has been observed to be extending further south. In 2002, the Great Lakes region of east Africa was affected by outbreaks in villages and refugees camps which caused more than 2200 cases, including 200 deaths (WHO, 2005).

1.2 Problem Statement

Cerebrospinal Meningitis 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 (Apwah, 2013). In the Yola North LGA which lie in the northern part of the country and within the Meningitis Belt of Africa, CSM continues to be a public health burden. In March 2009, CSM outbreak was reported in Yola North LGA which spread to about 23 LGAs of the state and claimed 13 lives within two days (Vanguard 2009). Cerebrospinal meningitis contributes significantly to under-five mortality rate in Nigeria. Young children have the highest risk for meningococcal disease and are therefore more affected during CSM outbreak (CDC, 2014).

The worrying phenomenon of meningitis has prompted expansive studies on especially the study area and the northern parts of the Nigeria. While most of these studies have basically explained the clinical, immunological and some other aspects of its epidemiology, (Odedina 2008; Ogunlesi et al., 2005;), there is scarcity and incomprehensive literature on knowledge, perception and practice of cerebrospinal meningitis especially with reference to mothers of children aged less than five years. Mothers of children aged less than five years have important role to play in preventive activities including immunization relating to CSM. Their roles are equally indispensible in the care of under five children who contact the disease. In order to play these roles effectively, their knowledge of the disease, practices and other predisposing factors

relating to the disease are essential. However, mothers of under five knowledge, perception and practice concerning the disease which can be used as baseline in designing educational programmes for involving them more effectively in the prevention and management of the disease have not been well investigated.

It is against this background that this study was designed to assess the knowledge, perception and practice of mothers of children under-five on cerebrospinal meningitis. The study was also set to identify the factors that can hinder or promote the prevalence of the disease among mothers of under five in Yola North LGA.

1.3 Justification of the Study

With the growing burden of disease on the health system, the need to adopt preventive strategies that will reduce the occurrence of communicable disease with high fatality rate cannot be overemphasized. Cerebrospinal meningitis continues to pose a threat to the entire population especially those who constitute the African meningitis belt where frequent epidemic of CSM was recorded. Result obtained from this study will be useful for designing cerebrospinal meningitis educational interventions to mothers to better equipped them and improve both their preventive and management skills of CSM. The findings from this study will also be useful in formulating policies relating to ways of mobilizing mothers to be involved in cerebrospinal meningitis control and prevention. This will in turn reduce mortality rate caused by CSM, improve the quality of life of citizens and increase the life expectancy of the population at large.

1.4 Research Questions

This study was designed to answer the following questions:

1. What is the level of knowledge of mothers who have children aged less than five years concerning cerebral-spinal meningitis?
2. What are the perceptions of mothers of under-five relating to cerebral-spinal meningitis?
3. What are the practices of mothers of under-five that could be linked to cerebral-spinal meningitis?
4. What are the factors that can hinder or promote the prevalence of cerebral-spinal meningitis in Yola North LGA?

1.5 Research Objectives

Broad Objective:

The broad objective of this study was to explore the knowledge, perception and practice of mothers of under-five on cerebral spinal meningitis in Yola North L.G.A. of Adamawa state.

The specific objectives:

The specific objectives of the study were to:

1. Assess the knowledge of mothers of under five on cerebral-spinal meningitis.
2. Document the perception of mothers of under-five about cerebral-spinal meningitis.
3. Identify the practices of mothers of under-five that could be linked to cerebral-spinal meningitis.
4. Identify the factors that can hinder or promote the prevalence of cerebral-spinal meningitis among mothers of under-five.

1.6 Study Variables

The variables to be studied in this research include Knowledge, Perception and practices of cerebrospinal meningitis among mothers of under five. The other variables relate to factors which can influence the occurrence of CSM among children aged less than five years in Yola North LGA.

CHAPTER TWO

LITERATURE REVIEW

2.1 Nature, Causes, Symptoms, Treatment and Prevention of Cerebrospinal Meningitis.

Cerebrospinal Meningitis could be very severe. While most people with meningitis recover, it can however cause serious complications, such as brain damage, hearing loss, or learning disabilities (Thigpen et al., 2011). There are several pathogens that can cause bacterial meningitis. Some of the leading causes of bacterial meningitis in the United States for instance include *Haemophilus influenzae*, *Streptococcus pneumoniae, group B Streptococcus, Listeria monocytogenes,* and *Neisseria meningitidis.* In the United States, about 4,100 cases of bacterial meningitis, including 500 deaths, occurred each year between 2003–2007 (Thigpen et al., 2011).

Common causes of bacterial meningitis vary by age group. The common pathogens that cause the disease among new born include group B streptococcus, Escherichia coli, Listeria monocytogenes. Among infants and children include Streptococcus pneumonia, Neisseria meningitides, Haemophilius influenza type b. similarly, Neisseria meningitides and streptococcus pneumonia are the common pathogen that cause meningitis in adolescent and yong adults. In older adults, streptococcus pneumonia, Neisseria meningitides and Listeria monocytogenes are the common cause of meningitis (Thigpen et al., 2011).

Everyone is at the risk of CSM. Although, several factors influences peoples vulnerability to CSM; these include Age, community setting, certain medical conditions, working with meningitis causing pathogens and travelling (CDC, 2011).

Experience has shown that infants are at higher risk for bacterial meningitis than people in other age groups (CDC, 2011) Infectious diseases tend to spread more quickly where larger groups of people gather together. College freshmen living in residence halls and military personnel are at increased risk for meningococcal meningitis caused by *Neisseria meningitides* (Lindsey et al., 2003)**.** Certain medical conditions such certain diseases, medications, and

surgical procedures may weaken the immune system thereby leading to increase risk of meningitis. (Stephens et al., 2007)

Microbiologists who are routinely exposed to meningitis-causing pathogens in the laboratory are at increased risk of infection. Travelling is an important risk factor. Persons travelling to meningitis belt in sub-Saharan Africa could be at risk for meningococcal meningitis, particularly during the dry season. Also at risk for meningococcal meningitis are travelers to Mecca during the annual Hajj and Umrah pilgrimages (Wilder-Smith, 2008).

The germs that cause bacterial meningitis can be contagious (Biluka and Rosenstein, 2005), however most of the bacteria that cause meningitis are not as contagious as viruses that cause the common cold or the flu (Biluka and Rosenstein, 2005).

Sometimes the bacteria that cause meningitis spread to other people. This usually happens when there is close or long contact with a sick person in the same household or daycare center (Thigpen et al., 2011). Transmission can also take place when one has direct contact with a patient's oral secretions. People who are as close contacts of a person with meningococcal or Haemophilus influenzae type b (Hib) meningitis are at higher risk of getting disease and may need preventive antibiotics (Thigpen et al., 2011). Close contacts of a person with meningitis caused by other bacteria, such as Streptococcus pneumoniae, do not need antibiotics (Thigpen et al., 2011). Healthy people can carry the bacteria in their nose or throat without getting sick. Rarely, these bacteria can invade the body and cause disease. Most people who 'carry' the bacteria never become sick. (Thigpen et al., 2011). The rapid spread of the disease is due to the ease in which the bacteria are transmitted. Droplets of respiratory or throat secretions transmit the bacteria through methods such as kissing, sneezing, coughing, and sharing of eating or drinking utensils (Amy and Sonricker, 2009).

Every disease has its peculiar sign and symptoms which could be used to facilitate diagnosis. Generally pregnant women are at increased risk of developing listeriosis (caused by the bacterium Listeria monocytogenes). Pregnant women with Listeria infection typically experience fever and other non-specific symptoms, such as fatigue and aches (Thigpen et al.,

2011). Infections during pregnancy can lead to miscarriage, stillbirth, premature delivery, or life-threatening infection of the newborn, including meningitis (Thigpen et al., 2011).

Pregnant women who test positive for group B Streptococcus can pass the bacteria to their baby, most often during labor and birth. A newborn infected with group B streptococcus bacteria can develop meningitis or other life-threatening infections soon after birth (Thigpen et al., 2011)

Meningitis infection could manifest by a sudden onset of fever, headache, and stiff neck. Meningitis can have symptoms such as Nausea, Vomiting, Increased sensitivity to light (photophobia), and Altered mental status (confusion).

The symptoms of bacterial meningitis can appear quickly or over several days. Typically they develop within 3-7 days after exposure. Babies younger than one month old are at a higher risk for severe infections (Thigpen et al 2011). In newborns and infants, the classic meningitis symptoms of fever, headache, and neck stiffness may be absent or difficult to notice. The infant may appear to be slow or inactive (lack of alertness), irritable, vomiting or feeding poorly. In young infants, doctors may look for a bulging fontanelle (soft spot on infant's head) or abnormal reflexes, could be signs of meningitis.

Bacterial meningitis can be treated effectively with antibiotics and it is important that treatment be started as soon as possible (Bilukha and Rosenstein, 2005). Appropriate antibiotic treatment of the most common types of bacterial meningitis should reduce the risk of dying from meningitis to below 15%. The risk however remains higher among young infants and the elderly (Bilukha and Rosenstein, 2005).

The most effective way of protecting oneself and children against certain types of bacterial meningitis is to complete the recommended vaccine schedule. There are vaccines for the following types of bacteria that can cause meningitis: Neisseria meningitidis (meningococcus), Streptococcus pneumoniae (pneumococcus), and Haemophilus influenzae type b (Hib) (Thigpen et al 2011).

Antibiotics could be recommended for close contacts of people with meningococcal meningitis. Antibiotics may also be recommended for the entire family if a family member develops severe Hib infection and there's a high-risk person in the house (Amy and Sonricker, 2009). This is to decrease the risk of spreading disease to other people in the family or household.

Epidemic meningococcal meningitis is a major public health problem still affecting tropical countries, particularly in Sub-Saharan Africa, which lies within African meningitis belt (Berkley et al., 2001). Repeated large scale epidemics of CSM have been reported in northern Nigeria for the past four decades and it is one of the important causes of morbidity and mortality in these regions. Mortality from the CSM remains high despite advances in treatment modalities. *Neisseria meningitides* serogroup A have been the major cause of large scale epidemics in tropical countries. . It was reported that about 10% of patients who had the disease will not survive despite effective treatment. (Petter and Mercel, 2005). Bacterial meningitis in the African meningitis belt remains one of the most serious threats to health.

More than one million cases of acute bacterial meningitis (ABM) amongst adults and children occur annually in sub-Saharan Africa (Sigauque et al., 2008). The adverse effect of a typical case that is not treated is 80%. Meningococcal meningitis disease is a major cause of death and sorrow all over the world (Peltola, 1983). The developing countries in the world have accounted for the large estimates of the occurrence of meningococcal disease; the proportion of carriers of the disease and those that have been hit by it is between 1:100 during epidemics to 1:1,000 in endemic areas (Greenwood et al., 1984), it means that people can build up a natural immunity of this disease in region where there is high risk of vulnerability to the causative agent. Majority of the people travelling from regions where the endimicity is low to high endemic regions most especially those people living in Europe but are visiting some areas in Africa, Asia, parts of South America and Middle East are vulnerable to meningococcal disease (Wilder-Smith, 2007). The highest reported meningococcal meningitis disease epidemic in the history of the world was in 1996 and most of the cases were found in Africa (Forgor, 2007).

2.2 Prevalence and Incidence of Cerebrospinal Meningitis

Cerebrospinal meningitis is an infectious disease due to the bacteria *Neisseria meningitis*. It appears around 200 years in Africa (Egypt and Sudan) and probably spread to West Africa mainly by pilgrim's migrations (Greenwood, 1999). Neisseria meningitis is highly contagious

and a person-to-person aerial transmission occurs through respiratory and throat secretions. Bacterial meningitis results in an estimated 170,000 deaths per year worldwide (WHO, 2008). Epidemic meningitis due to Neisseria meningitidis is one of the most common contributors to this global health threat (WHO, 2008). Despite antimicrobial therapy and intensive care, case-fatality ratios remain high, and 10%-20% of survivors develop permanent severe sequelae. Most of the epidemic meningitis risk occurs among countries situated in the African meningitis belt, extending from Ethiopia to Senegal (WHO, 2005. and Molesworth et al., 2002), which experiences epidemics during the hot, dry, and windy months from December through April. Because of a lack of affordable conjugate vaccines, African countries in the meningitis belt have adopted a strategy of reactive immunization. Although this strategy may prevent some cases, implementation of vaccination only once an epidemic has been declared will not prevent most cases, and use of polysaccharide vaccines does not interrupt carriage and transmission and does not leave vaccinated populations with long-term immunity.

Recent insights into epidemiology of infectious diseases have clearly shown the interest of associating empirical with theoretical studies in order to better describe and understand the mechanisms of disease transmission and epidemics emergence, therefore enabling better control of their impact on human health (Duncan et al., 2000). Epidemics of meningitis occur worldwide but the "meningitis belt" of the Africa Sahel region, which extends from Mali and Côte d'Ivoire in the west to Sudan and Ethiopia in the east, has the greatest incidences of cases, with large epidemics and high mortality rates. Different serotypes of N. meningitis are well known as serotypes A (the dominant), C, Y and W135. Epidemics occur throughout Africa in the dry season, coincide with periods of very low humidity and dusty conditions, and disappear with the onset of the rains (Greenwood et al., 1984 and de Chabalier et al., 2000). Climatic conditions, social interactions (e.g. pilgrims), transmission of more virulent serotypes (e.g. recent spread of the W135 serotype in Africa), and susceptibility of populations constitute the major favourable drivers of resurgence and dispersion of the disease.

The epidemiology of bacterial meningitis in the African ‘meningitis belt’ changes periodically. In order to design an effective vaccination strategy, Jean et al., (2013) have examined the epidemiological and microbiological patterns of bacterial meningitis, and especially that of meningococcal meningitis, in Niger during the period 2008–2011. During this period a mass

vaccination campaign with the newly developed meningococcal A conjugate vaccine (MenAfriVac®) was undertaken. Cerebrospinal fluid samples were collected from health facilities throughout Niger and analysed by culture, seroagglutination and/or speciation polymerase chain reaction, followed by genogrouping PCR for Neisseria meningitidis infections. A sample of strains were analysed by multi-locus sequence typing. The result of the study shows that N. meningitidis serogroup A cases were prevalent in 2008 and 2009 [98.6% and 97.5% of all N. meningitides cases respectively]. The prevalence of serogroup A declined in 2010 [26.4%], with the emergence of serogroup W Sequence Type (ST) 11 [72.2% of cases], and the serogroup A meningococcus finally disappeared in 2011. The geographical distribution of cases N. meningitidis serogroups A and W within Niger is described. They concluded that the substantial decline of serogroup A cases that has been observed from 2010 onwards in Niger seems to be due to several factors including a major polysaccharide A/C vaccination campaign in 2009, the introduction of MenAfriVac® in 10 districts at risk in December 2010, the natural dynamics of meningococcal infection and the persistence of serogroup A sequence-type 7 for about 10 years. The emergence of serogroup W strains suggests that there may be a need for serogroup W containing vaccines in Niger in the coming years.

Another study was also conducted by Mado et al. (2013) to determine the pattern of epidemic cerebrospinal meningitis in children at Federal Medical Centre Gusau. This study was a retrospective study carried out in children aged six months to 12 years admitted into Emergency Paediatrics Unit (EPU) with a diagnosis of cerebrospinal meningitis within the period January to May, 2009. The results of the study show that seventy- seven children with epidemic CSM were admitted and managed in EPU from January-May 2009. Mado concluded that *Neisseria meningitides* sero group A CSM is becoming the disease of young infants, and stresses the need for inclusion of CSM vaccine in early infancy in routine immunization policy, in areas within the meningitis belt in \Sub-Saharan Africa.International cooperation in Public Health and cross-disciplines studies are highly recommended to hope controlling this infectious disease.

2.3 The Global Nature of Cerebrospinal Meningitis

After the 2nd World War, the extensive outbreaks of meningococcal disease inflicted majorly the countries in the sub-Saharan areas within the “meningitis belt” (WHO, 2000). Regularly the

disease devours part of these countries. Over 340,000 occurrences and more than 53,000 casualties were accounted within 1951-1960 from this region of the globe when the total number was just 35 million. On the other hand, epidemics of meningitis are a global problem and can touch any area in the world in spite of the climate. In the 1960s, the disease was seen as a very severe health risk in some of the tropical countries but not a severe health risk in North American and countries in Europe, but this conception changed in the period within 1970s (WHO, 2000).

A report from WHO (1998) indicates that meningococcal epidemics manifest all over the world, and there is an increase in the occurrences of the disease within some countries of America, Europe and Asia displaying an epidemiological impression described by with frequent epidemics and consistent endemic sporadic occurrences of the disease. Between 1970 and 1971 there were cases in Italy, Portugal, Spain, Yugoslavia and Belgium, Argentina was in 1974, United Kingdom 1974 - 1975, and France was 1973 and 1978 with a sharp increase of incidence. There were outbreaks of M. meningitis at Finland, Mongolia and the USSR in the year 1973 and 1974, Norway, from 1975 all through to 1980s. Algeria and Chile in 1979, Vietnam and Rwanda were 1977 - 1978, with frequent outbreaks also reported from Brazil. There was an epidemic tide in 1980s of meningococcal disease which diffused all around the regions in Asia (India) about 6,133 outbreaks in 1985 in New Delhi; case fatality rate (CFR) was 13%, and 25% of cases urgency in the newly born. In Nepal (Katmandu valley) from 1982 – 1984, was about 103 occurrences in 100,000 populations, and in Africa specifically cases were found in Mali, Nigeria, Burkina Faso and Niger (WHO, 1998).
The epidemics of Meningococcal disease were also accounted in Cuba in 1982 to 1984 and Chile was in 1986 and 1993 (Leimkugel et al., 2009).

In a study of the spread of Meningococcal meningitis, Pollard (2001) showed that the outbreaks of the disease globally are not the same. Some regions have low endemicity, like the industrialized regions have a yearly outbreak amount of about 1-12 in 100,000. There is a very strong contrast with the yearly outbreak amount in the developing countries like the “African Meningitis Belt”, which is as high as 25 in 100,000. Major epidemics arises vary rapidly, and peaks within some weeks, and it is due to the pattern of the transmission of the disease which is

from one person to another person through the droplets of respiratory or the secretions from the throat of the carriers (Greenwood, 1984). Frequency rates usually remain high for 1 - 2 years after there was an epidemic. The epidemiology of meningitis is always changing, it should be noted that places where the meningitis is endemic are also vulnerable to regular epidemics. When there is an attack, rates reach up to 1,000 per 100,000 (Greenwood, 1984).

While epidemics of meningitis occur throughout the world, the greatest burden of the disease is in the "meningitis belt" of the Sahel of Africa, where widespread epidemics occur about once a decade, but not predictably. In addition to a steadily invariant fatality rate of 10%, about 10% of cases result in sequelae (WHO, 2012), both of which have long-term economic impacts on the households of those afflicted. Treatment often results in significant health care costs to the households. These factors suggest that meningitis poses a major risk to livelihoods in resource poor settings (Horton, 2005) like the Sahel. Costs of illness studies, related to a variety of diseases including meningitis, have reported that impoverishment results when households are forced to spend 40% of their non-food expenditures on medical expenses (Onwujekwe et al., 2012). Even much smaller expenditures on health care have been reported to be financially disastrous to households (Su et al., 2006).

2.4 Knowledge Relating to Cerebrospinal Meningitis

Lindsey et al., (2003) conducted a study to determine what college students actually know about meningitis, how many have received the vaccine before entering college or during college years, and what prompted them to receive the vaccine. The design used for the research was descriptive. There were 484 students that were surveyed. Only 45% had been vaccinated for meningitis and 55% of students surveyed had not been vaccinated. Only 23% of students believed that they were at high risk for contracting meningitis in relation to 83% who did not believe they were at a high risk. The findings also showed that education and business majors (79%) were more likely to receive the meningitis vaccination than science majors (76%) and art majors (61%). The findings also indicated that more science majors (45%) believed they were at high risk for contracting meningitis than education/business majors (42%) and art majors (22%). They concluded that education is a vital part to the prevention of meningitis. Most of the students who received the vaccine did so because of school requirement. Therefore, more education needs to be done by nurses and professors to equip students about the risks of the

disease and the benefits of the vaccination. Overall knowledge of the disease was low and many students were not aware of why they had received the vaccine. He then suggested that more education is needed to be done by nurses and professors to equip incoming college students and current college students about the risks, signs and symptoms, and transmission of this disease process as well as the importance of the vaccination

In another study concerning major causative organisms of purulent meningitis, such as *Haemophilus influenzae* and *Streptococcus pneumoniae* by Sunakawa (2005), questionnaire was used all over Japan medical institutions in Japan to investigate patient background factors, sequelae and causal relationships with the causative organisms. Responses from 84 institutions in various parts of Japan showed that diagnostic names of 227 patients from whom the questionnaire were recollected were as follows: Purulent meningitis 138 cases (patient under 15 years old; 134 cases); purulent meningitis and sepsis, 58 cases; sepsis, 28 cases; and others, 3 cases. The causative organisms for the patients with meningitis and meningitis + sepsis were as follows: *Haemophilus influenza* (132 patients) and *Streptococcus pneumonia* (44 patients). The result also claimed that with respect to age distribution among the patients with meningitis and those with meningitis + sepsis, the number of the patients of the age younger than 1 year old was more than twice larger than that of one-year-old patients. The percentage of the cases in which sequelae remained was 35.9% among the cases caused by Streptococcus pneumoniae and 13.4% among the cases caused by Haemophilus influenzae. A significant difference was observed between the bacterial strains (p=0.0025). The major initial symptoms observed were high fever, vomiting, consciousness disorder, drowsiness and poor sucking. The percentage of the patients with remaining sequelae was significantly high among the patients who exhibited convulsion in the early stage after the onset. Finally, as to the relationship with administration of dexamethasone, sequelae remained in 40.0% (10/25) of the patients who did not receive dexamethasone, and 17.3% (23/133) of the patients who received the drug. The percentage of the patients with remaining sequelae was significantly low among the patients who received dexamethasone (p=0.0043).

In a study conducted by Odedina (2008), cerebrospinal fluid (CSF) samples from one hundred and fifty children suspected of bacterial meningitis in the children's ward of the Federal Medical Centre, Bide, between January and December 2001 were studied. The children were

aged twelve and below. Only twenty five (16.7%) of the samples were microbiologically proven. The result of the study shows that the commonest pathogens isolated were Neisseria meningitides (13), Escherichia coli (7) and Streptococcus pneumonias (4). The three bacteria constituted 92.3% (24 of 26) of the detected organisms from CSF either by culture, or by direct smear or both. Antimicrobial susceptibility to Ofloxacin by E. coli and Str. pneumonias was 100% and 87% by N. meningitides. Susceptibility of N. meningitides and Str. pnuemoniae to penicillin was 0%. All the three main organisms showed poor susceptibility to Streptomycin. N. meningitis was 83.3% susceptible to Gentamicin while only one isolate each of the other organisms were tested on it and were found to be susceptible except E. coli that was resistant.

Michael et al., (2012) retrospectively reviewed laboratory records of all patients suspected of bacterial meningitis who underwent a lumbar puncture from January 1, 2008 to December 31, 2010. Data were retrieved from laboratory record books and double entered into a Microsoft® excel spreadsheet. Records of 4,955 cerebrospinal fluid samples were analysed. Of these, 163 (3.3%, 95%CI: 2.8% to 3.8%) were confirmed meningitis and 106 (2.1%, 95%CI: 1.7% to 2.6%) were probable meningitis cases. Confirmed meningitis cases were made up of 117 (71.8%) culture positive bacteria, 19 (11.7%) culture positive Cryptococcus neoformans and 27(16.6%) Gram positive bacteria with negative culture. The most prevalent bacteria was Streptococcus pneumoniae 91 (77.7%), followed by E.coli 4 (3.4%), Salmonella species 4 (3.4%), Neisseria meningitidis 3 (2.5%), Pseudomonas species 3(2.5%) and others. Pneumococcal isolates susceptibility to penicillin, chloramphenicol and ceftriaxone were 98.9% (95%CI: 94.0% to 100.0%), 83.0% (95%CI: 73.4% to 90.1%) and 100.0% (95%CI: 95.8% to 100.0%) respectively. They concluded that streptococcus pneumoniae is an important cause of meningitis among all age groups and its susceptibility to penicillin and ceftriaxone still remains very high. Ghanaians of all ages and possibly other developing countries in the meningitis belt could benefit from the use of the pneumococcal vaccine. Other bacterial and fungal pathogens should also be considered in the management of patients presenting with meningitis.

Ogunlesi et al (2005) conducted a study in 124 children with meningitis to review the etiology, antimicrobial susceptibility and outcome of disease in a Nigerian tertiary health facility. Of these, 97 (78.27%) were culture positive; in the rest 27(21.8%), diagnosis was based on Gram

staining of the CSF. Streptococcus pneumoniae, Haemophilus influenzae, Neisseria meningitidis, Staphylococcus aureus and Escherichia coli were isolated in 33.9%, 33.9%, 5.6%, 2.4% and 2.4% samples respectively. All the isolates had 100% sensitivity to both ceftriaxone and ciprofloxacin while the sensitivities to penicillin and ampicillin were remarkably low. The mortality was 33/ 124 (26.6%) while 16/ 91 (17.6%) of the survivors had various neurologic sequelae.

2.5 Perception of Cerebrospinal Meningitis

Cerebrospinal meningitis (CSM) is one of the infectious diseases likely to be affected by climate change. However, understanding public perception in relation to a phenomenon is very significant for the design of effective communication and mitigation strategies as well as coping and adaptation strategies. Samuel and Vivian (2014) use focus group discussions (FGDs) to fill this knowledge lacuna. Results of their study shows that although a few elderly participants ascribed fatal causes (disobedience to gods, ancestors, and evil spirits) to CSM infections during FGDs, majority of participants rightly linked CSM infections to dry, very hot and dusty conditions experienced during the dry season. They concluded that, community members use a suite of adaptation options to curb future CSM epidemics.

Meningitis episodes may deplete household resources and thus perpetuate poverty in already impoverished countries. In addition, few studies have assessed population-based perceptions of meningitis (Soubeiga, 2003 and Dagobi, 2003). Yet these perceptions will affect individuals' decisions regarding therapeutic and preventive interventions and thus influence disease occurrence and morbidity and mortality. This is particularly true in countries where traditional beliefs and systems of health care are still widespread. To address this lack of information, we conducted a microeconomic and anthropologic evaluation in Burkina Faso, which is located in the center of the meningitis belt and has experienced some of the largest epidemics yet documented (WHO, 2007).

Anaise et al., (2010) conducted an anthropologic and economic study to determine the cost of household and community perception of meningitis epidemics in the heart of meningitis belt in Burkina Faso. Respondents reported combining traditional and modern beliefs regarding disease etiology, which in turn influenced therapeutic care-seeking behavior; Households spent

US $90 per meningitis case, or 34% of the annual gross domestic product per capita, and up to US $154 more when meningitis sequelae occurred. Much of this cost was attributable to direct medical expenses, which in theory are paid by the government. Preventive immunization against meningitis will overcome limitations imposed by traditional beliefs and contribute to poverty reduction goals.

Dada and Jaiyeola (1976) studied the epidemiology and prognoses of pyogenic meningitis of 294 patients of different age groups. Peculiarities in medical practice in African countries, where they affect the prognosis, were stressed. Age, level of consciousness and bacteriology are important prognostic factors. Massive health education campaigns, dialogues among traditional healers, pharmacists and orthodox clinicians in order to limit the sphere of activity of each group strictly to its level of competence, may help in producing a more responsible attitude to this disease.

In a study conducted by Akweongo et al., (2013) on Cost of illness (COI), a survey was conducted between 2010 and 2011. The COI was computed from a retrospective review of 80 meningitis cases answers to questions about direct medical costs, direct non-medical costs incurred and productivity losses due to recent meningitis incident. The average direct and indirect costs of treating meningitis in the district was GH¢152.55 (US$101.7) per household. This is equivalent to about two months minimum wage earned by Ghanaians in unskilled paid jobs in 2009. Households lost 29 days of work per meningitis case and thus those in minimum wage paid jobs lost a monthly minimum wage of GH¢76.85 (US$51.23) due to the illness. Patients who were insured spent an average of GH¢38.5 (US$25.67) in direct medical costs whiles the uninsured patients spent as much as GH¢177.9 (US$118.6) per case. Patients with sequelae incurred additional costs of GH¢22.63 (US$15.08) per case. The least poor were more exposed to meningitis than the poorest. They concluded that Meningitis is a debilitating but preventable disease that affects people living in the Sahel and in poorer conditions. The cost of meningitis treatment may further lead to impoverishment for these households. Widespread mass vaccination will save households' an equivalent of GH¢175.18 (US$117) and impairment due to meningitis.

In another study conducted by Apwah (2013) 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, he 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.

Leimkugel et al., (2009) reviewed papers in an attempt to summarize the past and current trends in the etiology of IMD. Data was collected through the analysis of peer-reviewed studies and surveillance data on national, sub-national and regional levels performed. Despite the establishment of improved surveillance, the reasons for the differences in IMD epidemiology between endemic and epidemic settings are not fully understood. Factors influence the timing and distribution of epidemics including climatic, socio-economic and cultural factors involving changes in human lifestyle, natural growth of the human population, crowding and increased mobility. These have also strongly affected the global population structure of Neisseria meningitides and are still currently responsible for changing patterns in IMD epidemiology. In recent years, much interest has arisen on the subject due to both the development of conjugate vaccines and to the continuing occurrence of outbreaks, many of them in industrialized

countries. With antimicrobial resistance on the rise, effective and affordable vaccines along with continued surveillance are needed to help combat this complex disease.

2.6 Cerebrospinal Meningitis Related Factors

There are many factors that have been proven to be responsible for the outbreaks of meningitis in different regions of the world. One of those factors is the socioeconomic factor. So many studies have shown that this factor has a significant role in these following ways:

2.6.1 Poor Housing Condition and Household Overcrowding

A lot of studies that have been carried out have shown consistent evidence that meningococcal disease has a direct relationship with poor housing condition and household overcrowding (Baker et al., 2000).

Baker et al. (2000) conducted a case-control study to identify potentially modifiable risk factors for this disease. 202 cases of confirmed and probable meningococcal disease in Auckland children younger than 8 years of age recruited from May, 1997, to March, 1999 were noted. Controls (313) were recruited door-to-door by a cluster sampling method based on starting points randomly distributed in the Auckland region. They were frequency matched with the expected distribution of age and ethnicity in the meningococcal disease cases. With the use of a multivariate model and controlling for age, ethnicity, season and socioeconomic factors, risk of disease was strongly associated with overcrowding as measured by the number of adolescent and adult (10 years or older) household members per room [odds ratio (OR), 10.7; 95% confidence interval (CI), 3.9 to 29.5]. This would result in a doubling of risk with the addition of 2 adolescents or adults to a 6-room house. Risk of disease was also associated with analgesic use by the child, which was thought to be a marker of recent illness (OR 2.4, CI 1.5 to 4.0); number of days at substantial social gatherings (10 or more people for > 4 h; OR 1.8, CI 1.2 to 2.6); number of smokers in the household (OR 1.4, CI 1.0 to 1.8); sharing an item of food, drink or a pacifier (OR 1.6, CI 1.0 to 2.7); and preceding symptoms of a respiratory infection (cough, "cold or flu," runny nose, sneezing) in a household member (OR 1.5, CI 1.0 to 2.5). Some of these identified risk factors for meningococcal disease are modifiable. They found out that if a family is dwelling in an average sized house of six rooms, if there is any increment in

the number of adolescent or adults by one, there will be a high tendency of about 50 percent increase in the risk of meningococcal disease for a child that is living in the same household. Measures to reduce overcrowding could have a marked effect on reducing the incidence of this disease in Auckland children.

A study to buttress the fact that poor housing conditions and overcrowded household are more vulnerable to the outbreaks of the disease was also conducted by Fone et al., (2003). In a small area geographical study, Fone et al., (2003) ascertained 295 confirmed or probable cases occurring between 1996 and 1999 in the socially diverse resident population of Gwent Health Authority, equating to an average annual rate of 13.2 per 100,000. Incidence rates of meningococcal disease increased from 8.1 per 100,000 in the least deprived fifth of enumeration districts to 19.8 per 100,000 in the most deprived fifth, a relative risk of 2.4 (95% CI 1.7-3.6). In Poisson regression, the percentage change in the incidence rate arising from a unit change in the enumeration district Townsend score, was 9.4% (95% CI 6.2-12.6%). Strongest associations were found for the under 5 age group, serogroup B disease and with the overcrowding variable component of the Townsend index. In the study, they found out that the incidence risk for all cases was about 2.4 times greater in the areas that have poor housing conditions, but the greatest association was between meningococcal cases and overcrowding. The result of the study quantifies the strength of the relation between meningococcal disease and social deprivation at small area level and provides further evidence of the need for action to reduce health inequalities.

Another study Olowokure et al., (2006) on the Geographic's and socioeconomic variation of meningococcal disease shows clearly that the risk of the disease in the most deprived areas was twice that of the less deprived area. But earlier studies (Stanwell-Smith et al., 1994) discovered that there was no significant evidence between meningococcal cases and overcrowding but it becomes only a significant factor in the spread of the disease when overcrowding goes beyond a threshold. To further prove that overcrowding has a significant relationship with meningococcal disease, another study by Stanwell-Smith (et al., 1994) showed that close contact and overcrowding in an environment influences the outbreak of the disease. This study supported the discovery of an early study carried out by Glover (1920) about the military recruits in the First World War and also another research on civilian population.

Also another study Bruce et al., (2006) to determine rates of meningococcal disease in US college students and to identify risk factors for meningococcal disease in this population, they conducted a prospective surveillance study with nested case-control study of US college students with meningococcal infection from September 1, 1998, to August 31, 1999. Fifty state health departments and 231 college health centers participated. Incidence of and risk factors for meningococcal disease in US college students was measured. The result of the study shows that ninety-six cases of meningococcal disease were identified. The incidence rate for undergraduates was 0.7 per 100 000 persons vs 1.4 per 100 000 for the general population of 18- to 23-year-old nonstudents (P<.001). Freshmen living in dormitories had the highest incidence rate at 5.1 per 100 000. Of the 79 case-patients for whom information was available, 54 (68%) had illness due to vaccine-preventable meningococcal serogroups. On multivariable analysis of case-control study data, freshmen who lived in dormitories had an elevated risk of meningococcal disease (matched odds ratio, 3.6; 95% confidence interval, 1.6-8.5; P =.003) compared with other college students. They concluded that freshmen who live in dormitories have an independent, elevated risk of meningococcal disease compared with other college students and recommended the currently available quadrivalent polysaccharide vaccine among college students could substantially decrease their risk of meningococcal disease.

A similar research conducted by Tully et al., (2006) to examine biological and social risk factors for meningococcal disease in adolescents. They adopted a prospective, population based, matched cohort study with controls matched for age and sex in 1:1 matching in a six contiguous regions of England, which represent some 65% of the country's population. Controls were sought from the general practitioner. 15-19 year olds with meningococcal disease recruited at hospital admission in six regions (representing 65% of the population of England) from January 1999 to June 2000, and their matched controls. Blood samples and pernasal and throat swabs were taken from case patients at admission to hospital and from cases and matched controls at interview. Data on potential risk factors were gathered by confidential interview. Data were analysed by using univariate and multivariate conditional logistic regression. The result of the study shows 144 case control pairs were recruited (74 male (51%); median age 17.6). 114 cases (79%) were confirmed microbiologically. Significant independent risk factors for meningococcal disease were history of preceding illness (matched

odds ratio 2.9, 95% confidence interval 1.4 to 5.9), intimate kissing with multiple partners (3.7, 1.7 to 8.1), being a university student (3.4, 1.2 to 10) and preterm birth (3.7, 1.0 to 13.5). Religious observance (0.09, 0.02 to 0.6) and meningococcal vaccination (0.12, 0.04 to 0.4) were associated with protection. They concluded that activities and events increasing risk for meningococcal disease in adolescence are different from in childhood. Students are at higher risk. They also showed that altering personal behaviours could moderate the risk. However, the development of further effective meningococcal vaccines remains a key public health priority.

The prenatal period may be important for susceptibility to infections. Henrik et al., (2004) evaluated whether low birth weight, prematurity, and prenatal maternal smoking were associated with increased risk of invasive meningococcal disease. They linked the Danish nationwide National Registry of Patients, the Birth Registry, and social registries to obtain data on fetal growth and social factors on 1921 cases of meningococcal disease hospitalized between 1 January, 1980 and 31 December, 1999 (median age 31 months, interquartiles 13–65 months) and 37 451 population controls. The impact of maternal smoking was examined in a subsample of 462 cases and 9240 controls born after 1990, when data on smoking became available in the Birth Registry. The result of the study shows adjusted odds ratios (OR) of meningococcal disease associated with low birth weight (_2500 g) varied between 1.6 (95% CI: 1.1, 2.3) in infants _12 months to 1.5 (95% CI: 1.0, 2.3) in children _60 months of age at hospitalization for meningococcal disease. Premature children had an increased risk of meningococcal disease during the first year of life only (adjusted OR = 1.3, 95% CI: 1.1, 1.9). The effect of low birth weight was very similar among mature and premature children. The adjusted OR for maternal smoking was 1.8 (95% CI: 1.4, 2.2). They concluded that low birth weight is associated with an increased risk of meningococcal disease throughout childhood, while an effect of prematurity persists only for 12 months. Maternal prenatal smoking was associated with the risk of meningococcal disease.

Understanding predisposing factors for meningococcal carriage may identify targets for public health interventions. Before mass vaccination with meningococcal group C conjugate vaccine began in autumn 1999, MacLennan et al., (2006) took pharyngeal swabs from ≈14,000 UK teenagers and collected information on potential risk factors. Neisseria meningitidis was

cultured from 2,319 (16.7%) of 13,919 swabs. In multivariable analysis, attendance at pubs/clubs, intimate kissing, and cigarette smoking were each independently and strongly associated with increased risk for meningococcal carriage ($p<0.001$). Carriage in those with none of these risk factors was 7.8%, compared to 32.8% in those with all 3. Passive smoking was also linked to higher risk for carriage, but age, sex, social deprivation, home crowding, or school characteristics had little or no effect. Social behavior, rather than age or sex, can explain the higher frequency of meningococcal carriage among teenagers. A ban on smoking in public places may reduce risk for transmission. However, a similar study was carried out in South Korea (Durey A. et al 2012) it was found out that there was no significant relationship between Meningitis and living in a crowded hall like the dormitory. This finding is consistent with (MacLennan J. et al 2006), which did not find any relationship between crowded environment and meningococcal disease.

2.6.2 Education and Income Level

Education and income level are indicators used to measure the socioeconomic condition of a particular area (Kriz et al., 2000). In other words, the socioeconomic condition is proportional to the level of education and also the income level. A rich man will not prefer to live in an area that is deprived of facilities and services; he would prefer to live in area that has adequate facilities and services since he can afford it. The level of his education and exposure will guide him in the choice of where to live. Based on other studies Burgess et al., (2007), suggested that maternal education is an indicator for health of a child in the Czechoslovakia populace. Studies that have been carried out in US has consistently shown that African-American origin, low income level, low maternal education and other negative social characteristics were closely linked with increased risk of the disease. Generally speaking, studies consistently suggested that low socioeconomic condition increases the risk of meningococcal disease (Burgess et al., 2007). Women's education has been reported as a key factor in reducing infant and child mortality and morbidity. The higher a woman's level of education, the more likely it is that she will marry later, play a greater role in decision making and exercise her reproductive rights. Her children will tend to be better nourished and enjoy better health (Hobcraft, et al 1984).

2.6.3 Meningitis and Demography

The age and sex are other major factors in the spread of meningococcal disease. Studies have shown that the attack is much more common in some particular age target and at the same time some authors proposed that the attack rate is not same for both sexes. A study in Mali, West Africa by Imperato, (1983) revealed that boys that are within the age bracket of 5 to 15 years are more vulnerable to the disease due to some of their habits. Boys in Mali sleep beside each other, and the nocturnal closeness facilitates the spread of the disease within them. It goes in line with the findings of other studies carried out, (Joachim and Nade, 2011) that the cases of the disease are more common within this age limit. Some other studies by Al-Mazrou et al., (2003) indicated that children below the age of five were more vulnerable. It also goes in line with the study of that children that are below five years are more vulnerable to meningococcal disease especially those ones living at the deprived areas (Panjarathinam and Shah, 1993). To further buttress the fact that children between the age of 0 to 5 are more vulnerable, a study was conducted on the Meningococcal disease and prevention in Hajj, it was observed that 58% of the reported meningococcal disease targeted age zero to five, out of which 39% are within zero to two years old (Al-Mazrou et al., 2003). In another similar and a recent study by Ceyhan et al., (2012) on the meningococcal disease in the Middle East and North Africa (MENA), their findings showed that meningococcal disease in that region seems to be predominant in children that are between ages zero to five years old, though the disease sometimes affects older age group. On the other hand there were findings (Christensen et al., 2010) in another study that the prevalence rate is low in children but it increases as they grow to adults to a peak of 19 years old and later starts dropping in older adulthood. The possible reason for the high case rate in teenagers may be due to some other factors like social behaviors and contact patterns. It was noted (Joachim and Nade, 2011) that meningococcal disease is inversely related to age; about 49% of the cases appear in children that are less than two years of age. During epidemics, older children are more vulnerable to the disease. It was also indicated in a study (Bruce, 2001) that activities and events that increases the risk of meningococcal disease in adolescents are different from that of the childhood, probably that is the reason why the adolescents and young adults are more vulnerable to the disease.

2.6.4 Sex

Many studies that have been carried out in the past to ascertain whether there is a difference in the attack rate between male and female for meningococcal disease did not find a significant difference. Studies (Emele et al., 1999) revealed that there was no significant difference at the rate at which meningitis disease affects male and female. But a study (Hassan-King et al., 1979) on household contacts of meningococcal disease in Nigeria observed that the general prevalence of the risk was not influenced by sex, but the prevalence of the risk was in people of 20 years and below was significantly higher in men than in women. Likewise, there was a switch found in those people that are over 20 years old with prevalence of the risk significantly higher in women than in men. This confirms the study that was conducted in Mali, which shows that males between a particular the age group are more prone to the attack and it is due to some of the habits of the young males which facilitate the spread of the disease (Imperato, 1983). Another (Gagneux et al., 2002) similar finding was made that the risk of getting infected with meningococcal disease is not the same for male and female, the findings indicated that males are at a higher risk to get infected than the females. This could be as a result of the social patterns between men and women in the different traditional settings (Trotter and Greenwood, 2007). In some traditional settings like in northern Nigeria, most women are restricted to doing their daily living activities within their homes

2.6.5 Social Behaviour

So many studies have shown that social behavior is another factor that influences the meningococcal disease. The social behaviors that are influencing factors are activities like smoking, intimate kissing and clubbing are the things that exposes them to the attack of the disease (Kriz et al., 2000).

2.6.6 Respiratory Tract/Viral Infections

A number of studies carried out on the risk factors of meningococcal disease indicated that respiratory tract and viral infections are very significant risk factors. A Study on a cluster of meningococcal disease on a school bus after an epidemic of influenza (Harrison et al., 2009), the study shows clearly that influenza infection contributed to the outbreak of the disease in the bus because more than half of the school children had influenza prior to the outbreak of the

disease. The study was similar to the findings in a related research in Greece, which found out that respiratory tract infection is a significant risk factor in meningococcal disease (Blackwell et al., 1992). In the study, it was discovered that over 50 % of the people that had meningococcal disease had respiratory tract infection. The study in England (Davies et al., 1996) also revealed that respiratory tract and viral infections were risk factors to meningococcal disease. A research conducted in Kenya, Africa discovered that preceding upper respiratory tract infection is a significant risk factor for the disease. The studies shows consistency, however, another study in Northern Ireland pointed out that, respiratory tract infections were not seen as a risk factor to the spread of meningococcal disease (Dunlop et al., 2007).

2.6.7 Climatic Conditions

Climatic conditions play a major role in the seasonal rise of the meningococcal disease (Lapeyssonnie, 1963). A number of studies have shown that climatic conditions are a significant risk factor to meningococcal disease in these following ways;

2.6.7.1 Climatic and Geographical Location

Lapeyssonnie (1963) defined meningitis belt that it is in between latitudes 4° and 16° north which coincided with the 300-1100 mm mean annual rainfall isohytes from the south of Sahara, in which the semi-arid sub-Saharan Africa and Sahel is enclosed within. Within this area random attacks takes place in seasonal yearly cycles while epidemics of meningococcal disease with very high magnitude, occurring at large intervals in an inconsistent order (WHO, 200) and the epidemics are mostly during the dry season which abruptly stops immediately the rains starts (Greenwood, 1999). The countries within the meningitis belt include Ethiopia, The Gambia, Benin, Cameroon Burkina Faso, Chad, Ghana, Niger, Mali, Senegal, Nigeria and Sudan. The meningitis belt is characterized with low temperature at night during the dry season which is about 10°C and also there is a strong impact of harmattan (strong wind blowing particles and dust from Sahara) on the nasopharyngeal of an individual mucosa, which allows the meningococcus to attack the individual (Lapeyssonnie, 1963). A study on meningococcal disease in Zaire conducted by Cheesbrough et al. (1995), suggested that areas that are humid throughout the year have low disease rate. Very few epidemics were accounted from the areas

that are densely forested and humid even at the time that the neighboring areas within the meningitis belt were going through the attacks of the epidemics (Molesworth et al., 2003). An example of this is found in Nigeria; very few and scanty cases of meningitis are being reported from the southern part compared to the northern part that is always experiencing the epidemics.

2.6.7.2 Environment

Land cover has a strong influence on the risk of transmitting meningococcal disease. Meningitis belt is characterized with semi-arid climate, south from the Sahara with little rainfall as compared to the humid zone that has high rainfall (Lapeyssonnie, 1963). The region generally has short grasses and there are no thick forests. A study by Molesworth et al. (2003) indicated that land cover type is one of the factors that are independently associated with the locations of meningococcal disease and land cover can be used to distinguish between areas that have high and low risk for the disease. It was also discovered that areas that are humid throughout the year have low disease rate. Areas that has been ravaged by deforestation activities eventually results to erosion which favors the ventilation of aerosols and different kinds of micro particles (dust) which increases the risk of transmitting meningococcal disease infection (Dunlop et al., 2007).

2.6.7.3 Relative Humidity and Temperature

A result of a study by Molesworth et al. (2003) indicated that relative humidity was a very significant risk factor for meningococcal disease. The study was based on a model for humidity and land cover type, to be described in terms of the characteristics of the baseline. The study was able to propose a risk map for the experiences in epidemics of meningococcal disease. It was discovered in the study that the most significant factor that is linked with the distribution of epidemics was relative humidity. Areas that do have much difference for wet and dry seasons hardly have epidemics compared with those that have contrasting seasons. A positive relationship was proposed in a study between humidity and interannual variability of meningococcal disease (Besancenot et al., 1997), which is consistent with one of the early works on risk factors for epidemics of Meningitis, he suggested that low humidity is a determinant for the epidemics. In a study carried out in Nigeria, Africa, it was discovered that

during the epidemics in northern Nigeria of 1996, the temperature at that time was over 40°c suggesting that it was also a determinant factor to the disease (Mohammed et al., 2000).

2.6.7.4 Rainfall

Rainfall is another risk factor to meningococcal disease. Lapeyssonnie (1963) described the meningitis belt as having 300-1100mm mean annual rainfall which is seen as one of the determinants influencing the disease. Many studies have shown that, in African meningitis belt, the outbreaks are commonly in the dry seasons when there is no rainfall, but suddenly drops at the onset of the rains (Yaka et al., 2008). A study in Africa by Greenwood (1999) revealed that the spread of the disease stops immediately the rains starts, which points to the fact that rainfall is a risk factor on the disease. It is now abundantly clear that climate change is occurring globally (Field et al., 2014), and having impacts on ecological systems worldwide (Rosenzweig et al., 2008). It has therefore been suggested that attention should be given to studies that considers the link between climate change and infectious diseases, so as to have a better understanding of the nature of the relationship (Chaves and Koenraadt, 2010). Cerebrospinal meningitis (CSM) also referred to as meningococcal meningitis is one of such infectious disease likely to be affected by climate change ((Field et al., 2014). Furthermore, quite a substantial proportion of the studies have considered the seasonality of epidemics. Thus, it has been stated that epidemics stop with the onset of the rainy season, and resume in the dry season (De Chabalier et al., 2000). In addition, the disease is linked with humidity (Mueller et al., 2008), rainfall, dry harmattan winds and dusty conditions (Jackou-Boulama et al., 2005).

In a study conducted by Thigpen et al. (2007) on bacterial meningitis in the United States, the rate of bacterial meningitis declined by 55% in the United States in the early 1990s, when the *Haemophilus influenzae* type b (Hib) conjugate vaccine for infants was introduced. Thigpen et al. (2007) analyzed data on cases of bacterial meningitis reported among residents in eight surveillance areas of the Emerging Infections Programs Network, consisting of approximately 17.4 million persons, during 1998-2007. They identified 3188 patients with bacterial meningitis; of 3155 patients for whom outcome data were available, 466 (14.8%) died. The incidence of meningitis changed by -31% (95% confidence interval [CI], -33 to -29) during the surveillance period, from 2.00 cases per 100,000 population (95% CI, 1.85 to 2.15) in 1998-1999 to 1.38 cases per 100,000 population (95% CI 1.27 to 1.50) in 2006-2007. The median

age of patients increased from 30.3 years in 1998-1999 to 41.9 years in 2006-2007 (P<0.001 by the Wilcoxon rank-sum test). The case fatality rate did not change significantly: it was 15.7% in 1998-1999 and 14.3% in 2006-2007 (P=0.50). Of the 1670 cases reported during 2003-2007, S. pneumoniae was the predominant infective species (58.0%), followed by GBS (18.1%), N. meningitidis (13.9%), H. influenzae (6.7%), and L. monocytogenes (3.4%). An estimated 4100 cases and 500 deaths from bacterial meningitis occurred annually in the United States during 2003-2007. They concluded that the rates of bacterial meningitis have decreased since 1998, but the disease still often results in death. With the success of pneumococcal and Hib conjugate vaccines in reducing the risk of meningitis among young children, the burden of bacterial meningitis is now borne more by older adults.

A study of 1577 patients admitted at the Infectious Diseases Hospital, Kano by Mohammed et al. (1996) showed that 84% of those infected were aged < or = 20 years and that, for the first time, infants aged < or = 2 months were affected. Despite intervention, the case fatality rate of 9.1% among this group of patients was similar to the nationwide figure of 10.7%. Long-acting oily chloramphenicol proved highly effective in the treatment of patients, and its routine use in epidemic CSM is recommended. Over 13 million persons were vaccinated in the course of the epidemic. For the first time, cases of CSM were reported from States south of the 'African meningitis belt', suggesting an extension of the belt. The severity of this epidemic yet again underscores the need for a clear policy regarding control measures aimed at forestalling future epidemics. The availability of the recently developed polysaccharide-protein conjugate vaccine should facilitate a decision on mass vaccination for the prevention of epidemic CSM in Africa.

A study was conducted by Paireau et al. (2014) and was aimed at investigating factors, still poorly understood, that influence annual incidence of MM serogroup A, the main etiologic agent over 2004–2010, at a fine spatial scale in Niger. To take into account data dependencies over space and time and control for unobserved confounding factors, they developed an explanatory Bayesian hierarchical model over 2004–2010 at the health centre catchment area (HCCA) level. The multivariate model revealed that both climatic and non-climatic factors were important for explaining spatio-temporal variations in incidence: mean relative humidity during November–June over the study region (posterior mean Incidence Rate Ratio (IRR) = 0.656, 95% Credible Interval (CI) 0.405–0.949) and occurrence of early rains in March in a

HCCA (IRR = 0.353, 95% CI 0.239–0.502) were protective factors; a higher risk was associated with the percentage of neighbouring HCCAs having at least one MM A case during the same year (IRR = 2.365, 95% CI 2.078–2.695), the presence of a road crossing the HCCA (IRR = 1.743, 95% CI 1.173–2.474) and the occurrence of cases before 31 December in a HCCA (IRR = 6.801, 95% CI 4.004–10.910). At the study region level, higher annual incidence correlated with greater geographic spread and, to a lesser extent, with higher intensity of localized outbreaks. Based on these findings, we hypothesize that spatio-temporal variability of MM A incidence between years and HCCAs result from variations in the intensity or duration of the dry season climatic effects on disease risk, and is further impacted by factors of spatial contacts, representing facilitated pathogen transmission. Additional unexplained factors may contribute to the observed incidence patterns and should be further investigated.

Koomen et al. (2007) conducted a study to determine the occurrence of educational, behavioural and general health problems in Dutch school-age survivors of bacterial meningitis. A cohort of 680 school-age survivors of meningitis caused by the most common Gram-positive and Gram-negative bacteria was established approximately 6 years after the children's illness. Children with Haemophilus influenzae type b (Hib) meningitis were excluded because this form of the disease has virtually disappeared. Parents completed questionnaires on educational, behavioural and general health problems. The reference group comprised 304 school-age siblings and peers. The Results of the study shows that Post meningitic children were more likely than controls to under achieve at school: 20% vs 5% (odds ratio 5.6; 95% confidence interval 3.0–10.7). The pos tmeningitic children repeated a year twice as often as the children in the reference group (16% vs 8%, odds ratio: 2.5, 95% confidence interval 1.5–4.2) and were referred to a special-needs school four times more frequently (8% vs 2%, odds ratio: 5.5; 95% confidence interval 2.0–15.4). Parents also reported more behavioural problems at home. More than half of the post-meningitic children experienced general health problems. The causative pathogen or age at infection had no influence on the relative frequency of educational and behavioural problems, and reduced auditory functioning played only a small part in these problems. They concluded that parents perceive educational, behavioural and general health problems in more than 30% of post-meningitic children. Until it is clear which children are at

highest risk of developing these problems, it will be necessary to follow post-meningitic children into their school-age years

Proulx et al. (2005) conducted a study to determine whether delays in antibiotic administration are associated with mortality from bacterial meningitis, and to identify inappropriate diagnostic–treatment sequences leading to such delays in a retrospective case record study. They reviewed 123 cases of adult acute bacterial meningitis in 119 patients aged ⩾16 years admitted to hospital from January 1990 to March 2002, using multivariate regression analysis to assess the association between meningitis mortality and door-to-antibiotic time (the time elapsed between emergency room presentation and antibiotics administration). The result of the study shows that the case fatality rate was 13% (16/123). Adjusted odds ratios (OR) for mortality were: 8.4 (95%CI 1.7–40.9) for door-to-antibiotic time >6 h; 39.4 (95%CI 4.3–358.1) for afebrility at presentation; and 12.6 (95%CI 2.2–72.0) for severely impaired mental status at presentation. Factors associated with a door-to-antibiotic time of >6 h were: failure to administer antibiotics prior to transfer from another institution (OR 21.8); the diagnostic–treatment sequence: head CT then lumbar puncture, then antibiotics (OR 5.6); and the absence of the classic meningitis triad (OR 4.9). They concluded that there is an independent incremental association between delays in administrating antibiotics and mortality from adult acute bacterial meningitis. Inappropriate diagnostic–treatment sequences were significant predictors of such treatment delays.

In another prospective study to investigate nursing mothers' knowledge and factors influencing compliance there with immunization regimen in a state government-owned children hospital – Oni Memorial Children Hospital, Ibadan, Oyo State, Nigeria on Jan 5th, 2005, one hundred and forty (140) nursing mothers who had children aged between 0-24 were consented and randomly selected from 210 nursing mothers that daily visited the clinic on immunization day of January 5th, 2005 with structured questionnaires administered. The result of the studies shows that 71.4% of the mothers had enough knowledge on immunization regimen compliance while 28.6% of the mothers didn't have enough knowledge. 38.6% mothers with post-secondary education complied as a against 3.6% mothers with the same post secondary education who did not comply. 45.0% mothers viewed health workers' attitudes as pleasant while 8.6% mothers

perceived otherwise. 46.4% mothers employed by various organizations complied as against 27.9% self-employed mothers who did not comply. 28.6% mothers presenting their third baby at the time of study complied while 2.9% of mothers with their third baby did not comply. Five hypotheses were tested using chi-square at (0.05) level of significance and all the hypotheses were rejected. Though, it was discovered that most mothers studied had enough knowledge on the common childhood diseases as well as the importance of immunization in combating such, several factors have been found that can influence compliance with the immunization regimen.

A cross sectional study conducted by Manjunath and Pareek (2003) on immunization coverage in the town of Pilani was conducted and a total of 166 mothers were interviewed using a pre-tested interview schedule/questionnaire on Knowledge, Attitudes, Perceptions and Expectations (KAPE). The results showed that among the 12-24 month old children 50% fully, 31.3% partially and 18.7% not at all immunized. High levels of initial vaccination rates and low levels of OPV3/DPT3 (62.7%) and measles (51.8%) vaccines indicate that completing vaccination schedule needs attention. Almost all the children in the study, 165 out of 166 received two doses of polio vaccine from the Pulse Polio Immunization programme. Majority of the mothers expressed favourable attitudes and satisfaction regarding the programme. Though many were aware of the importance of vaccination in general, specific information about importance of completing the schedule and knowledge about vaccine preventable diseases other than poliomyelities was very limited. Obstacles, misconceptions/beliefs among the mothers of partially immunized children and lack of information among not at all immunized group were the main reasons of non-immunization. The implications of the study are: to enhance the maternal knowledge about the vaccine preventable diseases and importance of completing the immunization schedule through interpersonal mode and to overcome obstacles to immunization such as accessibility and lack of family support.

Emmanuel (2013) in a study described the various factors that have influenced the spread of the disease in different regions of the world. Risk factors for meningococcal meningitis disease were reviewed. The paper has clearly identified the most important factors like the socioeconomic level, climate and environment, urbanization level, geographical localization, respiratory Tract/Viral Infections, social behaviour, demography and recreational spaces as the cause of the spread of meningococcal meningitis. Having the knowledge of how these factors

influences the spread of the disease will go a long way in helping in the prevention strategies by the relevant authorities. According to Agbakwu (2002) education equips one with marketable skills thereby lifting the possessor up from the poverty arena. Essentially, through education, the individual learns good health habits, principles and practices which promote healthy living and longevity as well as acquire marketable skills that confer economic power on the educated.

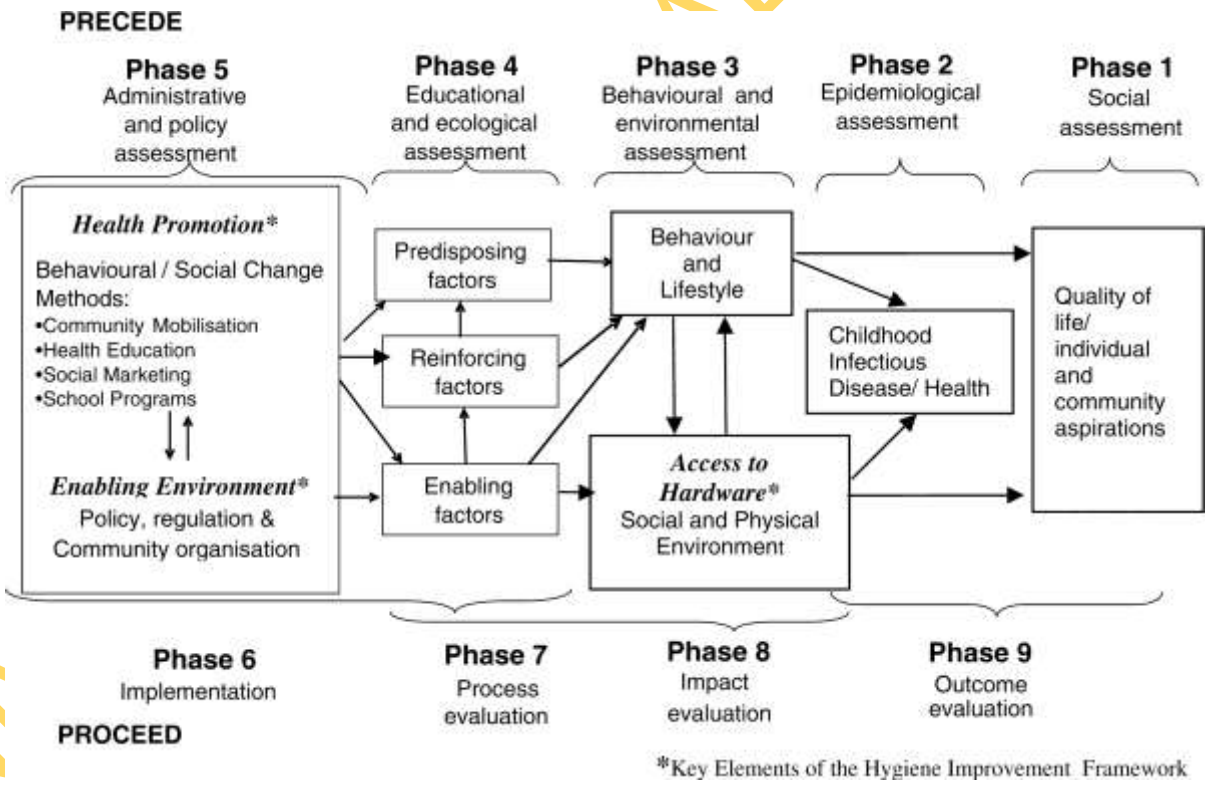
Endemic and epidemic group A meningococcal meningitis remains a major cause of morbidity and mortality in sub- Saharan Africa, despite the availability of the safe and inexpensive group A meningococcal polysaccharide vaccine, which is protective at all ages when administered as directed. Despite optimal therapy, meningococcal meningitis has a 10% fatality rate and at least 15% central nervous system damage. WHO's policy of epidemic containment prevents, at best, about 50% of cases and ignores endemic meningitis, which is estimated at 50 000 cases per year. The effectiveness of group A, C, W135, and Y capsular polysaccharides is the basis for recommending universal vaccination with group A meningococcal polysaccharide twice in infancy, followed by the four-valent vaccine in children aged two and six years. This could eliminate epidemic and endemic disease, prepare for the use of conjugates when they become available, and probably could have prevented the recent epidemics of groups A and W135 meningitis in Burkina Faso (John et al 2003)

2.7 Theoretical Framework

The model that was reviewed and adopted for this study is the PRECEDE model.

PRECEDE MODEL

The acronym PRECEDE stands for **P**redisposing, **R**einforcing and **E**nabling **C**onstructs in **E**ducational/**E**cological **D**iagnosis and **E**valuation. The model was developed by Larry Green and Marshall Kreuter in early 1970s. this model serve as conceptual framework in health education planning aimed at diagnosing the health problems of a community, understanding the factors that influence peoples behavior and developing intervention to promote healthy behavior and increase quality of life (Green and Kreuter, 1999). This model in this study tends to understand the predisposing factors, the enabling factors and the re-enforcing factors which can influence behavior, as it relates to prevalence and practice of CSM in Yola North LGA of Adamawa state. These factors are often called behavioral antecedent factors.



Predisposing Factor: the predisposing factors are behavioral antecedents factors that make any given health related behavior more or less likely to occur. They are factors which must be

present before a behavioral decision takes place (antecedents). These factors include knowledge, attitude, perception, beliefs, values, perceived needs and abilities (inherent qualities) which are useful for throwing more lights on health problems such as cerebrospinal meningitis in Yola North LGA of Adamawa state. for instance, little or lack of knowledge about CSM in a community will make members of the community take poor preventive measures towards the disease, also wrong community perceptions and beliefs or attitudes can lead to high/low prevalence of CSM in a given community. Predisposing factors that were consider in this study include knowledge, perception

Enabling Factors: these are factors that make any given health related behavior more or less likely to occur. These factors which are present before the behavioral decision takes place (antecedents) are environmental and personal resources that impact accessibility, availability and affordability they include programs and services, skills, money and time, facilities, laws, etc for instance, factors such as time and environment can influence the prevalence or incidence of CSM, other factors such as money can influence the rate at which health service is accessed in case of an incident. Enabling factors that were considered in the study includes timing of the disease, and healthcare preventive services.

Reinforcing Factors: these are factors that are related to the influence of significant, usually in the form of positive or negative feedback from peers, family, health care workers, law enforcement, media and religious bodies. Reinforcing factors considered in this study includes the influence of Husbands, friends, religious bodies and mass media as it relate to taking preventive measures such as immunization against CSM.

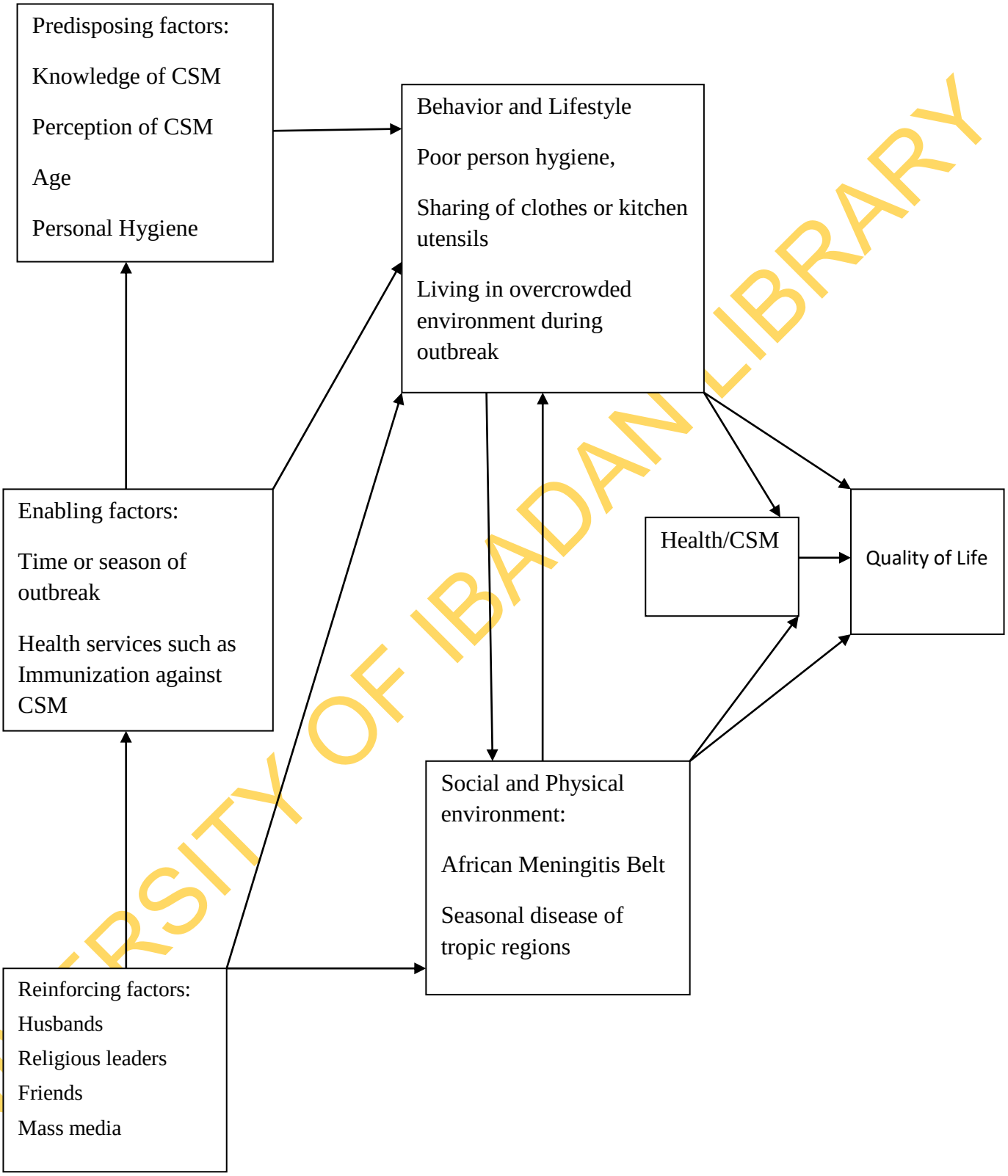


Figure 2.1 Schematic application of PRECEDE model to Cerebrospinal Meningitis

CHAPTER THREE

METHODOLOGY

This section deals with the research design, study population, sampling technique, methods and instruments for data collection, procedure for data collection and data analysis.

3.1 Study Design and Scope of the Study

This study was a cross-sectional descriptive survey. It focused on the determination of the knowledge, perception and practices of mothers of children under five relating to cerebrospinal meningitis in Yola North LGA of Adamawa state.

3.2 Description of Study Setting

The study was conducted in Yola metropolis, Yola North LGA. Majority of the population are Fulani, although there are various tribes within the Yola North LGA. The local government area is composed of ten wards with different settlements or communities in each of the wards. It has a semi-urban housing setting and cosmopolitan in nature. There are three different seasons in Yola, these includes dry season usually from February to July, raining season from August to October and the harmattan season usually from the period of November through January. The LGA has both primary and secondary health facilities and numerous private clinics. There are various schools ranging from primary level to tertiary level in the LGA. Endemic diseases which are usually common include malaria, HIV/AIDS, cholera outbreak, CSM outbreak etc.

3.3 Study Population

The study population constituted of mothers of under five (U-5) who were married, divorced, widows or single mothers, who were residing in Yola North LGA of Adamawa state.

3.4 Sample Size Determination

The sample size was determined using the following formula

$N=Z^2 PQ/d^2$

Where: N = minimum sample size

Z (1-α) = a standard score at 95% confidence interval = 1.96

P = Prevalence (Proportion of population with the disease or condition)

Q= Proportion of population without the disease or condition

I.e. q= 1-P

d = level of accuracy = 0.05

p= 0.264 (Jean M.C. et al 2013).

$N = (1.96)^2 (0.264) (0.736) / (0.05)^2$

N= 0.7464/ 0.0025= 298.56 = 299 approximately

In order to make up for the attrition or no response, 10% of the sample size was added 10 ⁄ 100 × 299 = 29.9

29.9 + 299 = 328.9 = 329 approximately

The sample size was however increased to 401 in order provide room for variability

3.5 Sampling Procedure

A three-stage Multistage Sampling Technique was used to sample the respondents for the research. Both simple random sampling and proportionate sampling techniques were used for the sampling and selection of respondents for the study.

Stage I: There are ten wards in Yola North LGA, these wards include; Limawa, Rumde, Yelwa, Nasarawo, Dogirai, Bekaji, Karewa, Jumbutu, Luggerai, and Ajiya. Simple Random Sampling technique (ballot method) was used to select six wards out of these ten wards. The six wards selected include; Jumbutu, Nasarawo, Karewa, Limawa, Yelwa and Luggerai.

Stage II: Each of these wards had different number of communities. A total of ten communities were picked proportionately from the six wards and 40 respondents were randomly selected using from each community. This was because the socio-demographic characteristics in terms of population of the communities selected were comparable. (Please see the table 3.1 for details)

Table 3.1 Proportionate sampling of respondents from communities

S/N	Wards	Communities	Proportionate Sampling	No of Respondents
1	Jumbutu	2	2/11 × 10 = 2	80
2	Nasarawo	2	2/11 × 10 = 2	80
3	Karewa	3	3/11 × 10 = 2	80
4	Limawa	1	1/11 × 10 = 1	40 + 1
5	Yelwa	1	1/11 × 10 = 1	40
6	Luggerai	2	2/11 × 10 = 2	80
	TOTAL	**11**	**10**	**401**

Stage III:

The first households within the selected communities were randomly selected using epi sampling technique. Subsequent household were selected by systematic sampling using every every 2nd household until the number of respondents allocated for the community were interviewed. In a household where there were more than one mothers of U-5, selection of who to be interviewed was done using simple random sampling.

3.6 Inclusion and Exclusion criteria

Those who participated in the study included mothers who have children less than five years who are residing in YN LGA. Those who are not residing in YN LGA but were found in the

communities during the time of the study were also not included in the study. Also Grandmothers who were living with their Grandchildren aged less than five years were also not included in the study.

3.7 Methods and Instrument for Data Collection

A validated semi-structured interviewer-administered questionnaire prepared in English and Hausa Language was the instrument used for the research, to obtain quantitative data on knowledge, perception and practice of mothers of U-5 on cerebrospinal meningitis in Yola North LGA (see Appendix I & II). The questionnaire contained both open-ended and closed-ended questions under the following sections:

A. Socio-demographic characteristics
B. Knowledge of mothers of U-5 on CSM
C. Mothers perception of CSM
D. Practice of mothers of U-5 related to CSM
E. Factors that hinder/promote the prevalence of CSM

The researcher reviewed all open-ended portion of the questionnaire; codes were later developed for coding responses. Twenty nine (29) points Knowledge scale was also developed to score the knowledge of respondents on cerebrospinal meningitis. The knowledge score point was categories as 20-29 to be good, 15-19 to be fair and < 15 was categorized as poor and codes were also assigned to the categories of knowledge scale. The instrument was translated to Hausa language because Hausa is the language spoken by most people in the LGA. It was also back translated to English to ensure appropriateness and no loos or change in context.

3.8 Recruitment of Research Assistants, Validity and Reliability

Recruitment of Research Assistance: Eight Research Assistants (RA) were recruited to assist in data collection. RAs were all women who represent six different wards in the LGA; this was done in order to increase easy access to the respondents. The RAs were well trained by the principal investigator on the use of the instrument. The training methods used were role plays, lectures, and discussions. Demonstration and return demonstration was also done with focus on interviewing skills.

Validity: validity of the research instruments was ensured through review of literatures, instruments given to supervisor and experts in epidemiology and clinicians to review. Content validity was ensured using pertinent variables teased out from the literature review; also senior colleagues were used to ensure face validity of the instrument.

Reliability: In order to determine the reliability of the questionnaire, a pretest was conducted on a sample size of 10% of the sample population (401) to get a pre-test sample of 41mothers of U-5 residing in Shasha community in Ibadan North LGA of Oyo state. Shasha community is a community that is densely populated by Hausa speaking people from the North (Hausa) who are recent migrants from the North to Ibadan. Shasha community residents share similar socio-demographic characteristics with the study population in Yola North LGA. Copies of the pretested questionnaires were cleaned, coded and entered into the computer. Facilitated by use of SPSS, the reliability of the questionnaire was determined using Cronbach's Alpha model technique of SPSS (Version 20). The obtained reliability coefficient was 0.95 implying that the instrument was very reliable. Few revisions were made on the instrument before it was finally used. Revisions made included the deleting of irrelevant questions and the building of skipping mechanism in the questionnaire.

3.9 Data Management, Analysis and Presentation

Each copy of the administered instrument was adequately checked after collection. Any instrument not appropriately filled was returned back to the field by the Research Assistant; this was done to ensure that accurate data were collected. A coding guide was developed and used to facilitate the coding of the questionnaires. Data entry and cleaning was done using Statistical Package for Social Science (SPSS) version 20 software. Frequencies and means were generated. The data were further analyzed using chi-square. The results are presented sequentially in tables, graphs and charts in chapter 4.

3.10 Ethical Consideration Including Informed Consent Form

Ethical approval was obtained from ethical Review Committee (ERC) of the Adamawa state ministry of health. The Respondents' consent was obtained after provision of adequate, clear and complete information about what the study entails. The confidentiality of information

disclosed by each participant was duly assured both during and after the conduct of the research. Also, some ethical considerations such as beneficence, non-maleficence, respect for persons and justice were ensured.

3.11 Limitation of the Study

A major limitation encountered relates to cultural acceptability. It was not easy to reach the mothers of U-5 for interviews. Most of the mothers do stay in-doors and culturally do not have the right to come out and/engage in conversations with a stranger. Similarly some of the mothers of under five who were eligible and sampled for the study were not easily accessed because they cannot take decision on their own to participate in the study but will have to depend on the decision of the husband. In order to overcome these limitations, female research assistances were recruited from each community that was selected for the study. This was done to enable easy access to respondents. Also, benefits of the study to the community were clearly re-emphasized to respondents who feel she requires are husbands consent before she can participate. In some situations where the husband was at home at the time of the interview, both the husband and the wives consent were obtained before the commencement of the interview.

CHAPTER FOUR

RESULTS

4.1 Respondents' Socio-Demographic Characteristics

In this section, results of respondents' socio-demographic characteristics are presented in tables 4.1 and 4.2.

Respondent's age ranged from 15-65 years, with majority (70.3%) of them being in the age range of ≤35. Majority of the respondents (70.0%) had less than four children. Most of the respondents' (81.9%) were married with very few being widowed, (see table 4.1 for more details). Islam (72.5%) accounted for the respondents' major religion. Thirty percent of respondents had tertiary education, followed by secondary education (28.4%) while those that had primary education (20.9%) and no formal education (20.9%) were of almost equal proportion. Almost half of the respondents (48.9%) reported that they were self employed (see table 4.1 for more details). Among those that are working (16.8%) are in the civil service and (10.2%) works in private organizations. Forty-five point two percent of those who work in civil service and private organizations are teachers while (14.3%) are health workers. Among those who are self employed (50.2%) accounted for traders/business women. Majority of the respondents (70.6%) were earning less than N20, 000.00 on the average in a month. Table 4.1 and 4.2 give more details on other socio-demographic characteristics of the respondents.

Table 4.1: Respondents' Socio-Demographic Characteristics (N=401)

Characteristics	Frequency	Percentage (%)
Age (in years)		
≤35	282	70.3
>35	119	29.7
Number of children (N=372)		
≤4	268	72.0
>4	104	28.0
Marital status (N=398)		
Single	36	9.0
Married	326	81.9
Divorced	19	4.8
Widowed	17	4.3
Religion (N=396)		
Christianity	109	27.5
Islam	287	72.5
Highest level of education (N=363)		
No formal education	75	20.7
Primary	76	20.9
Secondary	103	28.4
Tertiary	109	30.0
In what sector are you working		
Civil service	59	16.8
Private organization	36	10.2
Self employed	172	48.9
Unemployed	85	24.1

Table 4.2: Respondents' Socio-Demographic Characteristics (N=401)

Characteristics	Frequency N	Percentage (%)
Duty or role in civil service/private organization (N=84)		
Lecturing	2	2.4
Teaching	38	45.2
Auditor	4	4.8
Health worker	12	14.3
Secretary	8	9.5
Banker	6	7.1
Legislative assistance	6	7.1
Service men	2	2.4
Civil servant	4	4.8
Computer operator	2	2.4
Duty as self employed/unemployed (N=229)		
Trading/business	115	50.2
Farming	20	8.7
Housewife	67	29.3
Student	15	6.6
Artisan	12	5.2
Income per month (in Naira)		
≤20,000	283	70.6
>20,000	118	29.4

4.2 Respondents' knowledge about Cerebrospinal Meningitis

Most respondents (97.0%) reported that they had heard of Cerebrospinal Meningitis (CSM), with the three highest reported sources of information on CSM being from the news (78.7%), Health care professionals (71.2%) and from friends (57.8%) (See table 4.3a). Table 4.3b shows other details on sources of respondents' information. When asked about the categories of persons who can get CSM, most of the respondent (90.7%) reported children, followed by adolescents (84.8%), few (8.7%) incorrectly responded that no age group could get CSM. (See table 4.3b)

Amongst mode of transmission of CSM, majority of the respondents (82.0%) knew that when many people are overcrowded and/or chose to stay close to each other with infected persons was a means through which CSM spreads in a community. Over half (53.5%) stated correctly that sleeping in the same room with an infected person was another means through which CSM spreads from person to person in a community. The other responses given by respondents on how CSM can be spread in the community is shown in Table 4.4

Regarding the signs and symptoms of CSM majority (85.9%) of the respondents knew that stiff neck was common sign/symptoms of CSM, followed by severe headache (82.0%) and (66.3%) reported fever as sign/symptoms of CSM. (See Table 4.4 for more details). Majority of the respondents (87.1%) also knew correctly that one of the consequences/dangers of CSM included death, hearing loss (69.4%) and loss of sight (49.4%). Few (35.7%) respondents who wrongly said that madness was among the consequences/dangers of CSM (see Table 4.4 for more details).

Majority (74.3%) of the respondent knew that children less than five are more likely to get CSM than adults. Few (27.2%) of the respondents wrongly reported that CSM is not spread from person to person (Table 4.5 gives more details).

Mean Knowledge Score obtained by the respondents was 13.5±4.9; (Figure 4.1) shows Respondents' categories of knowledge scores about Cerebrospinal Meningitis. More than half of the respondents (52.4%) had poor knowledge of CSM scoring <15 points when placed on a

29 points knowledge scale. About (39.9%) of the respondents' had fair knowledge and only few (7.7%) had good knowledge of CSM scoring >19 points.

The association between respondent's level of knowledge and socio-demographic characteristics are presented in the table 4.5b. The table reveals that there is a significant association between required knowledge score and their marital status ($P \leq 0.05$). More respondents who are widowed (70.6%) had poor knowledge of CSM compared with the others. Similarly, religion, educational status and amount earned by respondents had a significant association with level of knowledge of respondent's ($P \leq 0.05$). (See table 4.5b).

Table 4.3a: Respondents' knowledge about Cerebrospinal Meningitis (CSM) (N=401)

Variables	Frequency	Percentage (%)
Ever heard about CSM		
Yes	389	97.0
No	12	3.0

Table 4.3b: Respondents' knowledge about CSM (N=389)**

Variables	Frequency	Percentage(%)
Sources of information about CSM		
Friends	225	57.8
News	306	78.7
Magazines	133	34.2
Workplace	148	38.0
Healthcare professional	277	71.2
Personal experience	114	29.3
Seen someone affected by CSM	164	42.2
Internet	93	23.9
Can't remember	95	24.4
Who can get CSM		
Children	353	90.7
Adolescents	330	84.8
Adults	244	62.7
All age groups	237	60.9
*None of the age groups	34	8.7

***Incorrect answer**

****Multiple responses were allowed**

Table 4.4: Respondents' knowledge about CSM **(**N=389)**

Variables	Frequency	Percentage(%)
How does CSM spread in the community		
Person to person through contact with body fluids of someone who has CSM	193	49.6
Person to person by sleeping in the same room with a person with CSM	208	53.5
Person to person through coughing/sneezing	71	18.3
Person to person by kissing a person who has CSM	80	20.6
Sharing of kitchen cutleries with person who has CSM	57	14.7
When many people are overcrowded and chose to stay close to each other with infected persons	319	82.0
Signs and symptoms of CSM		
Aching of the back	112	28.8
Fever	258	66.3
Severe headache	319	82.0
Vomiting	219	56.3
Convulsion	228	58.6
Stiff neck	334	85.9
Fear of light	105	27.0
Consequences or dangers of CSM		
Hearing loss	270	69.4
Epilepsy	97	24.9
Loss of sight	192	49.4
Death	339	87.1
Madness*	139	35.7

*Incorrect response

**Multiple responses were allowed

Table 4.5a: Respondents' knowledge about CSM **(**N=389)**

Statements	Frequency	Percentage
CSM is not spread from person to person	106	27.2
CSM can be treated with antibiotics	273	70.2
CSM can be caused by accident	45	11.6
Children less than 5 years are more likely to get CSM than adults	289	74.3
CSM can be prevented with the use of a vaccine	340	87.4
It is micro-organism such as bacteria and virus that cause CSM	199	51.2

Table 4.5b: Association between respondents' level of knowledge and socio-demographic characteristics

Socio-demographic characteristic	Poor Knowledge (%)	Fair knowledge (%)	Good knowledge (%)	X^2	df	P-value
Marital status						
Single	38.9	38.9	22.2	20.23	6	*0.003
Married	53.1	41.1	5.8			
Divorced	42.1	36.8	21.1			
Widow	70.6	29.4	0			
Number of children						
≤4	51.1	42.2	6.7	2.24	2	0.326
>4	58.7	37.5	3.8			
Respondents' Age						
≤35	53.2	39.0	7.8	0.319	2	0.853
>35	50.4	42.0	7.6			
Religion						
Christianity	73.4	22.9	3.7	25.78	2	*0.000
Islam	44.9	45.6	9.4			
Level of Education						
No formal education	52.0	42.7	5.3	13.80	6	*0.032
Primary	40.8	53.9	5.3			
Secondary	67.0	27.2	5.8			
Tertiary	53.2	41.3	5.5			
Amount earned monthly						
2,000-20,000	60.4	32.2	7.4	26.49	2	*0.000
>20,000	33.1	58.5	8.5			

*Significant at p≤0.05

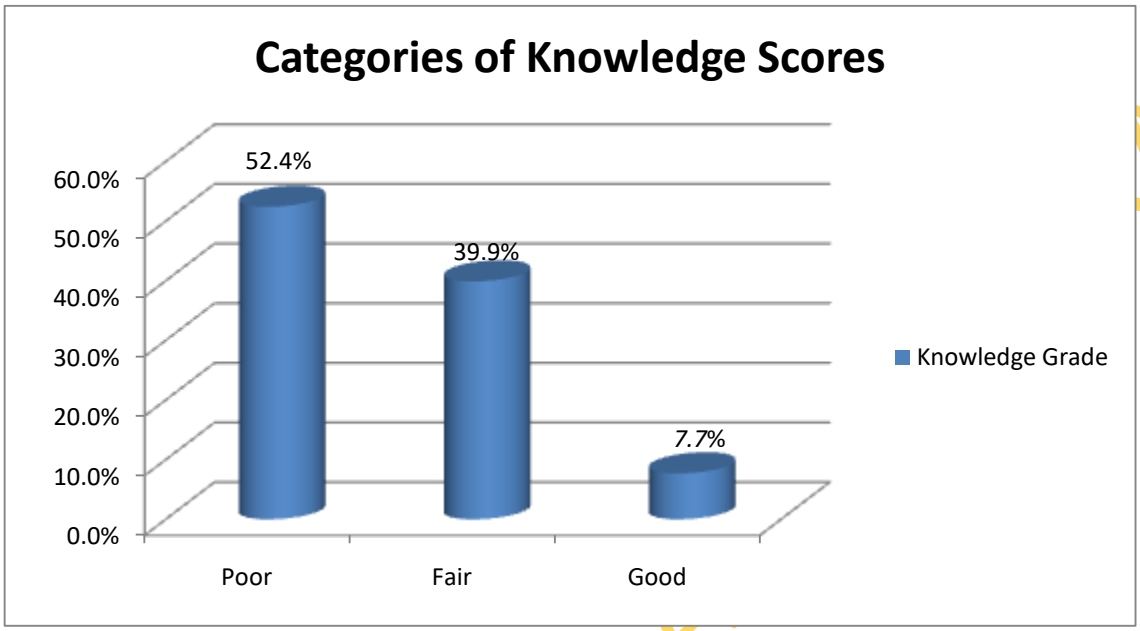


Figure 4.1: Respondents' Knowledge about Cerebrospinal Meningitis

Good knowledge: >19

Fair knowledge: 15-19

Poor knowledge: <15

4.3 Respondents' perception of CSM

Table 4.6 shows respondents perception of CSM. There was an almost equal perception among respondents who were of the view that malaria is more serious compared with CSM (46.3%) and those who were not of the view that malaria is more serious compared with CSM (43.7%). Majority (81.2%) also were of the view that CSM is deadly, while few respondents (14.4%) perceived that it is witches and wizards that determine who gets CSM. Twenty three point seven percent (23.7%) were of the view that CSM immunization is against their religious doctrines, while close to half (48.3%) were not of the view that CSM immunization is against their religion. (28%) of the respondents' could were neither. (See Table 4.6 for more details on other perceptions of CSM reported by respondents.).

Figure 4.2 shows respondents perception relating to their vulnerability to CSM; (38.4%) perceived themselves to be susceptible to CSM. Respondents' perception of degree of susceptibility to CSM is shown in figure 4.3. The proportion of respondents who felt highly susceptible was only (3.6%), while those that their susceptibility was low accounted for (21.8%). (See figure 4.3 for details).

Table 4.6: Respondents' perception of CSM **(N=389)**

Statements	Agree N (%)	Disagree N (%)	Undecided N (%)
Malaria is more serious compared with CSM	180 (46.3)	170 (43.7)	39 (10.0)
CSM makes people suffer but cannot kill	117 (30.1)	234 (60.1)	38 (9.8)
CSM is very deadly	316(81.2)	43 (11.1)	30 (7.7)
CSM is not a contagious disease so it cannot spread to other people	112(28.8)	188 (48.3)	89 (22.9)
CSM is only hereditary	96 (24.7)	212 (54.5)	81 (20.8)
It is witches and wizards that determine who gets CSM	56 (14.4)	251 (64.5)	82 (21.1)
CSM is a disease caused by hot weather	316 (81.2)	24 (6.2)	49 (12.6)
CSM is a seasonal disease and one can only get it during its season	304 (78.1)	45 (11.6)	40 (10.3)
Overcrowding cannot lead to the spread of CSM	103 (26.4)	250 (64.3)	36 (9.3)
Immunization against CSM can make male child impotent	75 (19.3)	208 (53.5)	106 (27.2)
It is against my religion to give CSM vaccines to children	92 (23.7)	188 (48.3)	109 (28.0)

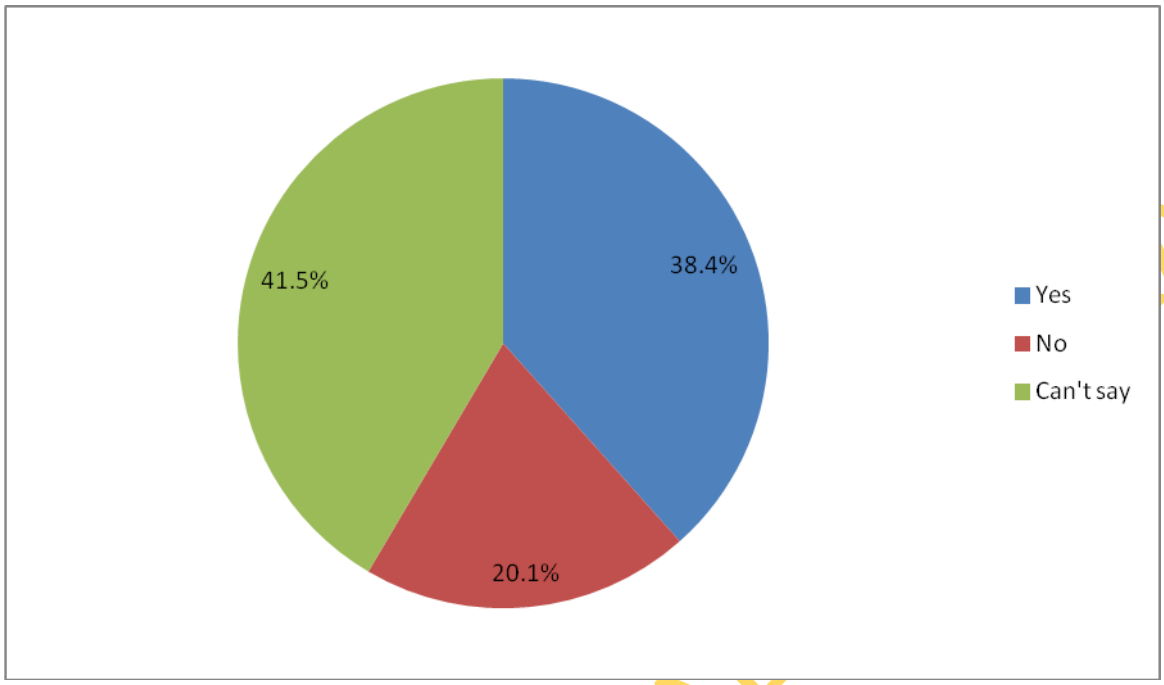


Figure 4.2: Respondents' perception of developing CSM

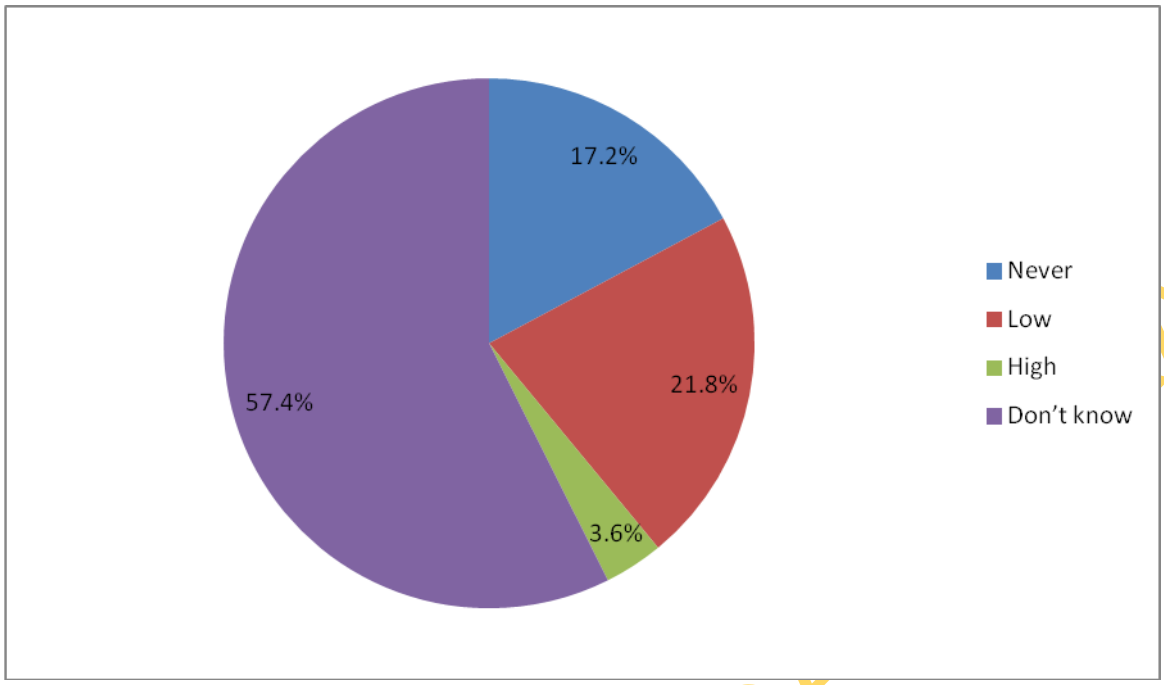


Figure 4.3: Respondents' perception of degree of susceptibility to CSM

4.4 Respondents' practices relating to CSM

Respondents who reported that their children had received immunization against CSM accounted for (54.4%), while mothers who themselves had ever received immunization against CSM were (59.6%). Respondents whose child/children had received immunization 6-7 months preceding this study accounted for (37.3%) only, with the majorly where CSM vaccine was received being government owned hospitals (86.0%); Table 4.7 gives more details.

Health care professionals (76.3%) and respondents' husband (53.9%) where the major persons who prompted respondents to receive CSM vaccination for themselves and their children (see Table 4.8). Various reasons were reported for receiving CSM vaccination, but the major reason (74.1%) was that respondents wanted themselves and children to be healthy (Other reasons are shown in table 4.8).

Reason for not getting children and themselves vaccinated against CSM reported by respondents who had never had CSM vaccination was husbands' decision (40.4%). Few stated that the vaccine it will make their child impotent (19.1%). The reason given by 14.9% was that they did not know where to get the vaccine (see table 4.8 for more details).

Respondents had varied practice with regards to the best time to receive CSM vaccine. Nearly half (48.1%) stated that the best time to receive CSM vaccines is when there is a meningitis outbreak. Slightly over half (51.7%) said it should be received during the hot season. (See table 4.9 for details)

Table 4.7: Respondents' practices relating to CSM (N=228)

Variables	Frequency	Percentage(%)
Have any of your children ever received immunization against CSM (N=375)		
Yes	204	54.4
No	171	45.6
Mothers' who ever received immunization against CSM (N=373)		
Yes	220	59.6
No	153	41.4
Did your child(ren) receive immunization against CSM in the last 6-7 months (N=375)		
Yes	140	37.3
No	235	62.7
Sources of CSM vaccine received (N=228)*		
Government owned hospitals	196	86.0
Private Clinics	45	19.7
Community pharmacy	24	10.5
Patent Medicine Vendors (PMV)	28	12.3
Community/Village Health workers	66	28.9
Traditional Doctor/healer	21	9.2
School/Church/Mosque	75	32.9
Market	2	0.9
Can't remember	24	10.5

No responses were excluded

*Multiple responses were allowed

Table 4.8: Respondents' practices relating to CSM (N=228)

Variables	Frequency	Percentage
Who prompts you and your children to take CSM vaccine**		
Health care professional	174	76.3
Mother in-law	31	13.6
Husband	123	53.9
Community leader	75	32.9
Religious leader	73	32.0
Personal decision	93	40.8
Friends	73	32.0
Reasons for receiving CSM vaccine**		
Just because everyone was receiving it	47	20.6
Health workers visited my house for immunization	58	25.4
It will make me and my child healthy	169	74.1
Fear of meningitis	100	43.9
Reasons for not receiving CSM vaccine (N=141) **		
It is expensive, I cannot afford it	30	21.3
Husbands decision	57	40.4
It is against my culture	17	12.1
I don't know where to get vaccination	21	14.9
Attitude of health workers	10	7.1
My religion prohibits it	8	5.7
It will make my child impotent	27	19.1

**Multiple responses were allowed

Table 4.9: Respondents' practices relating to CSM (N=389)

Variables	Yes N (%)	No N (%)	Don't know N (%)
Best time to receive CSM vaccine			
Whenever there is a meningitis outbreaks	187 (48.1)	133 (34.2)	69 (17.7)
When I start having the symptoms of meningitis	102 (26.2)	199 (51.2)	88 (22.6)
Every 6 months	128 (32.9)	153 (39.3)	108 (27.8)
Once yearly	148 (38.0)	140 (36.0)	101 (26.0)
During hot season (summer)	201 (51.7)	69 (17.7)	119 (30.6)

4.5 Factors that hinder or promote the prevalence of CSM among respondents

Majority of the respondents (76.9%) reported that one of the factors that hinders the prevalence of CSM is that of good personal hygiene. Majority (72.2%) also reported that regular hand washing during an outbreak could also prevent CSM spread. (See table 4.10 for more details on factors that respondents indicated could hinder/promote the prevalence of CSM).

The ways of controlling CSM during an outbreak reported by respondents include treatment of persons with CSM (83.0%), mass vaccination (85.9%) and Health education (71.4%). A little below half of the respondents (47.8%) suggested closure of schools, (See Table 4.10 for more details).

Other ways of preventing CSM that were mentioned by respondents were avoiding overcrowded rooms (5.4%), allowing cross ventilation in rooms (2.3%) and seeking protection from Allah (0.5%).

Table 4.10: Factors that hinder/promote prevalence of CSM among respondents (N=389)

Variables	Hinder N (%)	Promote N (%)	Don't know N (%)
Conditions that hinder or promote spread of CSM			
Regular hand washing during outbreak	281(72.2)	36 (9.3)	72 (18.5)
Keeping safe distance when talking	278 (71.5)	30 (7.7)	81 (20.8)
Covering ones mouth when coughing and sneezing	266 (68.4)	41 (10.5)	82 (21.1)
Visiting the nearest health centre when one come in close contact with someone who has meningitis	270 (69.4)	49 (12.6)	70 (18.0)
Good personal hygiene	299 (76.9)	37 (9.5)	53 (13.6)
Sharing kitchen utensils, towels and cloths with a person who gets meningitis	77 (19.8)	85 (21.9)	227 (58.3)
Avoiding crowding	264 (67.8)	87 (22.4)	38 (9.8)
	Yes **N (%)**	**No** **N (%)**	**Don't know** **N (%)**
Ways to control CSM outbreak in a community			
Treatment of persons with cerebrospinal meningitis	323 (83.0)	21 (5.4)	45 (11.6)
Mass vaccination i.e. everybody	334 (85.9)	16 (4.1)	39 (10.0)
Closure of schools	117 (30.1)	186 (47.8)	86 (22.1)
Health education	278 (71.4)	38 (9.8)	73 (18.8)

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

5.1 Socio-demographic characteristics and related information

Level of education of the respondents' shows that thirty percent (30%) of respondents had tertiary education, followed by secondary education (28.4%) while those that had primary education and no formal education were of almost equal proportion (20.9%) and (20.7%) respectively. The level of education of the respondents shows that most have had at least a form of formal education, although only few have reached tertiary level of education. This is in line with the belief that female education in Northern Nigeria is not given a priority attention; hence there is the need for programs and policies that will encourage female education as it is one of the indicators for child survival. Similarly, Burgess et al (2007) suggested that maternal education is an indicator for the health of a child and also pointed out that low socioeconomic conditions increase the risk of meningococcal disease. Additionally, Nichter (1995) opined, that with regards to vaccinations in the third world, what is in a mother's education, such as the content of the educational programme, affiliation with modernity, and social mobility, predisposes her to have her children vaccinated.

5.2 Knowledge of cerebrospinal meningitis

The result of the study shows that majority of the respondents (52.4%) had poor knowledge of cerebrospinal meningitis, as only 7.7% of the respondents had good knowledge of cerebrospinal meningitis. The mean knowledge Score obtained by the respondents was 13.5±4.9. These results may suggest why the incidence of cerebrospinal meningitis is higher in Northern Nigeria. The more knowledgeable a population is about a particular disease, the more the population tends to take preventive measures against such disease, thereby reducing the incidence and prevalence of the disease. This is also similar to a study conducted by Lindsey et al (2003) who reported that the overall knowledge of the disease was low among college students and many students were not aware of why they had received the vaccine. According to Lindsey et al (2003), most of them received the vaccine just to fulfill school requirements. These results are however contrary to the study carried out by Apwah (2013) in Ghana who

reported that majority of his respondents had good knowledge of CSM. There is therefore the need to educate the population about the risks of cerebrospinal meningitis, including its signs and symptoms, modes of transmission as well as the importance of vaccination to increase their knowledge on the disease.

Majority of the respondents (82.0%) agreed that overcrowding and staying close to people infected with CSM was a mode of transmission of CSM within the community. This agrees with the study carried out by Fone et al (2003), who also reported that poor housing conditions and overcrowded households are more vulnerable to the outbreaks of cerebrospinal meningitis disease. Similarly, Baker et al (2000) showed that the risk of getting the disease is strongly associated with overcrowding. He noted that measures to reduce overcrowding would have a marked effect on reducing the incidence of the disease.

There was also a significant association between respondents' level of education and their knowledge of CSM. Among the respondents, people who had secondary education (5.8%) had good knowledge of CSM, as compared to respondents with tertiary education (5.5%). Only 5.3% of those with primary education and no formal education had good knowledge of CSM. This is contrary to most studies that show that the higher the level of education, the better the knowledge on related health problems. This may be due to the fact that most of the mothers who have tertiary education with better socio-economic status are more likely to take preventive measures and thereby having reduced incidence of CSM as compared with mothers who have just secondary and primary education. Therefore personal experiences of CSM to their children or neighbors in community setting might have given them an opportunity to know more about the deadly disease and are likely to be more knowledgeable than mothers who have tertiary education and probably have had less experience of the outbreaks. This is supported by a study carried out by Olowokure et al (2006) who reported that the risk of being infected with the disease in the most deprived areas was twice that of the less deprived area.

The study also considered the association between amount earned and knowledge of CSM. The study revealed that there is a significant difference between amount earned and knowledge of CSM. While only 7.4% of those who earned between ₦2000 and ₦20, 000 have good knowledge, only 8.5% of those who earned greater than ₦20, 000 have good knowledge. This

may be due to the fact that most of the population earning higher than ₦20000 have good socio-economic status and thereby having a reduced risk of getting the disease. Emmanuel (2013) clearly listed socioeconomic status as an important risk factor for meningococcal meningitis disease.

There was a significant association between respondents' religion and their level of knowledge of CSM. Although most of the respondents (72.5%) were Muslims, only 9.4% of them presented with good knowledge of CSM, while among the 27.5% of the respondents who were Christians, only 3.7% of them had good knowledge of CSM. The level of education among women who are Muslims is usually low due to some religious and cultural barriers than women who are Christians. This however makes mothers who have children less than five years more vulnerable during outbreaks and therefore makes them likely to be more knowledgeable than the mothers who practice Christianity and have had higher level of education. Agbakwuru (2002) also agreed that education equips one with marketable skills thereby lifting the possessor up from the poverty arena. Essentially, through education, the individual learns good health habits, principles and practices which promote healthy living and longevity as well as acquire marketable skills that confer economic power on the educated.

5.3 Perception of cerebrospinal meningitis

Respondent's perception of susceptibility to the disease shows that the proportion of respondents who felt highly susceptible was only 3.6%, while those that felt low susceptibility was 21.8%, 17.2% felt "never" and 57.4% didn't know whether they were susceptible or not. The degree of susceptibility to CSM as presented by the respondents was low; this situation could lead to poor preventive practices relating to CSM. Studies by Lindsey et al (2003) among college students indicated that more science majors (45%) believed they were at high risk for contracting meningitis than education/business majors (42%) and art majors (22%). These support the results of this study as majority of the respondents didn't have formal education with very few of the respondents attending tertiary education. This shows that education is a vital part to the prevention of meningitis.

Most of the respondents (48.3%) were of the view that CSM is contagious. This is in line with what was noted by WHO (2008). Few of the respondents (14.4%) were also of the belief that it

is witches and wizards that determine who gets meningitis. Many of the respondents (81.2%) were of the opinion that CSM is caused by hot weather, while 71.8% opined that CSM is a seasonal disease. These agree with a study conducted by Samuel and Vivian (2014) who reported that few elderly respondents interviewed ascribed causes such as disobedience to gods, ancestors and evil spirits to CSM disease and reported that majority of the respondents rightly linked CSM infections to dry, very hot and dusty conditions experienced during the dry season. This study also supports findings by Rabasa et al (2003) and Greenwood et al (1979) who reported that high incidence of meningitis sometimes occurs during the hot, dry season, which is the usual period of epidemics in Northern Nigeria.

There was an almost equal perception among respondents who agreed (46.3%) and those who disagreed (43.7%) that malaria is more serious than with CSM. This is probably because the degree of severity of cerebrospinal meningitis among the respondents was a product of experience either directly or indirectly. For instance, a mother whose child or relative is affected by cerebrospinal meningitis that resulted in death or loss of sight or hearing may perceive CSM to be more serious than malaria, while a mother whose child died because of malaria and has not experienced an outbreak of cerebrospinal meningitis may perceive malaria to be more serious than CSM. Most of the respondents (81.2%) perceived the disease to be deadly. This is line with findings reported by WHO (2003). According to WHO, even when the disease is diagnosed early and adequate therapy instituted, 5% to 10% of patients still die (case fatality rate 10%), typically within 24–48 hours of onset of symptoms (WHO, 2003). In the event that a person survives, bacterial meningitis may result in complications such as brain damage, hearing loss, learning disabilities, epilepsy or other related neurological defects in 10% to 20% of survivors (Edmond, 2010). Also, according to Peltola (1983), the destructive nature of a typical case of CSM that is not treated is 80% and meningococcal meningitis disease is a very significant cause of death and sorrow all over the world.

This study also reports that few of the respondents agreed that immunization against CSM can make their male child impotent (19.3%). This can be attributed to the religious and cultural barriers that have affected the success of immunization. This problem could also be fundamentally traced back to the meningitis outbreak of 1996 when Pfizer an American based pharmaceutical company conducted a drug trial intervention in Kano using their newly

developed molecule Trovamycin (Trovan), with the aim to curb CSM outbreak. The drug trial however was unsuccessful and eventually killed about 5 children and left many more disabled. This is believed to have created distrust between the population and the western world with regards to healthcare delivery service such as immunization. Similar studies conducted by Alto (2006) on polio immunization in Nigeria, also reported that Muslim leaders believed that the vaccine contained contraceptive agents and other contaminants with which the Western world hoped to control population growth. Similarly, Babalola and Aina (2004) in their study pointed out that inequitable access to routine immunization in Nigeria has been attributed to fear and confusion about the intent and purpose of immunization. However, most of the respondents in this study (48.3%) disagreed that immunization is against their religion and believed that immunization against CSM is beneficial to them and their children. This could be attributed to increase in efforts to educate the population about the importance of immunization against childhood preventable diseases as well as increase in women education in the north. This supports Hobcraft (1984) who stated that women's education is a key factor in reducing infant and child mortality and morbidity. The higher a woman's level of education, the more likely it is that she will marry later, play a greater role in decision making in the family and exercise her reproductive rights. Her children will tend to be better nourished and enjoy better health.

5.4 Practice related to cerebrospinal meningitis

Respondent's practice of immunization shows that respondents who reported that their children had received immunization against CSM accounted for 54.4%, while 59.6% of the respondents had received immunization against CSM themselves. Respondents whose child/children had received immunization 6-7 months preceding this study accounted for 37.3% only, with the major places where CSM vaccine was received being government owned hospitals. This shows that the immunization coverage against CSM is still low, which could be attributed to poor knowledge of CSM amongst mothers of children under-five. This finding is contrary to studies conducted by Omole et al. (2012). The study which investigated nursing mothers' knowledge and factors influencing their compliance regimen in a state government-owned children hospital in western Nigeria, reported that majority of the nursing mothers were knowledgeable about immunization regimen compliance and also linked compliance regimen with level of

education as more of the respondents who didn't comply had no secondary education. The difference in knowledge of respondents about immunization regimen compliance as reported by Omole et al. (2012) and the one reported by this study could be attributed to the inequalities between women in Western Nigeria and their counterparts in the North, in terms of their level of education and income. Education always makes a difference in people's views about their health and how best they can protect and improve it.

Among the barriers leading to poor utilization of immunization services against CSM, 40.4% of the respondents who had never had CSM vaccination reported that they did not get themselves and their children vaccinated against the disease because their husbands didn't want them to do so. Few (19.1%) also expressed the fear that it will make their child impotent, while others (14.9%) did not know where to get the vaccine. This is similar to findings reported by Manjunath and Pareek (2003) in their cross sectional study on immunization coverage. Their study reported that obstacles, misconceptions and lack of information were among the barriers reported among mothers who were partially immunized or who were not immunized at all. Renne (2006) in her report also noted that some people believed that the vaccine was contaminated by anti-fertility substances. Some also distrusted claims about the safety of Western biomedicine, hence the need for a health intervention program that will be targeted at significant others in the community in order to increase knowledge and compliance on immunization against CSM.

5.5 Factors that hinder or promote spread of cerebrospinal meningitis

Among the factors that hinder or promote the spread of cerebrospinal meningitis, majority of the respondents (76.9%) rightly reported that factors that hinder the prevalence of CSM include good personal hygiene, 72.2% also reported that regular hand washing during an outbreak could also hinder the spread of the disease. Good personal hygiene makes the environment unfavorable for bacteria, viruses and other microorganisms to breed and this reduces the chance of being infected by such organisms that cause CSM. Amy and Sonricker (2009) also reported that the rapid spread of the disease is due to the ease with which the bacteria are transmitted. Droplets of respiratory or throat secretions transmit the bacteria through methods such as kissing, sneezing, coughing, and sharing of eating or drinking utensils. However in this study,

58.3% of the respondents did not know if sharing of kitchen utensils, towels and cloths with a person who has meningitis could promote or hinder the spread of CSM. There is therefore the need for health education interventions to provide information about CSM among mothers who have children less than five years so as to help improve preventive practices that will reduce the occurrence of CSM outbreak.

Among ways of controlling CSM during an outbreak, majority of the respondents opted for mass vaccination (85.9%), treatment of persons with cerebrospinal meningitis (83.0%) and Health education (71.4%). A little below half of the respondents (47.8%) suggested closure of schools. Other ways of preventing CSM that were mentioned by respondents were avoiding overcrowded rooms (5.4%), allowing cross ventilation in rooms (2.3%) and seeking prevention from Allah (0.5%). Dada and Jaiyeola (1976) reported that massive health education campaigns, dialogues among traditional healers, pharmacists and orthodox clinicians in order to limit the sphere of activity of each group strictly to its level of competence, may help in producing a more responsible attitude to this disease. Amy and Sonricker (2009) also reported that control measures used during epidemics, in places such as Nigeria include: enhanced epidemiological surveillance, prompt case management, and mass vaccinations in areas involved in the outbreak. This is important as poor knowledge of a particular disease generally leads to increase in the incidence and prevalence of such a disease. Also due to the contagious nature of CSM, it is important that crowding is avoided. Closure of school as suggested by some respondents is also an important factor to consider during outbreaks as it will reduce contact and hence help to curb outbreaks.

5.6 Implication for health promotion and education

This study on knowledge, perception and practice of mothers of under-five children on cerebrospinal meningitis has implications for health promotion and education. The findings from this study clearly show the poor level of knowledge about cerebrospinal meningitis. Health promotion and education is all about helping people to be able to attain their full health potential. This could be achieved through programs designed to help improve physical, psychological, educational and work outcomes for an individual. These programs could also help control or reduce overall health care cost by emphasizing prevention of health problems, promotion of healthy lifestyles, improvement in patient compliance and facilitation of access to

health services and care (Fertman and Allensworth, 2010). Poor knowledge about a particular disease generally leads to wrong/negative/unfavourable perception about such disease, poor preventive practices against such diseases and this will in turn leads to increase in incidence and prevalence of such disease in a given community. The whole concept of health promotion is to ensure individuals, families, communities, work place lives a socially and economically productive life, and this is not achieved in communities with high prevalence of a disease. It is also important to remember that the prevalence of a particular disease in a given community is a function of behaviour of the members of this community which is usually guided by certain antecedents factors classified as predisposing, enabling and reinforcing factors.

Health promotion and education generally adopts different strategies at three different stages, namely: primary prevention, secondary prevention and tertiary prevention, to ensure high quality of life among population, as well as increase the community life expectancy. These strategies are not applied blindly, but rather the choice of such programs and strategies are usually guided by evidence based data/information/research and studies like this. This will help to ensure appropriate choice of model to be used to plan, implement and evaluate programs that are aimed towards making members of the community to attain their full health potential. Cerebrospinal meningitis outbreak is responsible for large percentage of child mortality in Northern Nigeria; this is attributed to certain predisposing factors like poor knowledge of the disease, attitude and beliefs of members of the community especially towards personal hygiene etc. It is important to plan and develop a behavioural communication change program that will be aimed at improving the knowledge of mothers of under five children in Yola North LGA of Adamawa state, as this will help shape their perception and improve their preventive practices about cerebrospinal meningitis. It will also help reduce the occurrence of outbreaks, as well as reduce case fatality rate of the disease during outbreaks. This can be successfully achieved through the use of different health promotion strategies including training, community development and empowerment, partnership or resource linking, advocacy and social marketing.

The findings from this study also suggest that the practice of immunization against cerebrospinal meningitis is poor among mothers of children under five in Yola North LGA of Adamawa state. This necessitates the need for an intervention using the appropriate strategies,

that will be aimed at improving the practice of immunization among the population. Immunization services must be well marketed to the members of the community. They must also be able to fully access and utilize such services. This will play an important role in reducing mortality due to cerebrospinal meningitis outbreak. Similarly, findings from this study suggest that majority of the respondents perceived hot weather as the cause of cerebrospinal meningitis and therefore classified the disease as seasonal. This has an implication for health promotion and education as local knowledge can be utilized to solve related health problems. The community members may not be wrong as there is a strong relationship between hot weather/dry season and meningitis outbreak. Akande and Olu (1998) showed that climatic conditions characterized by dry winds, dust storms, low humidity and cold nights, considerably diminish the local immunity of the pharynx, thereby increasing the risk of meningitis. Therefore health promotion utilizes this local knowledge and adopts the appropriate strategy to plan and implement interventions that will further increase the knowledge of the community members and shape their perception towards cerebrospinal meningitis. This will in turn give rise to a socially and economically productive community.

5.7 Conclusion

The research explored the knowledge, perception and practice of mothers of children under five about cerebrospinal meningitis. Mothers of under-five children had poor knowledge of cerebrospinal meningitis in Yola North LGA of Adamawa state. Although some of the respondents knew that cerebrospinal meningitis is caused by infection from micro-organisms, majority of the respondents perceived that it is a seasonal disease caused by hot weather and overcrowding. The preventive practice of mothers who have children less than five years about cerebrospinal meningitis was poor; most of the mothers did not have their children vaccinated in the last six to seven months preceding this study. This brings the need for urgent behavioral communication change interventions that will be aimed at improving the knowledge of mothers of child bearing age about cerebrospinal meningitis. This will also play an important role in shaping their perception positively towards the disease, improve their preventive practices such as immunization against the disease and good personal hygiene and help reduce child mortality and permanent disability due to meningitis outbreak. This will in turn give rise to good quality of life and a productive society at large.

5.8 Recommendation

1. There is need to develop and implement policies that will increase female education in Northern Nigeria, as this will help increase their knowledge and awareness about certain childhood diseases, with special reference to cerebrospinal meningitis.
2. There is also the need to plan and implement awareness and health education programs that will awaken people's consciousness about cerebrospinal meningitis and the need to take precautionary measures such as immunization against cerebrospinal meningitis.
3. Periodic training and continuing education programmes should also be organized for health care workers, in order to improve their ability to properly manage cerebrospinal meningitis, particularly during outbreaks.
4. The Government should also provide well-built low-cost houses for the people, particularly in the Northern part of Nigeria, in order to reduce over-crowding.

REFERENCES

Agbakwuru, C., 2002. 'The role of primary education in the promotion of national integration and cohesion'. Knowledge Review 1(2), 15 - 23

Ahmad, O., Lopez, A., and Inoue, M. 2000. The decline in child mortality: a reappraisal. Bulletin of World Health Organization 78:1175-1191.

Akande, T.M., and Olu, O., 1998. Perception and attitude to outbreak of Meningitis. Niger. J. Med. 7:154–156.

Akweongo, P., Dalaba, M.A., Hayden, M.H., Awine, T., and Nyaaba, G.N., 2013. The Economic Burden of Meningitis to Households in Kassena-Nankana District of Northern Ghana. PLoS ONE 8(11)

Allan, R.T., Barry, J.H., Sheldon, L.K., Bruce A.K., Karen L.R., Michael W.S., and Richard, J. W., 2003. Practice Guidelines for the Management of Bacterial Meningitis 5, pp. 618–26,

Al-Mazrou, Y.Y., Musa, E.K., Abdalla, M.N., Al-Jeffri, M.H., Al-Hajjar, S.H., and Mohamed, O.M., 2003. Disease burden and case management of bacterial meningitis among children under 5 years of age in Saudi Arabia. Saudi medical journal, vol. 24, no. 12, pp. 1300–7,

Alto, V., 2008. 'Perspectives on polio immunization campaigns in Ibadan, Nigeria'. Michigan Discussions in Anthropology. Vol. 17, No.1, Department of Anthropology, University of Michigan Ann Arbor, MI: MPublishing

Amy L., and Sonricker H., 2009. Cerebrospinal meningitis spread in Nigeria, Disease Daily, www.healthmap.org

Anaïs, C., Fernand, B., Sylvie, Z., Fatoumata, O., Ousmane, B., Philippe, J., Emmanuel, S., Bradford, D.G., and Alfred, D.S., 2008. Costs for Households and Community Perception of Meningitis Epidemics in Burkina Faso

Apwah F., 2013. Patterns, Perceptions and Management of Cerebro-spinal Meningitis in the kassena-Nankana East and west districts University of Ghana http://ugspace.ug.edu.gh

Babalola, S., and Aina, O., 2004. Community and systemic factors affecting the uptake of immunization in Nigeria: A qualitative study in five states. National Report, Abuja: PATHS

Baker. M., McNicholas, A., Garrett, N., Jones, N., Stewart, J., Koberstein, V., and Lennon, D., 2000. Household crowding a major risk factor for epidemic meningococcal disease in Auckland children. The Pediatric infectious disease journal, vol. 19, no. 10, pp. 983–90,

Berkley, J.A., Mwangi, I., Ngetsa, C.J., Mwarumba, S., and Lowe, B.S., 2001. Diagnosis of acute bacterial meningitis in children at a district hospital in sub-Saharan Africa. Lancet 357: 1753–1757.

Besancenot, J.P., Boko, M., and Oke, P.C., 1997. Weather conditions and cerebrospinal meningitis in Benin (Gulf of Guinea, West Africa). European journal of epidemiology, vol. 13, no. 7, pp. 807–15

Bilukha O.O., and Rosenstein N., 2005. Prevention and Control of Meningococcal Disease. Recommendations of the advisory committee on immunization practices (ACIP). MMWR Recomm rep. 27; 54(rr-7):1–21

Black, R., Morris, S., and Bryce, J., 2003. Where and why are 10 million children dying every year? Lancet 361:2226-34

Blackwell, C.C., Tzanakaki, G., Kremastinou, J., Weir, D.M., Vakalis, N., Elton, R.A., Mentis, A., and Fatouros, N., 1992. Factors affecting carriage of Neisseria meningitidis among Greek military recruits. Epidemiology and infection, vol. 108, no. 3, pp. 441–8

Bruce, M.G., 2001. Risk Factors for Meningococcal Disease in College Students, JAMA: The Journal of the American Medical Association, vol. 286, no. 6, pp. 688–693

Burgess, D.S., Frei, C.R., Lewis, J.S.I., Fiebelkorn, K.R., and Jorgensen, J.H., 2007. The contribution of pharmacokinetic-pharmacodynamic modelling with Monte Carlo simulation to the development of susceptibility breakpoints for Neisseria meningitidis.," Clinical microbiology and infection: the official publication of the European Society of Clinical Microbiology and Infectious Diseases, vol. 13, no. 1, pp. 33–9

Center for Disease Control, 2011. Recommendation of the advisory committee on immunization practices (acip) for use of quadrivalent meningococcal conjugate vaccine (menacwy-d) among children aged 9 through 23 months at increased risk for invasive meningococcal disease. MMWR Morb Mortal Wkly Rep. Oct 14;60(40):1391–2.

Ceyhan, M., Anis, S., Htun-Myint, L., Pawinski, R., Soriano-Gabarró, M., and Vyse, A., 2012. Meningococcal disease in the Middle East and North Africa: an important public health consideration that requires further attention.," International journal of infectious diseases IJID official publication of the International Society for Infectious Diseases, vol. 16, no. 8, pp. e574–82

Chaves, L.F., and Koenraadt, C.J.M., 2010. Climate change and highland malaria: Fresh air for a hot debate. Quart. Rev. Biol. 85:27–55.

Chavez-Bueno, S., and McCracken, G.H.Jr., 2005. Bacterial meningitis in children. Pediatr Clin North Am 52(3):795-810.

Cheesbrough, J.S., Morse, A.P., and Green, S.D., 1995. Meningococcal meningitis and carriage in western Zaire: a hypoendemic zone related to climate. Epidemiology and infection, vol. 114, no. 1, pp. 75–92

Christensen, H., May, M., Bowen, L., Hickman, M., and Trotter, C.L., 2010. Meningococcal carriage by age: a systematic review and meta-analysis. The Lancet infectious diseases.

Collins, L., Dupont, L., and Nagle, D., 2003. The impact of educational efforts on first-year university students' acceptance of meningococcal vaccine. Journal of American College Health. 52(1). 41-43.

Dada, T.O., and Jaiyeola, B.O., 1976. Epidemiology and prognosis of pyogenic meningitis in Nigerians a study of 294 patients. Niger Med J. Apr;6(2):152-9

Davies, L.A., O'Flanagan, D., Salmon, R.L., and Coleman, T.J., 1996. Risk factors for Neisseria meningitidis carriage in a school during a community outbreak of meningococcal infection. Epidemiology and infection, vol. 117, no. 2, pp. 259–66

De Chabalier, F., Djingarey, M.H., Hassane, A., and Chippanx, J.P.C., 2000. Meningitis seasonal pattern in Africa and detection of epidemics: A retrospective study in Niger; 1990–1998. Trans. Roy. Soc. Trop. Med. Hyg. 94:664–668.

De Chabalier, F., Djingarey, M.H., Hassane, A., and Chippaux, J.P., 2000. Meningitis seasonal pattern in Africa and detection of epidemics: a retrospective study in Niger, 1990-98. Trans R Soc Trop Med Hyg, 94(6):664-668.

Desmond, N.A., Nyirenda, D., Dube, Q., Mallewa, M., Molyneux, E., David, G., Lalloo, and Robert, S., Heyderman, 2013. Recognising and Treatment Seeking for Acute Bacterial Meningitis in Adults and Children in. July 04, 2013. disease . A shifting etiology," Journal of Bacteriology Research, vol. 1, no. 1, pp. 6–18, 2009.

Duncan, S.R., Scott, S., Duncan, C.J., 2000. Modelling the dynamics of scarlet fever epidemics in the 19th century. Eur J Epidemiol, 16(7):619-626.

Dunlop, K.A., Coyle, P.V., Jackson, P., Patterson, C.C., and Shields, M.D., 2007. Respiratory viruses do not trigger meningococcal disease in children. The Journal of infection, vol. 54, no. 5, pp. 454–8

Durey, A., Bae, S.M., Lee, H.J., Nah, S.Y., Kim, M., Baek, J.H., Kang, Y.H., Chung, M.H., and Lee, J.S., 2012. Carriage rates and serogroups of Neisseria meningitidis among freshmen in a University dormitory in Korea. Yonsei medical journal, vol. 53, no. 4, pp. 742–7

Edmond, K., 2010. Global and regional risk of disabling sequelae from bacterial meningitis: a systematic review and meta-analysis. Lancet Infect Dis 10(5):317-328.

Emele, F.E., Ahanotu, C.N., and Anyiwo, C.E., 1999. Nasopharyngeal carriage of meningococcus and meningococcal meningitis in Sokoto, Nigeria.," Acta paediatrica (Oslo, Norway 1992), vol. 88, no. 3, pp. 265–9

Emmanuel, T.,U., Ahmed, N.M.L., Mohammed, R.M., Soheil, S., Chingle, M.P., Wallace, E., and Abdrazack, N.T.A., 2013. Risk Factors Responsible for the Spread of

Meningococcal Meningitis: International Journal of Education and Research Vol. 1 No. 2 February 2013

Federal Medical Centre afr. j. cln. exper. microbiol. 9 (3): 152-156

Field, C.B., Barros, V.R., Dokken, D.K., Mach, K.J., Mastrandrea, M.D., Bilir, T.E., Chatterjee, M., Ebi, K.L., Estrada, Y.O., Genova, R.C., 2014. Editors Contribution of Working Group II to the 5th Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press; Cambridge, UK: Intergovernmental Panel on Climate Change. Impacts; Adaptation and Vulnerability. Part A: Global and Sectoral Aspects.

Fisman, D.N., 2007. Seasonality of infectious diseases. Annu. Rev. Public Health. 28:127–143.

Fone, D.L., Harries, J.M., Lester. N., and Nehaul. L., 2003. Meningococcal disease and social deprivation: a small area geographical study in Gwent, UK.," Epidemiology and infection, vol. 130, no. 1, pp. 53–8.

Forgor, A.A., 2007. Meningococcal and Pneumococcal Meningitis in University of Basel

Frasch, C.E., 2005. Recent Developments in Neisseria Meningitidis Group A Conjugate Vaccines. Expert Opin Bio Ther, 5(2), 273-280.

Gagneux, S.P., Hodgson, A., Smith, T.A., Wirth, T., Ehrhard, I., Morelli, G., Genton, B., Binka, F.N., Achtman, M., and Pluschke, G., 2002. Prospective study of a serogroup X Neisseria meningitidis outbreak in northern Ghana., The Journal of infectious diseases, vol. 185, no.

Glover, J., 1920. Observations on the Meningococcus Carrier Rate and their Application to the Prevention of Cerebrospinal Fever, Medical Research Council Special Report vol 50.

Greenwood, B., 1999. Manson Lecture, Meningococcal meningitis in Africa. Trans R Soc Trop Med Hyg, 93(4):341-353.

Greenwood, B., 1999. Manson Lecture. Meningococcal meningitis in Africa. Transactions of the Royal Society of Tropical Medicine and Hygiene, vol. 93, no. 4, pp. 341–53

Greenwood, B., 2006. 100 years of epidemic meningitis in west Africa—Has anything changed? Trop. Med. Int. Health. 11:773–780.

Greenwood, B.M., Blakebrough, I.S., Bradley, A.K., Wali, S., and Whittle, H.C., 1984 Meningococcal disease and season in sub-Saharan Africa. Lancet, vol. 1, no. 8390, pp. 1339–42

Greenwood, B.M., Blakebrough, I.S., Bradley, A.K., Wali, S., Whittle, H.C., 1984. Meningococcal disease and season in sub-Saharan Africa. Lancet, 1(8390):1339-1342.

Greenwood, B.M., Bradley, A.K., Cleland, P.G., Haggie, M.H.K, Hassan-King, M., Lewis, L.S., Macfarlene, I.T., 1979. An Epidemic of Meningococcal Infection at Zaria, Northern Nigeria. General Epidemiological features. Transaction of the Royal Society of Tropical Medicine and Hygiene 73, 5: 557-62.

Grimwood, K., Anderson, P., Anderson, V., Tan, L., Nolan, T., 2000. Twelve year outcomes following bacterial meningitis: Further evidence for persisting effects. Arch. Dis. Child. 83:111–116.

Guidelines on the Control of Epidemic Meningococcal Disease. 1998. 2nd ed. WHO; Geneva, Switzerland

Harrison, L.H., Trotter, C.L., and Ramsay, M.E., 2009. Global epidemiology of meningococcal disease. Vaccine, vol. 27 Suppl 2, pp. B51–63

Hassan-King, M., Greenwood, B.M., Whittle, H.C., Abbott, J.D., and Sutcliffe, E.M., 1979. An epidemic of meningococcal infection at Zaria, Northern Nigeria. 3. Meningococcal carriage. Transactions of the Royal Society of Tropical Medicine and Hygiene, vol. 73, no. 5, pp. 567–73 Health, vol. 21, no. 4, pp. 153–158

Hélène, B., Solenne, P., Guillaume, C., Magny, D., Marie-Françoise, C., Benjamin, S. and Jean-François, G., 2007. Comparative study of meningitis dynamics across nine African countries: a global perspective International Journal of Health Geographics, 6:29

Heymann, D. 2003. The Evolving of Infectious Disease Threat: Implications for National and Global Security. Journal of Human Development, 4(2), 191- 207.

Hobcraft, J.N., Mcdonald, J.W., and Rutsein S.O., 1984. Socioeconomic factors in infant and child mortality: a cross-national comparison'. Population Studies: A Journal of Demography. Vol.38,Issue 2.

Holliman. R.E., 2007. Epidemiology of invasive pneumococcal disease in Kumasi, Ghana. Trans R Soc Trop Med Hyg 101(4):405-413.

Horton, R., 2005. The neglected epidemic of chronic disease. The Lancet 366: 1514–1514.

Imperato, P.J., 1983. Epidemic meningococcal meningitis: the case of Mali. Bulletin of the New

Jackou-Boulama, M., Michel, R., Ollivier, L., Meynard, J.B., Nicolas, P., Boutin, J.P., 2005. Correlation between rainfall and meningococcal meningitis in Niger. Med. Trop. 65:329–333.

Jean-Marc, C., Bassira, I., Maman, Z., Stéphane, H., Pierre, N., Muhamed-Kheir, T., Brian, G., and Jean-François, J.C., 2013. Epidemiological changes in meningococcal meningitis in Niger from 2008 to 2011 and the impact of vaccination BMC Infectious Diseases 13:576

Joachim, C., and Nadel, S., 2011. Management of meningococcal disease, Paediatrics and Child

John, B.R., Rachel, S., Emil, C.G., Idris, M., Abdulsalami, N., Jean-Philippe, C., Luis, B., and Moussa, A.M., 2003. Meningococcal meningitis in sub-Saharan Africa: the case for mass and routine vaccination with available polysaccharide vaccines Bulletin of the World Health Organization 81:745-750

Koomen, I., Grobbee, D.E., Jennekens., S.A., Roord, J.J., and Van-Furth, A.M., 2007. Parental perception of educational, behavioural and general health problems in school-age survivors of bacterial meningitis Volume 92, Issue 2, pages 177–185, February 2003

Kriz, P., Bobak, M., and Kriz, B., 2000. Parental smoking, socioeconomic factors, and risk of invasive meningococcal disease in children: a population based case-control study. Archives of disease in childhood, vol. 83, no. 2, pp. 117–21

Lapeyssonie, L., La meningitecerebrospinale en Afrique. Bulletin of the WHO 1963; 28 (suppl): 3-114.

Lapeyssonnie, L., 1963. The meningococcal meningitis in Africa.

Leimkugel, J., Racloz, V., Jacintho, S.L., and Pluschke, G., 2009. Global review of meningococcal disease. A shifting etiology Journal of Bacteriology Research Vol. 1(1), pp. 006 018

Leimkugel. J., Racloz, V., Silva, L.J., and Pluschke, G., 2009. Global review of meningococcal

Lindsey, A., Kayla C., Christine, R., and Kristen, S., 2004. Meningitis: What do college students know? This paper was written for Dr. Sauter's Nursing Research course

MacLennan, J., Kafatos, G., Neal, K., Andrews, N., Cameron, J.C., Roberts, R., Evans, M.R., Cann, K., Baxter, D.N., Maiden, M.C.J., and Stuart, J.M., 2006. Social behavior and meningococcal carriage in British teenagers. Emerging infectious diseases, vol. 12, no. 6, pp. 950–7

Martin, M., 2004. Impact of haemophilus influenzae type b conjugate vaccine in South Africa and Argentina. Pediatr Infect Dis J 23(9):842-847.

Michael, O., Samuel, B. N., Yaw, A.B., Ernest, B.B., Abdul-Raman, A., Robert A.L., and Yaw, A.S., 2012. Aetiological agents of cerebrospinal meningitis: a retrospective study from a teaching hospital in Ghana Annals of Clinical Microbiology and Antimicrobials 11:28

Michael, O., Samuel, B.N., Yaw, A.B., Ernest, B.B., Abdul-Raman, A., Robert, A.L., and Yaw, A.S., 2012. Aetiological agents of cerebrospinal meningitis: a retrospective study from a teaching hospital in Ghana Annals of Clinical Microbiology and Antimicrobials 11:28

Mohammed, I., Nasidi, A., Alkali, A.S., Garbati, M.A., Ajayi-Obe, E.K., Audu, K.A., Usman, A., Abdullahi, S.A., 1996. severe epidemic of meningococcal meningitis in Nigeria, Niger Med J. 1976 Apr; 6(2):152-9

Mohammed, I., Nasidi, A., Alkali, A.S., Garbati, M.A., Ajayi-Obe, E.K., Audu, K.A., Usman, A., and Abdullahi, S., 2000. A severe epidemic of meningococcal meningitis in Nigeria,

1996. Transactions of the Royal Society of Tropical Medicine and Hygiene, vol. 94, no. 3, pp. 265– 70

Molesworth, A.M., Cuevas, L.E., Connor, S.J., Morse, A.P., and Thomson, M.C., 2003. Environmental risk and meningitis epidemics in Africa. Emerging infectious diseases, vol. 9, no. 10, pp. 1287–93

Molesworth, A.M., Thomson, M.C., Connor, S.J., 2002. Where is the meningitis belt? Defining an area at risk of epidemic meningitis in Africa. Trans R Soc Trop Med Hyg 96:242-9.

Molesworth, A.M., Thomson, M.C., Connor, S.J., Creswell, M.P., Morse, A.P., 2002. Where is the meningitis belt? Defining an area at risk of epidemic meningitis in Africa. Trans. Roy. Soc. Trop. Med. Hyg. 96:242–249.

Moore, P.S., (1992) Meningococcal meningitis in sub-Saharan Africa: A model for the epidemic process. Clin. Infect. Dis. 14:515–525.

Mueller, J.E., Yaro, S., Madec, Y., Somda, P.K., Idohou, R.S., Lafourcade, B.M., Drabo, A., Tarnagda, Z., Sangare, L., Traore, Y., 2008. Association of respiratory tract infection symptoms and air humidity with meningococcal carriage in Burkina Faso. Trop. Med. Int. Health. 13:1543–1552.

Obionu, C.N., 2001. Primary Health Care for Developing Countries. Enugu: Delta Publications

Odedina, E.A., and Emumwen, E.G., 2008. Bacterial Meningitis Among Children in

Ogunlesi, T.A., Okeniyi, J.A.O., and Oyelami, O.A., 2005. Pyogenic Meningitis in Ilesa, Nigeria

Ogunmekan, D.A., 2007. Protecting the Nigerian Child against the Common communicable diseases, Tropical Medicine, 29 (15),389-392.

Ogunmekan, D.A., 2007. The influence of total environment on the Control of communicable disease in Lagos, Nigerian Medical Journal, 6 (3), 333 337.

Olowokure, B., Onions. H., Patel, D., Hooson, J., and O'Neill, P., 2006. Geographic and socioeconomic variation in meningococcal disease: a rural/urban comparison. The Journal of infection, vol. 52, no. 1, pp. 61–6,

Omotara B.A., Tamunoibuomi F. O., Samuel O. E., Omeiza B. and Eric G., 2012. Assessment of knowledge, Attitude and Practice of Stakeholders Towards Immunization in Borno state, Nigeria: A Qualitative Approach J Community Med Health Educ 2012, 2:9

Onwujekwe, O., Hanson, K., Uzochukwu, B., 2012. Examining Inequities in Incidence of Catastrophic Health Expenditures on Different Healthcare Services and Health Facilities in Nigeria. PLoS ONE 7: e40811.

Paireau. J., Maïnassara, H.B., Jusot, J.F., Collard, J.M., and Idi, I., 2014. Spatio-Temporal Factors Associated with Meningococcal Meningitis Annual Incidence at the Health Centre Level in Niger, 2004–2010. PLoS Negl Trop Dis 8(5): p2899.

Panjarathinam, R.. and Shah, R.K., 1993. Pyogenic meningitis in Ahmedabad, The Indian Journal of Pediatrics, vol. 60, no. 5, pp. 669–673,

Peltola, H., 1983 Meningococcal disease: still with us, Review of Infectious Disease, vol. 5, pp. 71–90,

Petter, B., and Mercel, V.D., 2005. Meningococcal infections at the start of the 21st Century. Advances in Pediatrics 52: 129-61.

Pollard, A.J., and Frasch, C., 2001. "Development of natural immunity to Neisseria meningitidis.," Vaccine, vol. 19, no. 11–12, pp. 1327–46,

Proulx, N., Fréchette, D. Toye, B., Chan, J., and Kravcik, S., 2005. Delays in the administration of antibiotics are associated with mortality from adult acute bacterial meningitis

Rabasa, A.I., Mohammed, R., and Omotara, B.A. 2003. Epidemiological Features and Outcome of Meningococcal Meningitis Outbreak in Children in Maiduguri, Borno State., Nigeria. Nigerian Journal of Clinical Practice June 6, 1:49 – 51

Renne, P.E., 2006. Perspectives on polio and immunization in Northern Nigeria'. Social Science and Medicine.Vol. 63 1857-1869

Renner, L.A., 2007. Introduction of Haemophilus influenzae type B conjugate vaccine into routine immunization in Ghana and its impact on bacterial meningitis in children younger than five years. Pediatr Infect Dis J 26(4):356-358.

Roberts, l. 2008. An ill wind, Bringing Meningitis Science, 320, 1710-1715.

Rosenzweig, C., Karoly, D., Vicarelli, M., Neofotis, P., Wu,Q.G., Casasa, G., Menzel, A., Root, T.L., Estrella, N., and Seguin, B., 2008. Attributing physical and biological impacts to anthropogenic climate change. Nature. 453:353–357.

Samuel, N.A.C., and Vivian A.N., 2014. Climate Change and Cerebrospinal Meningitis in the Ghanaian Meningitis Belt nt J Environ Res Public Health. 11(7): 6923–6939.

Savory, E.C., Cuevas, L.E., Yassin, M.A., Hart, C.A., Molesworth, A.M., Thomson, M.C., 2006. Evaluation of the meningitis epidemics risk model in Africa. Epidemiol. Infect. 2006;134:1047–1051.

Sigauque, B., Roca, A., Sanz, S., Oliveiras, I., and Martinez, M., 2008. Acute bacterial meningitis among children in Manhica, a rural area in Southern Mozambique. Acta Tropica 105: 21–27.

Singh, P., and Yadav, R., 2001. Immunization status of children of India, Indian paediat, 8 (3), 12.

Soubeiga, A., 2003. Les conceptions populaires moose de la méningite (Burkina Faso). In: Bonnet D, Jaffre Y, editors. Les maladies de passage: transmissions, préventions et hygiènes en Afrique de l'Ouest. Paris, France: Karthala; p. 279-93

Stanwell-Smith, R.E., Stuart, J.M., Hughes, A.O., Robinson, P., Griffin, M.B., and Cartwright, K., 1994. Smoking, the environment and meningococcal disease: a case control study. Epidemiology and infection, vol. 112, no. 2, pp. 315–28,

Stephens D.S., Greenwood B., Brandtzaeg P., 2007. Epidemic Meningitis, Meningococcaemia, and Neisseria Meningitidis. Lancet. 30;369(9580):2196–210

Su, T., Kouyaté, B., Flessa, S., 2006. Catastrophic household expenditure for health care in a low-income society: a study from Nouna District, Burkina. 2006: 618–626.

Sultan, B., Labadi, k., Guégan, J-f., and Janicot, S. 2005. Climate Drives the Meningitis Epidemics onset in West Africa. Plos Med 2(1), 0043- 0049

Sunakawa, K., 1998. Analysis by questionnaire survey concerning example such as purulent meningitis and severe infectious diseases--relation among patient background factor, sequelae, and infecting organism

Theodoridou, M.N., 2007. Meningitis registry of hospitalized cases in children: epidemiological patterns of acute bacterial meningitis throughout a 32-year period BMC Infect Dis 7:101.

Thigpen, M.C., Whitney, C.G., Messonnier, N.E., Zell, E.R., Lynfield, R., Hadler, J.L., Harrison, L.H., Farley, M.M., Reingold, A., Bennett, N.M., Craig, A.S., Schaffner, W., Thomas, A., Lewis, M.M., Scallan, E., Schuchat, A., 2007. Emerging Infections Programs Network, Bacterial meningitis in the United States, 1998-2007

Thigpen, M.C., Whitney, C.G., Messonnier, N.E., Zell, E.R., Lynfield, R., Hadler, J.L., 2011. Emerging Infections Programs Network. Bacterial meningitis in the United States, 1998-2007. N Engl J Med. 364:2016-25.

Trotter, C.L., and Greenwood, B.M., 2007. Meningococcal carriage in the African meningitis belt. The Lancet infectious diseases, vol. 7, no. 12, pp. 797–803

Tully, J., Viner, R.M., Coen, P.G., Stuart, J.M., Zambon, M., Peckham, C., Booth, C., Klein, N., Kaczmarski, E., and Booy, R., 2006. Risk and protective factors for meningococcal disease in adolescents: matched cohort study. BMJ (Clinical research ed.), vol. 332, no. 7539, pp. 445–50

Tyler, K.L., 2010. A history of bacterial meningitis, Handb Clin Neurol. 95:417-33.

UN, General Assembly., 56th session. Road map towards the implementation of the united nation millennium declaration: report of the Secretary General (UN document no: A/56326). New York: United Nations, 2001.

Vanguard March 2009. Meningitis hits Adamawa, kills 3 corps members http://nigeriavillagesquare.com

Varaine, F., Caugant, D.A., Riou. J.Y., Kondé, M.K., Soga, G., Nshimirimana, D., Muhirwa, G., Ott, D., Høiby, E.A., Fermon, F., and Moren, A., 1997. Meningitis outbreaks and vaccination strategy. Transactions of the Royal Society of Tropical Medicine and Hygiene, vol. 91, no. 1, pp. 3–7, vol. 10, no. 12, pp. 853–61

WHO, 1998. Control of Epidemic Meningococcal Disease. WHO Practical Guidelines. 2nd Edition.

WHO, 1999. Pneumococcal vaccines. Wkly. Epidemiol. Rec. 74:177–183.

WHO, 2000. "Detecting Meningococcal Meningitis Epidemics in Highly-Endemic African Countries,

WHO, 2000. Detecting meningococcal meningitis epidemics in highly-endemic African countries. Wkly. Epidemiol. Rec. 75:305–312.

WHO, 2003. Meningococcal Meningitis Fact Sheet, accessed on 11 March 2013. Available online: http://www.who.int/mediacentre/factsheets>/2003/fs141/en/indexhtml

WHO, 2003. Update on WHO/AFRO Paediatric Bacterial Meningitis (PBM) Surveillance .

WHO, 2005. Enhanced surveillance of epidemic meningococcal meningitis in Africa. Wkly. Epidemiol. Rec. 80:313–320.

WHO, 2012. Meningococcal Disease: situation in the African Meningitis Belt. WHO. Available: http://www.who.int/csr/don/2012_03_23/en/index.html. Accessed 11 October 2012

Wilder-Smith A., 2008. Meningococcal Disease: Risk for International Travellers and Vaccine Strategies. Travel Med Infect Dis. Jul;6(4):182–6.

Wilder-Smith, A., 2007 Meningococcal vaccine in travelers, Current Opinion in Infectious Disease Volume 20 - Issue 5 - p 454-460

World Health Organisation, 2011. Meningitis in Burkina Faso, Chad, Niger, Nigeria and Ghana: 2010 epidemic season. Wkly Epidemiol Rec 86(15):143-151.

World Health Organization, 2005. Enhanced surveillance of epidemic meningococcal meningitis in Africa: a three-year experience. Wkly Epidemiol Rec 80:313-20.

World Health Organization, 2011. Meningococcal meningitis [online]. 2011. Available from: http://www.who.int/mediacentre/factsheets/fs141/en/index.html webcite

Yaka, P., Sultan, B., Broutin, H., Janicot, S., Philippon, S., and Fourquet, N., 2008. Relationships between climate and year-to-year variability in meningitis outbreaks: a case study in Burkina Faso and Niger. International journal of health geographics, vol. 7, p. 34

York Academy of Medicine, vol. 59, no. 9, pp. 818–32, Nov. 1983.