Social Factors and Management of Cerebrospinal Meningitis in Magama Local Government Area of Niger State

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Abstract

Meningitis is a fatal disease known to cause huge mortalities in Sub-Sahara African Meningitis Belt. This study is driven by the sharp variation in the incidence and fatality rate of the disease in Niger State, Nigeria which have defied climatological explanations. To this end, the ecosocial theory was used to anchor the study. A survey research design was adopted and data were collected from 246 respondents in five meningitis-endemic communities. Questionnaire was used as an instrument of data collection. Descriptive and inferential statistical tools were used in the presentation and analysis of the data collected. Findings revealed most respondents as being familiar with three symptoms of meningitis namely stiff neck, fever and backache. While most of them only knew two causes of meningitis namely overcrowding and heat. Caregivers with little or no formal education knew fewer symptoms of meningitis as opposed to more educated caregivers who knew more causes of the disease, χ^2 (15, N=246) = 60.744, p<0.05. Furthermore, the health-seeking behaviour of the respondents was characterized by significant use of Patent Medicine Vendors as means of managing the disease. Religious affiliations of respondents influenced the respondents' choice of management method, χ^2 (6, N=246) = 26.945, p< 0.0005. Consequently, the study recommends among other things, introduction of basic and adult literacy programmes; and massive sensitization of the people using stakeholders such as religious organisations.

Keywords: Educational Attainment; Knowledge; Management; Meningitis; Religious Affiliation

Introduction

The change in the world's climate is evidently inevitable and is not without daring consequences. This change happens at an unprecedented speed thereby putting man and other life species at severe risks of unending hardship (Onu & Ikehi, 2015; Farauta, Egbule, Idrisa & Victoria, 2011). Infectious diseases have been aggravated by the incidence of climate change. This is owing to their high sensitivity to climatic variations. Consequently, sub-Saharan Africa (SSA) has been greatly affected. One of such infectious diseases which is currently taking a huge toll on the people in the region is the Cerebrospinal Meningitis or simply meningitis (Abdulsalam, 2014). Muller (2009) observes that Africa seems to be one of the areas prone to the dangers of climate change due to their disproportionate vulnerability and lack of adaptive capacity. In recognition of its severity and fatality, the world observes every April 24 as "World Meningitis Day". The disease, which is known to have high fatality rate, is endemic in the African Meningitis Belt (AMB) where Nigeria is counted amongst the "Big Five" countries that are worst hit (Perea, 2007).

Nigeria's experience with the disease has been a bitter one. WHO in Abdulsalam et al. (2014) indicates that over 35% of meningitis cases reported in Africa between 1996 and 2010 were from Nigeria, and 95% of these cases occurred in northern Nigeria. In the same vein, Mado, Abubakar, Onazi, and Adeoye (2013) note that meningitis disease has been a major cause of morbidity and mortality in northern Nigeria for the past four decades despite the advancement in treatment. This reveals the high level of susceptibility of the region to meningitis epidemic. Therefore, the disease

is a major health challenge confronting northern Nigeria. While northern Nigeria has been identified as the hub of meningitis epidemic, it is logical to expect a normal distribution in the incidence of the disease across the northern States given their similarity in climate which is believed to be the major predisposing factor. On the contrary, acute variations within the northern States characterise the incidences of meningitis epidemics in the Nigerian Meningitis Belt (NMB). In fact, within a northern State; some Local Government Areas (LGAs) record more cases and deaths than their counterparts despite their similarities in geographic and climatic configuration.

In this vein, one of such States with a share of the meningitis burden is Niger State. The National Centre for Disease Control [NCDC] (2017) classifies Niger State among the worse-hit States in the country as at 2017 epidemic season. As at 2017 incidence, 89% of the cases and all the mortalities recorded were from the Niger North District. The number of cases and deaths from meningitis in Niger State was eleven times and four times the number of cases and deaths in Kaduna State. Consequent upon the foregoing, these variations in the distribution of the incidence and fatalities of the disease defy the argument for single-factor causation offered by climatological studies. Despite this bitter experience of meningitis epidemic, remedial measures have heavily relied on solely on biomedical realms ignoring the largely social dimension of the disease. Most studies on the aetiology of the meningitis disease such as the studies of Abdulsalam (2014), Abdulsalam *et al* (2014), Perea (2007), Portier *et al* (2010) have been grossly preoccupied with the influence of climate on the disease. This leaves few studies such as the study of Osei-Somuah (2001) and Hayden *et al* (2013) among others to cater for the social underpinnings of meningitis. Thus, the inadequacy of these explanations justifies the need to launch a sociological investigation into the problem. To this end, this study seeks to investigate the role of social factors in the management of the meningitis disease in Magama Local Government Area (LGA) of Niger State.

Objectives of the Study

The general objective of this study is to investigate the role of social factors in the management of the meningitis disease in Magama Local Government Area (LGA) of Niger State. While the specific objectives are:
i.   To determine the educational attainment of respondents and their knowledge of number of meningitis symptoms Magama Local Government Area;
ii.   To examine the health-seeking behaviour of the caregivers to meningitis patients in Magama Local Government Area;
iii.   To ascertain the religious affiliation of respondents and their method of managing meningitis in Magama Local Government Area.

Cerebrospinal Meningitis: An Overview

Meningitis disease has many definitions most of which emphasis the symptoms and effects of the disease. Codjoe and Nabie (2014) define meningitis as a life threatening contagious disease that affects the protective membranes covering the brain and spinal cord which spreads through respiratory droplets to non-infected persons. It is an infection of the thin lining that surrounds the brain and spinal cord known as meninges. Given the importance of these organs to human survival, their destruction becomes life-threatening. Meningitis's fatality is due to its short incubation period within which severe damage can be done to the victim. If left untreated, the infection can be fatal in 50% of cases (WHO, 2015). In fact, even with prompt administration of treatment, 5% - 10% of the patients inevitably die (Kirsch, Barton, Kitchen & Giroir, 1996). Ahmed-Abakur (2014) also reiterates that 10% to 20% of the survivors mostly suffer from severe neurological defects such as

deafness, paralysis, and mental retardation. The high fatality rates of the disease coupled with its lifelong disability syndrome among survivors have combined to make the disease a major public health burden in SSA where it is highly feared. Consequently, Brian (2017) asserts that the fatality rate of meningitis exceeds the fatality rates of Lassa fever and monkey pox combined.

Meningitis epidemic usually starts with the commencement of the dry/hot season and quickly ends with the onset of the rainy season (Ahmed-Abakur, 2014). In Nigeria, the epidemic season commences around November and ends with the onset of the rainy season usually in May of the following year. However, Abdulsalam (2014) reveals that indications suggest the outbreak may commence as early as October due to the rapid rate of the changing climate.

Social Factors Affecting Meningitis Disease in Nigeria

Many factors have been advanced for the risk of meningitis outbreak. These factors cut across environmental factors, biological factors and social factors. However, the centrepiece of this paper lies in the preponderance of social factors influencing the disease. Abdussalam and Qaffas (2016) in their study of spatiotemporal pattern of meningitis risk factors in Nigeria found a strong link between meningitis epidemic and poverty cum low adult literacy. Furthermore, Ngbokai (2017) affirms that illiteracy and poverty were observed to be the major causes of deaths during the meningitis outbreak in Zamfara State. The report establishes most of the victims of the meningitis epidemic as the Almajiris, who are known to have little or no western education and are predominantly from poor backgrounds. These two underlying conditions make them vulnerable to the disease as evident in the 2017 epidemic. The works of NCDC (2017), Aina and Ejembi (2013), Muanya (2017) all highlight the roles of social factors. This implies that the case of Sub-Sahara Africa which hosts the African Meningitis Belt (AMB) and the poorest countries in Africa is not a mere coincidence. This pushes the argument for the poverty-meningitis nexus to a logical conclusion.

Figure 1: Meningitis Belt of Africa
Source: Adapted from NCDC, 2017

Poor housing conditions and overcrowding has also received a fair scholarly justification as a major risk factor for meningitis. This is illustrated in the works of Olowokure, Onions, Patel, Hooson, and O'Neill (2006), Hayden *et al* (2013), Codjoe and Nabie (2014), and Abdussalam & Qaffas (2016) among others. In the case of poor housing, Olowokure *et al* (2006) link poor housing conditions with the most deprived areas of the society. The study found that most poorly constructed houses are found in the most deprived neighbourhoods especially in the rural areas.

As such, chances are that a household may face the risk of meningitis not because such house is overcrowded, but due to its poor nature of construction which renders its inhabitants vulnerable. The thrust of this argument therefore inherently suggests the influence of poverty given that only the poor are predominantly found in the rural areas and the most deprived areas. This also implies that the predisposing factors may have some interconnection and could be reinforcing one another. Urbanisation has also been identified as a meningitis risk factor. The increasing rate of urbanisation will undoubtedly result in overcrowding which is a major risk factor for meningitis. Arguments posit that urbanisation increases the population density of a place; the population density leads to overcrowding due to inadequate housing facilities, and overcrowding leads to higher risks of meningitis. Umaru, Morenikeji, Martins and Owoyele (2015) illustrate this in a study of the effects of urban sprawl on meningitis in Kaduna metropolis between 2007 and 2011. The numbers of meningitis cases were higher in years that experienced relative higher rate of urbanisation than other years with a relatively lower rate. Other social factors which have played significant role in the distribution of meningitis as identified by scholars include close contact with patients (WHO, 2015); active/passive smoking [Action on Smoking and Health [ASH] (2011)]; resistance to vaccination Pandya *et al* (2015); poor knowledge of symptoms (Osei-Somuah, 2001), migration, recreational spaces (Umaru *et al,* 2013) among others. These social factors at different times have acted either individually or collectively in influencing the incidence and distribution of the disease.
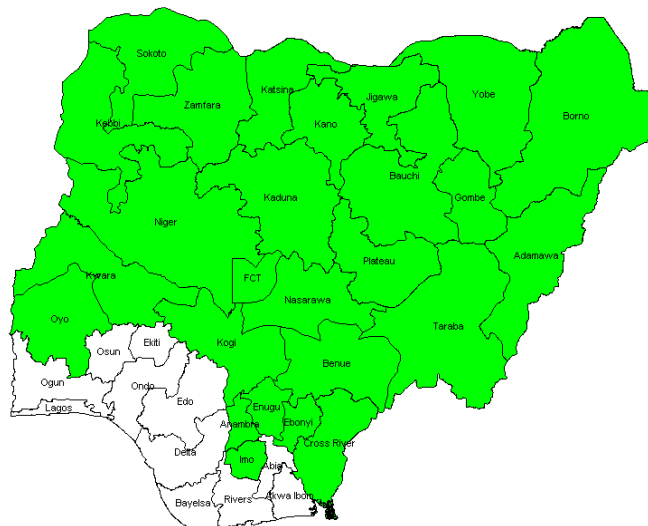

Figure 2: Meningitis Belt of Nigeria
Source: NCDC, 2017

Theoretical Framework

The ecosocial theory as propounded by Nancy Krieger in 1994 seeks to explain the complex interactions of ecological and social factors in influencing the incidence and distribution of disease conditions in the society. It argues for an understanding of historical, political, economic, temporal and spatial factors in the analysis of disease distribution. Consequently, it proves useful in the analysis of social factors affecting the incidence and prevalence of diseases. Guided by the ecosocial theory, the study commences with establishing the fact that Magama Local Government is situated in the northern part of Niger State which falls under the meningitis belt of Nigeria and by extension the African Meningitis Belt (AMB). Historically, the AMB's embodiment favours high occurrence of meningitis due to its geographical configuration (weather and climate). Many people in the AMB are believed to be carriers of the bacteria and can potentially infect others.

Furthermore, the pathways to embodiment emphasise how the culture of the Magama people such as polygamy exposes the people to the risk of overcrowding. The high rate of poverty in the northern part of the country to which Magama is not an exception subjects most people to risk of poor housing conditions as well and low SES all of which are predisposing factors to meningitis. Consequently, the ecosocial theory traces the high incidence of meningitis in Magama Local Government to its natural location in the Nigerian Meningitis Belt (NMB) and by extension the AMB. Furthermore, it has been established that carriers abound in the meningitis belt and are likely responsible for the fast spread of the disease through their daily contacts with other non-infected people. Consequently, the presence of a favourable climatic condition, history of high infection rate, polygamous culture of the people, and high rate of poverty and illiteracy make epidemics to be common in Magama LGA.

Materials and Methods

The study was conducted in Magama Local Government Area of Niger State. The study population consisted of all households that have recorded a meningitis case from a child between 0-14 years. Hence, a survey research design was adopted and the study purposively sampled 246 respondents. Respondents were drawn exclusively from parents and caregivers to children between ages 0-14 years who have recorded at least an episode of meningitis in the household. Semi-structured interview was used as instrument of data collection from the respondents.

In analysing the data, the researchers made use of both descriptive and inferential statistical techniques. The frequency distribution tables and chi square test of independence were used. The frequency tables were used to present the data on method of management of meningitis disease while chi square test was used in drawing inferences from the relevant hypotheses formulated.

Result of the Findings

The first objective of this study seeks to determine the educational attainment of respondents and their knowledge of meningitis symptoms. To this end, the following hypotheses are hereby tested:

H_01: There is no significant relationship between educational attainment of respondents and their knowledge of meningitis symptoms.
H_11: There is significant relationship between educational attainment of respondents and their knowledge of meningitis symptoms.

Table 1: Relationship between Educational Attainment and Knowledge of Meningitis Symptoms

No. of Symptoms Identified	Educational attainment				
	No formal education	Primary Education	Secondary Education	Tertiary Education	Total
One	0	2	4	2	8
Two	11	3	19	3	36
Three	79	33	33	23	168
Four	4	5	2	14	25
Five	2	0	2	2	6
Six	1	0	0	2	3
Total	**97**	**43**	**60**	**46**	**246**

χ^2 Cal= 60.744   d.f= 15   Significance= 0.05   Critical= 24.996

A chi square test of independence was computed to examine the relationship between educational attainment of respondents and their knowledge of number of meningitis symptoms. In this regard, data on the respondents' knowledge of meningitis symptoms were cross tabulated with data on their educational attainment. The relationship between the variables tested was significant, χ^2 (15, N=246) = 60.744, p<0.05. The critical value at 0.05 level of significance and 15 degrees of freedom is 24.996. Consequently, the null hypothesis is rejected and the alternative hypothesis is accepted. This means that the educational attainment of the respondents significantly affects the number of meningitis symptoms the respondents know. Thus, the higher a person's educational attainment, the higher his chances of knowing more symptoms of meningitis and vice versa.

Table 2: Management of Meningitis

Method of Management	Frequency	Percentage
Home treatment	21	8.5
Traditional/faith healers	29	11.8
PMVs	141	57.3
Hospital treatment	55	22.4
Total	**246**	**100.0**
Subsequent use of Hospital	**Frequency**	**Percentage**
Yes	188	98.4
No	3	1.6
Total	**191**	**100.0**
Reason for Resorting to Hospital	**Frequency**	**Percentage**
Persistence of symptoms	4	2.1
Worsening of symptoms	89	47.3
Failure of initial treatment	95	50.5
Total	**188**	**100.0**

Table 4.2 presents the treatment options utilised by respondents in managing a suspected meningitis case in the household. Most of the respondents (57.3%) patronised patent medicine vendors (PMVs) for treatment. Furthermore, 22.4% of them used hospitals; 11.8% used traditional/faith healers while 8.5% administered treatment at home. The above result implies that, cumulatively, 77.6% of the respondents did not start the health-seeking process from the hospital which entails grave danger for the patients. This could possibly influence the severity of the disease as delay in treatment has been identified by Hassan *et al* (2017) to be a major challenge in the successful management of the disease in Nigeria. In addition, most of the respondents (50.5%) only resorted to hospital use when other means of management adopted are perceived to have failed. 47.3% used the hospitals when they observe the symptoms of the disease have worsened. 2.1% of the respondents used the hospitals if the symptoms persist without worsening in severity. From the above table, it is apparent that hospital use among the respondents as a treatment option is usually considered to be the last resort and it is only adopted when alternative treatment options are believed to have failed. This trend is similar to the findings of Abdullahi (2015) where the study found the use of hospital to be the last option among mothers whose children were infected with malaria. Therefore, if treatment does not commence in the hospital, much time is wasted before the hospital is eventually visited for treatment and the condition would have worsened.

The study further probed the relationship between religious affiliation of respondents and their method of managing meningitis was conducted. Cross tabulation was done with the guide of the following hypotheses:

$H_0 2$: There is no significant relationship between religious affiliation of respondents and their method of managing meningitis.

$H_1 2$: There is significant relationship between religious affiliation of respondents and their method of managing meningitis.

Table 3: Relationship between Religion and Method Management of Meningitis

Method of Management	Religion			
	Islam	Christianity	Traditional religion	Total
Home treatment	11	4	6	21
Traditional/faith healers	25	3	1	29
PMVs	66	31	44	141
Hospital	43	5	7	55
Total	**145**	**43**	**58**	**246**

χ^2 Cal= 26.945   d.f= 6   Significance= 0.05   Critical= 12.592

The chi square test performed to examine the relationship between the religious affiliation of the respondents and method of managing meningitis disease revealed a significant relationship between the two variables, χ^2 (6, N=246) = 26.945, p< 0.0005. The critical value 12.592 is less than the calculated χ^2 value which suggests that the null hypothesis be rejected. This implies that the religious affiliation of the respondents affected their choice of managing meningitis disease.

Discussion of Findings

This study is premised on three specific objectives: to determine the relationship between educational attainment of respondents and their knowledge of meningitis symptoms; examine the health-seeking process of the caregivers; and to ascertain the influence of religious affiliation of respondents in the management of the meningitis disease. With respect to the first objective, the study found a significant relationship between educational attainment and knowledge of meningitis symptoms. This implies that the higher the educational attainment of a person, the higher the number of symptoms they know and vice versa. Given the low literacy level of people in the study area, the finding associates the high prevalence of meningitis to low literacy level driving poor knowledge of the symptoms amongst the respondents. Respondents were mostly familiar with a maximum of three symptoms namely stiff neck, high fever, and backache. These symptoms are signs of severity of the disease. Consequently, it is the manifestation of such severe symptoms that triggers early attempts to manage the disease. This has largely contributed to the worsening of the meningitis epidemic in the study area. This affirms the findings of Osei-Somuah (2001) where symptoms of meningitis that triggered health seeking behaviour among respondents were found to be symptoms of a severe meningitis infection. This also supports the submissions of Abdussalam & Qaffas (2016) which reported a high rate of meningitis epidemic in northern Nigeria due to high rates of poverty and low adult literacy. Low literacy is therefore a recurring decimal in the northern region of Nigeria and has contributed in worsening the burden of meningitis in the region including Magama LGA.

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In the second objective, the study examined the health-seeking behaviour of the caregivers. The caregivers were found to reach out to the Patent Medicine Vendors (PMVs) first than any other treatment option. This attests to the popularity of PMVs as an immediate point of call and when in medical distress. In addition, the use of PMVs as the first point of call before attempting hospitals implies two key issues which have consequences for fatality of the disease. Firstly, the meningitis symptoms identified by the respondents are symptoms of severity which do not manifest early. Secondly, the commencement of treatment after manifestation of symptoms starts with use of PMVs, sometimes even home treatment. Some of the respondents admit using *dogon yaro* leaves boiled with mango leaves in commencing home treatment. This allows for further worsening of the disease condition before patients proceed to the hospital. These two issues combined make the disease difficult to treat and gives room for high incidence of fatality from the disease. These findings concur with the submissions of Hayden *et al* (2013), Pandya *et al* (2015) and Hassan *et al* (2017) whose submissions emphasise delay in treatment as a major cause of meningitis deaths. In the third objective, the study was able to establish the existence of a significant relationship between religious affiliation of respondents and their method of managing the disease. Muslim and Christians patronised PMVs while traditional worshippers used home treatment more frequently. Therefore, the influence of religious affiliations in the choice of treatment cannot be overemphasised. This is similar to the findings of Jamo (2017) who reported the influence of religion on health-seeking behaviour of caregivers in Kaduna State.

Conclusion

This study is sets out to examine the influence of social factors in the management of meningitis in Magama Local Government Area of Niger State. Hence, the study concludes that the poor state of knowledge of meningitis in Magama LGA is anchored on the low educational attainment of the people. This has led many to remain ignorant of the symptoms of the disease without seeking medical attention at the right time. Furthermore, during the health-seeking process, most people visit the Patent Medicine Vendors (PMVs) than other treatment centres. Unfortunately, the use of PMVs is accompanied with serious delay before commencement of hospital treatment. Hospitals are visited only when the treatment option adopted proves abortive. This is responsible for high cases of fatality in the area. Lastly, religious affiliation has been found to play a key role in the choice of managing the disease. PMVs were frequently used by Muslims and Christians, while home treatment was adopted by traditional worshipers.

Recommendations

In light of the findings by this study, the following recommendations are made for effective eradication of the recurring meningitis epidemic in Magama LGA:

i. The State and Local Government authorities should introduce compulsory and free basic education for children and encourage adult literacy programmes to bolster the literacy level of the people. This would provide the requisite foundation for eradicating illiteracy and affording the people to gain better knowledge of the disease.

ii. Given the influence of religion, religious authorities should be engaged in sensitising people on the causes, symptoms, and best treatment options for the disease. The people should constantly be reminded, especially during the heat seasons, of the preventive and curative healthcare practices. Mosque and church congregations can be utilised for this purpose.

iii. Primary healthcare centres are located at the grassroots and are much closer to the people. Therefore, it is recommended that the primary healthcare centres be adequately equipped with

facilities to detect, diagnose, and manage any suspected meningitis case without the patients needing to travel over long distances. This will encourage hospital use among the people.

References

Abdullahi, A. A. (2015). Nexus between culture and health: perceptions and management of malaria in rural Nigeria. *Indilinga-African Journal of Indigenous Knowledge Systems*, 14:1.

Abdulsalaam, A. (2014). *Climate influences on infectious diseases in Nigeria, West Africa.* England: University of Birmingham.

Abdulsalam, A., Monaghan, A., Steinhoff, D., Dukic, V., Hayden, M., Hopson, T. (2014). The impact of climate change on meningitis in northwest Nigeria: A assessment using CMIP5 climate model simulations. *Weather, Climate and Society*, 6(3): 371-379.

Abdussalaam, A., & Qaffas, Y. (2016). Spatiotemporal patterns and social risk factors of meningitis in Nigeria. *Open Access Library Journal*, 3:2909. http://dx.doi.org/10.4236/oalib.1102909.

Action on Smoking and Health (ASH). (2011, December). *Smoking and meningococcal disease*. Retrieved from ASH Fact SHeet: http://citeseerx.ist.psu.edu/viewdoc/dowload?doi=10.1.1.800.4989&rep=rep1&type=pdf

Ahmed-Abakur, E. (2014). Meningococcal meningitis: etiology, diagnosis, epidemiology and treatment. *American Journal of Medicine and Nedical Sciences*, 4(6): 266-271.

Aina, O. & Ejembi, C. (2013). Socio-economic status of women and immunization of under five children in northern Nigeria - A case study of poliomyelitis in Kaduna State. *1st Annual International Interdisciplinary Conference*, (pp. 785-789). Azores, Portugal.

Brian, O. O. (2017). Leveraging on Prompt Proactive and Preventive Integrated Strategies (PPPIS) for meningitis control in Nigeria: getting it right. *Journal of Advances in Medical and Pharmaceutical Sciences*, 14(2):1-7.

Codjoe, S. & Nabie, V. (2014). Climate change and cerebrospinal meningitis in the Ghanaian meningitis belt. *Int. J. Environ. Res. Public Health*, 11: 6923-6939.

Farauta, B., Egbule, C., Idrisa, Y., & Victoria, C. (2011). *Climate change and adaptation measures in northern Nigeria: empirical situation and policy implications.* Kenya: African Technology Policy Studies Network.

Hassan, A., Mustapha, G., Lawal, B., Na'uzo, A., Ismail, R., Womi-Eteng Oboma, E. (2017). Time delays in the response to the Neisseria meningitidis serogroup C outbreak in Nigeria. *PLoS ONE*, 13(3):e0199257. https://doi.org/10.1371/journal.pone.0199257.

Hayden, M., Dalaba, M., Awine, T., Akweongo, P., Nyaaba, G., Anaseba, D. (2013). Knowledge, attitudes, and practices related to meningitis in northern Ghana. *American Journal of Tropical Medicine and Hygiene*, 89(2): 265-270.

Jamo, A. I. (2017). Sociocultural factors and the success of immunization in selected local governments of Kaduna State, Nigeria. *JORIND*, 15(1): 263-270.

Kirsch, E., Barton, R., Kitchen, L., & Giroir, B. (1996). Pathophysiology, treatment and outcome of meningococcemia: a review and recent experience. *Pediatr Infect Dis. J.*, 19958:106.

Mado, S., Abubakar, U., Onazi, S., & Adeoye, G. (2013). Epidemic cerebrospinal meningitis in children at Federal Medical Centre, Gusau, Zamfara state, Nigeria. *Niger J Paed*, 40(2): 169-171.

Muanya, C. (2017). *Meningitis outbreak exposes FG's unpreparedness for epidemics*. Retrieved from Sunday Magazine: https://t.guardian.ng/saturday-magazine/cover/meningitis-outbreak-exposes-fgs-unpreparedness-for-epidemics/

Muller, C. (2009). *Climate change impact on sub-Saharan Africa: an overview and analysis of scenarios and models.* German Development Institute (DIE).

Ngbokai, R. (2017, August 18). *Illiteracy, poverty major causes of death during meningitis outbreak - Emir*. Retrieved from Daily Trust: www.dailytrust.com.ng/illiteracy-poverty-major-causes-of-death-during-meningitis-outbreak-emire.html

Nigeria Centre for Disease Control (NCDC). (2017). *Preparedness and response to cerebrospinal meningitis outbreaks: a guide for health workers and authorities in Nigeria.* Abuja: Federal Ministry of Health.

Olowokure, B., Onions, H., Patel, D., Hooson, J., & O'Neill, P. (2006). Geographic and socioeconomic variation in meningococcal disease: a rural/urban comparison. *The Journal of Infection*, 52(1):61-66.

Onu, F. & Ikehi, M. (2015). *Mitigation and adaptation strategies to the effects of climate change on the environment and agriculture in Nigeria.* ResearchGate.

Osei-Somuah, S. (2001). *Socio-cultural perceptions of communities in Kassena-Nankana district of upper east region towards cerebro-spinal meningitis.* University of Ghana.

Pandya, R., Hodgson, A., Hayden, M., Akweongo, P., Hopson, T., Forgor, A. (2015). Using wearther forecasts to help manage meningitis in the West African Sahel. *American Meteorological Society*, 103-116.

Perea, W. A. (2007). Update on epidemiology of meningitis belt. *Meningitis Research Foundation* (pp. 1-23). London: WHO.

Portier, C., Thigpen, T., Carter, S., Dilworth, C., Grambsch, A., Gohlk, J., et al. (2010). *A human health perspective on climate change: a report outlining the research needs on the human health effects of climate change.* USA: Environmental Health Perspectives and the National Institute of Environmental Health Sciences.

Umaru, T., Ludin, A., Majid, M., Sabri, S., Moses, C., Enegbuma, W., et al. (2013). Risk factors for the spread of meningococcal meningitis: A review. *International Journal of Education and Research*, 1(2):1-30.

Umaru, T., Morenikeji, G., Martins, I., & Owoyele, S. G. (2015). Effects of urban sprawl on meningococcal meningitis incidence in Kaduna urban area, Nigeria. *Research on Humanity and Social Sciences*, 5(8): 141-153.

World Health Organisation (WHO). (2015). Weekly Epidemiological Record. Geneva: WHO.