ANALYSIS OF REPORTED TYPHOID FEVER CASES AMONG STUDENTS OF AHMADU BELLO UNIVERSITY, SAMARU CAMPUS ZARIA, NIGERIA

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AUGUST, 2017

DECLARATION

I hereby declare that the work in this dissertation "Analysis of reported typhoid fever cases among students of Ahmadu Bello University, Samaru campus Zaria, Nigeria" was carried out by me ABUBAKAR Maryam in the department of Geography under the supervision of Dr. I. J. Musa and Dr. B. Abdulkarim. The information derived from the literature has been duly acknowledged in the text and a list of references provided.

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Name of Student	**Signature**	**Date**

CERTIFICATION

This Dissertation titled "ANALYSIS OF REPORTED TYPHOID FEVER CASES AMONG STUDENTS OF AHMADU BELLO UNIVERSITY, SAMARU CAMPUS ZARIA, NIGERIA" by AbubakarMaryam meets the regulations governing the award of degree of Masters of Science, (Environmental Management) of Ahmadu Bello University, Zaria, and is approved for its contribution to knowledge and literacy presentation.

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Dean, School of Postgraduate Studies **Signature** **Date**

DEDICATION

This work is dedicated to my husbandDr. Musa A. Mahadi andmy lategrand-mother, Hajiya Hauwa'u Mohammad Lambar.

ACKNOWLEDGEMENTS

My profound gratitude goes to Almighty Allah for giving me good health and resources to successfully undertake and complete this study.

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ABSTRACT

Typhoid fever also known as enteric fever, it is a potentially fatal multisystem illness caused primarily by *SalmonellaTyphi*(S. Typhi). It is an important cause of morbidity and mortality globally. Itremains a major public health problem in developing countries such as Nigeria, where access toclean water and standards of sanitation and hygiene are inadequate. This study analyzedreported typhoid fever cases among students of Ahmadu Bello University, Samaru campus Zaria. The objectives of the study are to identify the sources of water supply, examine the demographic determinants of typhoid fever, examine the temporal trend of reported typhoid fever cases from 2009-2014, examine the spatial distribution of reported typhoid fever cases and examine the strategies adopted to control and prevent typhoid fever in the study area.Questionnaire and structured interview were the primary instrument for data collection while recorded typhoid cases from the university sick-bay was the secondary data used for the study. Accidental sampling technique was usedto select 396 respondents for the administration of questionnaire from a population of 45,000 students. Data was analyzed both descriptively and inferentially using the Statistical Package for Social Science (SPSS version 20). The study found that sachet water (46.5%) was the major source of drinking water and about half (50%) of the respondents attested that it is consumed more because they feel it is safe for consumption. Respondent's perceived typhoid fever to affect students' academicperformance through absenteeism from lectures. It also revealed that typhoid fever in the study area mostly affects age groups of 21-25years and the female sex (63.9%) although no significant difference was shown in typhoid cases between the age groups and sexes of the patients. The study established that April with 1287 recorded the highest cases of typhoid fever while December recorded the lowest over the six years period.Ribadu hostel recorded the highest number of typhoid cases in the study area. The occurrence of typhoid across the years reveals year 2012 with 2158 number of cases had the highest. Finally the

study found that 76.3% agreed that improved sanitation in the study area as a measure to be adopted to prevent typhoid fever in the study area. From the findings of this study, it can be concluded that the major source of water supply in the area is sachet water. Also, the perceived effects posed by typhoid fever is felt more on academics. Also, typhoid fever is a major health challenge among study participants. It is recommended thatthe university need to improve on the quality of drinking water supply to the campus in order to prevent/control the disease.

TABLE OF CONTENTS

Cover Page ……..i

Title page ……..……....ii

Declaration ……..iii

Certification ……iv

Dedication ……..……..v

Acknowledgements ……vi

Abstract.....vii

Table of Contents …….…….....ix

List of Tables ……...……..xii

List of Figures ……..…….xiii

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study ……1

1.2 Statement of the Research Problem ……...……4

1.3 Aim and Objectives ……5

1.4 Scope of the Study…….……..6

1.5 Justification of the Study ……6

CHAPTER TWO: CONCEPTUAL ISSUES, THEORETICAL FRAME WORK AND LITERATURE REVIEW

2.1 Introduction ……...8

2.2 Conceptual Framework ……..……..8

2.2.1 The concept of disease …….……8

2.3 Theoretical Framework ……..……...10

2.3.1Supernatural theory of disease causation ……...10

2.3.2 The humoral theory of disease causation ……...11

2.3.3The germs theory of disease causation ……...12

2.3.4 Disease ecology models ……13

2.4 Literature Review ……..16

2.4.1 Prevalence of typhoid fever ……16

2.4.2 Challenges of typhoid fever…….……...19

2.4.3 Temporal transmission of typhoid fever…….……20

2.4.4 Management of disease outbreak ……22

2.4.5 Control and prevention of typhoid fever in Nigeria……...25

CHAPTER THREE: STUDY AREA AND METHODOLOGY

3.1 Introduction ……...27

3.2Study Area ……27

3.2.1 Location ……..27

3.2.2 Climate ……...29

3.2.3 Soil and Vegetation ……30

3.2.4 Drainage ……31

3.2.5 Population ……...31

3.3 METHODOLOGY ……32

3.3.1 Reconnaissance Survey ……..32

3.3.2 Types of Data Used ……32

3.3.3 Sources of Data ……...32

3.3.4 Sample Size and Sampling Technique ……...33

3.3.5 Methods of Data Analysis ……..34

CHAPTER FOUR: RESULTS AND DISCUSSION OF FINDINGS

4.1 Introduction ……...35

4.2 Socio-Demographic Characteristics of Respondents ……35

4.2.1 Sex, Age and Status of the Respondent in the Community ……...35

4.3 Major Sources of Drinking Water Available in the Study Area ……...37

4.4 Demographic determinants of typhoid fever in ABU Samaru campus ……39

4.5 Perceived effects of typhoid on students in the study area ……..…….41

4.6 Typhoid Fever Occurrence in A.B.U Community from 2009-2014 …….43

4.7 Strategies adopted to control and prevent typhoid fever in ABU community ……..50

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of findings ……..……...53

5.3 Conclusion ……54

5.4 Recommendations …….55

References ……...56

Appendices ……..68

LIST OF TABLES

Table 4.1: Age of Respondents ….……37

Table 4.2: Sources of water consumed by respondent versus reason for consumption……..38

Table 4.3: Treatment method for drinking water…….……..…...38

Table 4.4: Distribution of reported typhoid cases based on age ……40

Table 4.5: Distribution of reported typhoid cases based on sex ……40

Table 4.6: Effects of typhoid fever on respondents in the study area ……41

Table 4.7: Reported typhoid fever cases in the study area …….……46

Table 4.8: Distribution of reported typhoid fever cases based on location ……47

Table 4.9: Distribution of respondents based on experience with typhoid fever ……50

Table 4.10: Measures of preventing typhoid fever in A.B U community ……...51

LISTS OF FIGURES

Figure 3.1: Map of the Study Area …… …….28

Figure 4.1: Sex of Respondents……..……36

Figure 4.2: Monthly Variation of recorded typhoid cases from 2009-2014 ……...43

Figure 4.3: Trend of typhoid cases across the months ……45

Figure 4.4: Distribution of typhoid cases by location of patients ……..…….49

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

A disease is a particular abnormal, pathological condition that affects part or all of an organism (Olson, 2002). It is often construed as a medical condition associated with specific symptoms and signs. It may be caused by factors originally from an external source, such as infectious disease, or it may be caused by internal dysfunctions, such as autoimmune diseases (McWhinney, 1987). In humans, "disease" is often used more broadly to refer to any condition that causes pain, dysfunction, distress, social problems, or death to the person afflicted, or similar problems for those in contact with the person. In this broader sense, it sometimes includes injuries, disabilities, disorders, syndromes, infections, isolated symptoms, deviant behaviours, and typical variations of structure and function, while in other contexts and for other purposes these may be considered distinguishable categories (Emson, 1987). Diseases usually affect people not only physically, but also emotionally, as contracting and living with a disease can alter one's perspective on life, and one's personality (Hanne and Hawken, 2007).

Typhoid fever also known as enteric fever, it is a potentially fatal multisystem illness caused primarily by *SalmonellaTyphi*(S. Typhi), which is an important cause of morbidity and mortality globally. Itremains a major public health problem in developing countries, where access toclean water and standards of sanitation and hygiene are inadequate.*S typhi* has been a major human pathogen for thousands of years, thriving in conditions of poor sanitation, crowding, and social chaos. The name *S typhi* is derived from the ancient Greek *typhos,* an ethereal smoke or cloud that was believed to cause disease and madness. In the advanced stages of typhoid fever, the patient's level of consciousness could be truly clouded. Although antibiotics have remarkably reduced the frequency of typhoid fever in the developed world, yet it remains endemic in developing countries(Fenwick, 2006).

Typhoid fever is widely recognized as a major public health problem in developing countries. It is characterized by acute fever, headache, abdominal pain, impatience and leukopenia. The etiological agent of typhoid fever is *Salmonella enterica*sub-sp*enterica*serotype Typhi (Abu Oshomole and Adeyemi*,* 2011).Humans are the only natural host and reservoir for S. Typhi, which can survive several months in soil or water (Ibekwe*et al.,* 2008).

The infection is transmitted by ingestion of food or water contaminated by faecal or urinary carriers excreting the bacterium. Transmission dynamics of typhoid fever is beyond an association between declining incidence with improvements in sanitation and risk factors.This is identified through classical epidemiological techniques, particularly case-control studies. Individual level risk factors are, among others, contaminated water and food, community-level risk factors include population density, temperature, rainfall and proximity to water sources (Ismail, 2006).

Typhoid fever is a major cause of morbidity in many regions of the world.About 12 to 33 million cases were reported in India, South and Central America and Africa which is characterized by rapid population growth, increased urbanization, and limited safe water, infrastructure, and health systems (WHO, 2013). Also, recent reviews by Dublish (2005) have estimated the annual global

number of episodes of disease caused by S. Typhi at between 21.6 and 26.9 million, with more than 216 000 deaths globally in 2000.

The situation in developing countries of Africa is high because typhoidal salmonellosis continues to pose a threat to public health with an estimated annual incidence of 540 per 100,000 (WHO, 2008; Ibekwe*et al*., 2008). In Nigeria, morbidity associated with illnesses due to *Salmonella* continues to be on the increase and, in some cases, resulting in death. Like other countries, treatment of patients has been based on the use of first-line antibiotics, such as chloramphenicol and co-trimoxazole, and the third-generation cephalosporins. However, efficacies of some of these drugs have been doubtful, following the emergence of multidrug resistance in *Salmonella* strains (Akinyemi, Coker, Olukoya, Oyefolu, Amoroghoye and Omonigbehin, 2000; Akinyemi, Smith, Oyefolu and Coker, 2005). The level of severity/intensity of typhoid in Nigeria varies in time and location. Studies suggest that sahelian areas and high elevated landscapes have low rate of typhoid transmission which was attributed to their micro climatic conditions of the areas(NPC and ICF Macro, 2009).

The precise trend in the incidence of typhoid fever in many areas is largely uncertain and individuals in endemic areas were found to be at risk of contracting the disease (Ukaegbu, Nnachi, Mawak, and Igwe, 2014). Ahmadu Bello University Zaria located in the Sudan savannah zone of Nigeria is among Nigerian's institution of higher learning with prevalence of typhoid among staff and students. Considering its terrain, a greater part of the landscape lies within the flood plain of river Kubani and its wetlands. The population of the community stands to be 35,000 students and 7,528 staff in general which is a population more than enough to influence the spread of diseases, as well as bring about environmental pollution and contamination through the generation of waste. Even though in its academic composition, the community have fields of medical specialization, and even a teaching hospital, it still faces the threat of several diseases especially typhoid. Prevalence of such diseases occurin both staff and students in their various areas of duty. Also the present effort of the university to dredge its dam might have greatly altered the quality and amount of water supplied to hostels and quarters for students and staff. Although contaminated water supply is not the sole determinant of typhoid fever, yet there is a need for this type of research in thestudy area. This is because water is essential for proper sanitation which helps prevent contamination of both food and water for consumption.

1.2 Statement of the Research Problem

Typhoid fever is very rampant especially in sub Saharan Africa due to contamination of drinking water and food as a result of poor sanitation. In Nigeria, contaminations of food and drinking water with pathogens have also been reported in several towns (Bai*et al.*, 2007). Thus, most households have to resort to drinking water from wells and streams especially in the rural and suburban communities. These water sources are largely untreated and might harbour waterborne and vector-borne diseases such as cholera, typhoid fever, diarrhoea, hepatitis and guinea worm (Rahman et al., 2001; Adekunle, 2004).

Ashraf, Robert, Masahiro and Emmanuel (2013) studied typhoid fever and its association with environmental factors in the Dhaka metropolitan area of Bangladesh. The study considers a range of both census data and spatial data from other sources, including remote sensing data as well as hospital records. The study revealed that areas of Dhakar are at high risk of typhoid while it appears that distinct seasonality, age and gender differences, influence typhoid infection with males and very young children being disproportionately infected.

Emmanuel, Osim, Okey, Emmanuel and Ndibukke (2013) in their four-year longitudinal study of prevalence of typhoid fever among those attending the General Hospital Etinan, Nigeria,using hospital-based data revealed that the cumulative prevalence of *Salmonella* infection was found to be 63.8% (58.0% for males and 68.2% for females). Prevalence was significantly higher among females than among males and when compared within the years, 2001 had the highest. It also revealed that there is variation in the prevalence among the various age groups.

Raji and Ibrahim (2011) studied the prevalence of waterborne infections in NorthwestNigeria using secondary data from hospital record.The study found high incidences of waterborne infections namely typhoid, cholera, dysentery, diarrhoea and gastroenteritis in three cities.The study also found a high frequency in children below the age of 5 years. Gender distribution of diarrhoea and dysentery cases in 2004 and 2005 showed on average that more female than male residents contracted the infections.

Studying these previous researches, much has been done on typhoid fever both within and outside Nigeria. Amongst all these researchesreviewed, none was carried out in A.B.U. community; furthermore, most of these past works considered the time of the year in which these diseases are most prevalent. Thus, this research was set to examine the prevalence of typhoid fever among students of AhmaduBello University, Zaria, Samaru campus.

This study therefore seeksanswers to the following research questions;

1. What are the sources of drinking water supply in the study area?
2. What are the demographic determinants of typhoid fever in the study area?
3. What is the temporal trend of reported typhoid fever casesin the study area from 2009-2014?
4. What is the spatial distribution of typhoid fever in the study area?
5. What are the strategies adapted to control and prevent typhoid feverin the study area?

1.3 Aim and Objectives

The aim of this study is to evaluate the reported typhoid fever cases among students of Ahmadu Bello University, Samaru campus Zaria. This was achieved through some objectives which are to;

i. identify the sources of drinking water supply in the study area
ii. examine the demographic determinants of typhoid fever in the study area
iii. examine the temporal trend of reported typhoid fever casesfrom 2009-2014 in the study area
iv. examine the spatial distribution of reported typhoid fever cases in the study area
v. examine the strategies adopted to control and prevent typhoid fever in the study area

1.4 Scope of the Study

The study coveredSamaru campusof Ahmadu Bello University. This area was selected by the researcher due to the population concentration in the community. A major limitation identified in the study is the erratic record collection by the UHS unit sick-bay in addition to the unreliable opinions of the students.

The study evaluated the temporal prevalence of *salmonella typhi*in the community using records of the disease from the University health services (sick-bay). The trend of the disease for the past six years (from July 2009 to July 2014) was examined, the areas where the disease occurred more, the effect of the disease on staff and students as well as the measures in place to mitigate the prevalence of the disease in the community.

1.5 Justification of the Study

Typhoid fever is among the most common diseases in the tropics. The disease has been associated with poverty and underdevelopment with significant morbidity and mortality. Typhoid fever remains disease of major public health importance in Nigeria, causing significant morbidity and mortality. The high endemicity has made it become almost a house-hold name to every Nigerian.

Typhoid share social circumstances that are imperative to its transmission. Therefore, a person living in such an environment is at great risk of contracting the disease(Uneke, 2008; WHO, 2013).

The prevalence of typhoid fever in a community like A.B.U. tends to pose serious threat on students especially towards their academics. This therefore calls for a research of such type. The findings of this research will to a large extent help ABU to know the impact oftyphoid fever on their students as suchfind ways for its prevention. This will also help othercommunities of Zaria with similar occurrence of typhoid to find a preventive measure for the disease. The outcome of this study will provide data for the university health services in planning on healthissues to staff and students. The study is also expected to be used by researchers for the advancement of knowledge in the subject matter.

CHAPTER TWO

CONCEPTUAL ISSUES, THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

This chapter presents conceptual and theoretical framework and a review of similar studies on typhoid feverprevalence. The concept of disease, disease ecology model, supernatural, humoral and germ theory of disease causation were considered. The literature reviewed the prevalence of typhoid fever, challenges of typhoid, temporal transmission of typhoid fever, management of disease outbreak, control and prevention of typhoid fever in Nigeria.

2.2 Conceptual Framework.

2.2.1 The concept of disease

The term disease is unique to human society and it has been defined variously. For instance, a disease has been defined as a reaction of body to something that interferes with its normal functioning (Scully, 2004). When strange objects enter the human system, the tendency is that uneasiness ensues. Besides the uneasiness, the same situation can also encourage the growth of other health problems in the system. Similarly, Dorland's Medical Dictionary (2014) has also defined disease as an abnormal condition that affects the body of an organism. The abnormal condition can be associated to a number of factors, which the body is not used to. World Health Organization (WHO, 1946), in an attempt to define a diseased state, described a disease as the opposite of health. Health according to the organization,is describedas the state of complete physical, mental and social well-being, not merely the absence of diseases or infirmity. In other words, in describing a disease, it must be holistic, by observing the mental, social and physical state of a person.

Disease can manifest through mental, physical or social disposition of individuals and

when objects within the system inhibit optimal metabolisms. Diseases were classified broadly as communicable and non-communicable. Communicable diseases are those diseases that being transferred from one person to another (Merriam-Webster, 2014). It is a result of invasion of human body by germs (bacteria, viruses, fungi, and protozoa). Examples of communicable diseases are cough, dysentery, TB, among others. Non-communicable diseases are diseases that are opposite the communicable diseases in their occurrence. They are genetically linked in occurrence. In other cases, the disease may be a result of a person social life style. Furthermore, Dorland's Medical Dictionary (2014), identified four classes of diseases as pathogenic, deficiency, hereditary and physiological. Pathogenic disease is linked to diseases resulting from invasion of human body by germs. This type of disease is common in areas that has attractants to germs, which can encourage thriving of diseases. Deficiency disease is linked to forms of malnutrition or deficiency hormones in the body.Thiscould be related to the socio-economic status of a person.Good example of disease in this category is kwashiorkor. Hereditary disease is disease that is inherited from either both parents or from one of them. Lastly, the psychological disease is a disease that emanate from state of mind. Where people experience insecurity, in term of non-availability of social justice, certain medical problems may arise. Without recourse to further break down of other types of disease, disease can have negative effects on the well-being of a person.

WHO (2013) opined that, diseases in whatever form might lead to death. For instance, malaria kills about 4million people each year in Africa south of Sahara and the same disease has reduced economic growth in Africa by about 1.3% each year since the last 30years. Similarly, diarrhea, another known water disease is associated with unsafe water and is responsible for about 4.0% of deaths globally. Diseases might also lead to high deaths among the children, especially in the areas known for contaminated water supply (Oguntoke, Aboderin and Bankole, 2009). Diseases can lead to total economic loss, and may further

plunge the people into abject poverty.

2.3 Theoretical Framework

Theories offer a set of statement or frame of reference which has established relationship of how the systems work (Peter, 2007). A number of theories have been advanced to explain the occurrence of disease in the environment of man. As man invade natural ecosystem for the purpose of making life comfortable for himself, the environment is exposed to many dangers (Elton, 1996). Thus, the chances of increasing human infections, through emergence of new diseases, most of which have become drug resistant, as such aided the inevitability of global disease outbreaks(WHO, 2014).

Craun, Caldren and Wade (2006) submitted that transmission of diseases has complex and manifold ecological relationships. According to Craun*et al* (2006), the cause of diseases can be linked to the hosts, which refer to either animal or plant on which the disease lives. Furthermore, diseases can be linked to the agents (biological, chemical, or physical) that are the transmitters of a disease, while environment (temperature, sanitation, poor ventilation) can also accounts for diseases in any human society. This tally with the theory of disease ecology and human behaviour in a type of ecosystem, which opined that human beings are known to go through certain social, cultural and individual behaviour in the elimination or dispersion of certain diseases (Cochran, Ewald and Cochran, 2000). Some of these theoretical orientations are germane to this research and they include the disease ecology model, Traditional, Humoral, Contagion and Germ theories.

2.3.1 Supernatural theory of disease causation

The traditional theory, while using epilepsy as a case study submitted that epilepsy was caused by divine visitation and hence could only be cured by gods. In The Chinese Medicine, disharmony and illnesses only arise when one is stuck in an emotion. Similarly, Carteret (2011), opined that in a personality system, illness is believed to be caused by

supernatural beings or a human being with special power such as witches and wizards. It is believed that, evil forces can cause illness in retaliation for moral and spiritual failure of the victim. Westhund (2006) also submitted that in some African cultures, the power of witches and wizards are also very relevant in disease causation.

Furthermore, Galanti (2004) equally affirmed that some Asian patients belief that though germs play a role in disease causation, but hot-cold imbalances make a person susceptible to illnesses. In the same vein, in Latino culture, Galanti submitted further that there are differences between natural and supernatural illnesses. Spector (2004) studied the African-Americans and concluded that for African-American Christians, religious faith and prayers remain powerful in disease eradication. While the African-American Muslims relied heavily on the month long Ramadan fasting as an anti-dote for cure of diseases. These views had little consideration for physical disorder and other environmental factors. Prior to interest shown in guinea worm studies, the occurrence of the disease was believed to have a divine link. With the passage of time and renewed efforts in the medical field, the submissions that diseases have divine causation are being replaced with other disease causation theories.

2.3.2. The humoral theory of disease causation.

Thagard (1997) reported that Hippocrates came up with the theory christened Humoral theory as an alternative to the traditional approach. Hippocrates, a Greek lived around 460BC, but this work according to Bulloch (1979) was translated by Galen and others. This theory affirmed that, all human diseases arise from imbalance between bile and phlegm when one of them either becomes too moist, too dry or too cold as a result of food and drinks. According to Gill (2014), human body is made up of four humors- blood, yellow bile, phlegm and black bile; hence imbalance and balance combination of these causes pain and health impairment respectively.

This school of thought opined that, too much bile may lead to various fever and too'

much phlegm can lead to epilepsy. The author defined health as a state in human body in which four humors mentioned above are in correct proportions to each other, both in strength and quantity and are well mixed. Further, bile and phlegm may produce diseases inside the body as a result of the foods and drinks, from exertions and wounds, from smell, sound, sight and venery and from heat and cold(Logan,1973).

Food and drinks are products of the environment that are subject to changes and which according to Centres for Disease Control (CDC) has aided the outbreak of the diseases. According to Vidal, (2012), there are about 852 million food unsecured people in the world. The result is that, because of scarcity of food, imbalance in the adequacy of food taken daily may ensue, creating a state of defective biological functioning in man leading to diseases. This theory did not last long as a result of weakness inherent in it, because the imbalance inbile and phlegm emphasized by the humoralist may occur from natural causes and may be treated by changing either the diet or environment or the humor imbalance itself. Additionally, an imbalance of either bile or phlegm may be eliminated through the inducement of vomiting or evacuation of bowel.

2.3.3 The germs theory of disease causation.

Tortora, Funke and Case (1995) confirmed that, the making of germs theory was a collective effort of many scientists which took many years. The list of these scientists included Pasteur, Lister, Koch and others (Geison, 1995). Thus the effort of these scientists from 1860 and 1870 resulted in germs theory, which today is central to explanation in germs causation. The germ theory viewed diseases in terms of their microbial causes, thus according to this school of thought, fever is not a disease, but a symptom of infection. The germ theory is the collection of research efforts of the scientist mentioned above. The work of Pasteur premised on the process of fermentation and was able to show that the yeast increase the weight of nitrogen and carbon content during fermentation, thus proving that yeast is a living

organism and in 1860s, Pasteur was able to discover bacteria. Furthermore, Lister and Pasteur delved into analogy between fermentation and disease.

They concluded in their work that just as fermentation is to yeast and bacteria, so also is diseases to micro-organisms. Pasteur was able to show that decomposition of organic substances is either made possible by oxygen or any of its gaseous constituents that the air owe, but the minute particles suspended in it, which are germs of various low forms of life. The principles of Pasteur were used by Lister to treat compound fracture. In the same vein Robert Koch, a German doctor, was able to show that many different kinds of bacteria are responsible for specified diseases. The result is that today, infectious diseases are classified as bacteria, viral and protozoa (Thagard, 1997).

Although, Hippocrates and others were the first set of scientists to have ventured into causes of diseases, their work has become a reference point to geographers. For example, Babatimehin (2005) has used the theory to explain the spatial analysis of *Onchocerciasis* in Kwara State. Germs are considered to be the cause of all diseases. A germ is a microorganism that causes diseases. A person is said to be diseased, if he/she is infected by a disease and this is manifested in symptoms. Consequently, diseases that result from germs infections are treated through vaccination. However, central to all the theories' highlighted above, is that, diseases are product of the environment that has remained a cog in the wheel of progress of man. The ultimate goal is therefore to eradicate it so that healthy living of man can be guaranteed.

2.3.4 Disease Ecology models

The approach used to study a particular disease may vary depending on how well the epidemiology of the disease is understood, the amount and quality of data available and the background and experience of the modellers. Most importantly the approach taken should reflect the purpose of the model (Caley, 2006). For example, models can focus on a broad understanding of disease dynamics or the impact of a general plan of action (so called ‘strategic’ models-McCallum, 2000). Other models may assist a complex, quantitative understanding of disease dynamics under specific detailed circumstances i.e. ‘tactical’ models (McCallum, 2000).

A model of health that emphasizes the linkages and relationships among multiple factors (or determinants) affecting health. Models used to study diseases in populations can vary from simple deterministic mathematical models (Pech and Hone, 1988) through to more complex spatial or stochastic mathematical models (Pech and McIlroy, 1990; Dexter, 2003), spatially explicit stochastic simulation models (Morris *et al*., 2001; Mangen*et al*., 2001; Bates *et al*., 2003; Schoenbaum and Disney, 2003; Garner and Beckett, 2005; Harvey *et al*., 2007) and decision-support systems (Sanson*et al*., 1999). However, it should be acknowledged that many models are on a continuum and may fit several categories at once. The model of Ward *et al*. (2007) is a simulation model using logic for decisions, yet includes susceptible/recovered/immune mathematical equations.Regardless, the use of categories can enhance understanding and some of the types of models are discussed briefly below.

One commonly used approach to study epidemic diseases both in animal and human populations is the deterministic, continuous time models popularized by Anderson and May (1979). In their simplest form, these mathematical models assume that populations are homogenous and mix randomly (density dependent transmission), with movement of individuals between different infection categories (e.g. susceptible, infected, removed) being described by differential equations. Recently though, density dependent transmission has been questioned and several alternative modes of transmission have appeared (McCallum *et al*., 2001). The major advantages of the mathematical models are that they are relatively simple to implement and run. Generally, these models are best used strategically to explore major assumptions about disease epidemiology. They are less tractable when large degrees of complexity are added and may be less suited to tactical situations where specific introduction and mitigation strategies are being assessed.

Another approach to model disease is to use simulation. Simulation models are composed of mathematical and logical relationships that are analyzed by numerical methods rather than analytical methods (Bagni*et al*., 2002). With this approach, output variables are predicted as a consequence of decision rules rather than through algebraic solutions. These types of models are often more flexible and able to incorporate a high degree of detail and can be useful as tactical models. They also tend to have a more transparent logical framework that is easier for non-mathematicians to follow (Taylor, 2003) but tend to be more complex to construct and time consuming to run compared to mathematical models (Carson, 2005). In addition to considering the differences between model purpose or mathematical and simulation approaches, models can also be considered according to how they treat variability, chance and uncertainty, time and space the following three key elements (Taylor, 2003).

Deterministic models are those that assign average or most likely values to all parameters and model the average or 'expected' outcome (Green and Medley, 2002). These models produce a single result for each set of input parameters, although sensitivity analysis can be used to test the effects of a range of input parameters. Models, which explicitly include variability and effects of chance, are termed 'stochastic'. As stochastic models allow parameter values to vary and they incorporate chance events, they can produce a range of results even with the same starting values and must be run repeatedly to generate a probability distribution of the outcome.

Models can also vary in the way they treat time—either as continuous or in discrete intervals, e.g. days, weeks, etc. Continuous time models use differential equations to represent

changes over time (Daley and Gani, 1999). This approach is mathematically and computationally elegant and widely used because it enables processes to be represented by relatively simple sets of equations. However, the approach may not adequately reflect processes that are not continuous in time. An alternate approach is treat time as discrete convenient units with changes taking place being simulated repeatedly over intervals as required (Taylor, 2003). Although this approach is computationally more complex, it is quite simple to incorporate processes that vary over time (e.g. seasonal effects). Models may be spatial or non-spatial. Non-spatial models assume that spatial proximity has no influence on disease transmission probability (French and White, 2004). In these models, only the size (or density) of the population (or sub-populations) is important and not the spatial relationship between individuals. Spatial models incorporate spatial attributes such as individual locations and contact structures between individuals to determine who is at risk of infection. Like time, space can be treated as a continuous or discrete variable (French and White, 2004).

Generally though, the most appropriate type of model to use in a given situation will depend on the purpose of the modelling exercise. For example, whilst deterministic models, which are typically based on average or expected value parameters, may be useful for understanding basic infection dynamics, they are of limited use as a predictive tool since any one epidemic is unique and unlikely to follow an 'average' pattern (Green and Medley, 2002). Whilst stochastic models cannot predict what will happen, they permit a distribution of likely outcomes under different scenarios to be studied.

2.4 Literature Review

2.4.1 Prevalence of typhoid fever

Typhoid fever still remains a major public health problem in developing countries even in the twenty first century (Lin *et al,* 2000; Otegbayo*et al,* 2003). This was also the case in America and Europe three centuries ago, until measures for sanitary disposal and supply of potable water were put in place. Typhoid fever has been reported in all age groups and classes in Nigeria (Rasaily*et al,* 1994; Parry *et al,* 2002). The disease is a major challenge and an essential health setback in some continents such as Asia and Africa particularly in Nigeria owing to poor hygienic environment and the absence of or insufficient clean water supply (Anita, Indrayan, Guteria, and Gupta, 2002).

Typhoid fever is amongst the major prevalent disease in Nigeria due to various interconnected factors such as scarce amenities for handling unwanted products and abuse of antibiotics (Akinyemi, Smith, Oyefolu and Coker, 2005). However, the precise incidence of theconcurrent typhoid fever in most geographicalareas is largely uncertain. Because it share social circumstances whichare imperative to its transmission, individuals inareas endemic for both diseases are at substantial riskof contracting the diseases, either concurrentlyor an acute infection superimposed on a chronicone.

According to Adebayo (2013), the prevalence of *S. typhi*among healthy food handlers in Lagos was 5.7%. Inadequate personal hygiene might have facilitated the transmission of these pathogens via food to humans.It can be concluded therefore that the carriers of *S. typhi*and other *Salmonella* species probably did not acquire the microorganisms from water alone used for drinking and in food preparation but also the food.Plasmids in salmonellas may code for antibiotic resistance;

however, the study did not ascertain whether or not the antibiotic resistance was plasmid-mediated. The rate of resistance or susceptibility to a particular antibiotic depends not only on the plasmid harboured but also on the rate of exposure to these antibiotics. Therefore, the high rate of multidrug resistance demonstrated by these isolates could make a case for the appropriate use of drugs in this environment.The study recommended that, typhoid fever vaccination programmesshould be implemented, as the new generation vaccines have been found to be very effective and relatively inexpensive.

Olajuyigbe, Alienate, Adegboyega and Salubi (2012), adopted GIS techniques to investigate the spatial variation of water borne diseases in Ile-Ife, Nigeria. The results showed that most reported cases of water borne diseases were due to environmental factors including poor environmental sanitation and topography. This implies that a continuous negligence and under estimation of the role of these factors in the spatial spread of the water borne diseases may increase the vulnerability and health risk of the people in the area. The study recommends frequent treatment of wells and boreholes, improved environmental sanitation and enhanced waste management strategies.

The study on prevalence of typhoid fever was carried out by Abu, Oshomole and Adeyemi,(2011) on outpatients visiting IBB Specialized Hospital and General Hospital in Minna, Niger State. Blood sampleswere examined for the presence of *Salmonella typhi*antibodies by Widal agglutinationtechnique. The standard Samonella 'O' and 'H' suspension were used as antigens. Of the 200sera tested, agglutinins to *Salmonella typhi*were prevalent in male and female subjects of the 'O' antigens and of 'H' antigens at the various dilutions. Thelevels of agglutinin of *Salmonella paratyphi*C-H *Salmonella paratyphi*A-Hand *Salmonella typhi*B-O in the males were however, low. More males had*Salmonella agglutinin* titres for *S. typhi*H and *S. typhi*O. More so, males had *Salmonella agglutinin* titres for *S. paratyphi*C-OA-O, B-H, A-H, B-O, and C-H. It also showed that more females had*Salmonella agglutinin* titres for *S. typhi*H followed by O, B-H, B-O, A-O, A-H, C-O and C-H.

Anyebe, Opaluwa, Ajayi, Garba, Obiako, and Alhassan E. (2007) parroted that, more females of all age andoccupational groups were affected with higher incidences in young adults and students among the patientsadmitted in Ahmadu Bello University Teaching Hospital, Zaria for typhoid fever. Most ofthe patients were urban dwellers and the incidence between patients using well waterand tap water was similar.Although all ages were affected in this study, the incidence was higher in the highly mobile age group of 11–30 years. This trend becomes even moreapparent in view of the high incidence found among students. The incidenceof typhoid fever however cuts across all occupational groups, with students mostlyaffected. These students coincidently are mainly in the more affected age group (11– 30 years). This group of patients are commonly found outside their homes and thusmay become prone to eating food and drinking water from contaminated sources.

2.4.2 Challengesof typhoid fever

Typhoid fever is widely recognizedas a major public health problem in Nigeria. This systemic infectious disease characterized by an acute illness, the first typicalmanifestations of which are fever, headache, abdominalpain, relative bradycardia, splenomegaly, andleukopenia constitute some of the health challenges associated with the disease (Uneke, 2008). It has been projected that the incidence of foetal loss which occurs from untreated typhoid cases during pregnancy might be as high as 80% (Gyang and Saunders, 2008). Special concern arises as soon as pregnancy is complicated

by *S. typhi*(Sulaiman and Sarwari, 2007). Diverse severe outcomes and morbidity connected with typhoid fever in pregnancy include, premature labor, spontaneous abortion and infection of the fetus. Due to the hormonal changes that suppress immunity, pregnant women are at an increased risk for getting food-borne infections (Smith, 1999). Hormonal changes which occur during pregnancy impair the cell mediated immune response and they increase the susceptibility of pregnant women to various infections. Pregnancy is considered as a high risk factor for acquisition of *Salmonella* infections (Pejcic-Karapetrovic*et al,* 2007).

The antibiotics used has a number of side effects. Moreover the salmonellae often get resistant to it leading to multi drug resistant typhoid (MDRST). Increasing resistance rates to the primary agents used (ampicillin, chloramphenicol, co-trimoxazole as well as quinolones) have been associated with complications and increased severity of illness. The burden of typhoid fever remains high in impoverished settings, and increasing antibiotic resistance is making treatment costly. The vaccines used are not fully effective. Some have low efficiency while other exhibit high efficiency as concluded from literature survey.

Sadly, Keong (2006) discovered that, in most parts of the tropics (Nigeria inclusive), the specific diagnosis of concurrent typhoid fever is based on blood smear microscopy and Widal test and in rare cases with the inclusion of bacterial culture. However, it is of concern thatunder-diagnosis continues to hinder effective typhoid control in the tropics. This is due to a combination of factors, including non-specific clinical presentation of the diseases, high prevalence of asymptomatic infections in many areas, lack of resources and insufficient access to trained health care providers and health facilities, and widespread practice of self-treatment for clinically suspected malaria or typhoid fever.

Uneke (2008) expressed concern that under-diagnosis continues to hinder effectivecontrol of concurrent malaria and typhoid fever in the tropics due to: non-specific clinical presentationof the diseases; high prevalence of asymptomatic infections; lack of resources and insufficientaccess to trained health care providers and facilities; and widespread practice of self-treatmentfor clinically suspected malaria or typhoid fever.It is clear from the study of Adeyemi,(2013) that, *Salmonella* agglutinins are common among apparently healthy people. Obviously therefore, the prevalence of typhoid fever and the increasing menace of Multi-Drug Resistance (MDR) of its causative agent are seriously constituting a menace in developing tropical countries. The resultant effect on health status would affect productivity, intellectual development and other aspects of life. Therefore, the infection caused by *S. typhi*remains an important public health problem, particularly in this part of the world.

2.4.3 Temporal transmission of typhoid fever

In Nigeria, transmission of typhoid fever occurs all year round but rates are slightly higher in April and July, coinciding with the height of the hot, dry season and the onset of the rainy season, respectively (Idoko, Anjorin and Lawande, 1988). The highest number of cases of typhoid fever are recorded during the rainy season in south-east Nigeria (Oboegbulam, Oguike and Gugnanai, 1995). Infection of pregnant women with *Salmonella* occurs as frequently as its infection in the general populace, with a prevalence of 0.2% positive rectal cultures at the point of delivery.

Emmanuel, Uttah, Osim, Emmanuel, and Ndibukke(2013) revealed that,there was high incidence of typhoid fever in Etinan, a suburban area in AkwaIbom State, Nigeria. In all the subgroups of age and sex between 2000 and 2003. This high incidence was sustained by the paucity of potable water, and the proliferation of unsupervised commercial boreholes that produced non-potable water used by inhabitants for domestic activities. There is need for detailed protocols for monitoring boreholes in the area to ensure that the quality of water sold to the people meet the minimum permissible standard. The need for awareness campaign to enlighten people on the epidemiology of typhoid fever cannot be over-emphasized, so also the need to regularly wash all water-storing containers and utensils on a regular basis and to improve sanitation and personal hygiene.

Anyebe, *et al.* (2007) in their retrospective, non-experimental study which involved the collection of case records (files) of patients admitted in Ahmadu Bello University Teaching Hospital, Zaria for typhoid fever for a five-year period (2000 and June 2005) showed that, most of the typhoid infections studied occurred during the rainy season in Zaria (May – November) with high cases at the beginning of the rainy season (May/June). This means there were twice as many cases of typhoid infection during the rainy season as in the dry season this is attributed to the transmission of *Salmonella typhi* through water contamination during the rainy season. Improper sewage disposal contributes to these findings. Thus, there were 20 registered cases in 2000, 38 in 2001, 41 in 2002, 35 in 2003, 28 in 2004 and 35 cases in 2005. Typhoid fever occurred throughout the months of the years under review except in September–December 2004 when there were no recorded cases of typhoid infection on admission (this period coincided with industrial action by health workers). It was also noted that the months of September–February had a low incidence (with the lowest incidence in December) throughout the five years under review.

Similar assertions have been made by Ikeme and Anan (1999) reported prevalence of typhoid in western Nigeria with high positive correlation with the rainy season. They implicated the contamination of drinking water as the most potent transmission factor. In Lagos, Nigeria, three peak incidences of typhoid infection in April, July and November had been reported (Ogunbiyi and Onabowale, 1996) coinciding with rain fall.Adeyinka, Wasiu andAkintayo(2014) demonstrated that, among the common waterborne disease in some parts of Nigeria. Typhoid cases ranked highest among the water related diseases recorded between 2002 and 2008 in Nigeria, followed by cholera, hepatitis and drancunliasis. This incidence of waterborne diseases is as a result of inability to gain access to potable water most especially people living in the rural areas of the country. People search for drinking water from all sorts of unsafe water sources, which expose them to all kinds of dangers related to drinking of unsafe water. Based on the problems facing Nigeria, the study strongly recommended that ministries of water resources and environment at both state and federal levels take necessary steps by organizing sensitization programmes addressing the issue of waterborne disease, working closely with World Health Organization (WHO)and other health organizations to provide direct support to Nigerian government.

2.4.4 Management of disease outbreak

Once any potential waterborne outbreak has been identified, the public healthauthorities have the responsibility of conducting further investigations. Theobjectives of these investigations are to determine the size and nature of theoutbreak and its cause. This is important in order to

implement control measuresto reduce the number of cases and to ensure that the outbreak does not happenagain (Ford, 1999).Effective management of disease outbreak depends on prior planning. This planning identified the agencies that need to beinvolved and will have obtained agreement with them over their roles. The priorplanning led to the setting up of appropriate surveillance systemswithout which outbreaks are unlikely to be identified.Once a possible outbreak is identified, the next step is outbreak confirmation.This is essentially a quick look at possible alternative explanations for theapparent increase in illness, such as laboratory false positives or changes innotification behaviour. Should there be no alternative explanation, an outbreakcontrol team is formed (Ford, 1999).

The first action of the outbreak control team is to agree on explicit statementof the case definition. This is essential to know whether individual illnessesshould be included in the outbreak (Andersson, 1991).Case definitions may include a range ofpossible onset dates, clinical symptoms, geographical locations andmicrobiological results. Case definitions can be very broad or very narrow toeither include many possible cases or few. The broader the definition, the morecases will be identified, although many of these additional cases may not berelated to the main outbreak. Case definitions can and should change as newinformation becomes available.Once a case definition has been agreed, case finding is the next step. For casedefinitions that include a microbiological diagnosis the easiest way ofidentifying cases is to review microbiology laboratory results.

A positivemicrobiological result will be very specific. However, relying on such resultswill exclude those patients who have not had microbiological investigationsamples taken. It may be necessary to encourage doctors to increase theirsampling rate or to report all episodes of particular clinical syndromes. Anotheralternative is to develop more than one case-definition, whichincludes microbial data which relies exclusively on clinical features (Andersson, 1992).The next stage of the investigation is outbreak description. Outbreakdescription requires that a basic set of data is collected on every individual whosatisfies the case definitions. As a minimum, these data will include name,address, age, sex, date of onset, the results of microbiological examination andsufficient clinical information to prove that the individual satisfies the casedefinition. It is also usual to record place of work or schooling, a basic food orcontact history and any travel history (Andersson, 1991).

This type of data may be collected by atrawling questionnaire that asks a series of open questions covering activitiesduring the period before the onset of illness. The results of these earlyinvestigations are usually presented in tabular and graphical form.At this stage it may be possible to develop a hypothesis as to the cause of theoutbreak. The hypothesis generated at this point may then indicate possiblecontrol measures. One of the more difficult decisions in any outbreakinvestigation is when control measures should be implemented. For controlmeasures to be effective, they have to be implemented early in the outbreak at atime when the working hypothesis is still far from proven. The damage to awater company’s image and financial position may be great if it has to makemajor changes to its treatment processes or issue a notice for its customers toboil their water. But if the outbreak is eventually proven to be due to another cause such as food,thenthe effort of the company will have been for no purpose (Ford, 1999).

Once a hypothesis as to the cause of the outbreak has been generated, thenext step is to prove it. This may involve further epidemiological investigationssuch as case-control studies, more microbiological investigations such as typingany isolates or environmental investigations into the

treatment plant and itsrecords. If the hypothesis is proven by the further investigations, then moredefinitive control measures may be put in place to prevent a recurrence.The final phase in any outbreak investigation is the dissemination of lessonslearnt. It is usual for a detailed report to be prepared for local stakeholders. Thisreport may be used by legal staff in possible civil and criminal proceedings. Asseen earlier, in many outbreaks more general lessons are learnt andthese should be published more widely in the medical or scientific literature (Ford, 1999).

2.4.5 Control and prevention of typhoid feverin Nigeria

Tomitigate salmonella infection treatments can be done by using antibiotics. Moreover the treatment can also be done by considering the immune system which is a defense system provided by body against microorganisms and pathogens. The immune system utilizes the mechanisms of vaccination to clear pathogen. Due to side effects of vaccination and antibiotics, herbs can be used because it is natural and lacks side effects.Bacterial infection can be minimized or removed by the use of antibiotics. Antibiotics are naturally occurring agents, which are produced by microorganisms and act on other bacteria. Synthetic antibiotics have been also been constructed to fight against microorganisms.

One strategy for reducing the typhoid morbidity and mortality is vaccination. Therefore effective and cost-effective vaccination is the control measure required to fight this infectious disease.Vaccination include: Vi polysaccharide vaccine, Ty21a vaccine, Vi polysaccharide vaccine, M01ZH09 vaccine, Vi vaccine and Vi-rEPA vaccine (Cook *et al.,* 2008).Medicinal plants are the back bone of traditional medicine. However, a number of infectious diseases are caused by different microorganisms. In Nigerian system of medicine, a large number of drugs of either herbal or mineral origin have been implicated in various diseases and other pathological conditions in humans. The plant extracts have been used as it lacks side effects.

Anyebe, *et al.* (2007) added that,Ciprofloxacin and ceftriaxone were the most frequently prescribedantibioticto patients of typhoid fever admitted in Ahmadu Bello University Teaching Hospital, Zaria between June 2000 and June 2005s. Chloramphenicol use is still relatively common despite the 12.4% mortality and 28% relapse rate recorded. WHO (1992) has prioritized some strategies for typhoid fever control, which were endorsed by the Global Malaria Conference for Health Ministers, held in Amsterdam, these are: Provision of early diagnosis andprompt treatment, Planning and implementation of selective andsustainable prevention measures, Early detection, containment and preventionof epidemics.Access to safe and good food and drinking water, strengthening of local capacities in basic and applied research for regular assessment of themalaria situation within countries and so on.

Studies such as Bhan, Bahl, and Bhatnagar (2005); Crump and Mintz (2010); Parry, Tran, Dougan, White, and Farrar (2002); Baker, Holt, Clements, Karkey, and Arjyal, (2011) shows that, improvements in water and sanitation infrastructure and in hygiene conditionsare essential for the control and elimination of typhoid fever. As water and sanitation improvements will require considerable investments in time and resources, however, preparednessplans must be developed, as epidemics will continue to occur in the short-tomediumterm. Tran *et al.*(2005) suggested that, in

resource-poor areas, improvingwater quality through targeted health education campaigns is the most realisticapproach to preventing typhoid fever transmission.

CHAPTER THREE

STUDY AREA AND METHODS

3.1 Introduction

This section provides the background information of the study area to facilitate discussion of results and these include; the location, climate, soil and vegetation, drainage and population. In addition, the methodology employed to answer the research questions of this study in the study area such as reconnaissance survey, the type and sources of data, sampling size and sampling techniques, instruments of data collection and data analysis were discussed.

3.2 Study Area

3.2.1 Location

The Main Campus of Ahmadu Bello University is located in Samaru, a suburb of Zaria in Kaduna State, Nigeria. Samaru is situated between latitude 11° 12' and 12° 00'North, and longitude 07° 37' and 8° 00'East, (see figure 3.1) at an altitude of 550-700 meters (Butu and Iguisi, 2013). It is approximately 13km from Zaria-city on the Sokoto road, 8km to Shika and 7km from Bassawa. Samaru settlement is an addition to the Zaria suburban area made up of Zaria-City, Tudun-Wada, the Government Reservation Area (GRA), and Sabon-Gari. Samaru evolved from a small colonial farming settlement to become a large community, a melting-pot, often referred to as “the University village”. It is cosmopolitan in nature, drawing and fusing people of divergent national and international backgrounds (Bako, 2011).

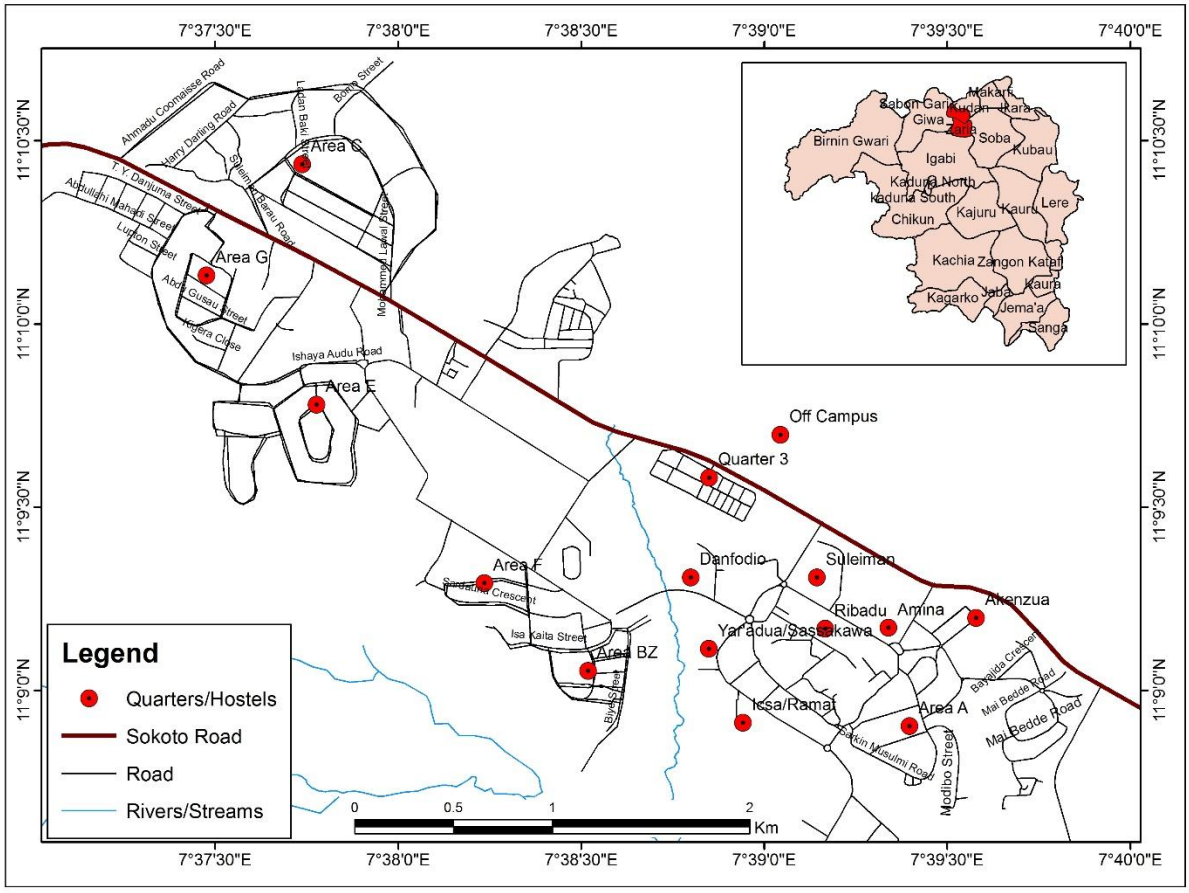


Figure 3.1: Map of AhmaduBello UniversitySamaru Campus

Source: Adapted from the administrative map of A.B.U (2014)

Zaria itself is a very large, heterogeneous city whose 1.490,000 population comes from different parts of the world. It is second in size only to the State capital, Kaduna. Zaria is accessible from different parts of the country by air via Kaduna, Kano, and Abuja and by rail and road via Kaduna, Jos, Kano and Sokoto. Zaria is located on the high plains of Northern Nigeria, 652.6 Meters above the sea level, some 950km away from the coast (112 031N 7 42E). The Zaria region is characterized by gentle rolling plains dotted with groups of rocky residual hills developed on granite bedrock (Yakubu, 2009).

3.2.2 Climate

Zaria possesses a tropical continental climate with a pronounced dry season, lasting up to seven months (October – May). During the dry season, a cool period is usually experienced between November and February.' This emanates from the influence of the North-easterly winds (the Harmattan) which control the tropical continental air mass coming from the Sahara. This weather prevails over most parts of the country. The NE winds are characterized by hazy to dusty conditions and low temperatures, as low as 10o C at night. In the afternoons, up to 402C is sometimes recorded. The humidity also drops to less than 15% in December/January (Yakubu, 2009). This type of climatic condition may hinder the breeding of microorganisms.

Zaria experiences a brief period of hot but dry weather in March and April, followed by a progressive incursion of tropical maritime air mass from the Atlantic Ocean which displaces the NE (Harmattan) winds. During this short period, the mean daily maximum temperatures are fairly stable, and they range from 38^0C to 42^0C. After that, the South Westerly Monsoon winds laden with moisture bring the rain in thunderstorms and squalls with heavy fall of high intensities. The rainy season lasts from May to September/October with long-term annual rainfall of c.1040mm in about 90 rain days (Yakubu, 2009). It is pertinent therefore to know that climatic variables such as, rainfall, vapour pressure and temperature have an important effect on the transmission and distribution of typhoid infections in human populations.

3.2.3 Soil and Vegetation

The study area falls within the basement complex of central northern Nigeria, and the soil type are derived from the weathering of rocks both within the area and nearby. The area comprises of mainly igneous rocks. Using the "D" Hoores classification of African soils, the soil of this area can be classified as ferruginous tropical soils. Also these soils can be classified as leached ferruginous soils (i.e those on the plains) while those in the fadama as hydromorphic soils (Ali, 2008).

The area initially has the tropical deciduous vegetation, but due to man's influence, the vegetation of the area has become degraded and classified under the northern guinea savannah zone. This type of vegetation is designated by wood land vegetation which is characterised by the *Isoberliniadoka, Isoberliniatomentosa* and *Vapacetogeomis* with a well-developed grass layer of tufted *Adropogeneae*. The vegetation is being cleared by man for cultivation, and construction purposes thereby hampering the vegetation and hence transforming the area to cultivated parkland (Jackson, 1970) with the characteristics cultivated field in the protected trees such as *Pakiamangefera, Butterosperm, Gaibaandosonic*. The non-cultural communities (exotic) which were deliberately established by man includes among other species *Ceibapentandra, Tamarindusindica, Andosoniadigitata, Khayasenegalensis, Dalbegia, Sissco, Eucalyptus*e.t.c. Trees of high economic

value in this area includes *Parkiaclappertoniana, Andasoniadigitata, Mangniferaindica* and *Acacia albida*(Sala, 2000).Despite the economic importance of the vegetation and soil in the area, on the other hand, it could also be a driving force in the occurrence of typhoid fever through the harbour of organism and mineral elements that can contaminate water and food. Also, some of these trees could be used for the traditional treatment of typhoid fever.

3.2.4 Drainage

The River Galma forms the main focus of the drainage systems in Zaria. Although the Galma carries water throughout the year, most of its tributaries such as the River Samaru dry up between January and June. The valleys of the streams to the North of Zaria are generally wide, shallow and not incised. To the west and north-west, the valley bottoms are alleviated and are singularly flat, wide and level. The soil in Samaru is made up of accumulated clay lying in a depth of between 36cm and 119cm (Butu and Iguisi, 2013). The drainage pattern of any location determines the area.

Proper surface and subsurface drainage to remove excess water in a safe and timely manner plays an important role in controlling water related diseases. Careful control and appropriate reuse of drainage water can help protect the environment and optimize the use of water resources.Water related vector-borne diseases are caused by bacteria, viruses and parasites (protozoa and helminths) transmitted by water related disease transmitting agents, also called vectors or intermediate hosts. Most infections can only be transmitted by a particular, disease-specific vector, e.g., malaria by *Anopheles* mosquitoes. An intermediate host has a similar role to a vector. However, such an organism does not actively transmit a pathogen, like freshwater snails in the case of schistosomiasis. Vectors and intermediate hosts represent critical elements in various disease transmission cycles of parasitic water related diseases. In general, they live in or near aquatic environments.

3.2.5 Population

AhmaduBello University is the largest University in Nigeria in terms of land mass and population.The community has a population of about 45,000 people (students), and a total land mass of approximately 7000 hectares (ABU, 2017).

3.3 METHODS

3.3.1 Reconnaissance Survey

A reconnaissance survey of the study area was carried out to acquaint the researcher with information about the most occurring disease in the area as well as the views of people on the effect of such diseases on man. During this survey, the researcher found out that typhoid is one of the most prevalent water borne disease in the community. It was also found that as at the time of this research, the university community was experiencing water scarcity due to the ongoing dam dredging at that period. It was further found that the source river of water supply into the community has much source pollution along its course.

3.3.2 Types of Data Used

i. Map of the study area at 1:200,000 scale

ii. Record of reported typhoid cases for the past six years (2009-2014).

iii. Socio-demographic data of respondents

iv. Data on drinking water sources, effects of typhoid fever and measures for mitigating typhoid

3.3.3 **Sources of Data**

Both primary and secondary sources of data formed the bases of this research. Structured questionnaire was used to obtain data from students.The questionnaire was validated by lecturers from departments of Geography and environmental management, Education and Statistics as well as some post-graduate students. The questionnaire was used to source data on disease occurrence, causes, effectand the interventions being carried out to prevent it as well as the challenges facingthe interventions. Also structured interview was conducted with the staff of the sickbay on the measures put in place to prevent the typhoid.

Secondary data was obtained from the University's health service unit (Sick-bay), and the University estate department.Case files were checked for recorded reported typhoid cases in the sick-bay. The data collected for each of the typhoid case contains the sex, age and location (resident) of the patient.

3.3.4 Sample Size and Sampling Technique

The target population for this study stands at 35,000 which are mostly students. Using the target population of 35,000 students and adopting the Yamene (1967) formula for sample size determination, the sample size was determined as follows;

$$Samplesize = \frac{N}{1 + N\ (e)^2}$$

Where N= Total number of population, e = error margin = 0.05

Therefore using the population of the university community (35,000) by 2014, the sample size is 395.5; as such 396 copies of questionnaire was administered.

A total of 396copies of questionnaire was administered for the purpose of this study. The sample size chosen is to ensure fair representation of the respondents and to allow for precision in the data analysis. Accidentalsampling technique was used to select the respondents. The questionnaire was self-administered (in rooms and classes)so as to ensure the retrieval of the whole 396 copies questionnaire for analysis. In a case where the respondent does not understand the question, the researcherexplained further for the respondent.

The questionnaire was divided into two sections. The first section is on the personal information of the respondents (demographic characteristics) while the second section is devoted to the questions that relate to the subject matter (prevalence of typhoid). Some of the questions were asked on typhoid experience, causes and its effect on academics.

3.3.5 Methods of Data Analysis

Objective I;identify the sources of water supply in the study area; to achieve this objective, data was gotten from the questionnaire. This was analysed using descriptive statistics in frequency and percentagessummarized in cross tables.

Objective ii; examine the demographic determinants of typhoid fever in the study area; to achieve this objective, data collected on reported typhoid cases was used. The statistical package for social science was used to present tabulate the number and percentage of recorded cases in accordance to the age and sex of the patient. Furthermore, the Kruskal-Wallis test was employed to establish significant differences in number of reported cases across the age groups. On the other hand, the Mann-Whitney U test was employed to establish significant differences in number of reported cases between the sexes of the patients.

Objective iii; examine the temporal trend of reported typhoid cases from 2009-2014 in the study area;Data for this was gotten from the university sickbay record office. The derived data was analysed using Microsoft excel to show the trend of the disease in the specified period of years using line graph. The trend was presented according to months and average monthly. Frequency and percentage was used to show typhoid occurrence over the specified years in the study area. Also, the Friedman ANOVA was employed to establish significant difference in number of recorded typhoid cases across the six years period.

Objective iv; examine the spatial distribution of reported typhoid fever cases in the study area; Recorded typhoid cases was used for this objective. The z-test analysis was employed to rank the distribution of the recorded typhoid cases across the resident location of the patient. The z-test result was also used to present on a map the distribution of the typhoid recorded cases according to level of occurrence (high, moderate and low).

Objective v; examine the strategies adapted to control and prevent typhoid fever in the study area;Data for this objective was sourced through the structured interview and analysed descriptively. The result of the analysis is presented in table of frequency and percentage.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.2 Introduction

This chapter presents the results obtained and its discussion from the analysis of the survey conducted in AhmaduBello University, samara campus, Zaria. It includes the socio demographic characteristics of respondents, major sources of drinking water supply available and demographic determinants of typhoid fever. The chapter also presents the trend of typhoid fever occurrence from 2009-2014, spatial distribution of typhoid fever in the campus and strategies adopted to control and prevent typhoid fever in the study area.

4.2 Socio-Demographic Characteristics of Respondents

The socio-demographic characteristics considered include; sex, age and marital status as well as the status of the respondents in the community.

4.2.1 Sex and Age of the Respondent

Sex, age and marital status of respondents in the community are presented in Figure4.1 andTable 4.1 respectively.

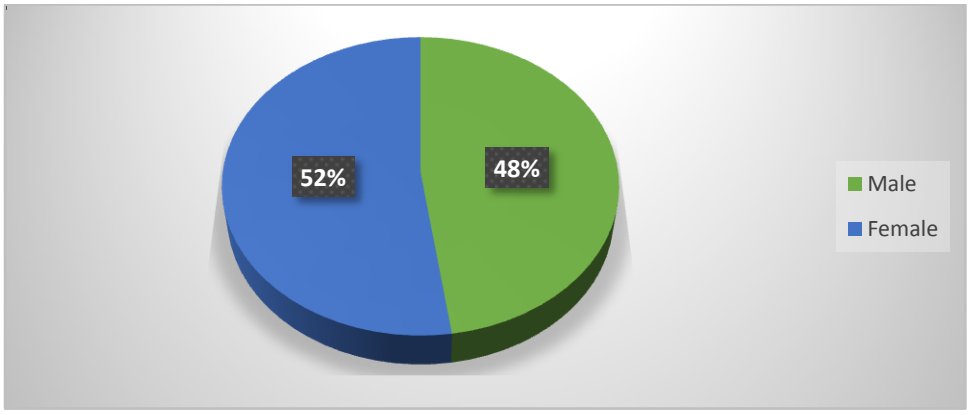


Figure 4.1: Sex of Respondents

Source; Field Survey, 2016

The study reveals that all more than half of the respondent making up 52% were female while 48% were male. This indicates that more female were contacted during the survey than male.

Table 4.1: Age of Respondents

Age	Frequency	Percentage
16-20years	64	16.2
21-25years	157	39.6

26-30years	56	14.1
31-35years	45	11.4
36-40years	27	6.8
41-45years	29	7.3
46-50years	11	2.8
51years and above	7	1.8
Total	**396**	**100.0**

Source; Field Survey, 2016

The age of 21-25 years constituted the highest proportion of respondents with 39.6%, respondents with 16-20years constituting 16.2% while respondents with 26-30 years made up 14.1% as indicated in by the study. It also shows that only about 1.8% of the respondents were above 50years of age. This implies that majority of the population in the study area were youths.

4.3 Major Sources of Drinking Water

Tables 4.2 and 4.3shows the means of water supply available in the study area, reason of respondent for consuming the water and the treatment method used by respondents before the water consumption.The study reveals that sachet water (46.5%) was the major source of drinking water which is followed by tap water with 24.2% while borehole water constitute 21.0% who consume the water. Only few respondents (1.3%) consume water from other sources such as well.

Table 4.2: Source of water consumed by respondent versus reason for consumption

Source of water supply	**Reason for consumption**								**Total**	
	Safer		**Mostly available**		**Cheaper**		**Others**			
	freq	**%**	**Freq**	**%**	**freq**	**%**	**freq**	**%**	**freq**	**%**
Tap water	96	24.2	0	0.0	0	0.0	0	0.0	96	24.2
Bottle water	28	7.1	0	0.0	0	0.0	0	0.0	28	7.1
Borehole water	74	10.4	9	10.6	0	0.0	0	0.0	83	21.0
Sachet water	0	0.0	80	11.9	104	26.3	0	0.0	184	46.5
Others (well)	0	0.0	0	0.0	0	0.0	5	1.3	5	1.3

Total	**198**	**50.0**	**89**	**22.5**	**104**	**26.3**	**5**	**1.3**	**396**	**100.0**

Source; Field Survey, 2016

It also reveals that about half (50%) of the respondents felt the water they consume is safer and that is why they consume it, but for about 22.5%, they regarded their water source as the most available at all times as such is more consumed while for 26.3%, their reason for the water they consumed was being cheap.

Table 4.3: Treatment method for drinking water

Treatment method for tap water	**Frequency**	**Percentage**
Decantation	12	12.5
Boiling	46	47.9
No treatment	38	39.6
Total	**96**	**100.0**
Treatment method for borehole water		
Decantation	27	32.5
Boiling	18	21.7
Chlorination	3	3.6
No treatment	35	42.2
Total	**83**	**100.0**

Source; Field Survey, 2016

In terms of treatment method for the drinking water for tap and borehole water consumers, the study reveals that most (47.9%) of those that consume tap water, used the boiling treatment method, 39.6% consume without treatment while only 12.5% decant the water before consumption. Forthose that consume borehole water, 42.2% consume without treatment, 32.5% decant, 21.7% boil while 3.6% chlorinate before consumption. This implies that sachet water is the most consumed water in the study area. Although choosing the best water source for consumption could be subjective, as there are personal preferences which vary among individuals. As such the availability of several options of sources of drinking water in the area gave rise to variation in choice of the water to consume by respondents.

It is believed that sachet water is one of the best to consume as it has been carefully processed to supplement the need of water for consumption and assumed to be more potable than tap water. This assumption could be right and could also be wrong, this is because during the reconnaissance survey, it was observed that some of the sachet water available within the ABU community appeared to be containing some observable particles. As such this gave consumers some

elements of doubt on its quality. The result of this study therefore slightly contradicts the findings of Anyebe*et al,* (2007) who revealed that there was a high usage of tap water for consumption in Zaria.

4.4 Demographic determinants of typhoid fever in ABUSamaru campus

The incidence of typhoid fever cases is said to increase with an increase in temperature and rainfall. These are said to be environmental determinants of typhoid fever. In the same vein, some demographic factors determines the occurrence of typhoid fever cases. These includes sex, age amongst others. As such Table 4.4 shows the distribution of reported typhoid cases based on age of the patient. It reveals thattyphoid fever in the study area mostly affects age groups of 21-25years followed by patients within the age groups of 12-20years. The Table also shows the result of Kruskal-Wallis testin other to show statistical difference between age groups of patients. It revealed that given a calculated significant level of 0.423, at 0.05 level of significance, there is no significant difference in number of reported typhoid cases between the age groups of the patients.This implies that despite typhoid fever in the study area mostly affects the younger population, yet the variation is not statistically significant.

Table 4.4: Distribution of reported typhoid cases based on age

Age	**Number of cases**	**Percentages**
16-20years	2171	21.6
21-25years	4968	49.5
26-30years	1155	11.5
31-35years	1001	10.0
36-40years	445	4.4
41-45years	201	2.0
46years and above	99	1.0
Total	**10040**	**100.0**
Df= 6, N= 6, Chi-square= 6.000, Asymp. Sig.= 0.423		

Source; Field Survey, 2016

This affirms the assertion of Crump and Mintz (2010), that typhoid fever especially in the tropics is more prevalent among youth and children within the ages of 9-19years. The study also corroborates the findings of Zailani, Aboderin and Onipede (2004) who found that in Ile-Ife south west Nigeria, although age does not influence typhoid fever, yet the occurrence of the disease appears to be more among the younger age groups of 25year and below.

The study reveals that typhoid fever in the study area mostly affects the female sex (63.9%). This could be that female students attend the university sick-bay for medical check-ups more than the male students. This findings corroborates the findings of Mensah (2007) who found that in the

city of Accra, Ghana, typhoid fever caused by contaminated water supply affects more females than males.

Table 4.5: Distribution of reported typhoid cases based on sex

Sex	Number of cases	Percentages
Male	3621	36.1
Female	6419	63.9
Total	**10040**	**100.0**
Mann-Whitney U= 0.000, Wilcoxon W= 1.000, Z= -1.000,Asymp. Sig. (2-tailed) = 0.317		

Source; Field Survey, 2016

On the other hand, the findings of the present study contradicts the findings of Idoko*et, al.,* (1988) who found that in Zaria, typhoid fever occurs more in male than female.

Table 4.5 also shows the result of Mann-Whitney test in other to show statistical difference between sexes of patients. It revealed that given a calculated significant level of 0.317, at 0.05 level of significance, there is no significant difference in number of reported typhoid cases between the sexes of the patients. This implies that though typhoid fever in the study area mostly affects female, the variation is not statistically significant.

4.5 Perceived Effects ofTyphoid on Students in the study area

Typhoid fever is endemic in the tropics and the disease has been associated with poverty and underdevelopment with significant morbidity and mortality. Typhoid fever remains disease of major public health importance in Nigeria, causing significant morbidity and mortality. The high endemicity has made it become almost a house-hold name to every Nigerian (Uneke, 2007).

Table 4.6: Effects of typhoid fever on respondents in the study area

	Effect	N	Mean	Average Mean
Academic	Class absenteeism	396	2.31	
	Lateness to class	396	1.81	
	Poor academic performance	396	2.38	
	Late submission of assignments	396	1.38	2.03
	Missing of exams and test	396	2.21	
	Lack of concentration	396	2.08	
Social	Absenteeism from games	396	2.04	

	Absenteeism from parties	396	1.42	
	Absenteeism from religious activities	396	1.81	1.70
	Absenteeism from friends gathering	396	1.60	
Physical/psychological	Loss of weight	396	2.42	
	Depression	396	1.83	1.96
	Inability to work	396	1.63	
Economic	Buying of drugs	396	1.77	1.77

Source; Field survey 2016

Thus, it is pertinent to consider the challenges which the disease might have posed on the ABU community who are mostly students. In such concern, attempt was made to look into the social, economic, physical and mental effects posed by typhoid fever in the study area as presented in Table 4.6.

Table 4.6 shows the mean distribution of respondents based on effect of typhoid fever in the study area. It reveals that respondents perceived academic, social, physical/psychological and economic effects. From the academic effects, poor academic performance with a mean of 2.38 is most perceived effect. This is followed by absenteeism from lectures (2.31) and missing of exams and test with 2.21 mean. From all the social effects perceived, absenteeism from games with a mean of 2.04 appears to be the most social effect felt by respondents. This is followed by absenteeism from religious activities (1.81) while being absent from parties is the least effect felt with a mean of 1.42. This means that social activities of respondents who might have fallen victims of the disease have ever been affected. This corroborates Adeyemi,(2013) who revealed that, *Salmonella* agglutinins are common among apparently healthy people and the resultant effect on health status would affect productivity through absence from work, intellectual development and other aspects of life.

In the case of economic effect which implies the cost of treatment or other indirect economic implications, the study reveals that buying of drugs which accounted for a mean of 1.77 was recorded by most of the respondents. This implies that cost of treating typhoid fever among respondents in the study area has made significant impact. The economic effect of typhoid fever could also be influenced by poor diagnosis as pointed byKeong (2006) that poor diagnosis continues to hinder effective typhoid control in the tropicsdue to a combination of factors such as lack of resources and insufficient access to trained health care providers and health facilities, and widespread practice of self-treatment for clinically suspected typhoid fever.

This thus, could increase average cost of treatment as it continues to prevail. The most perceived physical/psychological effect felt by respondents is loss of weight (2.42) followed by self-depression (1.83). Typhoid could also lead to losing of hearing abilities in some serious cases, perforation of the intestines in the long run that can lead to surgery. Although even at the beginning of the infection of the disease, it ischaracterized by an acute illness, the first typicalmanifestations of which are fever, headache, abdominalpain, relative bradycardia, splenomegaly, andleukopenia can

easily alter the victim's facial outlooks as pointed by Uneke, (2008). But in the case of mental effects, the study reveals that more than half (53.5%) of the total respondents disagreed that typhoid have affected victims mentally in the study area. This therefore contradicts the assertion by Pejcic-Karapetrovic*et al,*(2007) that typhoid fever especially among pregnant womencan lead to psychological trauma which is a preliminary level of mental disorder based on psychologist.

4.6 Typhoid Fever Occurrence in A.B.U Community from 2009-2014

In order to examine the trend in typhoid fever occurrence in the study area over a period of time, the record of reported cases of typhoid fever from the University's sick-bay was collected for a period of six (6) years. The data collected from the sick-bay are presented in Figures 4.2, 4.3 and 4.4 respectively.

Figure 4.2: Monthly Variation of recorded typhoid cases from 2009-2014

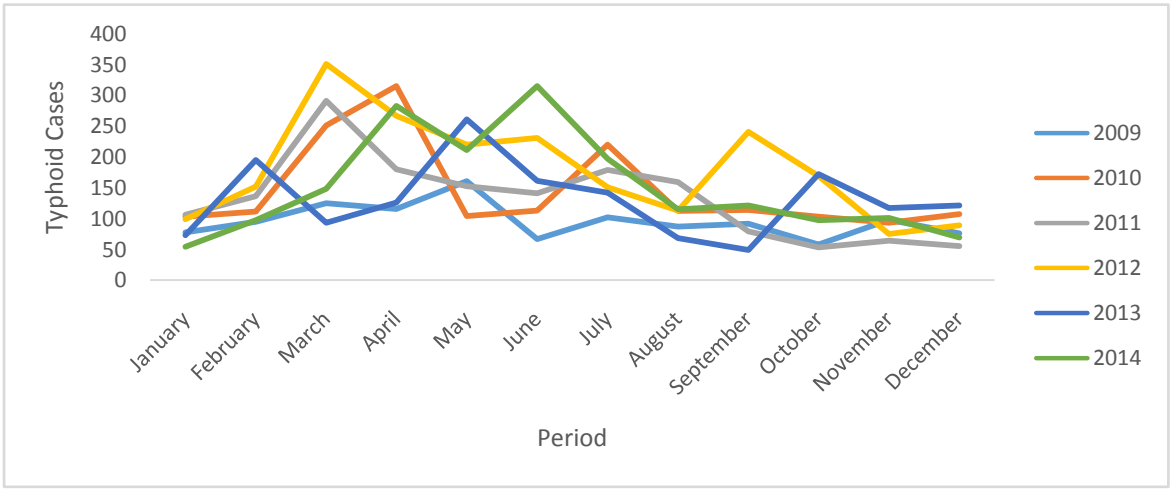


Figure 4.2 shows the number of reported typhoid fever cases from January-December between 2009 and 2014. It reveals that in 2009 highest recorded typhoid cases is in the month of May with 161 cases while October with 58 cases is the lowest. In 2010, April with 315cases recorded the highest while November with 93cases recorded the lowest.In 2011,March with 291 cases recorded the highest while October with 53cases recorded the lowest. The year 2012 recorded 351 cases in the month of March which stands to be the highest while November with 75 cases is the lowest.In 2013, May recorded 261 cases and September recorded 49 cases which stands to be highest and lowest respectively. Finally, in 2014 the month of June with 315 cases of typhoid is the highest while January whichrecorded 54 cases is the lowest. This implies that in 2011 and 2012, the number of reported typhoid cases in the study area is high in the first quarter of the year while in the last quarter it islow.But in 2009, 2010, 2013 and 2014, the highest cases were recorded in the second quarterwhile the lowest is in the last quarter. The monthly variation in number of recorded typhoid cases in the study area could be due to climatic changes over the months which includes increase and decrease in temperature and rainfall.Emmanuel, Uttah, Osim, Emmanuel, and Ndibukke (2013) also posited that paucity of potable water, and the proliferation of unsupervised commercial boreholes which produced non-potable water for consumption.

Figure 4.3 shows the average recorded typhoid cases in the study area over the months of the year for the whole six years under study. It reveals that from year 2009 to 2014, month of April

with 1287 recorded cases have the highest cases of typhoid fever. The month of December recorded the lowest number of cases in the study area over the six years period. On a general note the occurrence of typhoid in the study area showsa fast rise from January to April where it has its peak and then a slow and gentle decrease to the month ofJuly, a sharp and sudden decrease to the month of August and finally an increase to the month of September with decrease down to the month of December.

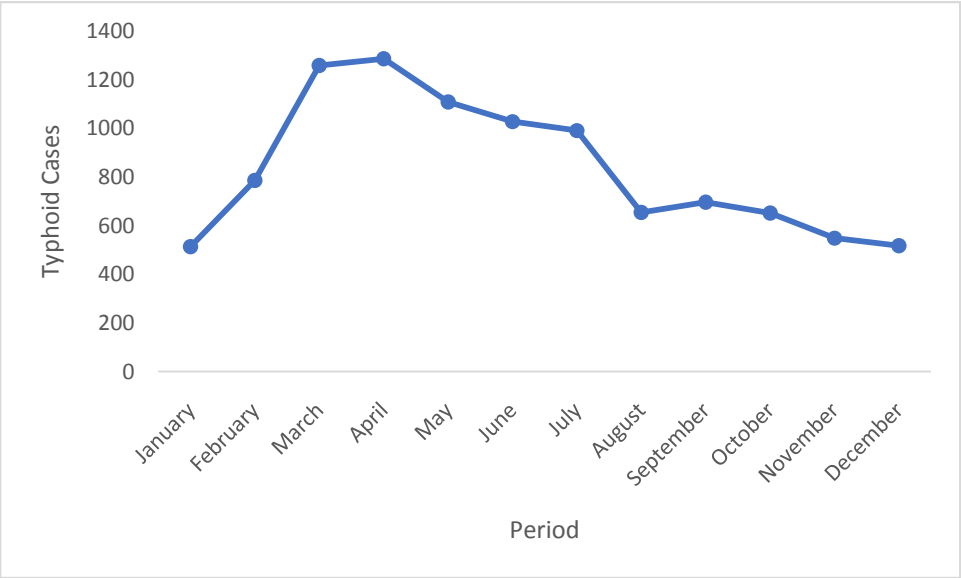


Figure 4.3:Trend of typhoid cases across the months

The nature of occurrence of typhoid feverin the area, goes along with the increase and decrease in temperature in the study area.Yakubu (2009) reported that temperature increases in Zaria from March to May where it has its peak but decreases from October to February. This implies therefore that climate of the study area could also have a role to play in the occurrence of typhoid fever in the study area. This therefore supports the assertion of Adebayo (2013) who pointed that typhoid fever increases with increase in temperature. The results also commemorates Idoko, Anjorin and Lawande, (1988) who pointed that in Nigeria, transmission of typhoid fever occurs all year round but rates are slightly higher in April-July, coinciding with the period high temperature and the onset of the rainy season, respectively. But considering Figures 4.3 and 4.4 simultaneously, the result contradicts the findings made by Oboegbulam, Oguike and Gugnanai, (1995) that the highest number of cases of typhoid fever are recorded during the rainy season in south-east Nigeria. So also Anyebe, *et al.* (2007) in their retrospective, non-experimental study revealed that, most of the typhoid infections studied occurred during the rainy season in Zaria (May – November) with high cases at the beginning of the rainy season (May/June). This differences could be attributed to the departure of students for semester breaks which most of the years falls within the months of the rainy season.

But the results of this study is similar to the assertions made by Ikeme and Anan (1999) who reported prevalence of typhoid in western Nigeria with high positive correlation with the onsetof rainy season which begins in the month of May in Zaria. Also in Lagos, Nigeria, three peak incidences of typhoid infection were found to be in April, July and November (Ogunbiyi and Onabowale, 1996) coinciding with temperature and rainfall in April and July.

Table 4.7 shows the occurrence of typhoid across the years from 2009-2014. It reveals that year 2012 with 2158 number of recorded typhoid cases had the highest number of recorded typhoid cases over the six years period. This is followed by the year 2014 with 1808 recorded number of cases. The year 2009 had the least recorded number of cases with 1155 typhoid cases.

Table 4.7: Reported typhoid fever cases in the study area

Year	Number of cases	Percentages
2009	1155	11.5
2010	1746	17.4
2011	1595	15.9
2012	2158	21.5
2013	1578	15.7
2014	1808	18.0
Total	**10040**	**100.0**

Df= 1, N= 6, Chi-square= 6.000, Asymp. Sig.= 0.014

Source; Field Survey, 2016

Table 4.7 therefore reveals that there has been fluctuating trend in the occurrence of typhoid fever in the study area. But on the average an increase over the years was recorded. This results corroborates Adeyinka, Wasiu andAkintayo(2014) who demonstrated that, among the common waterborne disease in some parts of Nigeria, typhoid cases ranked highest and showed an increase over the years from 2002-2008, followed by cholera, hepatitis and drancuncunliasis.

Table 4.7 also shows the result of Freidman ANOVA test in other to show statistical difference between the years. It revealed that given a calculated significant level of 0.014, at 0.05 level of significance,there is a significant difference in number of reported typhoid cases between the years. This implies that typhoid fever in the study area shows that the variation isin number of recorded typhoid cases across the years is statistically significant.

Table 4.8 and figure 4.5 shows the distribution of typhoid cases across the various residents of ABU Samaru community. It reveals that Ribadu hostel with 1975 total cases over the six years period had the highest number of typhoid cases in the study area. This is followed by Amina hostel with 1570 cases, Suleiman hostel with 1198 cases while Area A and quarter three with 109 cases each had the lowest recorded cases of typhoid over the six years period.

Table 4.8: Distribution of reported typhoid fever cases based on location

Location	Number of cases	Z-score	Ranking	Remaks
Ribadu hostel	1975	2.10191	1	High (13.3%)
Amina hostel	1570	1.44992	2	“
Suleiman hostel	1198	0.85107	3	Moderate (33.3%)
Off-campus	1155	0.78184	4	“
Danfodio hostel	1072	0.64823	5	“

Icsaramat hostel	989	0.51461	6	“
Sassakawa/yaradua hostel	780	0.17815	7	“
Akenzua hostel	315	-0.57042	8	Low (53.4%)
Area C	207	-0.74428	9	“
Area BZ	205	-0.74750	10	“
Area F	152	-0.83282	11	“
Quarter three	109	-0.90204	12	“
Area A	109	-0.90204	13	“
Area E	105	-0.90848	14	“
Area G	99	-0.91814	15	“

Source; Field Survey, 2016

This implies that the residents with highest cases of typhoid recorded the most occurrence of the disease over the six years period. Considering the residents with highest recorded number of cases, it could be seen that they are student’s residents mostly as shown in figure 4.5 and as such could mean that the students suffer most from the ill effects of typhoid fever in the study area.

Given the z-score in Table 4.8, ranking was aided which shows the location with the highest typhoid cases. This also aided the mapping showing the spatial distribution of typhoid fever in the campus. The z-score gave room for ranking of the typhoid cases according to areas with high, moderate and low cases. Figure 4.5 shows that the high concentration of typhoid cases in the area is more in the student’s hostel areas and specifically the female students. This could be because of the population concentration of students in the hostel which is more than those off-campus. Another factor is that most students living off-campus, may find it difficult to report to sick-bay for diagnosis as they report to other health facilities in their surroundings.

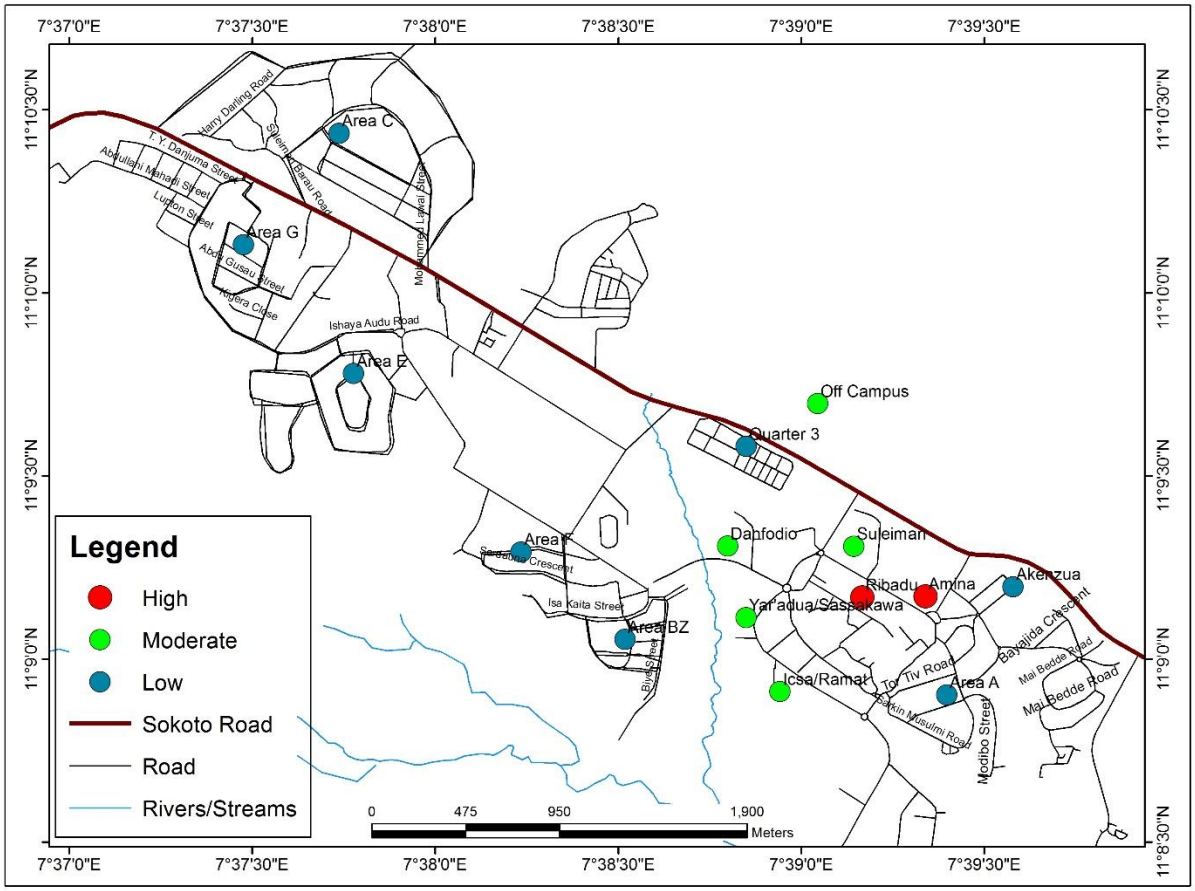


Figure 4.4: Distribution of typhoid cases by location of patients

This result corresponds with the findings of Anyebe, *et al,*(2007) who found that out of the more females of all age andoccupational groups who were affected with higher incidences of typhoid, most of them were young adults and students among the patientsadmitted in Ahmadu Bello University Teaching Hospital, Zaria for typhoid fever. This trend becomes even moreapparent in view of the high incidence found among students. The incidenceof typhoid fever however cuts across all occupational groups, with students mostlyaffected. These students coincidently are mainly in the more affected age group (11– 30 years). This the researchers attributed to the fact that students were commonly found outside their homes and thusmay become prone to eating food and drinking water from contaminated sources.

Table 4.9 shows the distribution of respondents based on their experience with typhoid and perception on water as the cause of typhoid in the study area. It reveals that most of the respondents which constituted 53.3% rarely experience typhoid, 26.8% experience typhoid often while only a few (3.8%) have never experience typhoid yet in the study area.

Table 4.9: Distribution of respondents based on experience with typhoid fever

Occurrence of typhoid	Frequency	Percentage
Never	15	3.8

Rarely	211	53.3
Often	106	26.8
Always	64	16.2
Total	396	100.0
Water as cause of typhoid		
Yes	239	60.4
No	157	39.6
Total	**396**	**100.0**

Source; Field Survey, 2016

Table 4.9 also reveals that majority of the respondents (60.4%)perceivedconsumption of contaminated water as the major cause of typhoid fever in the study area. This implies that more than 95% of the residents of ABU community might have had an experience with typhoid fever, also this implies that there most of the people in the study area don't feel safe with the water they consume. This results supports the assertion of Uneke (2008) who pointed that majority of the people in Nigeria have had an encounter with typhoid fever either as a person or as household. This results also is similar to that of Abu, Oshomole and Adeyemi,(2011) who reported that in Minna, Niger State, most of the people attributed the high prevalence of typhoid fever cases to the water consumed by the patients.

4.7 Strategies adopted to control and prevent typhoid fever A.B.U Community

There are different measures to*prevent salmonella* infection one among which is vaccination. Moreover the treatment can also be done by considering the immune system which is a defence system provided by body against microorganisms and pathogens. The immune system utilizes the mechanisms of vaccination to clear pathogen.

Table 4.10 shows the measures adopted in mitigating typhoid fever in the study area. It reveals that only 7.3% of the total respondents attested that vaccine was used in preventing typhoid fever in the study area.

Table 4.10: Measures of preventing typhoid fever in A.B U community

Measure	**Agreed**		**Undecided**		**Disagreed**		**Total**	
	Frq	%	Frq	%	Frq	%	Frq	%
Vaccine	29	7.3	189	47.7	178	44.9	396	100
Fumigation of surrounding	262	66.2	94	23.7	40	10.1	396	100

Improved sanitation	302	76.3	55	13.9	39	9.8	396	100
More awareness on personal hygiene	234	59.1	115	29.0	47	11.9	396	100

Source; Field Survey, 2016

This implies that ABU Samaru community have improved sanitation. This therefore supported the studies of Bhan, Bahl, and Bhatnagar (2005); Crump and Mintz (2010); Parry, Tran, Dougan, White, and Farrar (2002); Baker, Holt, Clements, Karkey, and Arjyal, (2011) which shows that, improvements in water and sanitation infrastructure and in hygiene conditionsare essential for the control and elimination of typhoid fever. This was confirmed by a statement by one of the university health services staff during an interview who stated that….

> *…we fumigate the surroundings especially the hostels as well as the quarters once in a while. But as for cleaning the environment, that we do on a daily basis from the hostels to the quarters and even the classes areas*(University cleaner).

Finallythe study reveals that most (59.1%) of the respondents attested that there is creation of more awareness on personal hygiene as a wayof preventing typhoid fever in the study area. This result therefore supported the opinion of Tran *et al.*(2005) who suggested that, in resource-poor areas, improvingwater quality through targeted health education campaigns is the most realisticapproach to preventing typhoid fever transmission. The result of this study was confirmed by a statement by one of the university health services staff during an interview who stated that….

> *…provision has been made with the ICT unit of the University to make public notifications on the need for proper hygiene and environmental sanitation by dumping waste properly to avoid litter of waste. This I am sure and have seen that it is being done via the public electronic bill board that is close to the former school bookshop.*(University health services publicity officer).

This implies that amongst the outlined measures, only vaccine is not popularly used to prevent typhoid in the area. Although this could be lack of information supplied to the residents of the community on whether vaccine for typhoid is available or not. It could also be due to the negligence of residents. This was further buttressed by one of the discussant during an interview session with the University's health services officials who stated that …..

> *…the University health service unit made provisions for vaccination of various types of diseases such as meningitis, hepatitis and typhoid fever. But the problem is that most of the students and even staff don't come for this vaccines but do come for treatment when caught up with any of these diseases.*(Sick-bay doctor).

This could be true as even Cook *et al.,*(2008) opined that one strategy for reducing the typhoid morbidity and mortality is vaccination. Therefore effective and cost-effective vaccination is the control measure required to fight this infectious disease. The results of this study on measures of preventing typhoid fever in the area shows that vaccination is not commonly used as a preventive measure of typhoid fever.This contradicts the revelation by Anyebe, *et al.* (2007) which shows thatvaccination is mostly advisedin Ahmadu Bello University Teaching Hospital, Zaria. It means that

there need for more effortif vaccination is to be used as amajor preventivemeasure of typhoid fever in the study area.Also, WHO (1992) has prioritized some strategies for typhoid fever control, which includes among others planning and implementation of selective andsustainable prevention measures.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary of findings

The study found that more than half of the respondents (52%) were female while 48% were male. The age group 21-25 years constituted the highest proportion of respondents with 39.6%, majority of the respondents (77.3%) were single while majority were also students which constitute 84.3%.

The study also found that sachet water (46.5%) was the major source of drinking water which is followed by tap water with 24.2% while a few respondents consume water from other sources such as well. About half (50%) of the respondents felt the water they consume is safe, most (47.9%) of those that consume tap water, used the boiling treatment method, 39.6% consume without treatment while for those that consume borehole water, 50% consume without treatment, 28.1% decant, 18.8% boil while 3.1% chlorinate before consumption.

The study found that typhoid fever is perceived to affect student's academicsthrough absenteeism from lectures which can influence poor academic. Perceived social effects of typhoid were found to be mostly absenteeism from games and from religious activities. On the other hand, perceived economic effects was found to be mostly buying of drugs while physical/psychological effect was mostly loss of weight and depression.

It was revealed by the study that typhoid fever in the study area mostly affects age groups of 21-25years. The Kruskal-Wallis test with a calculated significant level of 0.423, shows that there is no significant difference in number of reported typhoid cases between the age groups of the patients.On the other hand, typhoid fever in the study area mostly affects the female sex (63.9%). The Mann-Whitney test with a calculated significant level of 0.317,shows that there is no significant difference in number of reported typhoid cases between the sexes of the patients. The study revealed that there is a significant difference in number of reported typhoid cases between the years.

The study established that on the average from year 2009-2014 recorded cases of typhoid fever in the study area, the month of April with 1287 recorded the highest cases of typhoid fever while December recorded the lowest over the six years period. On a general note the study revealed a fast rise from January to April and then a decrease down to the month of December.The occurrence of typhoid across the years reveals year 2012 with 2158 number of cases had the highest while 2009 had the least with 1155 typhoid cases.

Finally the study found that Ribadu hostel with a z-score of 2.10191 recorded the highest number of typhoid cases in the study area, followed by Amina hostel with 1.44992.About 7.3% of the total respondents attested that vaccine was used in preventing typhoid fever in the study area, 66.2% attested that fumigation of the surrounding is been done in the area, 76.3% attested for improved sanitation in the study area while most (59.1%) of the respondents confirmed the creation of more awareness on personal hygiene as a measure adopted to prevent typhoid fever in the study area.

5.3 Conclusion

From the findings of this study, it can be concluded that the major sources of water supplyfor students of A.B.U Samarucommunity are sachet water and tap water. Also,the perceived effects posed by typhoid fever is felt more on academics and physically/psychologically in the area. Demographics determinants such as age and sex does determine the occurrence typhoid fever among students in the study area. Also, there is no significant difference in occurrence of typhoid fever between sexes and age groups of students in the study area. Though a statistical significant difference was established in the occurrence of typhoid fever between the specified years studied. Finally, it canbe concluded that typhoid is not being adequately prevented in the area.

5.4 Recommendations

Based on the findings of the study, the following recommendations were made.

- Stored water should be treated by adding some disinfecting agents such as chlorine which might help in reducing the risk of microbiological contaminations from storage tanks especially the plastic tanks.
- There should be public awareness and enlightenment campaignsby UHS on the implication of water-borne diseases on human health and the need to adopt hygienic practices such as hand washing, boiling of drinking water before consumption and use of disinfectant (chlorine) and regular washing of storage tanks.
- Appropriate drugs should be made available for treatment of typhoid patients in the university so as to reduce the academic, social, physical/psychological and economic effects of the disease.

- Finally there is need for further research on the role of other environmental factors in the occurrence of typhoid fever in the study area.

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Appendix I
QUESTIONNAIRE
DEPARTMENT OF GEOGRAPHY,
FACULTY OF SCIENCE,
AHMADU BELLO UNIVERSITY, ZARIA

Dear respondent,

I am a student of the above named school and department, carrying out a research on the topic "**Analysis of *salmonella typhi*prevalence in A.B.U community, Zaria, Nigeria"**. Please kindly answer the questions below as all information supplied would be used mainly for academic purposes and shall be treated as highly confidential. Thank you.

Section A: Socio-Demographic characteristics

1. Sex: M [ ] F [ ]
2. Age:_____

Section B: Sources of water supply

3. What is your source of domestic water supply? Tap water [ ] Bottle water [ ] Borehole [ ] Sachet water [ ] Others specify _____
4. What is your reason for the water consumption? Safer [ ] Most reliable [ ] Cheaper [ ] Others specify _____
5. What treatment method do you adopt for your tap water treatment? Decantation [ ] Boiling [ ] No treatment [ ]
6. What treatment method do you adopt for your borehole water treatment? Decantation [ ] Boiling [ ] Chlorination [ ] No treatment [ ]

Section C: Typhoid Experience

7. How often have you been experiencing typhoid? Never [ ] Rarely [ ] Often [ ] Always [ ]
8. Do you think the water you consume is the cause? Yes [ ] No [ ]
9. Measures taken to prevent typhoid occurrence in the area

Measure	**Agree**	**Undecided**	**Disagree**
Vaccine			
Fumigation of surrounding			
Improved sanitation			

Creation of more awareness on personal hygiene			

Section D: Perceived Effects of Typhoid Fever

Effect	Agree	Undecided	Disagree
Academic effect			
Class absenteeism			
Lateness to class			
Poor academic performance			
Late submission of assignments			
Missing of exams and test			
Lack of concentration			
Social effect			
Absenteeism from games			
Absenteeism from parties			
Absenteeism from religious activities			
Absenteeism from friends gathering			
Physical/psychological effect			
Loss of weight			
Depression			
Inability to work			
Economic effect			
Buying of drugs			

Appendix II

Interview Guide

1. What do you think of typhoid prevalence in ABU community?
2. What do you think may be the causes of typhoid among residents of ABU community?
3. In what ways do you think typhoid affects its victims in ABU community?
4. What are the measures on ground for mitigating typhoid in ABU community?