FIVE CHILD-KILLER DISEASES AND UNDER-FIVE MORTALITY IN YOLA ADAMAWA STATE, NIGERIA (2001-2015)

BY

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Declaration

I Hamidu Umaru Waniyos hereby declare that this study "Five Child-Killer Diseases and Under-Five Mortality in Yola Adamawa State, Nigeria" is my original work and has never been submitted to any other Institution or University for an award. All references cited have been dully acknowledged.

Hamidu Umaru Waniyos

Signature..

Date..... 26th/07/2017 .....

Approval

This project work titled "Five Child-Killer Diseases on Under-Five Mortality in Yola, Adamawa State Nigeria" is supervised by me for the award of Master of Science degree in Statistics of Kampala International University, Uganda.

Approved by:

Dr. Nafiu Lukman Abiodun

Signature..

Date: 25/01/2016

Dedication

This project work is dedicated to my family.

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List of Acronyms

UNICEF	-	United Nations Children's Fund
UNDP	-	United Nations Development Program
WHO	-	World Health Organization
UNDESA	-	United Nations Department of Economics and Social Affairs
PHCDA	-	Primary Health Care Development Agency
MOH	-	Ministry of Health
DSS	-	Demographic Surveillance System
UNFPA	-	United Nations Population Fund
WHA	-	World Health Assembly
NNT	-	Neonatal Tetanus
MDG	-	Millennium Development Goals
TDIOD	-	Total Deaths Irrespective of the Disease
DT	-	Demographic Transition
DTM	-	Demographic Transition Model
ORT	-	Oral Rehydration Therapy
DSNO	-	Diseases Surveillance and Notification Officer
SCSN	-	Supreme Council for Shari'ah in Nigeria
GPEI	-	Global Polio Eradication Initiative
CDCP	-	Centres for Disease Control and Prevention
tOPV	-	trivalent oral polio vaccine

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Abstract

The study was set out to investigate the prevalence of the five-child killer diseases and its cause effect on under-five mortality. It was driven by four major objectives; Determining the prevalence rate of the five child-killer diseases; Determining the proportion of mortality due to the five child-killer diseases to the total under-five mortality in the studying area; Examining the correlation between the five child-killer diseases and under-five mortality and Determining the cause effect of the five child-killer diseases on under-five mortality. The study used an entirely quantitative approach using secondary data between 2001 and 2015 obtained from the document of Adamawa state, Primary Health Care Development Agency (PHCDA). Data was collected regarding the number of children immunized, diseases and deaths due to Pneumonia, Diarrhoea, Measles, Tetanus, Polio and overall under-five mortality within that timeframe. The study used uni-variate descriptive analytical tools, measures of prevalence rate per a thousand, measures of proportionality, correlation analysis and regression tools for analysing and developing a model for describing the data. The results indicate that the prevalence rates have generally been decreasing with Pneumonia recording the highest prevalence and Tetanus recording the lowest prevalence. Polio was excluded from the analysis because it did not register any incidences or deaths. The data also showed that pneumonia and diarrhoea recorded the highest proportion of deaths while tetanus and measles recorded the lowest. The correlation matrix revealed that Pneumonia, Measles and Tetanus had strong positive and significant correlations with under-five mortality while diarrhoea had a weak positive and insignificant correlation. The regression model showed that there is a strong positive and significant relationship between Pneumonia and mortality and a weak non-significant relationship between diarrhoea and mortality. Furthermore, there was a strong but non-significant relationship between measles and mortality and a weak non-significant relationship between tetanus and mortality. The four variables explained 72.02 percent of the variation in overall mortality and the overall model was very significant. Due to high incidences of pneumonia and diarrhoea, the study made some recommendations and conclusions

CHAPTER ONE:

INTRODUCTION

1.0 Introduction

This chapter consists of the historical background of the study, problem statement, purpose of the study, objectives, hypothesis, and significance of the study.

1.1 Back ground of the study

1.1.1 Historical perspective

Globally, under-five mortality have dropped from 12.7 million per year in 1990 to 5.9 million in 2015; this being the first year the figure has gone below the 6 million mark; according to the *9 September 2015* WHO report. New estimates in *"Levels and trends in child mortality report 2015,"* released by UNICEF, WHO, the World Bank Group, and the Population Division of UNDESA, indicates that although the global progress has been substantial, 16 000 children under-five still die every day. The 53% drop in under-five mortality however is not enough to meet the Millennium Development Goal of a two-thirds reduction between 1990 and 2015 (Adebayo, Fahrmeir & Klasen, 2004).

The risk of a child dying before completing five years of age is still highest in the WHO African Region (81 per 1000 live births), about 7 times higher than that in the WHO European Region (11 per 1000 live births). Many countries still have very high under-five mortality – particularly those in WHO African Region, with an under-five mortality rate above 100 deaths per 1000 live births. In addition, inequities in under-five mortality between high-income and low-income countries remain large. The under-five mortality rate in low-income countries was 76 deaths per 1000 live births – about 11 times the average rate in high-income countries (7 deaths per 1000 live births). Reducing these inequities across countries and saving more children's lives by ending preventable child deaths are important priorities (Adetunji, 1995).

Nigeria, in the past few years has experienced some worsening of under-five mortality. The under-five mortality rate was evaluated at 100 per 1000 in 2003 and at 87 per 1000 in 1990. This can be in part explained by the persisting low numbers of births occurring in health centres and the low number of births attended by trained healthcare service providers. In

2003, two third of the births in Nigeria still occurred at home. In addition only slightly more than one-third of births are attended by doctors, nurses, or midwives (Mathews & Mac Dorman, 2011).

Underneath the statistics lies the pain of human tragedy, for thousands of families who have lost their children. Even more devastating is the knowledge that, according to recent research, essential interventions reaching women and babies on time would have averted most of these deaths. Although analyses of recent trends show that the country is making progress in cutting down under-five mortality rates, the pace still remains too slow to achieve the Millennium Development Goals of reducing under-five mortality by a two-third by 2015. The deaths of newborn babies in Nigeria represent a quarter of the total number of deaths of children under-five (Orubuloye & Caldwell, 2011). The majority of these occur within the first week of life, mainly due to complications during pregnancy and delivery reflecting the intimate link between newborn survival and the quality of maternal care. The main causes of these deaths are birth asphyxia (suffocation), severe infection including tetanus and premature birth. Preventable or treatable child-killer diseases such as: pneumonia, diarrhoea, measles, tetanus and polio etc, account for more than 70 per cent of the estimated one million under-five deaths in Nigeria (Orubuloye & Caldwell, 2011).

In Adamawa State, among other states in Nigeria, there are about 31 under-five die daily in 2003, and 147 die daily in 2008 (Okechukwu, Benedict, John, 2015).
The prevalence of tetanus among children investigated in Adamawa State were found to be 4% in 2008, 8% in 2009 and 12% in 2013 (Jalal-Eddeen, 2014).

MOH (1999) revealed that under-five mortality rates in Enugu Nigeria were 74.3 deaths per 1000 live birth. This alarming high death rate among children of this age, attracted the attention of World Health bodies namely WHO, Federal government, donor agencies and states government ministries of Health as well as non-governmental donor agencies such as UNICEF, World Bank, United State Agency for International Development (USAID) among others. Efforts were made by these bodies to combat this evil trend.

1.1.2 Theoretical Perspective

The theory that underpinned this study is the Demographic Transition Theory which asserts that fertility and mortality rates change in a predictable manner, when a society evolves from a traditional to a modern form (Caldwell et.al, 2006). Initially, death rates were high, because of the primitive technology and economic poverty of a traditional society, so birth rates were also high to sustain a stable population. Deaths and diseases have a good relationship with technology and poverty. This theory is proven by the fact that the risk of a child dying before completing five years of age is higher in the WHO African Region than in WHO European Region, and also higher in low income countries than in high income countries (Adetunji, 1995).

The Malthusian theory asserts that the evolutionarily stable states of a population are described by fecundity (powerful productivity) and mortality distributions which maximize the population growth rate (Boldrin & Jones, 2002).

1.1.3 Conceptual Perspective

The term mortality comes from the Latin word *mortalitas*. Mortality rate is a parameter in epidemiology for characterizing the deaths within a given population. Under-five mortality rate is the number of deaths in children 0-5 years of age per time, usually expressed per 1,000 or 100,000 persons per year (Norman, Spilsbury & Semmens, 2011). Operationally, under-five mortality also known as child mortality, in this study refers to the deaths of children under the age of five.

The factors that directly influence the risk of death in an individual are: Personal behaviors; which include hygiene, alcohol and tobacco use, sexual behavior, etc. Environmental exposures; these include exposure to infectious or chemical or physical agents, occupational hazards, etc. Nutrition; which include under nutrition, micronutrient deficiency, over nutrition/obesity etc. Injury; these include intentional or accidental injuries. Personal illness control; which include preventable or treatable infectious actions. Operationally, in this study, emphasis will be laid on Preventable or treatable infectious five-child killer diseases such as pneumonia, measles, diarrhoea, polio, and tetanus.
However, five child-killer diseases are grouped classification of the five diseases that are frequently responsible for the death of children in Adamawa State, Nigeria.

1.1.4 Contextual perspective

This research work was conducted in Yola Local government area of Adamawa State Nigeria in west Africa, which lie between latitudes 9^0 11'N to 9^0 19' N and longitudes 12^0 20' N to 12^0 30'N, covering a total area of 1,213.30 km^2.

1.2 Statement of the problem

Globally, the rate at which under-five mortality occurs is alarming and several studies showed significant figures of under-five mortality in the developing nations, at least 6.3 million under-five died across the globe in 2013. In Nigeria about 2,300 under-five die every day, making it second largest contributor in the world (Abiola, 2015). Studies also revealed that under-five mortality is very high in Adamawa State, among other states in Nigeria, that there are about 31 under-five die daily in 2003, and 147 die daily in 2008 (Okechukwu, Benedict, John, 2015). Based on these studies, over 11,000 die in 2003 and over 53,000 die in 2008, this indicate a high rate of under-five mortality which will negatively affect the population. Due to the alarming increase, several studies were conducted with the intention of controlling the rate. Most of these studies concentrated on investigating how to control the child killer diseases in order to reduce under-five mortality. Despite the efforts of both federal and state government to control the spread of the diseases by provision of adequate drugs, vaccines, and good health facilities, yet the under-five mortality is becoming higher. Could this be due to the prevalence of the five child-killer diseases or there are other factors influencing the under-five mortality? Hence, this study will investigate prevalence of the five child-killer diseases and the cause effect of five-child killer diseases on under-five mortality in Yola Adamawa State Nigeria, in order to proffer a better method or measure of controlling the child killer diseases, to minimize the under-five mortality which affects the economy of the country through labour productivity.

1.3 General objective of the study

The general objective of this study is to determine the prevalence of the five child-killer diseases and its cause effect on under-five mortality and to establish a measure of controlling the mortality in the studying area.

1.4 Specific objectives

1) To determine the prevalence rate of the five child-killer disease in the study area.
2) To determine the proportion of mortality due to the five child-killer diseases to the total under-five mortality in the studying area.

3) To examine the correlation between the five child-killer diseases and under-five mortality.
4) To examine the cause effect of five child-killer diseases on under-five mortality.

1.5 Hypothesis

1. H_0: There is no significant correlation between the five child-killer diseases and under-five mortality.

2. H_0: There is no cause effect of five child-killer diseases on under-five mortality.

1.6 Research questions

1) What is the prevalence rate of the five child-killer disease in the study area?
2) What is the proportion of mortality due to the five child-killer diseases to the total under-five mortality in the studying area?
3) What is the level of correlation between the five child-killer diseases and under-five mortality in the study area?
4) Is the correlation level between the five child-killer diseases and under-five mortality statistically significant?
5) What is the cause effect of five child-killer diseases on under-five mortality in the study area?
6) Is the cause effect of five child-killer diseases on under-five mortality statistically significant?

1.7 Scope of the study

1.7.1 Geographical Scope

This study was carried out in Yola Metropolicy City Adamawa State, North-eastern Nigeria.

1.7.2 Theoretical Scope

This study adopted the theory of demographic transition which asserts that fertility and mortality rates change in a predictable manner, when a society evolves from a traditional to a modern form (Caldwell et.al, 2006). Initially, death rates were high, because of the primitive technology and economic poverty of a traditional society, so birth rates were also high to sustain a stable population.

1.7.3 Contextual Scope

The scope of this study was limited to the five-child killer diseases which include; pneumonia, measles, diarrhoea, polio, and tetanus, using secondary data running from 2001 to 2015, collected from the study area.

1.7.4 Time Scope

This study which involved collection and analysis of data was completed within a period of one year, from February, 2016 – January, 2017

1.8 Significance of the study

Since the study revealed the extent of the prevalence of the five child-killer diseases in the study, recommendations was provided as to how the prevalence rate of the can be stemmed through effective prevention and control measures. Besides, the study will be served as a spring board for the formulation and implementation of community health programmes in the study area.

In addition, the study is significant as useful research materials for future academic research. The developed model can be used to predict or forecast future under-five mortality in the Yola.

CHAPTER TWO

LITERATURE REVIEW

2.0. Introduction

This section presents a review of the theoretical back up describing the linkage between the five child-killer diseases and their relationship with under-five mortality in the study area. It also presents a conceptual framework depicting the relationship between the dependent variable and all the independent variables plus the other extraneous variables that could have an effect on the overall outcome of the dependent variable in the model. Lastly, the section presents a discussion of literature that has been done on the subject in the recent years.

2.1. Theoretical review

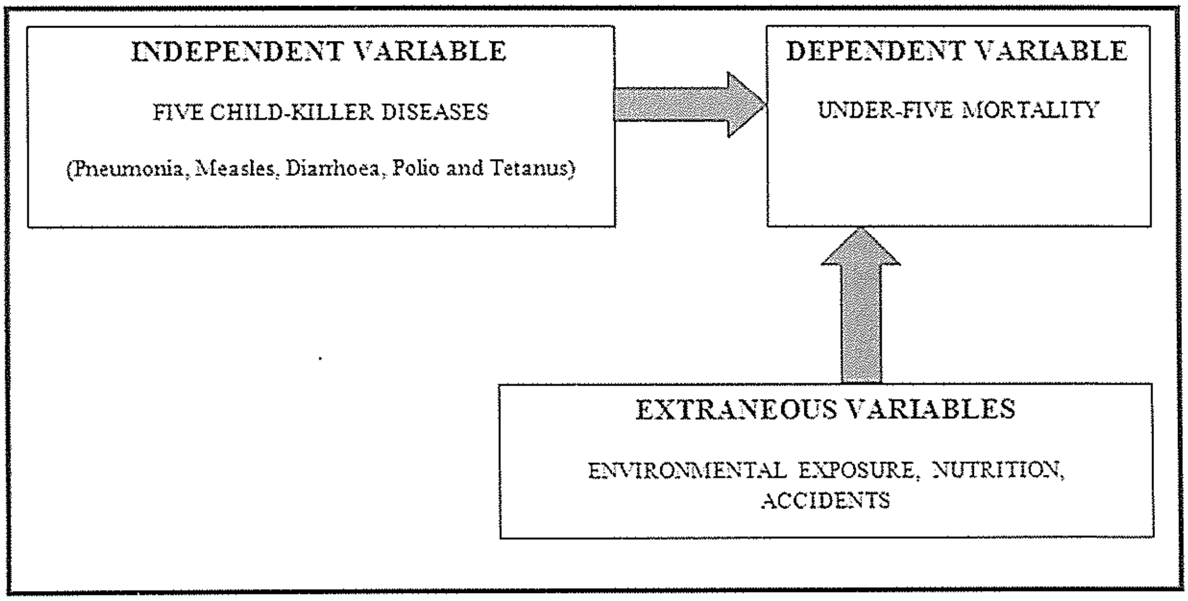
2.1.1. Demographic Transition Theory

Demographic transition (DT) refers to the transition from high birth and death rates to low birth and death rates as a country develops from a pre-industrial to an industrialized economic system. This is typically demonstrated through a demographic transition model (DTM). The theory is based on an interpretation of demographic history developed in 1929 by the Warren Thompson (1887–1973). Thompson observed changes, or transitions, in birth and death rates in industrialized societies over the previous 200 years. Most developed countries are in stage 3 or 4 of the model; the majority of developing countries have reached stage 2 or stage 3. The major (relative) exceptions are some poor countries, mainly in sub-Saharan Africa and some Middle Eastern countries, which are poor or affected by government policy or civil strife, notably Pakistan, Palestinian territories, Yemen, and Afghanistan. Adolphe Landry of France made similar observations on demographic patterns and population growth potential. In the 1940s and 1950s Frank W. Notestein developed a more formal theory of demographic transition.

2.1.2. Malthusian theory

The Malthusian theory asserts that the evolutionarily stable states of a population are described by fecundity and mortality distributions which maximize the population growth rate. In the context of this theory, the intensity of selection, i.e. the ability to discriminate between alternative genotypes, will be measured by the sensitivity of the Malthusian parameter to changes in the age-specific fecundity and mortality schedule (Hamilton 1966). Malthusian theory propounds a linkage between income and population growth, particularly the relationship between economics and mortality. Malthus' argument that income affects mortality is valid if the assumption is made that increase in consumption of certain items decreases mortality (food, medical services) while other items will have no effect at all (art objects, for example). Such consumption may be the result of either a change in income or a change in supply (a rise in the price of drugs or a shortage of physicians). When supplies drop, as in time of bad harvest, poor people feel the shortage most and their mortality rises while wealthy families do not feel much of an effect. However, when bad harvest follows bad harvest, even the wealthy had higher mortality.

2.2. Conceptual Frame Work



Source: Researcher, 2016.

Figure 2.1: The conceptual frame work depicting the relationship between the variables in the model.

The above conceptual frame work shows how the five child-killer diseases such as pneumonia, diarrhoea, measles, tetanus and polio influences the under-five mortality in the study area. The extraneous variable such as environmental exposure, nutrition, accidents, other diseases, access to health services, demographic and socio-economic data, etc where not considered in the study.

2.3. Review of related literature of five child-killer diseases

Pneumonia:

Rudan (2008) explained that Childhood pneumonia is the leading single cause of mortality in children aged less than 5 years. The incidence in this age group is estimated to be 0.29 episodes per child-year in developing and 0.05 episodes per child-year in developed countries. This translates into about 156 million new episodes each year worldwide, of which 151 million episodes are in the developing world. Substantial evidence revealed that the leading risk factors contributing to pneumonia incidence are lack of exclusive breastfeeding, under-nutrition, indoor air pollution, low birth weight, crowding and lack of measles immunization.

Liu et.al (2012) updated total numbers of deaths in children aged 0–27 days and 1–59 months were applied to the corresponding country-specific distribution of deaths by cause. They applied the multinomial logistic regression model to vital registration data for low-mortality countries without adequate vital registration. The results of their study indicate that between 2000 and 2010, the global burden of deaths in children younger than 5 years decreased by 2 million, of which pneumonia, measles, and diarrhoea contributed the most to the overall reduction. However, only tetanus, measles, and pneumonia (in Africa) decreased at an annual rate sufficient to attain the Millennium Development Goal 4.

Scott et.al (2008) note that historically, pneumonia was the main cause of under-five mortality in developed countries, and in the United States in 1900, it is estimated that pneumonia killed 47 of every 1,000 children before the age of 5 years. Improvements in nutrition and living standards in the United States in the first 40 years of the 20th century led to a substantial reduction in pneumonia mortality well before antibiotics became available. However, in the low-income countries of Asia and Africa, pneumonia is still the main cause of under-five mortality. In developing countries, over one-quarter of children have an episode of clinical pneumonia each year throughout the first 5 years of their lives.

Dieckmann et.al (2005) writes that mortality and morbidity from pneumonia were measured among 3000 children under the age of 5 years in a rural area of Gambia, West Africa. Using a post-mortem questionnaire technique, pneumonia was identified as the probable cause of 4% of infant deaths and of 25% of deaths in children aged 1 to 4 years. The pneumonia mortality rate was 6·3 per 1000 per year in infants and 10·7 per 1000 per year in children aged 1 to 4 years.

In Nigeria, Esangbedo (2010) explained that pneumonia kills nearly 1.6 million children under five annually worldwide. An estimated 98 percent of children who die of pneumonia live in developing countries and according to 2008 estimates, about 177,000 children under the age of five died of pneumonia in Nigeria. This means that within an hour, 20 children across Nigeria will die from pneumonia. This number is the highest in Africa and second highest overall in the world.

Tetanus:

Studies have shown that out of the more than 4 million neonatal annual global deaths, 38% is as a result of NNT (Jalal-Eddeen, 2014). It is overwhelming to note that Nigeria is not an exception to this scourge, as NNT remains a significant cause of death among children under the age of 5 years (Jalal-Eddeen, 2014). Literature has shown that in spite the increase in use of tetanus toxoid immunization across the globe and the significant reductions in deaths due to NNT, it is still far from reality in some developing countries especially from the sub-Saharan Africa (Jalal-Eddeen, 2014).

In 1988, the WHO estimated that around 787,000 under-five mortality were due to tetanus, indicating that an estimated proportionate mortality rate due to tetanus was 6.7 deaths per thousand under-five children. This number shows the high magnitude of tetanus in global under-five mortality (UNICEF, WHO, UNFPA, 2000). It is as a result of these alarming statistics that the 42nd World Health Assembly (WHA) held in 1989 called for the elimination of maternal and child tetanus by 1995 (UNICEF, WHO, UNFPA,2000). Furthermore, the World Summit for Children held in 1990 listed neonatal tetanus elimination as one of its goals; this goal was endorsed once again in 1991 at the 44th World Health Assembly.

The slow implementation of the recommended tetanus elimination strategies by countries around the world resulted in a change in the target date for tetanus elimination to 2000. The WHO, UNICEF, and UNFPA came together to review progress towards the attainment of the global elimination goal in 1999; these bodies realized that there was a need for review of the initiative, adding elimination of maternal tetanus to the initial tetanus elimination goal with a change in date to a 2005 target, which was subsequently changed to 2015 (WHO, 2014; UNICEF, 2014). Despite the global success recorded in the tetanus elimination strategy, it is disheartening to note that Nigeria is still among the 25 remaining countries that are yet to achieve the tetanus global elimination target set by the WHO (UNICEF, WHO, UNFPA, 2000). In the 2010 report, the WHO estimated that 58,000 newborns died as a result of tetanus, a 93% reduction from the late 1980s. In spite the appreciable progress made in this regard, statistics show that as of December 2013, 25 countries still have not reached the tetanus elimination status (UNICEF, WHO, UNFPA, 2000; WHO, 2014). However, there is optimism that many additional countries are likely to meet the revised deadline of 2015 (UNICEF, WHO, UNFPA, 2000; WHO, 2014).

It was observed that the prevalence of tetanus in the north-eastern region of Nigeria was due to poor utilization of antenatal services by pregnant women, reasons behind the lack of trained birth attendants to receive deliveries, the unclean birth practices among rural women and in proper disposal of waste materials. The global tetanus elimination initiative, which aims to reduce the disease to a level that is no longer a major public health problem, requires achieving the following: Immunization of pregnant women and other women of reproductive age and practice of hygienic deliveries and clean cord care (Jalal-Eddeen, 2014).
Since the campaign for elimination of tetanus started in 1994, 104 out of the 161 developing countries have been able to achieve the goal, with 22 other countries close to achieving it (Jalal-Eddeen, 2014).

This elimination campaign has led to a decrease in deaths from tetanus across the globe, from 470,000 to 215,000 (Jalal-Eddeen, 2014). However, in spite of the significant achievement of the tetanus elimination campaign and the millennium development goals (MDG) goal four, targeting a reduction in under-five mortality across the globe by 2015 (MDG, 2013), tetanus is still among the leading causes of death in 25 developing countries. Literature has shown that there are at least 355,000 cases of tetanus across the globe annually, resulting in about 250,000 deaths (MDG, 2013)

Polio:

The international drive to eradicate poliomyelitis, a highly infectious disease spread by a virus that kills or paralyses from the waist downwards, began in 1988, with the Global Polio Eradication Initiative (GPEI) spearheaded by the World Health Organisation (WHO), Rotary

International, the United States Centres for Disease Control and Prevention (CDCP) and UNICEF (WHO, 2005; 2008). This move followed the successful eradication of smallpox in 1980 and the goal was to rid the world of polio by 2000. Although the 2000 goal was not met as a global target, substantial gains were made through the routine immunisation of infants with trivalent oral polio vaccine (tOPV), supplemental national or regional rounds of tOPV among young children, active surveillance of acute flaccid paralysis and rapid response to disease outbreaks (Modlin, 2010).

According to Modlin, by year 2000 cases had fallen by 99% to fewer than 1000 annually, continuous endemic transmission was halted almost everywhere and the extinction of Type 2 wild-type (naturally occurring) polio virus proved that eradication was possible. In line with the goals of the GPEI, African leaders in 1996 launched the polio eradication campaign tagged "Kick Polio out of Africa." That year, polio was rampant in 41 African countries, but by 2002 most countries, including several states in Southern Nigeria, were declared free of the disease (WHO, 2005). As part of the global effort, national immunisation days were set aside in Nigeria by the federal government (four days set aside to administer over 40 million doses of the tOPV nationwide) commencing in the last quarter of the year 2000. This campaign was resisted from the onset by some religious leaders in the north who described the exercise as being against Islamic injunctions and rumours of contamination with the AIDS virus were also widespread (Abuh, 2002). The crisis was further aggravated in July 2003, when in the midst of a nationwide campaign, two very influential Islamic groups in the North.

The Supreme Council for Shari'ah in Nigeria (SCSN) and the Kaduna State Council of Imams and Ulamas held a news conference during which they declared that the vaccine contained anti-fertility substances and was part of a western conspiracy to reduce the population of the developing world. Given the revered status of the two groups among Muslims, the stage was set for a major revolt. Notably however, politicians in the south campaigned for the use of the vaccine (Falade, 2015) thereby distancing themselves from the western conspiracy theme. The country was split along regional and religious lines on the issue and it soon transformed from a conspiracy against the developing world to one against Muslims.

The revolt peaked when some states in Northern Nigeria banned the use of the OPV citing its "contamination by sterilizing substances" (Falade, 2015). The ban raised world-wide fears of the reversal of the gains already made and between 2003 and 2005, several previously polio free countries, including Nigeria's neighbours: Ghana, Benin, Chad, Niger, Burkina Faso and Togo were re-infected (UNICEF, 2009). The rumours of a western plot to sterilise Muslims even spread beyond Africa to Pakistan where some clerics issued a 'Fatwa' or decree against vaccination (New Scientist, 2007). Vaccination, the scientific method for disease prevention and eradication, became enmeshed in local and international politics. It became a war between God and science. What the different peoples, faiths and regions of Nigeria made of the oral polio vaccine reflected the social nature of common sense as people sought to familiarise the unfamiliar (more on this later in theoretical perspective). Understanding this process of familiarisation requires some background knowledge of the history and composition of the common sense of the people of modern day Nigeria before and after colonisation and the relationship between God, gods, regions and science.

Diarrhoea:

Childhood diarrhoea is caused by many organisms, mainly viral, bacterial, and protozoan. When associated with passage of blood in stool, this is referred to as dysentery. Diarrhoea can also be due to intolerance of some types of food especially lactose containing milk. Infections in other parts of the body can lead to parenteral diarrhoea. By far the foremost cause of diarrhoea leading to death and morbidity worldwide in childhood is rotavirus infection. It is only second to pneumonia as a killer in children (Okoro & Itombra-Okoro 1996). It derives its name from the wheel-like shape of the organism when viewed under the electron microscope. There are many strains of this virus, some of which can also infect birds and other animals, but the main types that cause disease in man (children mainly) belong to the Group A. Occasional human infections by Groups B and C have also been seen. These groups are important because they can induce antibody production against the virus, thereby leading to immunity against the virus. All over the world, the number of cases of rotavirus infection leading to diarrhoea annually is estimated at 125 million in children under the age of 5 years (Synder & Merson 1982, Bern, Martines, Zoysa & Glass 1992). Out of this number, almost 20 million cases have severe diarrhoea, while over million lose their lives to dehydration. Since most of these estimates are made by research bodies in Europe and America, it is believed that the actual figures in Africa including Nigeria could be much higher, because of poverty, ignorance, malnutrition, and some other social factors.

Before the age of 5 years, practically every child in the African environment has had at least one episode of childhood diarrhoea with some having up to three episodes per year (Okoro & Itombra-Okoro, 1996). The introduction of oral rehydration therapy (ORT) in 1975 has significantly reduced the mortality from this disease condition. This mode of treatment is cheap, acceptable, affordable, safe, and can be applied in virtually any environment (Grant, 1993).

ORT which consists of rehydration, continued feeding of normal diet, and replacement of continuous fluid loss, now saves more than 1 million children annually (Oral rehydration Therapy In Children With Acute Gastroenteritis 2009) Since this treatment can be successfully applied at home, it is necessary to reassess the knowledge and practice of ORT by mothers in our locality since its campaign was launched in Nigeria in 1985. This will help ascertain whether the gains made after the introduction of this mode of therapy in Nigeria in the late 1980s and early 1990s is being sustained (Oral rehydration Therapy In Children With Acute Gastroenteritis 2009).

The efficacy of existing interventions to prevent or treat diarrheal diseases and to thereby reduce diarrhoea mortality has been proved. Large reductions in child mortality could be achieved with their implementation. Therefore, careful planning and evaluation of interventions to control cases and deaths due to diarrhoea will be important if under-five mortality is to be reduced and goal four of the Millennium Development Goals (to reduce under-five mortality by two-thirds by 2015, from the base year 1990) is to be achieved in the African region (United Nations, 2000)

Measles:

In Nigeria a study conducted by Onyiriuka (2011), it was clear that cases of measles accounted for 3.1% of all admissions in the Paediatric Department, with the age distribution as follows: 47.8% between 13 and 24 months of age; 18.1% were under 9 months old. Although 22.1% had vaccination against measles, 77.9% were not vaccinated against the disease. It was further observed that a significant number of the cases occurred in the dry season (80.5%) as compared to the wet season (19.5%) at $P < 0.001$. In addition, the two main reasons shared by the mothers for not immunizing their children against the disease were child ill (35.0%) and child <9 months old (23.3%).

Grais et.al (2007) conducted a study to investigate measles mortality in three recent epidemics in Niamey (Niger), N'Djamena (Chad), and Adamawa State (Nigeria). Children in these countries still face unacceptably high mortality from a completely preventable disease. They conducted three exhaustive household retrospective mortality surveys in one neighborhood of each of the three affected areas: Boukoki, Niamey, Niger (April 2004, n = 26,795); Moursal, N'Djamena, Chad (June 2005, n = 21,812); and Dong District, Adamawa State, Nigeria (April 2005, n = 16,249), where n is the total surveyed population in each of the respective areas. While the successes of measles mortality–reduction strategies and progress observed in measles control in other countries of the region are laudable and evident.

Fagbule & Orifunmishe (1988) investigated measles vaccination in two hundred and sixty-nine children who presented with measles between April 1983 and March 1986 at the University of Ilorin Teaching Hospital, Nigeria. Lack of vaccination, high vaccination failure rate, early age of contracting the disease, malnutrition, prevalent bacterial infections and a delay in seeking medical attention were the main factors identified as the probable causes of high morbidity and mortality in measles in Ilorin.

In Europe, the outcome of the 2-year study conducted by Muscat *et al.* (2009), shows that of the 12,132 cases of measles recorded, 85% were from Romania, Germany, UK, Switzerland, and Italy. Nonetheless, majority were children and either unvaccinated or could not complete their vaccination. The measles-related deaths recorded during the 2-year study were seven. It observed that the high incidence of measles in some of the European countries was because of suboptimum immunization coverage. The statistics revealed that out of the 210 measles cases reported as being imported, 117 (56%) were from European country and 43 (20%) from Asia.

2.4 Study gaps

Most of the previous studies conducted were outdated, with less relevant to the present situation, due to dynamic nature of environment, technology implication and human perception. Abiola, in 2015 observed that time difference and methodology inadequacy were some of the gaps of study. Therefore most methods applied in previous investigation where more qualitative than statistical inferences which can be generalized in determine the variation in phenomenon.

Similarly the content of the prevalence of five child-killer diseases is adequately addressed. Most studies concentrated on single variable like the work of Jalal-Eddeen (2014). Hence this study had determined the prevalence rate of five child-killer diseases and its cause effect relationship on under-five mortality. It also determined the proportion of mortality due to the five child-killer diseases to the total under-five mortality. The previous studies also failed to develop a regressive model which can be used to forecast future under-five mortality in the study area.

CHAPTER THREE

METHODOLOGY

3.0 Introduction:

This section of the study discussed the general procedures that were used in the process of collecting and analyzing the data with a presentation of all the diagnostic tests that were consulted after the process of the regression analysis. Furthermore, a presentation of the statistical techniques used in the process of analyzing each of the objectives that were stated in the introductory section including all the tests of hypothesis were discussed in this section.

3.1 Research design

The research used ex post facto design which was quantitative in approach, because it involved the use of numerical information or data which was obtained from record of an institution. This consist of secondary data on five child-killer diseases and under-five mortality across the study area from 2001 to 2015 in order to determine the prevalence and cause effect relationship of the five child-killer diseases on under-five mortality.

3.2 Data Source

The source of the data is Adamawa State Primary Health Care Development Agency (PHCDA), Yola. The health care among its schedules is primarily responsible for collection and collation of diseases surveillance data in the State.

Be responsible for routine immunization services and effective control of vaccines preventable diseases.

Ensure collection of health data form through the local government PHCDA from all public and private health facilities within the State. (MOH, 2008). Hence, this is where all kind of health care data are kept.

3.3 Data collection

The secondary data of the five child-killer diseases used for this study was collected from the Diseases Surveillance and Notification Officer (DSNO) of Adamawa State Primary Health Care Development Agency. The data is restricted and accessible only to an authorized person on getting approval from the chairman of Adamawa State Primary Health Care Development Agency. Approval was obtained from the chairman to access the data for the purpose of this study. The data was secured in electronic files and restricted with password to avoid unauthorized access. Based on the objectives of the study, the data was obtained in a designed template as shown in appendix.

3.4 Diagnostics tests

3.4.1 Tests for normality

Normality tests are used to determine if a data set is well-modelled by a normal distribution and to compute how likely it is for a random variable underlying the data set to be normally distributed. Since the study used the parametric technique for carrying out the analysis, it was very essential to carry out statistical test of normality to ensure that it conforms to the requirements for further analysis that was conducted. When the data is not normally distributed, the parametric methods of analysis including regression are inappropriate and inapplicable. A graphical tool for assessing normality was used to test for normality in this study. Graphically, a data is said to be normally distributed if the histogram of the residual formed a bell shape. But for this research work, a probability plot of the residual was used to determine the normality of the data. Also Kolmogorov-Smirnov test was also used to confirm the normality of the data as shown in figure 4.11

3.4.2 Tests for multicollinearity

Multicollinearity is a situation where the independent variables are strongly related to each other in the model. Although the regression coefficients obtained in instances of multicollinearity may be close to the true value, they cannot be used for making forecast and estimates for they will results into very large confidence intervals leading to very poor interpretations (Salles & Thalassinos, 1991).

For no multicollinearity, the $TOL > 0.1$ and $VIF < 10$, (Neter, Wasserman and Kutner, 1989).

Statistical tests of no multicollinearity, for instance tolerance (TOL) and the Variance Inflation factors (VIF) were done after regression analysis as shown in table 4.13

3.4.3 Tests for homoscedasticity

Besides normality and multicollinearity, it is vital that the data is homoscedastic that is to have a constant variance before a regression model is fitted into the data (Jarque & Bera, 1980). Similar to the problem of multicollinearity identified in the previous sections, when the data is not homoscedastic, the coefficients obtained from the regression analysis will hold, the confidence intervals obtained from them will be extraordinarily large for any further inference about the data.

Using residual plots for the calculations of the homoscedastic, a Breusch-pagan/Cook-Weisberg test was done on the collected data. Homoscedasticity test was done on the basis of the significance of the residual obtained from regression as shown in table 4.14

3.4.4 Tests for autocorrelation

Autocorrelation is said to exist in a given data set if some of the error terms that are associated with the data are in some way related to each other (Andrews, 1991).When the autocorrelation is minimal, the regression coefficient obtained can be used without fear of obtaining unrepresentative results. However, when there is a serial correlation (autocorrelation) in the data, the regression results will not be valid as any inference made on the data will be considered unrepresentative of the real situation. A statistics known as Durbin Watson has mechanisms and hence was used in testing for the autocorrelation as shown in table 4.14. Thus, conclusions regarding regression analysis were made using the results of Durbin Watson. That is in case of serial correlation, the data can be transformed by taking its logarithm. The Durbin Watson test was also used to explore the stationarity of the data. The stationarity of the data was also confirmed from the figures of the descriptive statistics, prevalence and proportion.

3.5 Method of data analysis

The methods of data analysis used in this study were based on the technicality of the objectives. The method includes the following:

3.5.1 Descriptive statistics

Descriptive statistics describe the nature of the data before the tools of analysis. It gives the empirical description or picture of data size, mean, variation or deviation, range etc before the analysis of the objectives as shown in chapter four.

3.5.2 To determine the prevalence rate of the five child-killer diseases

The method used to determine the prevalence rate of the five child- killer diseases in the study area is given by this expression:

$$Prevalence\ rate = \frac{Number\ of\ all\ cases\ of\ disease\ at\ time\ t}{Number\ of\ persons\ at\ risk\ at\ time\ t} \times 1000$$

Where number of all cases of disease at time t: Are the number of children that have a particular disease in the given of year

And the number of persons at risk at time t: Are the number children that were immunized at that particular year

3.5.3 To determine the proportion of mortality due to the five child-killer diseases to the total under-five mortality

The proportion of mortality due to the five child-killer diseases to the total under-five mortality is given by the expression as:

$$Proportion\ of\ mortality = \frac{Number\ of\ deaths\ due\ to\ given\ disease}{Total\ of\ under - five\ mortality}$$

Where number of deaths due to given disease: Are the number of deaths recorded due to a specific disease.

And total of under-five mortality: Are Total Deaths Irrespective of Disease (TDIOD) that were recorded including the five child-killer diseases.

3.5.4 To examine the correlation between the five child-killer diseases and under-five mortality

Using correlation matrix, the data of the five-child killer diseases was correlated against the Total Deaths Irrespective of Disease (TDIOD) to determine the correlation between the five-child killer disease and the under-five mortality. STATA was used and the data for each of these variables was fed into the computer and analyzed. All interpretations were done based on the results obtained.

Furthermore, based on the results of the correlation matrix obtained, the hypothesis that: There is no significant correlation between the five child-killer diseases and under-five mortality was tested at 95% confidence interval and the results for each disease was interpreted.

3.5.5 To examine the cause effect of five child-killer diseases on under-five mortality

In order to examine the cause effect of the five child-killer diseases and under-five mortality, a multiple regression model was established between the dependent variables, the Total Deaths Irrespective of Disease ie the under-five mortality and the remaining four-child killer diseases; Measles (Mea), Pneumonia (Pne), Diarrhoea (Dia), Tetanus (Tt) and immunization level. The coefficient of determination denoted by R^2 was used to examine the percentage of the variation in the dependent variable that is explained by the four independent variables and immunization level that are included in the model. The four independent variables, immunization level and the one dependent variable were joined together in a multiple regression model as shown in the equation below;

$$TDIOD_t = \alpha + \beta_1 Iml_t + \beta_2 Mea_t + \beta_3 Pne_t + \beta_4 Dia_t + \beta_5 Tt_t + \varepsilon_i$$

Where;

TDIOD_t : The $under - five$ mortality at a time, t of the study.

Iml_t: The Immunization level of children in the study at a time, t.

$\mathrm{M}ea_t$: The deaths recorded due to Measles in the study at a time, t.

Pne_t : The deaths recorded due to Pneumonia in the study at a time, t.

Dia_t : The deaths recorded due to diarrhea in the study at a time, t.

Tt_t : The deaths recorded due to tetanus in the study at a time, t.

ε_i : The error term also called the stochastic error term is used to represent all the other variable that were not captured, which includes: access to health services, demographic, and socio −economic factors, etc which may have influence in the model.

t: The subscript is used to represent the time component in the regression model summarizing the year when the data was collected.

α *and* β: These regression coefficients represent the relationship between the dependent variable and each of the independent variables in the model.

Using STATA, the data for each of these variables was fed into the computer and a regression model was run. Other test of model fitting for instance the F-statistic was also carried out. All interpretations were done based on the results obtained.

Furthermore, based on the results obtained, the hypothesis that: There is no cause effect of five child-killer diseases on under-five mortality was tested at 90% confidence interval and the results for each disease was interpreted.

CHAPTER FOUR

ANALYSIS OF RESULTS AND FINDINGS

4.0. Introduction

This section of the study presents a comprehensive analysis of the data gathered for explaining the variation in the overall under-five mortalities as explained by the five major killer diseases that were considered in this study. The section has several sections that are specifically devoted to analyzing the variables in the study as well as answering the different objectives that were stated in the study. The first section of the analysis considered each of the individual variables in turn as a univariate level in a bid to explain how they have been varying over time given the data at hand. There is also analysis of the prevalence rates of the independent variable and its correlation with the dependant variable as stated in the objectives. The last section provides a multivariate analysis of the data aimed at building a full comprehensive regression model that attempts to explain the proportion of the variation in the dependent variable by the independent variables that were considered in the study.

4.1. Description of the variables

Incidences and deaths due to Pneumonia

Previously done studies show that Pneumonia is a major cause of death amongst the children of under-five years. Despite the advancement in science that has led to improvement in the treatments of this disease, available data still shows that this disease is still a major killer disease. Adamawa State government working closely with Primary Health Care Agency Yola, rolled out a proper work plan for alleviating the incidences of this and several other diseases due to alarming under-five mortality in the state. The table below presents the descriptive statistics of Pneumonia incidences and consequent deaths associated with this disease.

Table 4.1: Incidences and deaths due to Pneumonia

Descriptive Statistics	Disease: Pneumonia	Deaths: Pneumonia
Mean	191.00	14.33
Standard Error	35.91	2.45
Median	135.00	13.00
Standard Deviation	139.08	9.48
Sample Variance	19343.00	89.81
Kurtosis	-0.60	-0.14
Skewness	0.87	0.77
Range	437.00	32.00
Minimum	38.00	3.00
Maximum	475.00	35.00
Sum	2865.00	215.00
Count	15.00	15.00

Source: Researcher's Results, 2016

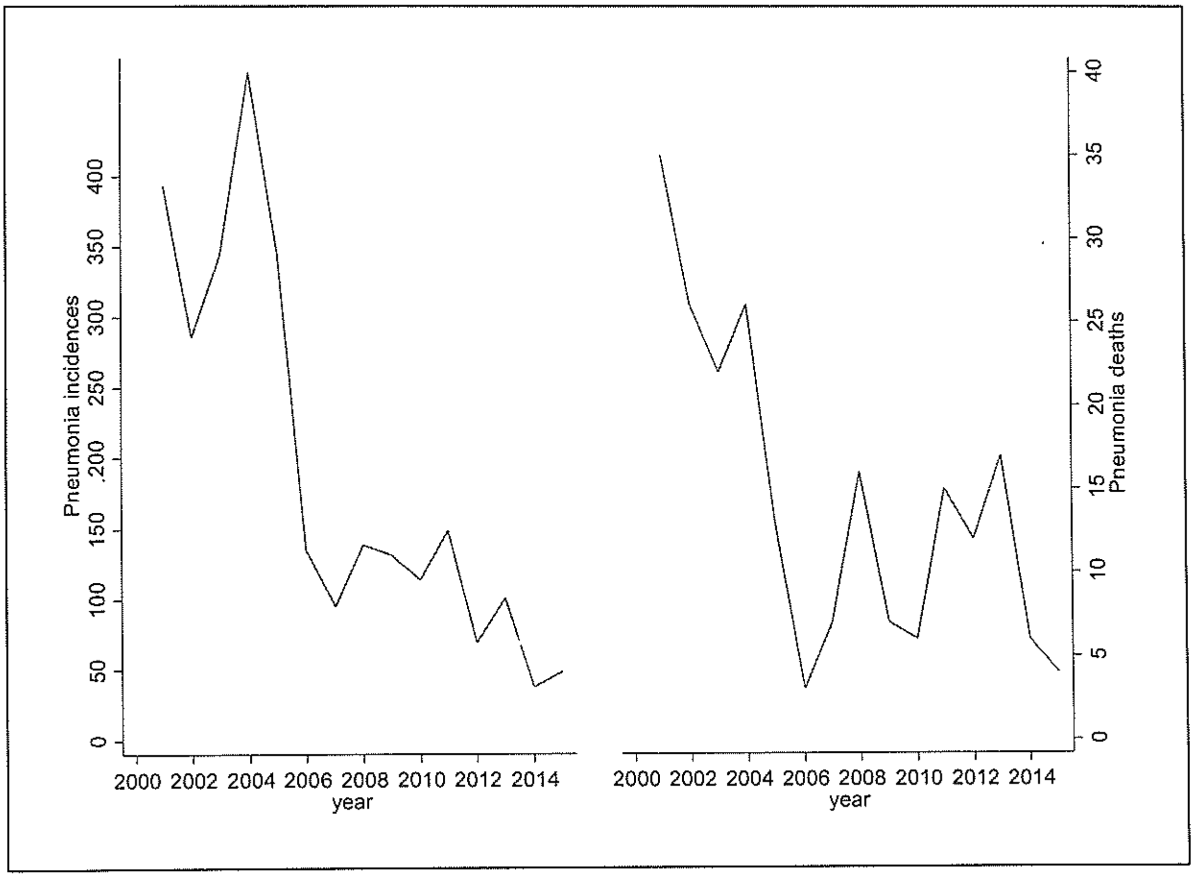


Figure 4.1: Incidences and deaths due to pneumonia

Source: Researcher's Results, 2016

Result in table 4.1 shows that for a 15-year period between 2001 and 2015, a total of 2865 pneumonia cases have been reported in Yola. This total was associated with an average incidence rate of 191 (SE = 35.91) for the same year period. Of these reported cases, a total of 215 deaths of under-five mortality have been reported as per the records from PHCDA. This was associated with an average death rate of 14.3 (SE = 2.45) for the same 15-yeasr period. That means that a crude incidence rate of 7.5% has been reported for all the aggregated incidences and deaths due to pneumonia for the 15-year period.

The analysis indicates that the year 2014 recorded the lowest incidences of pneumonia with 38 registered cases, whereas the year 2004 recorded the highest incidences with 475 amongst under-five children.

A closer look at figure 4.2 shows that overall; the number of incidences of pneumonia and deaths has been reducing on average for the 15-year period of this study. The greatest of this reduction was recorded for the 2-year period from between 2014 and 2015 as shown in the figure. This was then followed by random spikes in both the incidences of pneumonia and deaths, then increases in 2006 though such increases were still not very far from the average rate.

Incidences and deaths due to Diarrhoea

Diarrhea is a leading cause of death amongst under-five children as it leads to severe dehydration on their vulnerable bodies. Fortunately, the Adamawa State government in collaboration with Primary Health Care Development Agency Yola has envisaged program that would alleviated and combat future incidences and deaths due to Diarrhoea in a bid to increase the probability of survival of the young children in the state.

Table 4.2: Incidences and deaths due to Diarrhoea

Descriptive Statistics	Disease: Diarrhoea	Deaths: Diarrhoea
Mean	330.13	31.67
Standard Error	35.76	3.54
Median	363	33
Standard Deviation	138.50	13.71
Sample Variance	19183.27	188.10
Kurtosis	0.52	0.23
Skewness	-1.09	-0.64
Range	457	49
Minimum	26	3
Maximum	483	52
Sum	4952	475
Count	15	15

Source: Researcher's Results, 2016

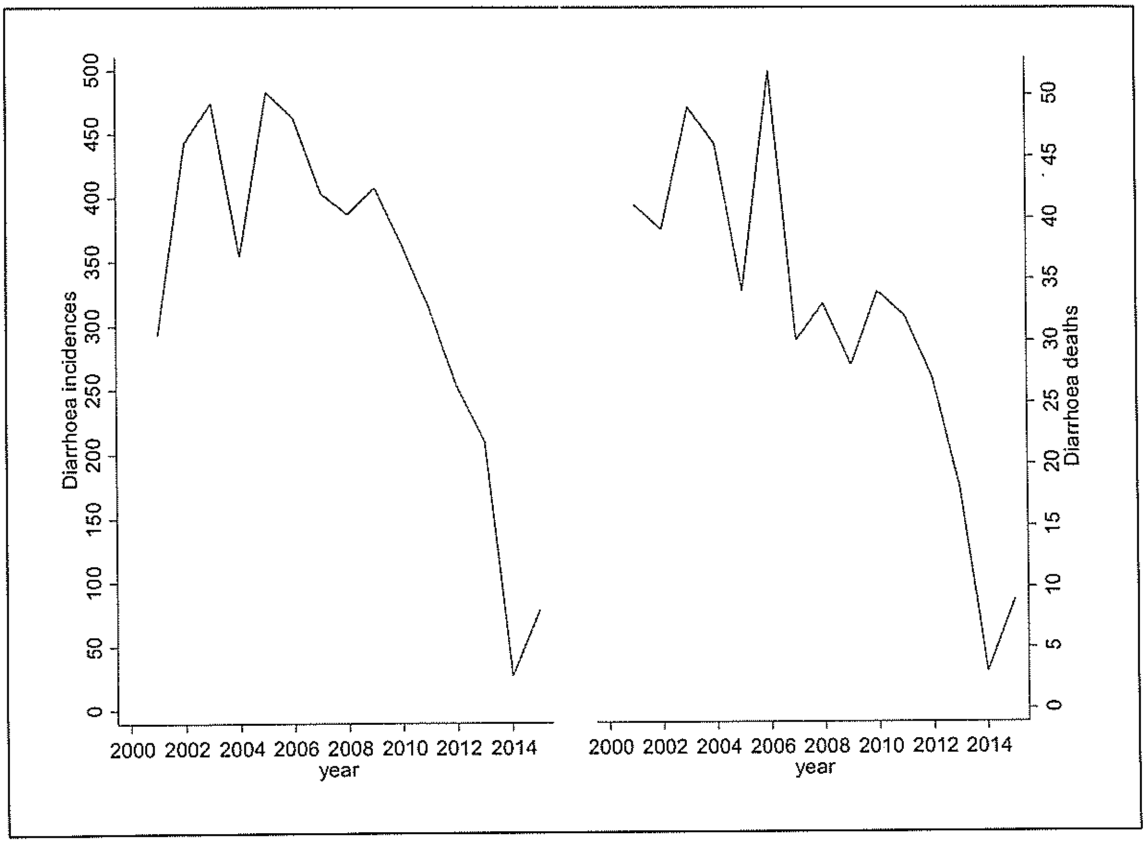


Figure 4.2: Incidences and deaths due to Diarrhoea

Source: Researcher's Results, 2016

Result in table 4.2 shows that for a 15-year period between 2001 and 2015, a total of 4952 Diarrhoea cases of under-five children were reported in Yola. This total was associated with an average incidence rate of 330.13 (SE = 35.76) for the same year period. Of these reported cases, a total of 475 deaths for under-five mortality have been reported as per the records from Primary Health Care Development Agency, Yola. This was associated with an average death rate of 31.67 (SE = 3.54) in the same 15-years period. That means that a crude incidence rate of 9.6% has been reported for all the aggregated incidences and deaths due to Diarrhoea for the 15-years period.

The analysis indicates that the year 2014 recorded the lowest incidences of Diarrhoea with 26 registered cases, whereas the year 2005 recorded the highest incidences with 483. Regarding the deaths, the data shows that 2014 recorded the lowest deaths due to Diarrhoea with 3 and the year 2003 recorded the highest with 54.

A closer look at figure 4.2 shows that overall; the number of incidences of Diarrhoea has been reducing on average for the 15-year period this study was carried. The greatest of this reduction was recorded for the 5-year period from between 2009 to 2014.

Similarly, the greatest reduction in the deaths due to Diarrhoea was recorded for the 4-year period from 2010 to 2014, where the deaths decreased from 34 to 3 for that period. Such a reduction could be associated with a recent intervention by government program that involved allocation of significant number of funds to the health sector for reducing and handling cases of Diarrhoea and a series of other five-killer diseases.

Incidences and deaths due to Measles

Despite the fact that Measles is a disease that can be completely eradicated by taking the necessary measures like immunization, the number of young children that continue dying due to its scourge is still alarming. Measles stands as one of the major causes of death in Yola. No wonder the government has laid out a strategic plan for having it eradicated. This study compares the yearly incidences of measles and compares them to the overall mortality rate of these under-five children in a bid to contribute to a long lasting solution. The following description presents an analytical look at the incidences and deaths associated with Measles for the 15-year period.

Table 4.3: Incidences and deaths due to Measles

Descriptive Statistics	Disease: Measles	Deaths: Measles
Mean	30.73	3.93
Standard Error	9.52	1.46
Median	19	1
Standard Deviation	36.86	5.64
Sample Variance	1358.50	31.78
Kurtosis	-0.56	1.35
Skewness	0.98	1.48
Range	104	18
Minimum	0	0
Maximum	104	18
Sum	461	59
Count	15	15

Source: Researcher's Results, 2016

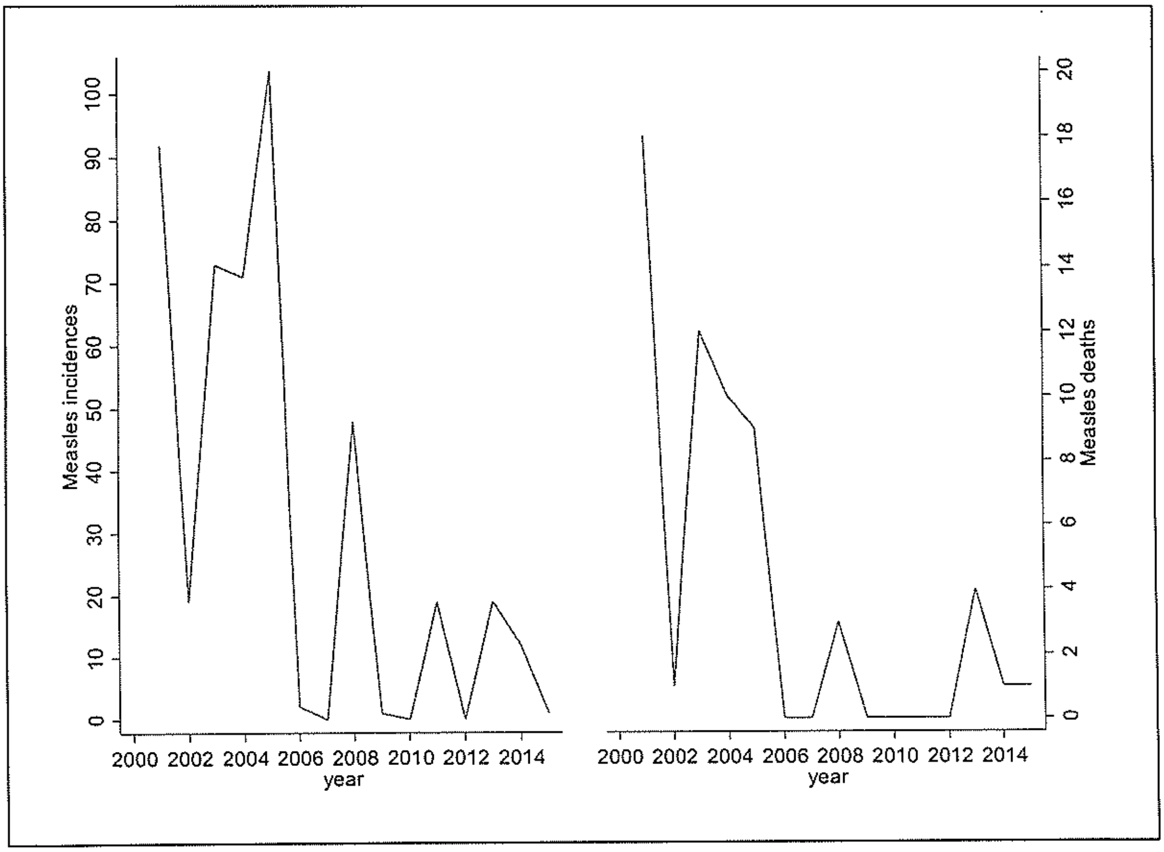


Figure 4.3: Incidences and deaths due to Measles

Source: Researcher's Results, 2016

Result in table 4.3 shows that for a 15-year period between 2001 and 2015, a total of 461Measles cases for under-five children were reported in Yola. This total was associated with an average incidence rate of 30.73(SE = 9.52) for the same year period. Of these reported cases, a total of 59 deaths for under-five mortality have been reported as per the records from PHCDA. This was associated with 3.93 (SE = 1.46) yearly average death rate for the same 15-years period. That means that a crude incidence rate of 12.8% has been reported for all the aggregated incidences and deaths due to Measles for the 15-year period.

The analysis indicates that the year 2007, 2010 and 2012 recorded no incidences of measles compared to the other years in the 15-years period. The year 2004 recorded 104 as the largest incidence of measles compared to all the other years in the study. A closer look at figure 4.3 shows that the number of incidences and deaths thereof has been reducing on average for the 15-year period. The greatest of this reduction was recorded between 2004 and 2006 though it was followed by sharp increase in the incidences between 2007 and 2008 but not as high as the previous years. Similarly, the greatest reductions in the deaths due to measles were recorded for the 3-years period from 2000 and 2002 where the deaths decreased from 18 to 1. Generally, the deaths due to Measles have been at a low level for the last 15 years compared to the other child killer disease in that category. However, it contribution to the overall level of under-five mortality will be further studied in subsequent sections of this study.

Incidences and deaths due to Polio

Similar to measles, Polio. is one of those diseases whose spread and life threatening effects can be averted and completely eradicated by vaccination of the children in the vulnerable years. Furthermore, besides affecting and deforming the bones of the infected child, it normally takes a long time for an individual to die due to polio. In most cases, the virus may reside within the body of the child for a long time only to show its effects like changes in the body growth or even death at a later age when they have gone beyond the Under-five mark considered in this study.

For that reason, the data for incidences and deaths associated with polio may be unrepresentative of the real scenario at the hand. This is because some of the children that are infected with the polio disease die after they have gone way beyond the vulnerable age. In fact, the data for the 15-year period that was considered in this study shows that there were no cases of polio or deaths associated with it between 2001 and 2015. That shows that the government has been very effective in eliminating this disease through its compulsory immunisation and eradication programs. Further discussion of its implication will be presented in subsequent sections of the study at hand.

Incidences and deaths due to Tetanus

Before the invention of tetanus immunisation, tetanus was a leading cause of death in Yola, Adamawa state Nigeria. With the tetanus toxoid, the number of children under-five year that die or a reported sick with it has greatly reduced though some isolated cases are still reported. Several factors will be highlighted to explain its prevalence in Yola as further discussed in the subsequent sections of this study. In the following section, analysing of the trend of reported incidences and deaths due to tetanus for the children under-five years will be discuss.

Table 4.4: Incidences and deaths due to Tetanus

Descriptive Statistics	Disease: Tetanus	Deaths: Tetanus
Mean	3.47	0.93
Standard Error	0.92	0.33
Median	2	1
Mode	1	1
Standard Deviation	3.56	1.28
Sample Variance	12.70	1.64
Kurtosis	2.75	7.67
Skewness	1.81	2.50
Range	12	5
Minimum	1	0
Maximum	13	5
Sum	52	14
Count	15	15

Source: Researcher's Results, 2016

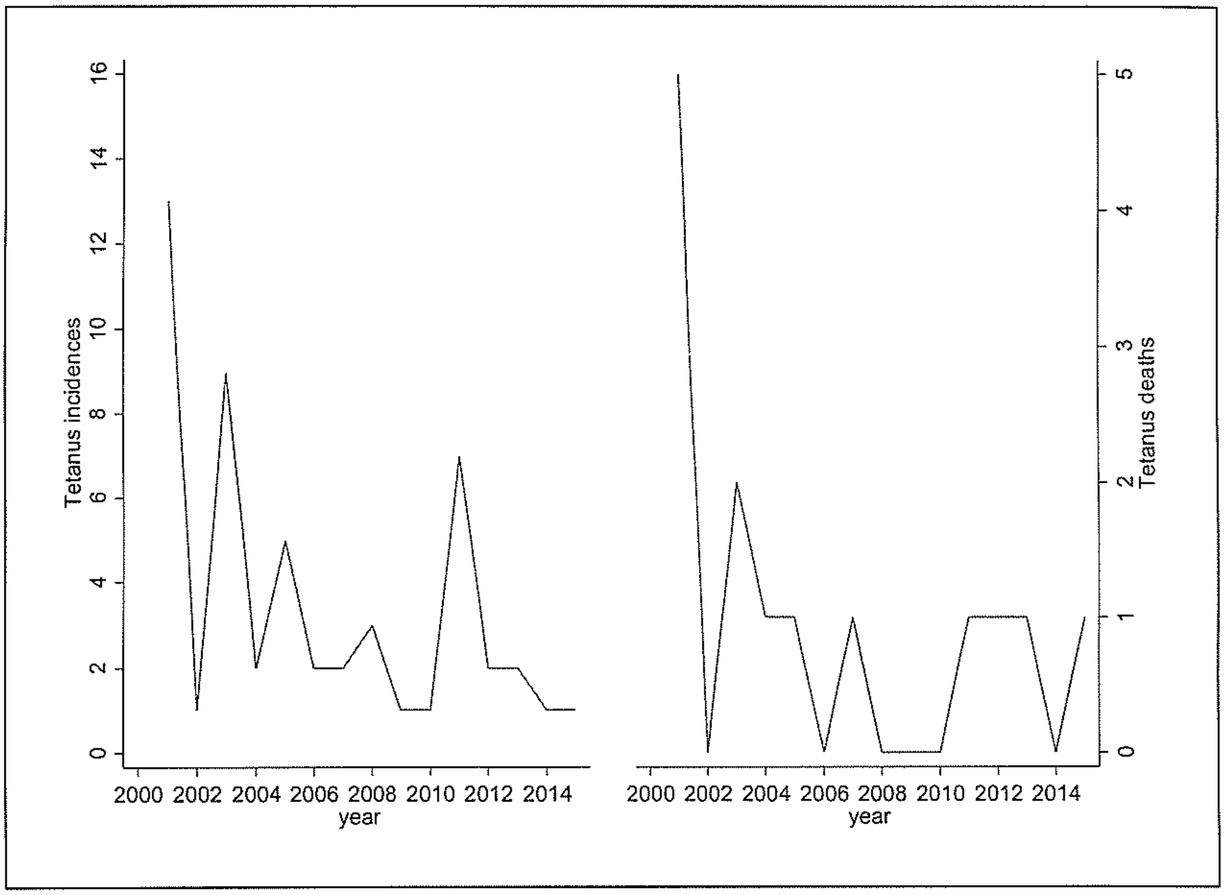


Figure 4.4: Incidences and deaths due to Tetanus

Source: Researcher's Results, 2016

Result in table 4.4 shows that for a 15-year period between 2001 and 2015, only 52 Tetanus cases for under-five children were reported in Yola, Adamawa state. This total was associated with an average incidence rate of 3.47 (SE = 0.92) for the same year period. Of these reported cases, a total of 14 deaths for under-five mortality have been reported as per the records from PHCDA. This was associated with 0.93 (SE = 0.33) yearly average death rate for the same 15-year period. That means that a crude incidence rate of 26.9% has been reported for all the aggregated incidences and deaths due to tetanus for the 15-year period. That shows that Tetanus is a real child killer because the probability of succumbing after being diagnosed with it is high compare to other diseases considered in the study.

Figure 4.4 shows that there have been random spikes in the incidences and deaths due to tetanus compared to the other five child-killer diseases in Yola.

4.2. To determine the prevalence rate of the five child-killer diseases

Table 4.5: Prevalence rate for the Pneumonia diseases

Years	Children Immunized	Pneumonia Diseases	Prevalence Rate
2001	4554	394	87
2002	4845	286	59
2003	5843	344	59
2004	6342	475	75
2005	6431	345	54
2006	8922	135	15
2007	9469	95	10
2008	10821	139	13
2009	9113	132	14
2010	10544	114	11
2011	11898	149	13
2012	19050	69	4
2013	18530	101	5
2014	14428	38	3
2015	18553	49	3

Source: Researcher's Results, 2016

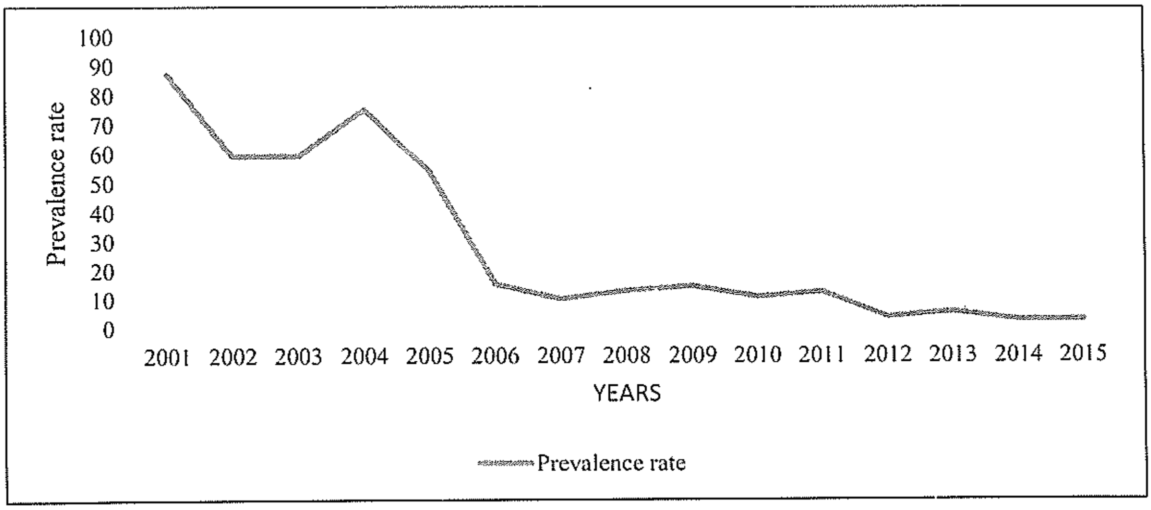


Figure 4.5: Prevalence rate for the Pneumonia diseases

Source: Researcher's Results, 2016

Result in table 4.5 and figure 4.5 show that, the prevalence rates for pneumonia have been generally decreasing from time to time. From the data, it can be seen that the slight decrease between 2001 and 2002 (87 -59 person per thousand) was followed by an increase in 2004

(75 persons per thousand). However, there was a drastic and huge decrease in the pneumonia prevalence rates through 2007 where a relatively sustained rate was maintained up to 2015 (3 persons per thousand) as shown in figure 4.5.

Table 4.6: Prevalence rate for the diarrhoea diseases

Years	Children immunized	Diarrhoea Diseases	Prevalence Rate
2001	4554	293	64
2002	4845	443	91
2003	5843	474	81
2004	6342	354	56
2005	6431	483	75
2006	8922	462	52
2007	9469	404	43
2008	10821	387	36
2009	9113	408	45
2010	10544	363	34
2011	11898	313	26
2012	19050	254	13
2013	18530	210	11
2014	14428	26	2
2015	18553	78	4

Source: Researcher's Results, 2016

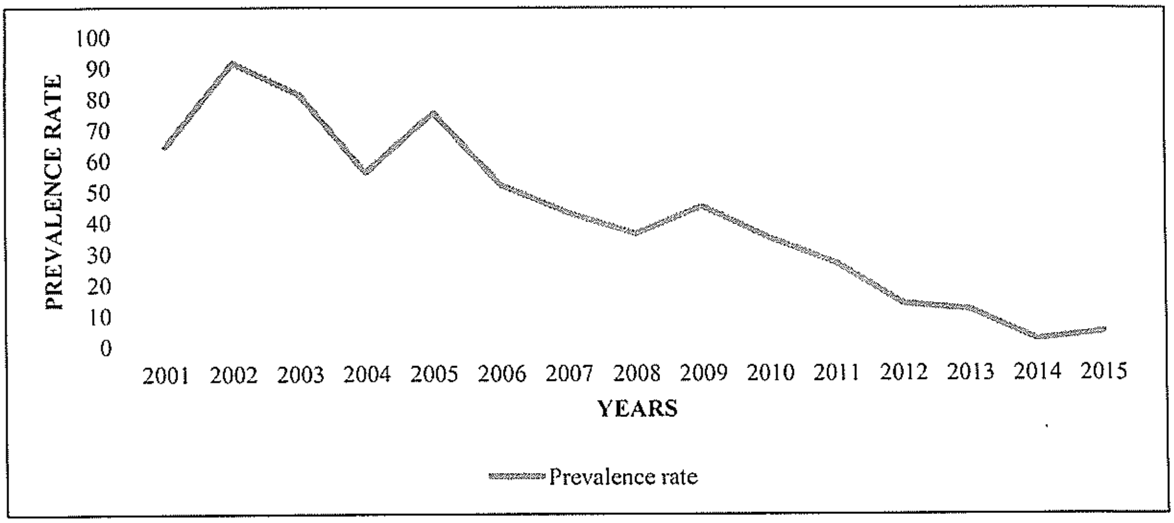


Figure 4.6: Prevalence rate for the diarrhoea diseases

Source: Researcher's Results, 2016

Result in table 4.6 and figure 4.6 show that, the prevalence rates for diarrhoea for under-five children have been generally decreasing from time to time. From the data, it can be seen that 2002 recorded the highest prevalence rate of 91 persons per thousand and this rate them reduced drastically through 2003. However, this was then followed by a sudden increase in 2005. Following this year, the prevalence rate kept on decreasing at a relatively uniform rate until it registered its lowest points in 2014 with 2 persons per thousand as shown in both table 4.6 and figure 4.6.

Table 4.7: Prevalence rate for the Measles diseases

Years	**Children Immunized**	**Measles diseases**	**Prevalence rate**
2001	4554	92	20
2002	4845	19	4
2003	5843	73	12
2004	6342	71	11
2005	6431	104	16
2006	8922	2	0
2007	9469	0	0
2008	10821	48	4
2009	9113	1	0
2010	10544	0	0
2011	11898	19	2
2012	19050	0	0
2013	18530	19	1
2014	14428	12	1
2015	18553	1	0

Source: Researcher's Results, 2016

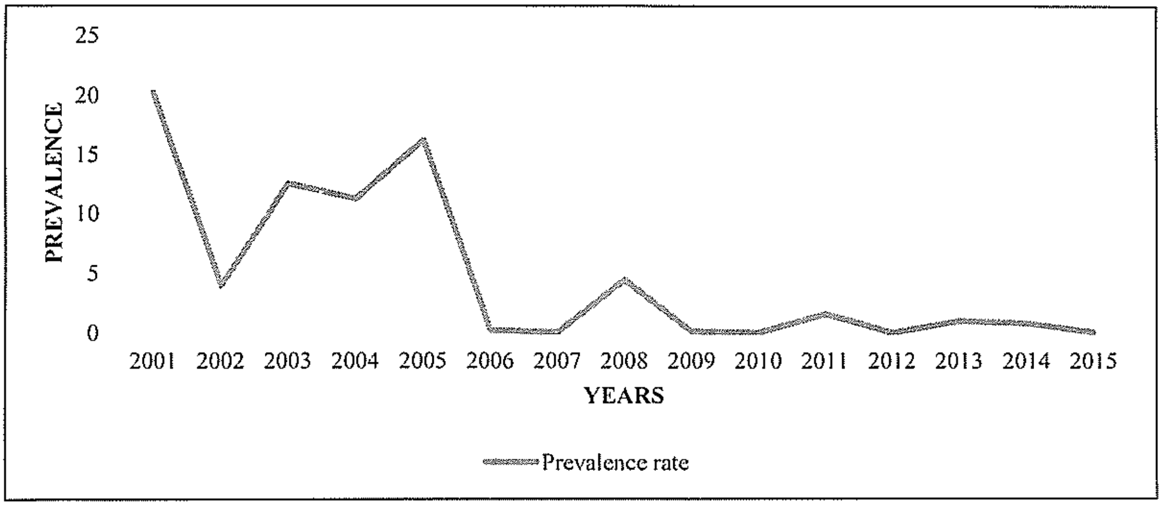


Figure 4.7: Prevalence rate for the Measles diseases

Source: Researcher's Results, 2016

The data shows that prevalence rates for measles have generally decreased for the 15-year period between 2001 and 2015. However, this decrease has registered several irregular ups and downs in its overall changes over time. There was a huge decrease in the prevalence rate from 20 to 4 persons per thousand between 2001 and 2002 as shown in figure 4.7. This was then followed by a sudden increase in the prevalence rate in 2005 with 16 persons per thousand after which the prevalence rates were relatively lower than the previous years and in 2015, no rates were registered as can be seen in table 4.7.

Table 4.8: Prevalence rate for the Tetanus diseases

Years	Children Immunized	Tetanus Diseases	Prevalence rate
2001	4554	13	3
2002	4845	1	0
2003	5843	9	2
2004	6342	2	0
2005	6431	5	1
2006	8922	2	0
2007	9469	2	0
2008	10821	3	0
2009	9113	1	0
2010	10544	1	0
2011	11898	7	1
2012	19050	2	0
2013	18530	2	0
2014	14428	1	0
2015	18553	1	0

Source: Researcher's Results, 2016

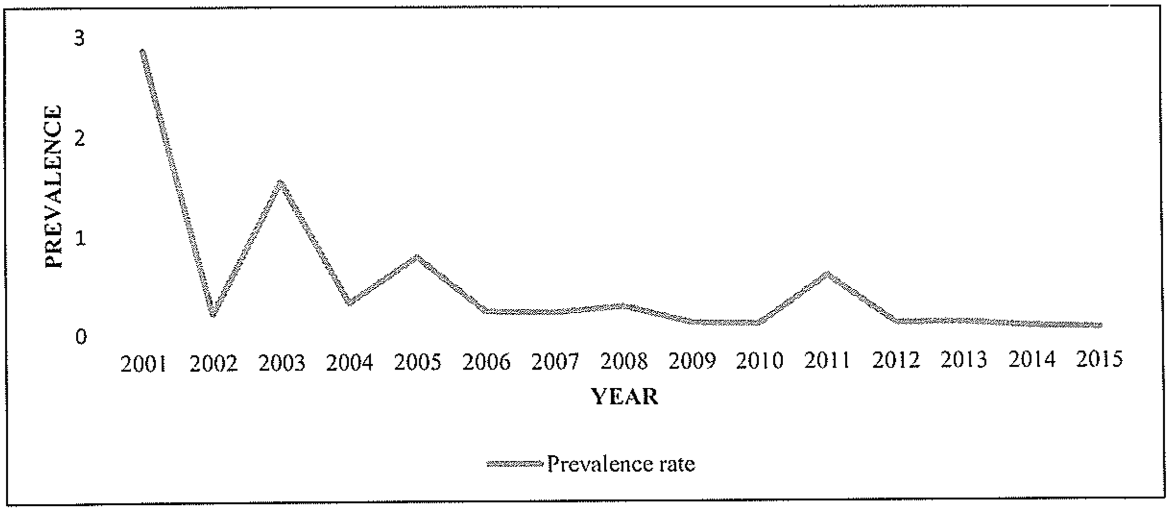


Figure 4.8: Prevalence rate for the Tetanus diseases

Source: Researcher's Results, 2016

Compared to all the other three diseases under the category of the Five-child killer diseases in the study, the data shows that tetanus has registered the lowest prevalence rates besides polio which did not register any incidences for the 2001-2015 years period. Nevertheless, result in table 4.8 and corresponding figure 4.8 show that the largest decrease in the prevalence of

Tetanus was between the year 2001 and 2002 where the prevalence decreased from 3 to 0 persons per thousand as shown in the figure above. Although some slight increase in the prevalence rates was registered between 2002 and 2003, but it was still negligible. Such negligible increases and decreases in the overall prevalence for Tetanus were sustained through 2012, 2013, 2014 and 2015 where no cases were registered.

Table 4.9: Prevalence rate for the five child-killer diseases

Years	Children Immunized	Pneumonia Prevalence rate	Diarrhoea Prevalence Rate	Measles Prevalence Rate	Tetanus Prevalence rate	Polio Prevalence rate	Overall Prevalence rate
2001	4554	87	64	20	3	0	174
2002	4845	59	91	4	0	0	154
2003	5843	59	81	12	2	0	154
2004	6342	75	56	11	0	0	142
2005	6431	54	75	16	1	0	146
2006	8922	15	52	0	0	0	67
2007	9469	10	43	0	0	0	53
2008	10821	13	36	4	0	0	53
2009	9113	14	45	0	0	0	59
2010	10544	11	34	0	0	0	45
2011	11898	13	26	2	1	0	42
2012	19050	4	13	0	0	0	17
2013	18530	5	11	1	0	0	17
2014	14428	3	2	1	0	0	6
2015	18553	3	4	0	0	0	7

Source: Researcher's Results, 2016

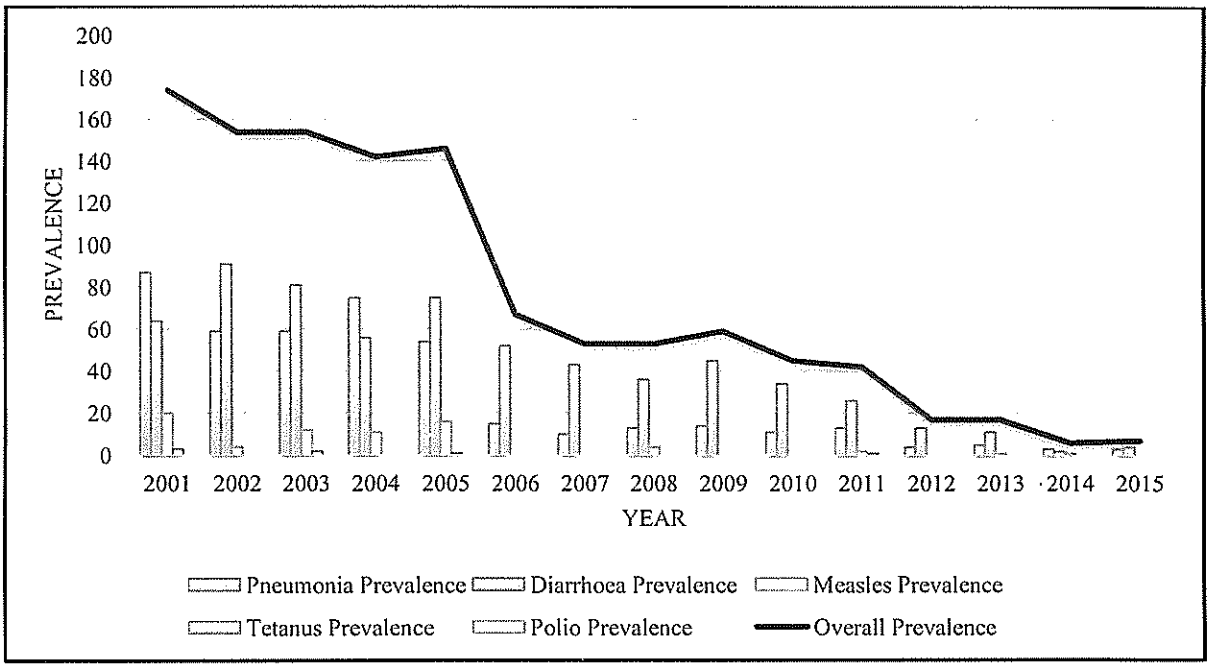


Figure 4.9: Prevalence rate for the five child-killer diseases

Source: Researcher's Results, 2016

Table 4.9 and figure 4.9 shows the overall prevalence rate of the five child-killer diseases in Yola, Adamawa state. The data shows that the prevalence decreases throughout the 15-year period this study was carried out. There was slight decrease in the prevalence rate of the five child-killer diseases from 174 to 146 persons per thousand live births between 2001 and 2005. This was followed by a sudden decrease to 53 persons per thousand live births in 2008. Then the prevalence increased to 59 persons per thousand in 2009 and continues decreases to 2015. Individually, the largest contributor of prevalence rate among the five child-killer diseases in the data was diarrhoea with 91 persons per thousand live births in 2002, followed by pneumonia with 87 persons per thousand in 2001; measles with 20 persons in 2001, tetanus with 3 persons in 2001 and polio did not register any deaths for the 15-year period the study was conducted.

4.3. To determine the proportion of mortality due to the five child-killer diseases to the total under-five mortality

Table 4.10: Proportion of mortality due to the five child-killer diseases

Years	Total under-five Mortality	Pneumonia Proportion	Diarrhoea Proportion	Measles Proportion	Tetanus Proportion	Polio Proportion	Overall Proportion
2001	250	0.140	0.164	0.072	0.02	0	0.396
2002	175	0.149	0.223	0.006	0	0	0.377
2003	287	0.077	0.171	0.042	0.007	0	0.296
2004	251	0.104	0.183	0.040	0.004	0	0.331
2005	155	0.084	0.219	0.058	0.006	0	0.368
2006	100	0.030	0.52	0	0	0	0.550
2007	126	0.056	0.238	0	0.008	0	0.302
2008	101	0.158	0.327	0.030	0	0	0.515
2009	146	0.048	0.192	0	0	0	0.240
2010	124	0.048	0.274	0	0	0	0.323
2011	169	0.089	0.189	0	0.006	0	0.284
2012	161	0.075	0.168	0	0.006	0	0.248
2013	203	0.084	0.089	0.020	0.005	0	0.197
2014	115	0.052	0.026	0.009	0	0	0.087
2015	107	0.037	0.084	0.009	0.009	0	0.140

Source: Researcher's Results, 2016

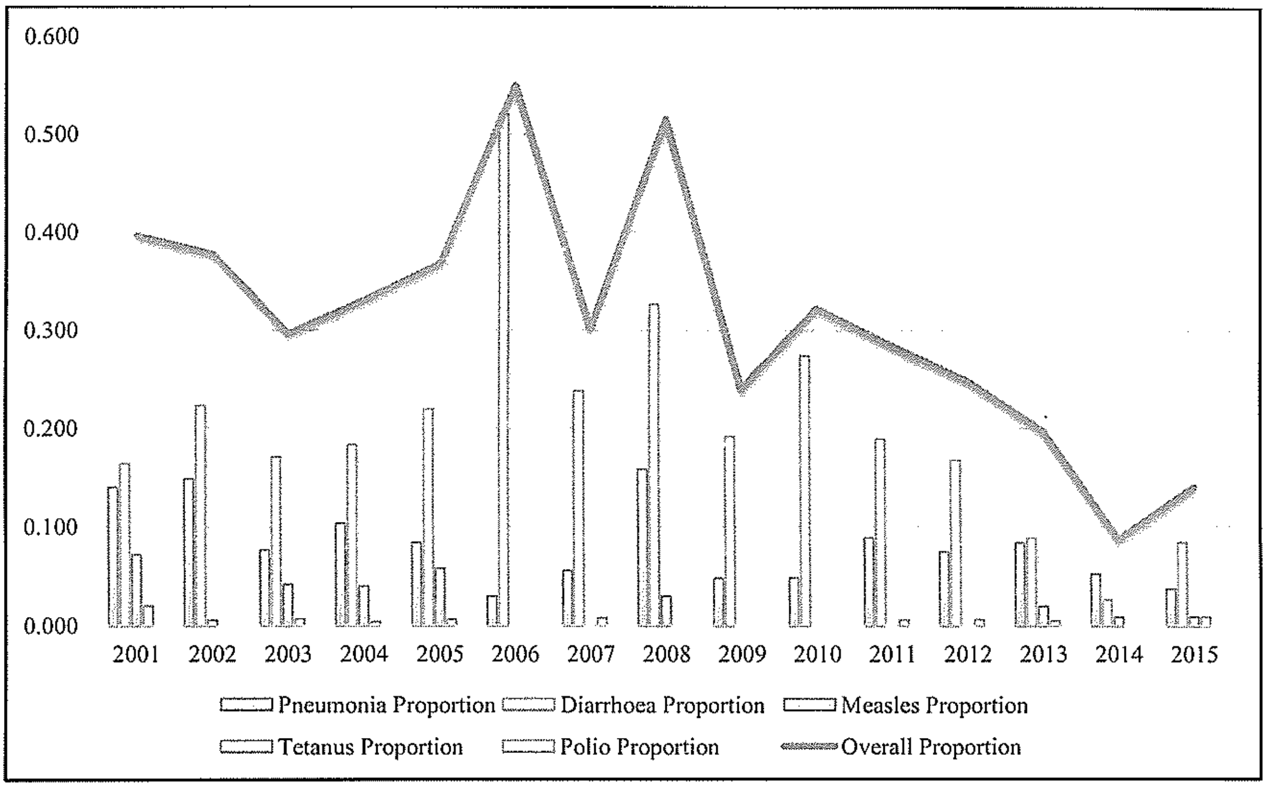


Figure 4.10: Proportion of mortality due to the five child-killer diseases

Source: Researcher's Results, 2016

Table 4.10 and figure 4.10 shows the percentage or proportion in the overall mortality for the under-five children as explained by the five child-killer diseases in Yola, Adamawa state. The data shows that this proportion has been fluctuating up and down throughout the 15-year period. There was slight decrease in the proportion of overall mortality from 40% to approximately 30% between 2001 and 2003. This was followed by a sudden increase in this proportion to 55% in 2006, being the largest proportion so far. A decrease to 30.2% in 2007 was then followed by a drastic increase to 51.5% in 2008. Individually, the largest contributor of mortality in the data was diarrhoea with 52% in 2006, followed by pneumonia, 15.8% in 2008; measles 7.2% in 2001, tetanus 2% in 2001 and polio did not register any deaths for the 15-year period the study was conducted.

4.4. To examine the correlation between the five child-killer diseases and under-five mortality

This section of the analysis considers the correlation between the five child-killer diseases and the overall mortality rate of the children under the age of five. A total of five different diseases were considered in order to answer this objective, which include pneumonia, diarrhoea, measles, tetanus and Polio as the major causes of death for the children under-five years. However, since no incidences of polio were reported for the 15-year period considered in this study, the data for polio was dropped in the analysis. Furthermore, the variable of under-five mortality was represented by the Total Deaths Irrespective of Disease (TDIOD) as shown in the subsequent sections.

Using correlation matrix, the data of the four-child killer diseases after excluding polio was correlated against the Total Deaths Irrespective of Disease (TDIOD) to examine the correlation between the four-child killer disease and the under-five mortality. STATA was used and the data for each of these variables was fed into the computer and analyzed whose results present the individual relationships as shown in table 4.11.

Table 4.11: Correlation matrix of five child-killer diseases on under-five mortality

	Disease: *Pneumonia*	***Disease:*** *Diarrhoea*	***Disease:*** *Measles*	***Disease:*** *Tetanus*	*TDIOD*
Disease: Pneumonia	1				
Disease: Diarrhoea	0.497	1			
Disease: Measles	0.845	0.327	1		
Disease: Tetanus	0.554	0.197	0.690	1	
TDIOD	0.760	0.206	0.625	0.638	1

Source: Researcher's Results, 2016

Hypothesis: There is no significant correlation between the five child-killer diseases and under-five mortality.

The results of the analysis as summarized in table 4.12 indicate there exist a relatively strong and positive correlation between the incidences of Pneumonia and overall under-five mortality in Yola. The Pearson correlation coefficient associated with this relationship is r =

0.760 (t = 6.4872, p-Value = 0.000014), an increase in the number of pneumonia cases may be associated with an increase in the number of deaths for the children under five years. The correlation was significant since it associated with a P-Value less than the stated level of significance.

Furthermore, the results also show that there exists a very weak correlation between the case of diarrhoea and under-five mortality. Pairwise Pearson correlation coefficient produced a value of r = 0.206 (t = 0.7756, p-Value = 0.450889), implying that an increase in the diarrhoea cases would be associated with a subsequent increase in the deaths for the children under-five years. This correlation was not significant since it was associated with a P-Value more than the stated level of significance.

The analysis also revealed that measles and under-mortality has a strong positive correlation, r = 0.625 (t = 3.6977, p-Value = 0.002388). That implies that an increase in the incidences of measles in the under-five children would be associated with an increase in the under-five mortality. The correlation was significant since it associated with a P-Value less than the stated level of significance.

Furthermore, the study also shows that there exist a strong positive correlation between incidences of tetanus and under-five mortality in Yola. The Pearson correlation coefficient r = 0.638 (t = 3.8791, p-Value = 0.001669). This implied that as an increase in one of the two variables would lead to an increase in other. This correlation was significant since it associated with a P-Value less than the stated level of significance.

4.5. To examine the cause effect of the five child-killer diseases on under-five mortality

In order to examine the cause effect of the five child-killer diseases on under-mortality in Yola, a regression model that incorporates four independent variables and immunization level against the total mortality in Yola was run. In this analysis, the deaths arising from pneumonia, those arising from diarrhea, deaths arising from measles and the deaths arising from tetanus and immunization level were considered in the study. The deaths arising from polio were inherently dropped in this analysis since the data has no deaths or incidences associated with polio.

Additionally, since it was shown from the preliminary plots that most of the data for these variables is not stationary, a different form of regression, Newey-West, which adjusts the coefficients for stationarity was run to avoid over estimation of the standard errors associated with the regression model at 90% level of significance.

Table 4.12: Newey West regression output for four child-killer diseases on under-five mortality.

Regression with Newey-West standard errors

Number of obs =	15
F(5, 9) =	5.36
Prob > F =	0.0146
R-squared =	0.7487
Adj R-squared =	0.6092

tdiod	Coef.	Std. Err.	t	P>|t|	[90% Conf.	Interval]
childrenimmunized	.0033768	.0033677	1.00	0.342	-.0027965	.0095501
pneumonia	3.233354	1.709158	1.89	0.091	.1002738	6.366435
diarrhoea	1.037913	1.092317	0.95	0.367	-.9644273	3.040252
measles	5.1977	4.000176	1.30	0.226	-2.135074	12.53047
tetanus	-3.50461	14.60273	-0.24	0.816	-30.27307	23.26385
_cons	32.40969	68.41351	0.47	0.647	-92.99999	157.8194

Source: Researcher's Results, 2016

Hypothesis: There is no cause effect of five child-killer diseases on under-five mortality in Yola, Adamawa state Nigeria.

The analysis above shows that there exists a strong causal relationship between the deaths due pneumonia and the total under-five mortality in Yola ($\beta = 3.233, p - value < 0.1$). This results shows that such a relationship was significant enough because it was associated with a relatively low level of significant as shown in table 4.12 above.

The analysis above shows that there exists a relatively weak positive causal relationship between the deaths due diarrhea and the total under-five mortality in Yola ($\beta = 1.038, p - value > 0.1$). This results shows that such a relationship was not significant enough because it was associated with a relatively high P- value as shown in table 4.12 above.

The analysis above shows that there exists a strong positive causal relationship between the deaths due measles and the total under-five mortality in Yola ($\beta = 5.197, p - value > 0.1$).

This results shows that such a relationship was not significant enough because it was also associated with a relatively high P- value as shown in table 4.12.

The analysis above further shows that there exists a negative causal relationship between the deaths due to tetanus and the total under-five mortality in Yola ($\beta = -3.505, p - value > 0.1$). This results shows that such a relationship was not significant enough because it was also associated with a relatively high P- value as shown in table 4.12. The analysis also shows that there exists a weak positive relationship between the immunization and the total under-five mortality in Yola ($\beta = 0.0034, p - value > 0.1$). It shows that such a relationship was not significant as it associated with a relatively high P- value as shown in table 4.12.

A closer look at the model in table 4.12 implies that the overall model was significant. Such a conclusion was arrived at by assessing the F-statistic ($F = 5.36, P - value < 0.1$).

The result of the Newey-West regression analysis also shows that the four explanatory variables and immunization level explain at least 60.92 percent of the overall variation in the mortality. This result shows that a substantial percentage of the overall variation in under-five mortality rate.

4.6 Regression model for future forecast of under-five mortality

Based on Newey-West regression model in Table 4.12, the regression model for future prediction of under-five mortality in the study area is given by:

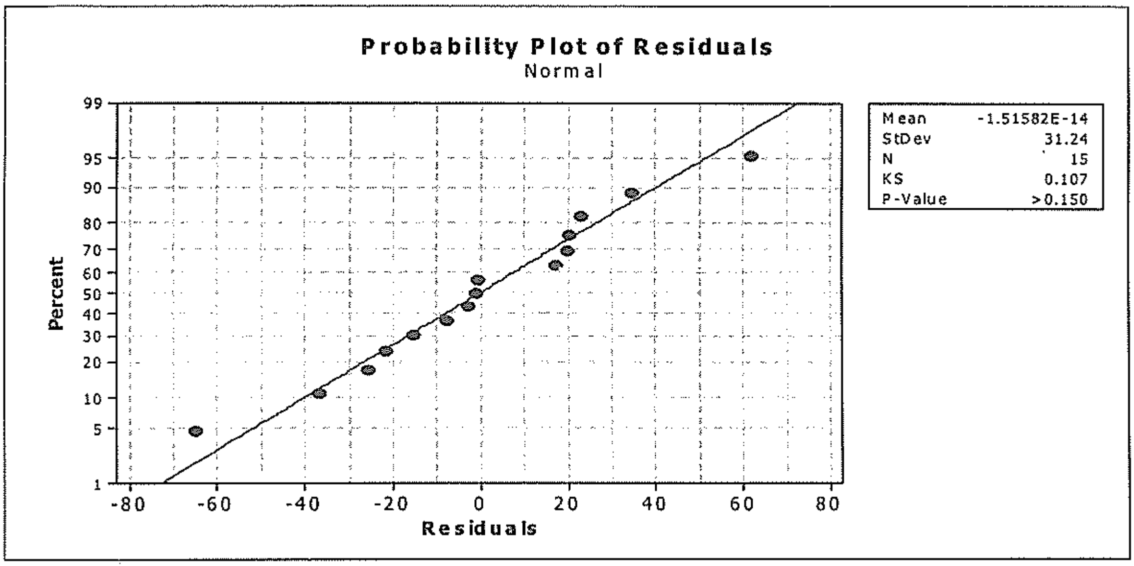
$$TDIOD_t = 32.409 + 0.0034Iml_t + 3.233Pne_t + 1.039Dia_t + 5.198Mea_t - 3.504Tt_t + \varepsilon_i$$

Where

ε_i : The error term also called the stochastic error term is used to represent all the other variables that were not captured due to the scope, which includes: access to health services, and demographic, and socio – economic factors, etc which may have influence in the model.

4.7 Diagnostic test

4.7.1 Normality test



Source: Researcher's Results, 2016

Figure 4.11: Normality plots of the residuals for the regression model

Using the residuals associated with the regression model, a plot of the normal probability plot and its associated statistics for testing normality are shown in figure 4.10 above. Under the null hypothesis that the data is normally distributed, the results of Kolmogorov-Smirnov test for normality reveals that the residuals of the regression model are normally distributed with little or no outliers. For instance, the K-S tests for normality for the residuals produced a K-S statistics value of 0.107 with an associated P-value greater than 0.150 as summarized in figure 4.10. This value is insignificant since it is greater than the stated level of significance (0.1).

4.7.2 Multicollinearity test

When the data has got inter-correlations or multicollinearity, the results that are obtained may not have the required statistical preliquisites for further analysis. Thus, using the variance inflation factors and Tolerance statistics, the multicollinearity diagnostics for the variables after regression were obtained as summarized below.

Table 4.13: Multicollinearity test for the regression model of five child-killer diseases on under-five mortality

Variable	VIF	TOL
Deaths: Measles	4.57	0.219
Deaths: Tetanus	3.27	0.306
Deaths: Pneumonia	2.65	0.377
Deaths: Diarrhoea	1.34	0.744
Mean VIF	2.96	

Source: Researcher's Results, 2016

Result in table 4.13 shows that the independent variables in the study do not have exact inter-correlations or collinearity between themselves. The data shows that they were all associated with variance inflation factors (VIF) that are less than 10, implying non-collinearity.

4.7.3 Homoscedasticity and auto-correlation test

Table 4.14: Homoscedasticity and auto-correlation test of the regression model

Diagnostic	**Test statistic**	**Results of the test statistic**	**P-value**
Heteroscedasticity	Breusch-Pagan	2.81	0.0939
Autocorrelation	Durbin Watson	1.796	0.8596

Source: Researcher's Results, 2016

Result in table 4.14 shows that the error terms in the regression error terms were entirely heteroscedastic based on the Breusch-Pagan / Cook-Weisberg test for heteroscedasticity (Breusch-Pagan statistic = 2.81, P-value < 0.1). However, there are no instances of serial correlation as implied by the insignificant statistics associated with the measures of autocorrelation (Durbin Watson statistic = 1.795742, P-value > 0.1). These diagnostics imply that the initial requirements for performing an OLS regression analysis are not fully satisfied in this analysis, but Newey West regression analysis is permissible.

CHAPTER FIVE

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

5.1. Discussion of findings

Prevalence rate is one of the determinants of the rate at which a given disease spreads through any given population as well as the efficacy of any sought programs to alleviate its spread. In this analysis, the prevalence rate was expressed as the proportion of individuals that would be infected at time t to the total number of persons at risk at a given time t. The figure was multiplied by 1000 to depict the proportion of individuals that are sick with any given disease at time t given a sample of 1000 individuals.

Jalal-Edden, (2014) reported that in Adamawa State, the prevalence rate of tetanus among children investigated are 4%, 8% and 12% in 2008, 2009 and 2013 respectively, while this study confirmed the prevalence to be 0% during the respective years. This can be acceptable due to the fact that this study considered only Yola Metropolicy city of Adamawa State, while Jalal-Edden considered the whole area of Adamawa State.

A study was conduct in Somali by (WHO, 2011), that the prevalence rate of tetanus, pneumonia, and diarrhoea in 2004 among children below the age of five years are 49, 13, and 21 per 1000 live birth respectively. This high prevalence might be due to the fact Somali have being in civil war for many years which lead to unstably governance to fight diseases and poverty. In the same the period (2004), this study revealed that the prevalence rate of tetanus, pneumonia, and diarrhoea in Yola Adamawa State Nigeria are 1, 54, and 75 per 1000 live birth. These results are unacceptable due to fact that Nigeria has a functional and stable government that can control the outbreak of child killer diseases.

In Yola, the prevalence of child killer disease has been decreasing irrespective of the kind of disease under consideration. The reason highlighting the explanation why Pneumonia and diarrhoea recorded the highest prevalence amongst all the other five diseases under consideration is that these diseases have strong attribution to environmental conditions for instance, diarrhoea is heavily related to hygiene and pneumonia has an association to cold climatic and whether conditions. This implies that other factors like relatively high congestion in most health centres in Yola, coupled with the high level of poverty and or inadequacy of drugs could explain such high figure recorded for Pneumonia and diarrhoea as compared to the other three diseases.

In this study, the proportion of mortality due to the five child-killer diseases considered the percentage of under-five children that died as a result of the five killer diseases. It considered the number of deaths by a given disease by the Total Deaths Irrespective of Disease (under-five deaths) in Yola using data from PHCDA. Although all the deaths are not attributed to the five-killer diseases in this study, the study was meant to investigate the proportion of the deaths that can be explained by the five child killer diseases in this study.

Dieckmann et.al (2005) explained that mortality and morbidity from pneumonia were measured among 3000 children under the age of 5 years in a rural area of Gambia, West Africa. The pneumonia mortality rate was 17.0 per 1000 per year in children aged less than five years. In this study, the 15-years data that was analyzed revealed that pneumonia under-five mortality in Yola was estimated to be 14.0 persons per 1000 live birth in 2001 and 3.0 persons per 1000 live birth in 2015, which can be acceptable. This implies that the Adamawa Sate government has taken some positive measures to bring down pneumonia under-five mortality in Yola.

MOH (1999) revealed that under-five mortality rates in Enugu Nigeria were 74.3 deaths per 1000 live birth. Although this study has no mortality rate for 1999, but the data of 2001 revealed that the under-five mortality is 39.6 deaths per 1000 live birth. This can be acceptable since the under-five mortality rate in Yola is decrease compare to that of Enugu.

This study revealed that, pneumonia and diarrhoea account for the largest proportion of the deaths that were recorded for the 15-year period. However, it was also found out that the deaths due diarrhoea are decreasing faster over time than pneumonia. This could be explain may be the health centres in the study area do not have proper equipment like incubators and warmers for the newly born babies thus raising their risk of getting pneumonia.

Furthermore, although these two diseases are not only alleviated by immunisation, people should increase awareness with sanitation and hygiene so that the prevalence of diarrhoea can be reduced.

For polio, the zero incidence rates across the 15-year period is due to the fact that polio is regarded as a pandemic and as such it was eliminated due to worldwide efforts to combat the disease as it has threatening effects on human growth and physical appearance.

One of the objectives of this study was meant to determine how each of the five child-killer diseases explain the variation in the overall mortality basing on the association results reported by each of these diseases. The study shows that pneumonia still stands out as having the largest relationship with the overall under-five mortality with Pearson correlation coefficient associated with this relationship r = 0.760 (p-Value = 0.000014) which is significant with the p-value. This is understandable because the data also shows that it has the highest incidences yet its treatment is not yet satisfactory.

Furthermore, the data shows that both measles and tetanus, diseases that are known to be preventable through immunisation have got a relatively high relationship with under-five mortality with Pearson correlation coefficient r = 0.625 (p-value = 0.002388) and r = 0.638 (p-value = 0.001669) respectively, which were both significant. This could be due to the fact the prevalence of immunisation in the populations is still low due to people's perceptions. For instance, some communities are still opposed to immunisation due to societal and traditional beliefs. For diarrhoea, the Pearson correlation coefficient associated r = 0.206 (p-value = 0.450889), which was not significant

Additionally, immunisation of children against the five child-killer diseases are mostly conducted in respective houses where the concerned health workers move house to house while immunising vulnerable children. This means the health workers may sometimes unknowably immunize the children with expired vaccines; explain the high relationship between these diseases and overall under-five mortalities in Yola.

Similarly, it is also known that children are sometime immunised against these diseases at age later the required, such a delay means that some children are infected before they are immunised which may increase their probability of death.

Since it was shown from the preliminary plots that most of the data for these variables is not stationary, a different form of regression, Newey West, which adjusts the coefficients for stationarity was run to avoid over estimation of the standard error at 90% level of significance.

In a related study by Orubuloye and Caldwell (2011), the child-killer diseases account for than 70 percent under-five mortality while this study revealed that the child-killer diseases account for at least 60.92 percent of the overall variation in the under-five mortality. This can be acceptable due to the fact that the Adamawa state government is succeeding in reducing the under-five mortality due to child-killer diseases in Yola.

The result also shows that there is a positive and significant relationship between pneumonia and under-five mortality for the data under consideration. This result implies that an increase in pneumonia cases is attributed to three times an increase in the under-five mortality. Furthermore, a unit increase in the deaths due to measles is associated with a three times increases in the overall number of deaths in the Yola. Also diseases like diarrhoea and measles associated positively and insignificant with under-five mortality in Yola, while tetanus associated negatively and insignificant.

The overall model resulting from the overall under-five mortality due to these child-killer diseases was very significant as it was associated with a very significant Fischer's F-statistic $(F = 5.36, P - value < 0.1)$.

5.2. Conclusion

The study reveals that although Adamawa state, Yola considers Pneumonia, diarrhoea, measles, tetanus and polio as the greatest child killers, polio needs to be excluded since the investigation shows that no diseases and deaths associated to polio were recorded for a period of 15 years considered by this study.

Furthermore, although the numbers of children that are immunised are increasing year by year, the measles still explains a significant proportion of the variation in the overall child mortality in Yola. In fact, its variation with under-five mortalities is equivalent to the rates recorded by pneumonia, this calls for a significant change in policies for immunisation.

The results also showed that diarrhoea explains a small percentage of the variation in under-five mortality, the number of children that die due to diarrhoea at a marginal level is still great. Although no variable for measuring sanitation was incorporated in this study, these figures show that the level of hygiene in Yola is not good enough.

Among the five child-killer diseases considered in this study, pneumonia has the highest and most significant correlation with the under-five mortality.

The study showed that the five child-killer diseases considered in this study explain 60.92% of the overall under-five deaths which is also significant.

The model explains that at zero five child-killer diseases, the under-five mortality is 32 persons.

5.3. Recommendations

Since the study has discovered that; pneumonia associated significantly with deaths compared to other diseases like tetanus, measles and polio, Adamawa state government need to implement the Global Action Plan for Pneumonia and Diarrhoea (GAPPD) with immediate effect as campaigned by WHO and UNICEF.

Both government and individual should promote adequate nutrition as a key factor to improving children's natural defences against child-killer diseases, starting with exclusive breastfeeding for the first 6 months of life.
Addressing environmental factors such as air pollution, encouraging sanitation and good hygiene in crowded area would be an ideal solution to reduce the prevalence of the child killer-diseases.

Children infected with HIV/AIDs should be given daily vaccines to reduce the risk of contracting the child killer-diseases like pneumonia and diarrhoea.

Furthermore, measles showed that it explains a huge relationship with under-five mortality although it was not significant on statistical grounds. That implies that the Policy makers have to make adequate provision for transportation and storage of vaccines and revise the immunization policies so that a significant number of children at risk receive unexpired and genuine vaccines against the child-killer diseases for the recommended number of dosage to reduce the incidences.

The government programs for reducing and even curbing the spread of these diseases among the children in the vulnerable age needs to be revised because the percentage of the variation in under-five mortality due to these five-killer diseases is still high.

5.4. Suggestions for further study

Further studies should investigate the efficacy of government programs for alleviating the spread incidences of these five-child killer diseases since this study has shown that they still explain a substantial percentage of the variation in the overall under-five mortality. Such studies should investigate the percentage of resources, for instance, funds that the government usually allocates to programs that are aimed at reducing the incidences and possible deaths arising from these diseases.

On the other hand, the procedure for computing prevalence in this study tends to overestimate the prevalence arising from the diseases. Thus, future studies should consider investigating the children under risk by obtaining figures of all the under-five years for the same time period.

5.5 Contribution to knowledge

A model was developed which can be use for future prediction of under-five mortality in the study area.

Most studies concentrated on single variable like the work of Jalal-Eddeen (2014), but this study adequately addressed the prevalence rate of five variables (child-killer diseases) and its cause effect on under-five mortality in the study area.

References

Abiola, A. (2015). Child mortality in Nigeria. Fitila Explanatory and data journalism, published in Health February, 2015. www.fitila.ng/child-mortality Nigeria.

Adebayo, S. B., Fahrmeir, L., & Klasen, S. (2004). Analyzing infant mortality with geoadditive categorical regression models: a case study for Nigeria. *Economics & Human Biology*, *2*(2), 229-244.

Adetunji, J. A. (1995). Infant mortality and mother's education in Ondo State, Nigeria. *Social Science & Medicine*, *40*(2), 253-263.

Andrews, D. W. (1991). Heteroskedasticity and autocorrelation consistent covariance matrix estimation. *Econometrica: Journal of the Econometric Society*, 817-858.

Basu, A. M., Stephenson, R. (2005). Low levels of maternal education and the proximate determinants of childhood mortality: a little learning is not a dangerous thing. *Social science & medicine*, *60*(9), 2011-2023.

Bern C, Martines J, Zoysa I. D, & Glass R. I.(1992). The magnitude of the global problem of diarrhoeal diseases: A ten year update. Bull World Health Organ 1992;70:705- 14.

Boldrin, M., Jones, L. E. (2002). Mortality, fertility, and saving in a Malthusian economy. *Review of Economic Dynamics*, *5*(4), 775-814.

Bruce-Chwatt, L. J. (1951). Malaria in Nigeria. *Bulletin of the World Health Organization*, *4*(3), 301.

Caldwell, J. C., Caldwell, B. K., Caldwell, P., McDonald, P. F., &Schindlmayr, T. (2006). *Demographic transition theory* (pp. 23-49). Dordrecht: Springer.

Chessed, G., Lazarus, J.T.,Yako, A.B. and Egbucha, K.(2013). Prevalence and management of malaria among infants and children in Yola local government area, Adamawa state, Nigeria.

Dieckmann D., John A. J. M., Maurice W. S., & Sigmund K. (2005). Epidemiological Studies of Streptococcus Pneumonia in infant. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, *81*(3), 478-486.

Esangbedo D. (2010) http://www.nigerianbestforum.com/blog/%E2%80%98nigeria-has-highest-pneumonia-burden-in-africa%E2%80%99-%E2%80%93-second-highest-worldwide/

Fagbule, D., Orifunmishe, F. (1988). Measles and childhood mortality in semi-urban Nigeria. *African journal of medicine and medical sciences*, *17*(3), 181-185.

Falade, B. (2015). Familiarising Science: A Western Conspiracy And The Vaccination Revolt In Northern Nigeria. *Papers on Social Representations, 24*(1).

FMOH, Abuja (2008). National Policy on Integrated Disease Surveillance and Response. Federal ministry Health Abuja, Nigeria. National IDSR policy

Grant J. P. (1993). Diarrhoeal disease; a strategy for the 90s. The state of the World Children. UNICEF; 1993. p. 22-3.

Grais, R. F., Dubray, C., Gerstl, S., Guthmann, J. P., Djibo, A., Nargaye, K. D. & Nathan, N. (2007). Unacceptably high mortality related to measles epidemics in Niger, Nigeria, and Chad. *PLoS Med, 4*(1), e16.

Hamilton, W. D. (1966). Narrow roads of gene land. Vol. 1. Evolution of social behaviour. W.H. Freeman, New York.

Jalal-Eddeen, A. S. (2014). Prevalence of Neonatal Tetanus in North-eastern Nigeria. Walden Dissertation and Doctoral Studies. http://scholarworks.waldenu.edu/dissertations

Jarque, C. M., & Bera, A. K. (1980). Efficient tests for normality, homoscedasticity and serial independence of regression residuals. *Economics letters, 6*(3), 255-259.

Korenromp, E. L., Williams, B. G., Gouws, E., Dye, C., & Snow, R.. W. (2003). Measurement of trends in childhood malaria mortality in Africa: an assessment of progress toward targets based on verbal autopsy. *The Lancet infectious diseases, 3*(6), 349-358.

Liu, L., Johnson, H. L., Cousens, S., Perin, J., Scott, S., Lawn, J. E..& Mathers, C. (2012). Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *The Lancet, 379*(9832), 2151-2161.

Mathews, T. J., & MacDorman, M. F. (2011). Infant mortality statistics from the 2007 period linked birth/infant death data set. *National vital statistics reports: from the Centers for Disease Control and Prevention, National Center for Health Statistics, National Vital Statistics System, 59*(6), 1-30.

MDG Report (2012). We can end poverty 2015. UN Publication, New York. Retrieved from http://www.endpoverty2015.org/en/category/millennium-development-goals/

MOH (1999) Enugu State Ministry of Health, Nigeria

Murray, C. J., Rosenfeld, L. C., Lim, S. S., Andrews, K. G., Foreman, K. J., Haring, D. & Lopez, A. D. (2012). Global malaria mortality between 1980 and 2010: a systematic analysis. *The Lancet*, *379*(9814), 413-431.

Neter, T., Wasserman, W., & Kutner, M. H. (1989). Applied Linear Regression Models. Homewood, IL:Irwin.

NewScientist. (2007). Polio stakes get higher. Retrieved 13/02/2010, from http://www.lexisnexis.com/uk/nexis/results/docview/docview.do?docLinkInd=true&risb=21_T11379346362&format=GNBFI&sort=BOOLEAN&startDocNo=1&resultsUrlKey=29_T11379346367&cisb=22_T11379346366&treeMax=true&treeWidth=0&csi=158275&docNo=13

Norman, P. E., Spilsbury, K., & Semmens, J. B. (2011). Falling rates of hospitalization and mortality from abdominal aortic aneurysms in Australia. *Journal of vascular surgery*, *53*(2), 274-277.

Okechukwu D.A., Benedict N.A., John O.U. (2015). Trends and disparities in infant and child mortality in Nigeria using pooled 2003 and 2008 demographic and health survey data, published in sage journals 19th October, 2015. sgo.sagepub.com/content/5/4/2158244015611936.figures-only

Okoro B. A, & Itombra-Okoro J. (1996). Childhood Morbidity from Diarrhoea and its Home Management. Nig J Paediatr

Onyiriuka, A. N. (2011) Clinical profile of children presenting with measles in a Nigerian Secondary health-care institution. http://www.academicjournals.org/JIDI.

Oral rehydration Therapy In Children With Acute Gastroenteritis (2009). Available from: http://www.accesslibrary.com/coms2/summary_0286-31765453_ITM J.

Orubuloye, I. O., & Caldwell, J. C. (1975). The impact of public health services on mortality: a study of mortality differentials in a rural area of Nigeria. *Population Studies*, *29*(2), 259-272.

Rudan, I., Boschi-Pinto, C., Biloglav, Z., Mulholland, K., & Campbell, H. (2008). Epidemiology and etiology of childhood pneumonia. *Bulletin of the world health organization*, *86*(5), 408-416B.

Salles, M., & Thalassinos, L. (1991). A Test for Detecting Multicollinearity. *Indian Economic Journal*, *38*(4), 109.

Scott, J. A. G., Brooks, W. A., Peiris, J. M., Holtzman, D., & Mulholland, E. K. (2008). Pneumonia research to reduce childhood mortality in the developing world. *The Journal of clinical investigation*, *118*(4), 1291-1300.

Synder J. D, & Merson M. H. (1982). The Magnitude of the Global Problem of Acute Diarrhoeal Diseases: A review of active surveillance data. Bull World Health Organ 1982;60:605-13.

UNICEF, WHO, UNFPA (2000). Maternal and neonatal tetanus elimination by 2005. Strategies for achieving and maintaining elimination. Retrieved from http://www.unicef.org/health/files/MNTE%5Fstrategy%5Fpaper.pdf

UNICEF. (2009). Communities in West Africa prepare for extensive polio vaccination campaign. From http://www.unicef.org/health/niger_48285.html

UNICEF. (2014). Elimination of maternal and neonatal tetanus. Retrieved from http://www.unicef.org/health/index_43509.html

United Nations. 2000. United Nations Millennium Declaration. General Assembly resolution 55/2, United Nations, New York. http://www.un.org/millennium /declaration/ares552e.pdf.

WHO. (2005). Polio eradication in Nigeria: Backgrounder. Retrieved 08/07/2010, from http://www.who.int/countries/nga/mediacentre/backgrounders/2005/polio_backgrounder_060505.pdf

WHO. (2008). Nigeria epidemiological profile. Retrieved from http://search.who.int/search?q=malaria+profile+nigeria&ie=utf8&site=default_collection&client=_en&proxystylesheet=_en&output=xml_no_dtd&oe=utf8

WHO. (2011). Child mortality and morbidity in Somalia http://reliefweb.int/sites/reliefweb.int/files/resources/layout_childhealth_9mar.pdf

WHO. (2014). Maternal and Neonatal Tetanus Elimination: The initiative and challenges. Retrieved from http://www.who.int/immunization/diseases/MNTE_initiative/en/

Appendix

Table of under-five cases of immunization, diseases, and deaths in Yola

Years	Children immunized	Diseases					Deaths					TDIOD
		Pneumonia	Diarrhoea	Measles	Polio	Tetanus	Pneumonia	Diarrhoea	Measles	Polio	Tetanus	
2001	4554	394	293	92	0	13	35	41	18	0	5	250
2002	4845	286	443	19	0	1	26	39	1	0	0	175
2003	5843	344	474	73	0	9	22	49	12	0	2	287
2004	6342	475	354	71	0	2	26	46	10	0	1	251
2005	6431	345	483	104	0	5	13	34	9	0	1	155
2006	8922	135	462	2	0	2	3	52	0	0	0	100
2007	9469	95	404	0	0	2	7	30	0	0	1	126
2008	10821	139	387	48	0	3	16	33	3	0	0	101
2009	9113	132	408	1	0	1	7	28	0	0	0	146
2010	10544	114	363	0	0	1	6	34	0	0	0	124
2011	11898	149	313	19	0	7	15	32	0	0	1	169
2012	19050	69	254	0	0	2	12	27	0	0	1	161
2013	18530	101	210	19	0	2	17	18	4	0	1	203
2014	14428	38	26	12	0	1	6	3	1	0	0	115
2015	18553	49	78	1	0	1	4	9	1	0	1	107

Source: Adamawa State Primary Health Care Development Agency, Yola