NEAR EAST UNIVERSITY
INSTITUTE OF HEALTH SCIENCES

Logistic Regression Analysis to Determine Significant Factors Associated with Malaria among Pregnant Women in Nigeria

A THESIS SUBMITTED TO THE GRADUATE INSTITUTE OF

HEALTH SCIENCES, NEAR EAST UNIVERSITY

BY

RUKAYYA SUNUSI ALKASSIM

In Partial Fulfillment of the Requirementsfor the degree of
Master of Science in Biostatistics

NICOSIA, 2017

T.R.N.C

NEAR EAST UNIVERSITY

INSTITUTE OF HEALTH SCIENCES

Logistic Regression Analysis to Determine Significant Factors Associated With Malaria among Pregnant Women in Nigeria

By:

RUKAYYA SUNUSI ALKASSIM

Master of Science in Biostatistics

Advisor:

Assoc.Prof.Dr.IlkerEtikan

NICOSIA, 2017

T.R.N.C

DEDICATION

I dedicate this dissertation to my lovely parent friends, and **Alkassimwayya** family, especially my father **ALHAJI SUNUSI ALKASSIM** who had always been a great source of encouragement in my life.

APPROVAL PAGE

Thesis submitted to the institute of health sciences of Near East University in partial fulfillment of the requirements for the degree of **Master of Science in Biostatistics**.

Thesis committee

Chairman of the committee: Prof. Dr. S. Yavuz SANİSOĞLU
YıldırımBeyazıtUniversity
Sig: ………………

Advisor: Assoc.Prof. Dr. İlker ETİKAN
Near East University
Sig: ……………

Member: Ass. Prof. Dr. Özgür TOSUN
Near East University
Sig: …………………

Approved by: ‘ Prof. Dr. İhsan ÇALIŞ
Director Health Science Institute
Near East University
Sig: ………………….

ACKNOWLEDGEMENT

All praise and salutations be to **Almighty Allahwho** blesses me courage to complete this research work, may each moment of my life be dedicated for his praise. All respects and regards to the holly prophet **Muhammad (S.A.W)**. Who came as a light of knowledge to all seekers.

My profound gratitude goes to my teacher and dignified Advisor **Assoc.Prof. Dr. İlker ETİKAN** for his strong interest, attention, vital and intellectual suggestion throughout the research work. I am highly appreciative to him for his graciously offered help to complete this tedious task. May god bless him with health, happiness and long life.

I offered my profound thanks to **Prof. Dr. S. Yavuz SANİSOĞLU** and my teacher **Ass**. **Prof. Dr. Özgür TOSUN** for his advice, continued patience, all the moral support and guidance throughout my research work. No words express the depth of my heartiest feelings for the help extended to me all times.

No expressions, verbal or written, can express my deepest gratitude to my beloved parents (**Abba, Aunty, mami and Hajiya**) for bestowing me the gifts of education and guidance that set success as goal of my life, my brothers and sisters (**Aisha, Iman, Sumayya, safwan, sauban, Nawas, Abba, zanna, mami, mash, maama, zee, abul, muazzam, Khadija, Bilkisu, ramlat, sajida, Bashir**^{2} **and Ummulkhair**) and my entire family as whole, for their consistent prayers and deep love for me.

I would never forget the polite and persisted support of **Mal. AbubakarIliyasu** for his encouragement, support and guidance. I offer a special thanks to my nice colleague and a Brother as well **SulaimanAbubakar Musa**, my friend as well as a sister **Maryam Muhammad isah,G – 9 Kwankwasiyya Students** and sincere friends around me.

Not the least but the last, I would also like to acknowledge **Near East University** which provided me the opportunity to undertake this research work and complete it within due course of time. I specially thank **Kano State Government** together with **National Bureau of Statistics Nigeria** for extending all the help and good wishes.

Rukayya Sunusi Alkassim

Table of Contents

LIST OF TABLES

ACRONYMS

ACT	Artemisinin-based combination therapies
ANC	Antenatal care
CI	Confidence interval
df	Degree of freedom
IPTp	Intermitted preventive disease
IQR	Inter quartile range
ITN	Insecticide treated net
NGOs	Nongovernmental Organizations
NBS	National Bureau of Statistics
OR	Odds Ratio
RTD	Rapid diagnosis test
SP	Sulfadoxine-Pyrimethamine
UNICEF	United Nations Children's Fund
WHO	World Health Organization

Abstract and keywords

Malaria during antenatal period was a major health problem that lead to both mother and child death. The aim if this study is to assess the predictors of malaria during pregnancy among six states of Nigeria based on ant malarial prescribed to pregnant women by the health facility. The data used for this research came from a study conducted by Federal Ministry of Health Nigeria, in collaboration with National Bureau of Statistics (NBS) and World Bank. A total of 1676 antenatal women responded for malaria related questions were selected from the data base for this analysis. The analysis involves chi square test for independent association between the predictors and risk of malaria diagnosis among the qualitative variables, Mann Whitney u test for quantitative variables and binary logistic regression for the multivariate analysis. Each variable with (p-value < 0.05) was considered significant. The analysis shows that the risk of malaria during pregnancy was significantly associated with Age, IPTp-uptake, ITN use, source of energy for lightening, main material use for room's rooftop and livestock keeping.Hence the study suggested that with the appropriate use of insecticide treated bed nets, intermitted optimal preventive treatment against malaria uptake and other protective measures, teamed with some elements such as sources of energy for lightening and main material for room's rooftop. There was a decreased in the incidence rate of malaria infectious disease among antenatal women. However, the research also suggested that the illiterates and poor women are less probable of using these preventive measures in other to reduce the spread of malaria disease among pregnant women and entire population as whole.

Key words: Malaria, pregnancy, Chi-square test, Mann-Whitney-U test, Logistic Regression.

ÖZET

CHAPTER ONE

1.1 INTRODUCTION

Human life is exposed to the risk of various diseases. Numerous diseases affected the large proportion of our population in which the incidence and mortality rates are increasing briskly. Several efforts were made in order to improve awareness among people pertaining to risk factors associated with the disease, and this will help in minimizing the incidence of the disease by suggesting different treatment for curing such diseases.

Many infectious diseases such as cholera, tuberculosis, gonorrhea, hepatitis, pneumonia, typhoid fever, yellow fever etc. are caused by infectious agents such as bacteria, fungi, viruses, nematodes and so on. Malaria is one of the infectious diseases, causing frequent fever of abrupt onset. Current tries at controlling this disease such as insecticides and drugs are insufficient. It is a powerful parasitic disease in the developing world, causing high morbidity and mortality.

1.2 Malaria

A life hostile parasitic infectious disease conveyed by female anopheles mosquitoes is called malaria (W.H.O., 2001). In human body, malaria is caused by a protozoan of the Plasmodium type of the four subspecies, which include *P.falciparum*, *P.vivax, P.malariae and P.ovale*. The subspecie that causes greatest sickness and death in African countries was *P.falciparum*. This parasitic disease is transmitted by the bites of female anopheles mosquitoes of the genus Anopheles which is the most efficient and responsible for disease transmission in Africa (Nchinda, 1998). Initially the parasites starts by infecting the liver where it begins to build up. After some days, the developing parasites are discharged into the blood stream to infect the red blood cells, where they continue to increase, ultimately bursting the red blood cells and infecting others in advance. If they reach high numbers they may cause severe disease or even death as well (Miller, Good &Milon, 1994).

1.2.1 Malaria during Pregnancy

One of the major health problems that cause both maternal and neonatal mortality is malaria during pregnancy. Low birth weight is one of the major factors that cause child mortality, where malaria during pregnancy reduces the birth weight. In Africa, maternal and neonatal mortality were associated with up to 300,000 death estimate in each year as indicated by statistics (Yoriyo, Kennedy &Hafsat, 2014). Luxemburger *et al,* (2001) make an estimate among koren population living in Thailand, malaria during antenatal period have an effect on child mortality during the first month of child's life. It was observed both falciparum and vivax malaria during pregnancy period were related with low birth weight but affect the age of gestation. Premature birth is related with febrile illness in the week prior to delivery. Neonatal mortality was associated with fever in the week before delivery, Preterm and full-term low birth weight. Maternal fevers close to term has a strong connection with the deaths of infants aged between 1 to 3 months, but there is no in risk factors that could be identified for deaths that occurred later in infancy. Therefore, lowering birth weight tends to neonatal mortality which was increased due to malaria during pregnancy, while maternal fever in the week prior to delivery together with premature birth inducing had advance independent influence.

Therefore preventing malaria during pregnancy will increase the survival of young babies as well as the mothers. Antenatal women are also expressly at risk; about 125million pregnant women are exposed to risk of infectious disease annually. In sub-Saharan Africa, 200,000 estimated neonate's death was associated with malaria during pregnancy in each year (Hertman*et al*, 2010). Miscarriage at the initial stage of antenatal period may possibly be caused by one in four deaths of children less than five years which is responsible by malaria (Butler, Maurice, & Obrien, 1997).

1.2.2 Sign and symptoms

The most common key signal of malaria is fever, cerebral malaria is the severely appear mostly among children and people with prior immunity. Pregnant women and inpants as well were essentially affected by anemia (Garcia, Markus, & Madeira, 2001). Common complains of patients suffering from simple malaria include:

- Headache
- Fever or a prior history of fever within last 2-3 days
- Rigors (shivering)
- Chills (feeling strangely cold)

Other clinical features may include:

- Loss of appetite
- General body and joint pain
- Nausea with or without vomiting
- Sweating
- Dizziness
- Bitterness in the mouth
- Abdominal Pain (especially in children)
- Irritability and refusal to feed (in infants)

Statistical analysis play an important role in medical research area and the estimates and predicted values obtained provides change in the dynamic of epidemiology of malaria among antenatal women in a valuable vision. Therefore this study employs the application of logistic regression to analyze factors associated with malaria during pregnancy, and the model obtained was purely based on statistical result.

1.3 Statement of the Problem

In earlier studies like Ayele*et al* (2012), Exavery *et al*, (2014) and Andrew (2014), malaria infection among pregnant women were studied in different part of Nigeria using different statistical tools. Conclusions and recommendations were drawn based on the results obtained in such researches. Some of their inferences based on descriptive analyses with partial use of such complicated methods of data analysis such as regression analysis. However, Ayele*et al* (2012) determine the Prevalence and risk factors of malaria in Ethiopia base on the rapid diagnosis test (RDT) survey results conducted by the Carter Center. In addition, one would seek to know the risk factors that have an effect on malaria during pregnancy period in that Ethiopia or other country.

1.4 Aim and Objectives

This study aimed at fitting logistic regression model to analyze predictors of malaria among pregnant women in Nigeria. This aim was achieved through the following objectives.

I. To identify the factors that has significant impact on malaria among pregnant women.

II. To fit a logistic regression model.

III. To determine the significant interaction between the factors in II above.

1.5 Significance and Justification of the Study

As is apparent in many researches, statistical analysis of several infectious diseases provides a comprehensive assessment on curing such diseases. Ayele*et al* (2012) investigate the prevalence and related demographic, geographic and socioeconomic factors of malaria based on the rapid diagnosis test (RDT) survey results in Ethiopia; method of generalized linear model was employed in the analysis. Hence this study intends to extend such work by analyzing the risk factors associated with malaria during pregnancy in Nigeria using binary logistic regression analysis, and furthermore, the results obtained from this work will assist in determining the factors that have a significant impact with malaria in Nigerian pregnant women.

1.6 Source of Data

The information use in this research was a documented data obtained from National Bureau of Statistics Nigeria, they were health results based on financing Nigeria in the year 2013, and the survey was conducted by Federal ministry of Health in collaboration with National Bureau of Statistics and World Bank. It was an exit interview for antenatal care visit.

1.7 Definition of Some Terms

1. **Primigravida:** This refers to antenatal woman with first pregnancy. The plural form of primigravida refers to as primigravidae

2. **Multigravida:** This refers to pregnant woman with at least more than one pregnancy. The plural form of multigravida refers to as multigravidas.

3. **Odds ratio**: An association between the risk factor or exposure and the result was measured by Odds ratio. The odds that malaria among pregnant women will occur given a particular risk factor, compared with odds of occurrence of malaria in the absence of that risk factor was presented by odds ratio.

4. **Confidence interval**: It is a specified probability that the value of a parameter lies within ranges of values

CHAPTER TWO

Literature review

Different researches have been carried out on the application of logistic regression in modeling malaria among pregnant women and other related issues in individuals. In this Chapter, a review of literature on these previous researches would be discussed. This serves as a guide for further study, and also helps to show that the researcher is familiar with what was already known or still undergoing. An effective research work is based on past knowledge, therefore this will help to minimize or eliminate duplication.

2.2 Review of Previous Studies

Okwa (2003) examined the Status of Pregnant Women having Malaria in Lagos State, Nigeria. A study was carried out on the status of malaria among 800 randomly selected pregnant women in Lagos State, Nigeria. Blood samples were obtained from finger pricking and tested for malaria parasites in thin blood films and 60% prevalence of malaria parasites was obtained. Interviews were conducted and structured questionnaires were administered to the pregnant women to obtain information on the clinical and social aspects of malaria. Results show that primigravidae accounted for a greater part of the 60% prevalence of malaria that affected mainly women in their 1st to 3rd month of pregnancy. The ages of the infected women ranged from 30 to 39 years (77%). Women with blood groups A and O had the highest prevalence of malaria, but there was no statistically significant difference between them and the uninfected women. Women with genotype AA had the highest prevalence of malaria, while pregnant women in Ikeja division had the highest incidence of malaria (41.7%). Majority of the infected women believed that mosquito bites and stress were responsible for their infection. Only 21.8% of the women did not associate mosquitoes with malaria. All the women were familiar with the symptoms of malaria but did not see it as a serious disease that could lead to death. Most of the women used bed nets but not the impregnated brands. There is need to educate women, especially during antenatal visits, on the severity of malaria and the risk of their susceptibility to it during pregnancy.

Gill et al (2007) examined the Inferiority of Single-Dose Sulfadoxine-Pyrimethamine Intermittent Preventive Remedy for Malaria during the pregnancy of women with HIV-Positive Zambia. Maternal and neonatal birth outcomes were compared; they served as a function of doses the mothers received (1 to 4 doses). IPTp-SP Dose was a familiar result of trying to apply the standard optimal dose treatment and was lower to all other dosing regimens. It implied that monthly SP - IPTp may eventually be more effective than the standard procedure by reducing the risk unintentionally under-dosing mothers.

Adefioye *et al* (2007) determined the Prevalence of Malaria Parasite Infection amongPregnant Women in Osogbo, Southwest of Nigeria. Questionnaires were also distributed to ascertain their state of health before recruiting them into the study. Where (72%) of the 250 pregnant women considered were found that have malaria diseases in which the age group 36-39 years had the highest frequency rate of 88.2% and statistically the pregnant women and age groups were significantly different. The prevalence rate among the illiterate women was 54.4% and use of drug was also considered, in which local herbs had 100% sensitive to *P.falciparum*than orthodox curative drug.

Raimi and Kanu (2010) examined the prevalence of malaria parasite infection among pregnant women living in a suburb of Lagos, Nigeria. The result showed that malaria infection was prevalent during pregnancy period. A total of 26 (52%) of the pregnant women were malaria positive and proved symptoms of malaria whereas 24 (48%) were negative and showed no symptoms of malaria. The results showed that the prevalence of malaria infection especially *P. falciparum* infection among pregnant women and younger women living in the area were more at risk. Malaria infection should therefore be accepted and recognized as a global significance in health care more especially during the pregnancy period.

Rogawski et al (2012) studied the Effects of Malaria and Intermittent Preventive (IPTp) Treatment During Pregnancy on Fetal Anemia in Malawi with Unconditional linear and logistic regressions were achieved on a cross-sectional study of 3,848 mothers and babies delivered at Queen Elizabeth Central Hospital in Blantyre, Malawi between 1997 and 2006, with multiple charge for missing covariates to measure the relations between malaria, IPTp with SP, and fetal anemia. It was observed that women pregnant at the first time who did not receive IPTp had children at highest risk for fetal anemia. There was no significant association between SP use and cord Hb or fetal anemia. It was recommended that intermittent preventive treatment during pregnancy with SP may continue to be safe and effective in preventing malaria in pregnancy and fetal anemia regardless of development of SP resistance.

De Beaudrap et al (2013) studied the Impact of malaria during pregnancy on pregnancy outcomes in a Ugandan potential cohort with intensive malaria screening and prompt treatment. Multivariate analysis was employed to analyze the association between characteristics of mother and malaria risk, as well as between malaria in pregnancy and birth outcome, length and weight at birth. It was observed that the risk of peripheral malaria was higher in young mothers infected with HIV, with lower education level, lived in rural areas or reported no insecticide treated mosquito net use, however more regular malaria disease with infection during late pregnancy were associated with risk of placental infection. The risk of miscarriage and pre-term delivery was increased in mothers infected with HIV disease, living in rural areas and with malaria in pregnancy occurring within two weeks of delivery. It was recommended that prompt malaria detection and treatment should be offered to pregnant women irrespective of signs or other preventive measures used during the pregnancy period, and with increased focus on mothers living in remote areas.

Andrew (2014) madean assessment of the spatial pattern of malariainfection in Nigeria. The pattern of spatial variation in the rate of malaria infection was analyzed using principal component analysis (PCA). Where the results indicated that, seasonal variations played significant roles in malaria infection in Nigeria. High concentration of malaria infections in some few states was shown. Therefore it was recommended that meditative effort should be made by Federal Ministry of Health to increase the distribution of treated mosquito nets and drugs in the affected areas and an increment in the financial allocation to the affected areas.

Exavery et al, (2014) measured the level and predictors of optimal IPTp-SP doses in six districts of Tanzania using Chi-Square to test the independent association between IPTp uptake and risk factors of malaria during antenatal period, and multinomial logistic regression for multivariate analysis. From the result, it was observed that, 43.6% of the antenatal women received optimal IPTp dose while 28% received partial dose. One of the predictor of both partial and optimal IPTp uptake was being counseled on the dangers of malaria infection during antenatal period (OR = 6.470, 95% C.I = 4.660 - 8.97) and (OR = 4.240, 95% C.I = 3.000 - 6.00), respectively. Higher chance of uptake of optimal doses of IPTp-SP (OR = 2.050, 95% C.I = 1.18-3.57) was associated with early ANC commencement. Furthermore, receipt of optimal SP doses by secondary or higher education level women during the antenatal period almost doubled those who had never been to school (OR = 1.930, 95% CI = 1.040 - 3.560). For marital status, married antenatal women 60% was associated with decline in the partial uptake of IPTp-SP (OR = 0.400, 95% CI = 0.170 - 0.960). There were statistically significant variations ($p < 0.05$). among both optimal and partial IPTp-SP doses uptake in the interdistrict.

Alaku and Abdullahi (2015) studied the Epidemiology of Malaria Infection in Pregnant Women in Some selected areas of Nassarawa State, Nigeria. Among the 360 samples examined, 316 (88%) had malaria in their blood. Age group 25–28 years recorded the highest prevalence rate and the difference between the age groups and pregnant women were statistically significant. Illiterate pregnant women had the highest mean parasite density with prevalence rate (97.3%). Drugs used were also considered in which traditional herbs had 100% sensitive to plasmodium falciparum than conventional medicinal drugs.

Olasehinde (2010) determined the prevalence and management of p.*falcipariummalaria* among neonates and children (0-12) years in ota, Ogun state of Nigeria. Overall, 215 (80.5%) of the 267 children investigated were malaria positive. Age category (0-5 years) had the highest frequency of 84.7% with mean parasite density of 900 and there was a statistical significant difference ($p<0.05$) between the age groups. Children of non-educated parents from villages had the greatest mean parasite density of 850 with 78.1% prevalence rate. Local herbs were give to 20% of the children and 22%

used orthodox medicine as prophylaxis. 18% used insecticide treated nets while 24% of the parents spray anti malaria to prevent mosquito bites. The study suggest need for more awareness on effective Insecticide treated Nets and use of drugs in malaria hyperendemic regions.

Oyewole et al (2011) usedcoefficients of correlation to find level ofrelationship between the frequencies of the knockdown resistance allele andresistance among the survivor and exposed mosquito samples to examine the Epidemiology of malaria and insecticide resistance burden in Nigeria, which were susceptible to the diagnostic doses of insecticides tested. Analysis ofvariance (ANOVA) was used to determine variation between five of the six ecological zones in Nigeria between 2002 and 2004. A significant level of resistance was recorded particularly in forest- savanna and Guinea savanna. However, there was no significant difference in knockdown resistance allele effects of insecticides in all the zones ($p < 0.0001$). There was a level of correlation between the frequency of the knockdown resistance alleleand frequency of resistance among the survivor and exposed samples ($p = 0.0037$). Hence this may indicate that knockdown resistance is associated with resistance in *Anopheles* mosquito to the analyzed insecticides.

Ayele et al (2012) investigate the prevalence and risk factors of malaria based on the rapid diagnosis test (RDT) in Ethiopia. The method of generalized linear model (GLM) was used to analyze the data and the dependent variable was presence or absence of malaria using the rapid diagnosis test (RDT).The analyses showed that the RDT shows a statistical significant association between age and gender. Main source of water, trip to obtained water, main material used for wall and roofing, toilet facility and total number of rooms were other significant covariates.The prevalence of malaria for households with clean water was found to be less. Spraying anti-malaria insecticide to the house was found to be one of the methods of reducing the risk of malaria. Malaria rapid diagnosis found to be higher for earth/local dung plaster floor and thatch and stick/mud roof. Furthermore, the housing condition, source of water and its distance, ages in the households and gender were identified in order to come up with two-way interaction effects. It was concluded that individuals with poor socio-economic situations are positively associated with malaria disease. Improving the housing situation of the household is one of the ways of reducing the risk of malaria. Female household members and children were the most exposed to the risk of malaria.

CHAPTER THREE

Material and Methods

This Chapter deals with the theory of logistic regression analysis, build an account of how logistic regression differs from conventional regression analysis. The history of logistic regression, its' application to medical sciences was also discussed. Measures of Model fit such as deviance, the likelihood ratio test and Cox & Snell's R^2, which are used to assess the significance of individual coefficients for inclusion or exclusion in a model in stepwise logistic regression were discussed.

3.1 Study Area

The information use in this research was a documented data obtained from National Bureau of Statistics Nigeria, it was health results based on financing Nigeria in the year 2013, and the survey was conducted by Federal ministry of Health in collaboration with National Bureau of Statistics and World Bank. It was an exit interview for antenatal care visit in six states of Nigeria namely Adamawa, Benue, Nassarawa, Ogun, Ondo and Taraba State which represent the six geopolitical zones of Nigeria. The data was analyzed both descriptively and inferentially using standard methods of applied statistics in health sciences. The analysis were done using univariate, bivariate and Multivariate statistical method. In this study the variables of interest were as follows.

3.2 Variables

The dependent or outcome of interest is prescription or given Quinine or fansider antimalarial pills by the health worker at ANC unit. Many drugs such as Arthimeter, chloroquine and pyrimethamine/sulfadoxine (Fansidar) are the most common drugs used for curing malaria in Nigeria and Africa as whole, such drugs assist in malaria treatment during pregnancy (Unicef, 2000). Thus, the dependent variable is binary, signifying whether or not a person was positive for malaria according to these antimalarial pills prescription, and it was derived from the question:

"During this visit, has a health worker given or prescribed you any antimalarial pills?"

The response was categorized in two categories such that:

Given or prescribed antimalarial pills = $\begin{matrix} YES : \textit{indicates malaria positive} \\ No : \textit{indicates absent of malaria} \end{matrix}$

Independent variables include Age, Highest level of Education, marital status, spouse education level, pregnancy weeks, IPTp uptake, primigravidae status, use of insecticide treated net, health insurance scheme, land asset, total family, main source of water, main source of energy for cooking and lightening, main material use for house wall, roof and floor, number of nets/person and livestock keeping (see table 3.1).

Table 3.1: The main categories of predictors variables used in this study

Variables	**Meaning**	**Variable type**
Age	Patients age	Quantitative
Education level	Highest education level of the pregnant woman.	Qualitative
Marital Status	Marital status of the woman.	Qualitative
Husband Education Level	Her spouse's level of education.	Qualitative
Weeks of pregnancy	How many weeks pregnant is the woman?	Quantitative
IPTp-uptake	Did the pregnant woman take IPTp dose?	Qualitative
Primigraidae	Is this your first pregnancy?	Qualitative
ITN	Do you own an insecticide treated net?	Qualitative
Health insurance scheme	Is the woman covered under health insurance scheme?	Qualitative
Land asset	Does her household own any land or house?	Qualitative
Total number of rooms	How many rooms does your household have?	Quantitative

Number of family	How many people live in your household now a day?	Quantitative
Room's wall material	What is the main material used for your room's wall?	Qualitative
Room's rooftop material	What is the main material used for your room's rooftof?	Qualitative
Room's floor material	What is the main material used for your room's floor?	Qualitative
Source of water during dry season	What is your main source of water for drinking during dry season?	Qualitative
Source of water during rainy season	What is your main source of water for drinking during rainy season?	Qualitative
Source of energy for lightening	What is your main source of energy for lightening?	Qualitative
Source of energy for cooking	What is your main source of energy for cooking?	Qualitative
Toilet facility	What kinds of toilet facility mainly use by people in your household?	Qualitative
Total number of nets	How many mosquito nets own?	Quantitative
Livestock keeping	Does your household own any animal?	Qualitative
States	From which state are you?	Qualitative

3.3 Statistical tools

Cleaning and data analysis was done using IBM SPSS Statistics (Demo version 20) package.The "Statistical Package for the Social Sciences" (SPSS) is a package of programs for manipulating, analyzing, and presenting data; the package is widely used in the social and behavioral sciences. There are several forms of SPSS. The core program is called SPSS Base and there are a number of add-on modules that extend the range of data entry, statistical, or reporting capabilities. In our experience, the most important of these for statistical analysis are the SPSS Advanced Models and SPSS

Regression Models add-on modules. SPSS Inc. also distributes stand-alone programs that work with SPSS (landau, 2004).

In the univariate analysis, frequency distribution and percentages for each qualitative variable while median and interquatile range (IQR) of the each quantitative variable were stated. Secondly, bivariate analysis was conducted, in which the outcome variable, presence or absent of malaria was cross tabulated against each and every independent variable. The statistical significant relationship between each pair of variables was tested using Pearson's Chi-Square ($\chi 2$) test, for the categorical variables, while for the continuous variables, due to violation of normality assumption which is one of the main parametric assumptions, a non-parametric version of independent sample t- test was used, hence Mann Whitney U test was considered to test the difference between each predictor with the response variable. Where p-value less than 5% (p-value $\leq$ 0.05) of the outcome and each of the independent variables reject the hypothesis of no significant association between the variables, and hence concluded that they were significantly associated, else, no association was deduced. Furthermore, multivariate analysis was done in bivariate way, were logistic regression with each single variable was performed to compare the result with the p-value for the bivariate and further analysis.

Finally, each variable from the chi-square result which is significant at 20% or less was subjected to multivariate analysis using binary logistic regression in a multivariable way. This was to ensure that all variables were adjusted for one another in order to obtain independent predictors of the malaria risk diagnosis. An interaction between the significant variables in the multivariate analysis was also done to see the significant association for interaction between variables. The category "present of malaria" of the outcome variable was made a baseline/ reference outcome hence assessing what predicts absence of malaria. For multivariate analysis, selection of predictor variables for building model depends on each one's to become statistically significant in the overall model. Also the model was assessed using Hosmer and Lemeshow's test from the measures of model fit, in which the model with Hosmer and Lemeshow's p-value greater than 0.05 was considered good model. From the model outputs, estimates, odds ratio (OR), their corresponding 95% confidence intervals (CI) and p-values were all reported. 5% significance level was considered.

3.3.1 Chi-squared test

This is one of the oldest and best known and used among many statistical tools. It is sometimes use to test whether an actual frequency distribution differs significantly from a hypothesized theoretical one. This can be achieved through employing a Chi Squared test by associating the actual and expected frequencies (Kirkwood and Sterne, 2003). The two application of Chi Squared test includes: testing whether there is an association between the row and the column variables and second is to test whether two proportions are equal or not, hence if the two groups are paired, then McNemar's test is suitable(Bowers, 2008).

Usman (2012) determine steps to follow when performing a Chi Square test, the first step can be achieved by hypothesizing the probability distribution which the data fits in, secondly the values of each parameter of the distribution from the actual data must either be hypothesized or estimated so that it will be used to find the probability and the theoretical frequency for each category, then finally employing chi square to test whether the data was fitted best in the distribution

The chi square test statistic is given as:

$$\chi^2 = \sum_{i=1}^{k} \frac{(o_i - e_i)^2}{e_i} \qquad (3.1)$$

where

$o_i$is the actual frequency while e_i is the expected frequency. The test statistic has approximately a chi square distribution with *v=k-1 degree of freedom*, the approximation is considered acceptable under the following condition:

i. For v=1 degree of freedom, no value of e_i must be smaller than 5

ii. For v>1 degrees of freedom, no value of e_i must be smaller than 1 and no more than 20% of the expected frequency must be less than 5.

Using SPSS, chi square test can be analyse through

Analyze – descriptive statistics – crosstab – statistics – chi square test – continue – ok.

3.3.2 Mann Whitney U test

This test is a nonparametric alternative to the independent sample t-test. Equality of means cannot be tested if the sample was drawn from nonmormal distribution which indicates presence of small sample size. In this case, medians are better parameters of measure of central tendency since the population is distribution free, hence nonparametric version of independent t-test should be employed which is Mann Whitney U test (Elston and Johnson, 2008).

The Mann Whitney U test statistic is defined as:

$$U = n_1 n_2 + \frac{n_1(n_1+1)}{2} + R_1 \qquad (3.2)$$

where

n_1 and n_2 are first and second sample sizes respectively, and R_1 is the rank sum.

Using SPSS package, the analysis can be achieve through:

Analyze - Nonparametric tests – Legacy dialogue – 2-Independent samples – Choose the variables – Ok.

3.4 Logistic Function and Logistic Regression

A regression method is a statistical method use in analyzing the relationship between dependent or response variable and one or more independent variables. Linear regression is the most popular method in which least square method is used in estimating the model coefficients; this is referred to as conventional regression analysis. It is applicable only if the response variable is independent and identically distributed (iid). Conventional regression analysis is not appropriate in cases where the dependent variable is categorical (Al-Ghamdi, 2001). It is also a statistical method that utilizes the relationship between two or more continuous variables so that the dependent variable can be predicted from other independent variable or variables. The method is widely use in behavarioral medical sciences, business, social and behavioral sciences and many other disciplines (Faraway, 2014).

Logistic regression measures the association between a treatment and risk factor for any event or a disease, after making an adjustment for other variables. Linear regression finds an equation that predicts an outcome variable which must be a measured or continuous (a variable that can take on any value) from one or more independent variables, while Logistic regression finds an equation or model that best predicts an outcome variable which must be categorical, such as the presence or absence of disease from one or more explanatory variable (Harvey, 1995). It is used because having a categorical outcome variable violates the assumption of linearity and normality in normal regression analysis. According to Kleinbaum*et al* (2008), logistic regression analysis quantifies the relationship between the binary predicted variable and the predictors using odds or relative risk ratios. Odds ratio is the probability that an event will occur say ***p***, divided by the probability that the event will not happen say ***1-p***. In this study the odds ratio is the probability that a pregnant woman is malaria positive divided by the probability that the pregnant woman is not having malaria disease.

If the dependent variable is discrete, application to linear regression model in such case would not be satisfactory, since the fitted predicted response would ignore the restriction of binary values from the observed data, hence logistic regression analysis would be employed in this case. Logistic regression is a method use to for the analysis of binary outcome variables (Press & Wilson, 1978 and Daniel &wayne 1995). Many research question with dichotomous outcome were tackled by either ordinary least squares regression analysis or linear discriminant function analysis. Both techniques were successively found to be less than perfect method for handling binary outcomes due to their strict statistical assumptions which include linearity, normality, and continuity for Ordinary Least Square regression analysis and multivariate normality with homogeneity of variances and covariances for discriminant function analysis (Cabrera, 1994; Cleary and Angel, 1984; Cox and Snell, 1989; Efron, 1975; Lei and Koehly, 2000; Tabachnick and Fidell, 2001).The central mathematical concept that brings about logistic regression is the logit, which is the natural logarithm of an odds ratio (Peng, Lee, & Ingersoll, G. M. (2002).

Generally, logistic regression analysis is well appropriate for describing and testing hypotheses about relationships between a qualitative outcome variable and one or more qualitative or quantitative predictor variables (Zar, 1999).In this research binary logistic regression analysis was employed to analyzed factors associated with malaria diagnosis among antenatal women in Nigeria, the response variable was the presence or absence of malaria among pregnant women which was suggested using antimalarial pill prescribed or given to the pregnant woman by the health facility. The independent variables include Age, Highest level of Education, marital status, spouse education level, pregnancy weeks, primigravidae status, prescription of antimalarial pills, use of insecticide treated Net, health insurance scheme, land asset, total family, main source of water, main source of energy for cooking and lightening, main material use for house wall, roof and floor, number of Nets/person and livestock keeping.

3.4.1 Binary logistic regression

Binary Logistic regression is an extrapolative model that is fitted in a condition where the dependent variable is a dichotomous or binary like in this instance where the researcher is attentive in whether a woman is having malaria or not during pregnancy period. Mostly, the categories are coded as “0" and "1" as it results is a direct interpretation. Usually the category of interest also kindly referred to the case is typically coded as "1" and the other category is also known as a "non-case" as "0" (http://en.wikipedia.org/wiki/Logistic_regression). In this research a pregnant woman that are malaria positive “case”, will be denoted by a 1 and if the pregnant woman is malaria free “non-case” will be denoted by 0.

3.4.2 Assumption of logistic regression

According to (faraway, 2014), the assumptions of logistic regression include:

- There is no linear relationship between the response and the predictor variables.
- The response variable must have two categories.
- The explanatory variables need not be normally distributed, nor interval, nor linearly related, nor homogeneity of variance within each group.
- Categories of the response variable must be mutually exclusive.
- Larger samples are needed than for linear regression since coefficients of maximum likelihood are large sample estimates. A minimum of 50 cases per predictor is recommended.

3.4.3 Logistic regression with a single variable

The logit or logistic function is used to transmute an ’S’-shaped curve to an approximately straight line and also to change the range of the proportion from 0 – 1 to -

∞ to +∞. In this study, single variable logistic regression will be employed to see the effect of each predictor only, in the absence of other predictors.

3.3.4 Odds

The ratio of the probability that malaria is present is p_i over the probability that malaria is not present $1 - p_i$ is called odds, and is given by

$$odds = \frac{p_i}{1 - p_i} \tag{3.6}$$

3.4.5 Logit function

The logit function is defined as the natural logarithm of the odds of an outcome. That is,

$$Logit = \ln\left(\frac{p}{1 - p}\right) \tag{3.3}$$

where

p is the probability of event occurrence. For single predictor variable, the logit function is:

$$Logit(p) = \ {}_0 + \ {}_1 x \tag{3.4}$$

Even though this model looks similar to simple linear regression model, the fundamental distribution is binomial distribution and the parameters and cannot be estimated using ordinary least square as exactly the same way as for simple linear regression model. Instead, maximum likelihood estimation method was use to estimate the parameters of the model, which is discussed below.

The formula for logistic regression is given by

$$p_i = p(y_i = 1 | x_i) \tag{3.5}$$

where

$y_i =$ 0, *if a pregnant woman is □aving malaria*
1, *if a pregnant woman is not □aving malaria*   i = 1,2,…,n

3.4.6 Logistic regression with several explanatory variables

In this case, we may wish to investigate how present or absent of malaria can be predicted by more than one control variable among the pregnant women. Like ordinary linear regression, logistic regression can be extended to fit in more than one explanatory variable, which may be either continuous or categorical. For example, given that controlled malaria patients at risk for death are prejudiced by predictors such as type of treatment, length of stay, referral and distance. Two of these predictors are qualitative; these are treatment type and referral. Therefore this study was carried out using seventeen (17) qualitative variables and five(5) quantitative variables (see table 3.1).

Logit from the logistic model is usually denoted by taking the logarithm of odds, and it can be express as

$$\log\left(\frac{p_i}{1-p_i}\right) = {}_0 + {}_1x_1 + {}_2x_2 + \cdots + {}_nx_n \qquad (3.6)$$

Taking the exponential of equation (3.6)

$$\frac{p_i}{1-p_i} = {}_0 + {}_1x_1 + {}_2x_2 + \cdots + {}_nx_n \qquad (3.7)$$

$$p_i = e^{\left({}_0 + {}_1x_1 + {}_2x_2 + \cdots + {}_nx_n\right)} - p_i\, e^{\left({}_0 + {}_1x_1 + {}_2x_2 + \cdots + {}_nx_n\right)} \qquad (3.7)$$

$$p_i\left(1 + e^{\left({}_0 + {}_1x_1 + {}_2x_2 + \cdots + {}_nx_n\right)}\right) = e^{\left({}_0 + {}_1x_1 + {}_2x_2 + \cdots + {}_nx_n\right)} \qquad (3.8)$$

$$p_i = \frac{1}{1 + e^{\left({}_0 + {}_1x_1 + {}_2x_2 + \cdots + {}_nx_n\right)}} \qquad (3.9)$$

According to Usman (2012), since the influence of dependent variable is explained in terms of the odds ratio in binary logistic regression, the categorical variable has only two values. Generally, 1 and 0 which represent success and failure respectively. Logistic regression uses a logit function to relate the probability of success and predictors, and applies maximum likelihood estimation method to estimate parameters.

3.4.7 Maximum Likelihood (ML) estimation

This is one of the classical methods of estimation, a method of moment was the common and easiest method usually applies, but it doesnot yield a good estimators.To obtain the actual values of parameters that would have most likely be the source of the data that we in fact observed, maximum likelihood method has to be employed.For most cases of practical concern, the performance of maximum likelihood estimators is best for large enough data. This is one of the most flexible methods for fitting parametric statistical models to data (Ramachandran&Tsokos, 2009). Maximum likelihood is use to find best fitting equation, and it maximizes the probability of getting the observed result given the fitted regression coefficients.

Following binomial distribution, the probability density function is

$$f(Y_i) = p_i^{y_i}(1-p_i)^{1-y_i} , \qquad y_i = 1,2,\ldots,n \tag{3.10}$$

Y_i is assumed to be independent, therefore the joint density function is

$$p(y_1 \ldots y_n) = \prod_{i=1}^{n} f(y_i) = L(\quad) \tag{3.11}$$

Where **β**isp a vector of unknown parameters

$$= \prod_{i=1}^{n} p_i^{y_i}(1-p_i)^{1-y_i} \tag{3.12}$$

Taking the natural logarithms of the function, we obtained;

$$\ln p(y_{i,\ldots} y_n) = \sum_{i=1}^{n} y_i \ln\left(\frac{p_i}{1-p_i}\right) + \sum_{i=1}^{n} \ln p(1-p_i) \tag{3.13}$$

From equation (3.13)

$$L(\quad) = \sum_{i=1}^{n} y_i \ln(\ _0 + \ _1x_1 + \ _2x_2 + \cdots + \ _nx_n) + \sum_{i=1}^{n} \ln[1-(\ _0 + \ _1x_1 + \ _2x_2 + \cdots + \ _nx_n)]$$

(3.14)

The maximixation of the $L(\quad)$function be carried out using one of numerical optimization methods, which iteratively improves current estimates of function maxima using estimates of its first and second order derivatives (Usman, 2012).

3.5 Measures of model fit

These measures will be used to see any difference in their level of goodness of fit, and hence provide us some directives in choosing an appropriate model (zar, 1999).

3.5.1 Likelihood ratio tests

The likelihood ratio test for a parameter compares the likelihood of getting the data when the parameter is zero (L_0) with the likelihood (L_1) of getting the data evaluated at the Maximum Likelihood Estimate (MLE) of the parameter. Likelihood ratio test is analogous to the sum squares residual in multiple regression, hence Large values indicate poorly fitting statistical models.

3.5.2 Cox and Snell's R^2

It based on calculating the proportion of unexplained variance that is decreased by adding variables to the model. It is an alternative key of goodness of fit related to the R^2 value from linear regression analysis, it is problematic as its maximum value tends to (0.75), when the variance is at its maximum (0.25).

3.5.3 Hosmer and Lemeshow's test

This represents the proportional reduction in the absolute value of the log-likelihood test. It measures how much the "badness of fit" improves as a result of the inclusion of the predictor variables.

CHAPTER FOUR

Results

The chapter describes the results of our research in detailed. The analysis was divided into three parts. The first part involves a univariate analysis of the independent test of Malaria diagnosis among pregnant women with some of our variables in the data, the second part involves a Chi-Square between the dependent variable with each independent variable, and the last part was a multivariate analysis which was carried out using binary logistic regression analysis.

4.1 Descriptive analysis of Data

A total of 1,676 antenatal women aged from 9to 48 responded to malaria related questions from six states of Nigeria, of which 39.7% were from Adamawa state, 6.1% from Benue state, 16.6% from Nassarawa state, 5.0% from Ogun state, 22.3% from Ondo state and 10.3% were from Taraba state, all missing values were excluded. The majority of women (97%) were married, and about 32.2% have secondary education level. Occupationally, majority of the pregnant women were livestock keepers. From the descriptive statistics result, it was observed that 49.5% of the women were prescribed or given an antimalarial pill by the health facility, while 50.5% of the pregnant women were not prescribed(You could test this with Chi-Squared test!). Furthermore, 60.1% of the women were multigravidae, 44.3% take partial intermitted preventive treatment against malaria, while 20.3% took optimal IPTp-doses. Also 51.7% were using insecticide treated net, while only 9.6% of the women were covered under health insurance scheme (Table 4.1).

Table 4.1: Profile of Respondents

Variables	N	(%)
Education level		
Preprimary	485	28.9
Primary	356	21.2
Secondary	573	34.2
Higher	89	5.3
No education	173	10.3
Marital Status		
Single	36	2.1
Married	1625	97.0
Widowed	7	0.4
Divorced	8	0.5
Husband Education Level		
Preprimary	283	16.9
Primary	212	12.6
Secondary	697	41.6
Higher	237	14.1
No education	247	14.7
First pregnancy		
Yes	656	39.1
No	1020	60.1
Use of IPTp		
0-Dose	594	35.4
1-Dose	742	44.3
2-Doses	340	20.3
Use of ITN		
Yes	867	51.7
No	809	48.3
Health insurance		

Variables	N	(%)
Yes	161	9.6
No	1515	90.4
Husband own land or house?		
Yes	938	56.0
No	738	44.0
Material use for room's wall		
Bricks/blocks	932	55.6
Mud /earth/stick	564	33.7
Concrete/cement only	180	10.7
Main material of room's rooftop		
Corrugated iron/metal	1201	71.7
Thatch/grass	341	20.3
Asbestos	134	8.0
Main material of room's floor		
Concrete/cement only	1234	73.6
Earth/mud	339	20.2
Tiles	103	6.1
Main source of water (dry season)		
Protected	512	30.5
Tap water	130	7.8
Borehole	748	44.6
Unprotected	286	17.1
Main source of water (rainy season)		
Protected	534	31.9
Rain water	338	20.2
Borehole	648	38.7
Unprotected	156	9.3
Source of energy for lightening		
Electricity	544	33.1
Kerosene/Gas	150	8.9

Variables	n	(%)
Wood/coal/charcoal	972	58.0
Source of energy for cooking		
Electricity	60	3.6
Generator/solar/gas	379	22.6
Traditional sources	1237	73.8
Toilet facility		
Pit latrine	1022	61.0
No toilet facility	307	18.3
Toilet with flush	347	20.7
Livestock farming		
No	382	22.8
Yes	1294	77.2
States		
Adamawa	666	39.7
Benue	102	6.1
Nassarawa	278	16.6
Ogun	84	5.0
Ondo	374	22.3
Taraba	172	10.3

4.2 Bivariate analysis

In the Bivariate analysis, chi square test was employed for the categorical variables, education level of the pregnant women was found to have a significant association with malaria diagnosis ($p < 0.001$), majority of preprimary educated women were malaria positive, while majority of women with secondary education level were malaria free. Marital status was insignificant, whereas husband education level have a significant relationship with malaria diagnosis ($p < 0.001$). From the chi square test result, it was observed that spouses with secondary education level, their wives were most likely malaria free. Primigravidae has a significant relationship with malaria diagnosis ($p = 0.024$). Such that malaria positive was highest among primigravidae compared to multigravidae. Furthermore, use of intermitted preventive treatment against malaria was found to have a significant association with malaria risk ($p < 0.001$), were majority of women with positive malaria did not received either partial or optimal IPTp- doses. While most of them with partial IPTp were malarial free. Use of ITN was found to have a statistical significant relationship with malarial diagnosis ($p = 0.014$). Health insurance scheme was found to have insignificant relationship with malaria risk, as well as material used for room's wall and floor. But material used for room's rooftop was found to have a significant relationship with malaria risk ($p < 0.001$), were majority of women with corrugated iron/metal were found to be malaria positive. Main sources of water for drinking during both dry and rainy season were found to be significant ($p = 0.010$ and $p < 0.001$). Women drinking borehole water, were found have malaria risk diagnosis in both seasons.

Table 4.2: Independent test for malaria status versus all the qualitative predictor variables

Variables	**n**	**Present of malaria**	**Absent of malaria**	χ^2	**p-value**
Education level					
Preprimary	485	295	190	38.43	<.001*
Primary	356	150	206		
Secondary	537	257	316		
Higher	89	40	49		
No education	173	87	86		
Marital Status					
Single	36	19	17	5.779	0.123
Married	1625	807	818		
Widowed	7	2	5		
Divorced	8	1	7		
Husband Education Level					
Preprimary	283	172	111	30.738	<.001*
Primary	212	85	127		

Variables	n	Present of malaria	Absent of malaria	χ^2	p-value
Secondary	697	322	375		
Higher	237	110	127		
No education	247	140	107		
First pregnancy					
Yes	656	347	309	5.083	0.024*
No	1020	482	538		
Use of IPTp					
0-Dose	594	418	176	161.544	<.001*
1-Dose	742	288	454		
2-Doses	340	123	217		
Use of ITN					
Yes	867	454	413	6.409	0.014*
No	809	375	434		
Health insurance					
Yes	161	81	80	0.051	0.821
No	1515	748	767		
Husband own land or house?					
Yes	938	491	447	7.080	0.008*
No	738	338	400		
Material used for room's wall					
Bricks/blocks	932	457	475	2.031	0.362
Mud/earth/stick	564	274	290		
Concrete/cement only	180	98	82		
Main material of room's rooftop					
Corrugated iron/metal	1201	557	644	32.326	<0.001*
Thatch/grass	341	215	126		
Asbestos	134	57	77		
Main material of room's floor					

Variables	n	Present of malaria	Absent of malaria	χ^2	p-value
Concrete/cement only	1234	606	628	1.032	0.597
Earth/mud	339	175	164		
Tiles	103	48	55		
Main source of water (dry season)					
Protected	512	223	289	11.251	0.010*
Tap water	130	63	67		
Borehole	748	396	352		
Unprotected	286	147	139		
Main source of water (rainy season)					
Protected	534	258	276	22.326	<.001*
Rain water	338	133	205		
Borehole	648	355	293		
Unprotected	156	83	73		
Source of energy for lightening					
Electricity	544	235	319	17.027	<.001*
Generator/solar/Gas	150	75	75		
Traditional sources	972	519	453		
Source of energy for cooking					
Electricity	60	30	30	16.315	0.002*
Kerosene/Gas	379	153	226		
Wood/coal/charcoal	1237	646	591		
Toilet facility					
Pit latrine	1022	551	471	20.910	<.001*
No toilet facility	307	133	174		
Toilet with flush	347	145	202		
Livestock farming					
Yes	382	633	168	5.953	0.009*
No	1294	661	214		

Variables	n	Present of malaria	Absent of malaria	χ^2	p-value
States					
Adamawa	666	318	348	3.010	0.698
Benue	102	49	53		
Nassarawa	278	145	133		
Ogun	84	38	46		
Ondo	374	189	185		
Taraba	172	90	82		

*p < 0.050.

Main source of energy for lightening was found to have a statistical significant relationship with malaria risk ($p < 0.001$), where majority of pregnant women using traditional source of lightening were found to be malaria positive. Also main source of energy for cooking was found to have a statistical significant relationship with malaria diagnosis ($p = 0.002$), where majority of women using wood/coal/charcoal were found to be malaria positive. Toilet facility was a significant factor of malaria ($p < 0.001$), in which majority of women using pit latrine were found to be malaria positive. Occupationally, livestock keepers have a significant relationship with malaria diagnosis ($p = 0.009$), such that majority of livestock keepers women were found to be malaria positive, whereas relationship with malaria risk and states was in significant.

Table 4.3: Independent test for malaria versus all qualitative predictors

Variable	Median (IQR)		Z	p-value
	Present of malaria	Absent of malaria		
Age	25.00 (10)	25.00 (10)	-1.733	0.083
Week of Pregnancy	20.00 (10)	20.00 (12)	-1.168	0.243
Total number of family	5.00 (4)	4.00 (4)	-0.948	0.343
Total of rooms	3.00 (2)	3.00 (2)	-1.674	0.094
Total of nets/person	1.00 (2)	1.00 (2)	-1.067	0.286

*p < 0.050.

For continuous variables, Mann Whitney U-test was used to test the difference between the response and the predictors, due to violation of one of the main parametric assumption which is normality. Based on the result obtained, median age of positive and negative malaria was 25years with interquartile range (10), median weeks of pregnancy was 20weeks with interquartile range for positive and negative malaria (10 and 12) respectively, median total number of family was 4 and 5 with interquartile range (4), median number of rooms was 3 with IQR (2) and median number of nets per person is 1 with IQR (2). All the qualitative variables were found to be insignificant at 0.05 level of significant, but Age and number of rooms were found to be significant at 0.1 level of significance. (See table 4.3)

4.3 Binary Logistic Regression using single variable

Binary logistic regression analysis was done using each single independent variable with the dependent variable to see the significant relationship between each single predictor with the response variable in the absence of other predictors. It was observed from the result that Age was significant single predictor of malaria risk (p = 0.011). For a unit increase in age indicates an increase in odds of positive malaria (OR=1.021, 95% CI=1.005 – 1.038). Education level was found to be a significant single predictor for malaria diagnosis. Such that, pregnant women with primary education were 34.4% lower risk of positive malaria diagnosis (OR=0.652, 95% CI=0.459 – 0.924) compared to women with no education. Marital status was found to be insignificant predictor of malaria risk, but husband level of education was a single predictor of malaria diagnosis, such that spouses with primary level of education, their wives were significantly 1.955 times higher of positive malaria diagnosis compared to those with no education (OR=1.955, 95% CI=1.349 – 2.837), also those having secondary level spouses were1.524 times likelihood of malaria risk (OR=1.524, 95% CI=1.137 – 2.041) as well as those with spouses having higher education were 1.511 times higher risk of malaria (OR=1.511, 95% CI=1.056 – 2.162). Weeks of pregnant was found to be insignificant, while primigravidae was a significant factor of malaria during pregnancy, primigravidae were 20.2% less probable of malaria risk diagnosis (OR=0.798, 95% CI=0.655 – 0.971) compared to multigravidae.

Use of intermitted preventive treatment against malaria was a significant single predictor of malaria diagnosis. Women who received partial IPTp dose were 76.1% less likely than those were not treated (OR=0.239, 95% CI=0.180 – 0.317). Antenatal women sleeping under ITN were 21.4 lower risk of malaria compared to pregnant women who were not sleeping under ITN (OR=0.786, 95% CI=0.180 – 0.952). Health insurance scheme was found to be insignificant, but household owning land or house was a significant factor in which the pregnant women were at lower risk of malaria among those that their household own land or house (OR=0.769, 95% CI=0.634 – 0.933).

Table 4.4: Logistic regression with single variables

Variables	Estimate (β)	OR	95% C.I		p-value
			Lower	Upper	
Age	0.021	1.021	1.005	1.038	0.011*
Education level (ref. No education)					
Preprimary	-0.428	0.652	0.459	0.924	0.016*
Primary	0.329	1.389	0.965	2.001	0.077
Secondary	0.218	1.224	0.885	1.748	0.209
Higher	0.215	1.239	0.742	2.070	0.413
Marital Status (ref. Divorced)					
Single	-2.057	0.128	0.014	1.148	0.066

Variables	Estimate (β)	OR	95% C.I		p-value
			Lower	Upper	
Married	-1.932	0.145	0.018	1.180	0.071
Widowed	-1.030	0.357	0.025	5.109	0.448
Husband Education Level (ref. No education)					
Preprimary	-0.0169	0.844	0.597	1.194	0.339
Primary	0.670	1.955	1.349	2.837	<.001*
Secondary	0.421	1.524	1.137	2.041	0.005*
Higher	0.413	1.511	1.056	2.162	0.024*
Pregnancy week	0.007	1.007	0.995	1.018	0.256
First pregnancy (ref. No)					
Yes	-0.226	0.798	0.655	0.971	0.024*
Use of IPTp (ref. 0-Dose)					
2-Dose	-1.433	0.239	0.180	0.317	<.001*
1-Doses	-0.113	0.894	0.685	1.166	0.407
Use of ITN (ref. No)					
Yes	-0.241	0.786	0.649	0.952	0.014*
Health insurance (ref. No)					
Yes	-0.038	0.963	0.696	1.333	0.821
Husband own land or house? (ref. No)					
Yes	-0.262	0.769	0.634	0.933	0.008*
Room’s wall material (ref. Concrete/cement only)					
Bricks/blocks	0.217	1.242	0.902	1.711	0.184
Earth/mud/stick	0.235	1.265	0.903	1.771	0.171
Concrete/cement only					
Room’s rooftop material (ref. Asbestos)					
Corrugated iron/metal	-0.156	0.856	0.597	1.228	0.398
Thatch/grass	-0.835	0.434	0.289	0.652	<.001*
Room’s floor material (ref. tiles)					
Concrete/cement only	-0.100	0.904	0.604	1.353	0.625
Earth/mud	-0.201	0.818	0.526	1.272	0.373

Variables	Estimate (β)	OR	95% C.I		p-value
			Lower	Upper	
No. of room	0.010	1.010	0.997	1.023	0.118
No. of family	-0.006	0.994	0.979	1.008	0.395
Main source of water (dry season) (ref. unprotected)					
Protected	0.315	1.371	1.025	1.832	0.033*
Tap water	0.118	1.125	0.743	1.703	0.579
Borehole	-0.062	0.940	0.716	1.235	0.657
Main source of water (rainy season) (ref. unprotected)					
Protected	0.196	1.216	0.851	139	0.283
Rain water	0.561	1.752	1.195	1.570	0.004*
Borehole	0.064	0.932	0.661	1.332	0.722
Source of energy for cooking (ref. Wood/coal/charcoal)					
Electricity	0.442	0.555	0.260	0.916	<.001*
Kerosine/Gas	0.136	1.146	0.812	1.616	0.438
Source of energy for lightening (ref. Traditional sources)					
Electricity	0.089	1.093	0.651	1.835	0.736
Generator/solar/gas	0.479	1.615	1.278	2.039	<.001*
Toilet facility (ref. Toilet with flush)					
Pit latrine	-0.488	1.614	1.480	2.785	<.001*
No toilet facility	-0.063	0.939	0.688	1.281	0.692
No. of nets	0.053	1.055	0.979	1.136	0.161
Livestock farming (ref. No)					
Yes	0.282	1.330	1.057	1.673	0.015*
States (ref. Taraba)					
Adamawa	0.183	1.201	0.859	1.680	0.285
Benue	0.172	1.187	0.727	1.938	0.493
Nassarawa	0.007	1.007	0.688	1.473	0.972
Ogun	0.284	1.329	0.787	2.248	0.287
Ondo	0.072	1.074	0.748	1.545	0.697

*p < 0.050; ref = reference/baseline category.

Main material for room's wall and floor were found to be insignificant. Women with thatch/grass as their rooftop were found to have 56.6% lower risk of malaria diagnosis (OR=0.434, 95% CI=0.289 – 0.652) compared with those using Asbestos. Number of room and family were insignificant, but pregnant women using protected water as their main source of water for drinking during dry season were 1.375 times highercompared with those drinking unprotected water (OR=1.375, 95% CI=1.025 – 1.832). Also pregnant women using rain water during rainy season were 1.752 times higher compared to those drinking unprotected water (OR=1.752, 95% CI=1.195 – 1.570). Pregnant women using electricity as their main source of cooking were found to be less likely diagnosed as positive malaria than those using wood/coal/charcoal as the their main source of energy for cooking (OR=0.555, 95% CI=0.260 – 0.916). Furthermore, women using generator/gas/solar as their main source of energy for lightening were found to be 1.615 times highercompared to those using traditional sources of lightening (OR=0.615, 95% CI=0.278 – 1.039). Pregnant women who were using pit latrine were found to be at higher risk compared to those that uses toilet with flush (OR=1.614, 95% CI=1.480 – 2.785). Furthermore number of nets per person was insignificant, but women who were livestock keepers were at1.330times higher risk of malaria than those who were not (OR=1.330, 95% CI=1.057 – 1.673).

4.4 Binary Logistic Regression with multiple variables

In this section, binary logistic regression analysis was done between the variables without interaction between them. Each variable having a significant value less than or equal to 20% from chi square test was chosen to run a binary logistic regression to see their effect in the model. Table 4.4 gives the estimates of significant geographic, socio-economic and demographic factors on malaria during pregnancy. Husband's education, antimalarial pill prescription, use of insecticide treated nets, room's rooftop material, main source of energy for cooking, and livestock keeping were found to be significant main effects. Based on the outcome obtained, malaria risk increases by 8.1% among pregnant women with unit increase in age (OR=0.919, 95% CI=0.896 – 0.943). furthermore women who took optimal IPTp doses, were 90.9% less likely diagnosed as malaria positive compared to those who did not received the treatment at all (OR=0.091, 95% CI=0.059 – 0.140) as well as those that received partial IPTp dose, the risk of positive malaria decreased by 43.5% (OR=0.565 95% CI=0.409 – 0.780) compared to those with none or 0-IPTp dose. First pregnancy was a statistical significant predictor of malaria diagnosis ($p < 0.001$), such that the odds of positive malaria among premigravidae was found to be 34.2% compared with multigravidae (OR=0.658, 95% CI=0.523 – 0.828). Furthermore, insecticide treated net was found to be a significant predictor of malaria during pregnancy ($p = 0.001$). Pregnant women using ITN were 30.4% less likely than those who were not using ITN (OR=0.696, 95% CI=0.559 – 0.876). Source of energy for cooking was found to be a significant predictor of malaria during pregnancy, such that women using electricity for cooking were 57.9% less probable to have positive malaria (OR=0.421, 95% CI=0.091 –0.850) compared with traditional sources users. Livestock keeping was also a significant predictor of malaria risk. The relative risk of Livestock keepers among pregnant women was significantly 1.453 higher compared to those who were not livestock keepers (OR=1.453, 95% CI=1.125 – 1.877). Main material for room's rooftop was also a significant predictor of malaria risk. Women with thatch/grass were found to be less likely compared to those with asbestos (OR=0.470, 95% CI=0.291 – 0.759).

Table 4.5: Logistic regression with multiple variables

Variables	**Estimate**	**Odds**	**95% C.I**		**p-value**
	β	**ratio**	**Lower**	**Upper**	
Age	-0.084	0.919	0.896	0.943	<.001*
Education level (ref. No education)					
Preprimary	-0.361	0.697	0.444	1.095	0.117
Primary	0.193	1.213	0.770	1.909	0.405
Secondary	0.059	1.061	0.675	1.666	0.797
Higher	0.107	1.113	0.562	2.206	0.759
Marital Status (ref. Divorced)					
Single	-1.701	0.182	0.018	1.800	0.145

Variables	Estimate (β)	OR	95% C.I		p-value
			Lower	Upper	
Married	-1.852	0.157	0.018	1.383	0.095
Widowed	-0.678	0.508	0.032	7.987	0.630
Husband Education Level (ref. No education)					
Preprimary	0.043	1.043	0.665	1.638	0.853
Primary	0.433	1.542	0.986	2.412	0.058
Secondary	0.097	1.102	0.750	1.619	0.620
Higher	-0.013	0.987	0.608	1.603	0.958
Use of IPTp (ref. 0-Dose)					
2-Dose	-2.398	0.091	0.059	0.140	<.001*
1-Doses	-0.572	0.565	0.409	0.780	0.001*
First pregnancy (ref. No)					
Yes	-0.419	0.658	0.523	0.828	<.001*
Use of ITN (ref. No)					
Yes	-0.363	0.696	0.559	0.867	0.001*
Husband own land or house (ref. No)					
Yes	-0.046	0.955	0.759	1.202	0.697
Total number of rooms	0.010	1.010	0.996	1.024	0.160
Source of water during dry season (ref. unprotected)					
Protected	0.137	1.147	0.781	1.684	0.485
Tap water	0.089	1.093	0.652	1.831	0.736
Borehole	0.076	1.079	0.644	1.808	0.773
Source of water during rainy season (ref. unprotected)					

Variables	Estimate (β)	OR	95% C.I Lower	95% C.I Upper	p-value
Protected	-0.072	0.931	0.587	1.476	0.761
Tap water	0.317	1.373	0.857	2.201	0.188
Borehole	-0.219	0.803	0.440	1.466	0.476
Source of energy for cooking(ref. Traditional sources)					
Electricity	-0.380	0.684	0.380	1.231	0.205
Generator/solar/gas	0.180	1.197	0.876	1.635	0.259
Source of energy for lightening (ref. traditional sources)					
Electricity	-0.351	0.421	0.091	0.850	0.009*
Generator/solar/Gas	0.021	1.021	0.696	1.497	0.915
Toilet facility (ref. Toilet with flush)					
Pit latrine	-0.243	0.784	0.570	1.078	0.135
No toilet facility	0.229	1.258	0.850	1.861	0.251
Livestock farming (ref. No)					
Yes	0.374	1.453	1.125	1.877	0.004*
Room's rooftop material (ref. Asbestos)					
Corrugated iron/metal	-0.243	0.784	0.523	1.176	0.240
Thatch/grass	-0.754	0.470	0.291	0.759	0.002*
Intercept	5.532	252.730			<.001*

*p < 0.050; ref = reference/baseline category.

4.4.1 Use of Hosmer and Lemeshow Test to Assesses the Model Fit

The model can be assessed through formulating the hypothesis below:

H_0: The data fits in the postulated Model

H_1: The data does not fit in the postulated Model

From Table 4.6, since the p – value = 0.082, which is greater than level of significance (α = 0.05), hence the null hypothesis was failed to be rejected (H_0) meaning that a sufficient evidence was enough to show that the data Fits in the postulated Model set used in predicting malaria among Nigerian pregnant women. Hence, this indicates that the risk factors are not significantly different from those foretold by the model and the overall model fit is clear.

Table 4.6: Assessing the model using Hosmer and Lemeshow Test

Chi-square	Df	p-value
13.986	8	0.082

4.5 Interaction effect

Table 4.6 present an interaction between significant variables in the above model. An interaction between age and first pregnancy was significant predictor of malaria diagnosis (p = 0.034), malaria risk decreases among women with first pregnancy with unit increase in age (OR=0.034, 95% CI=0.980 – 0.999). Furthermore, malaria risk increases with 1.135times among pregnant women using ITN and partial IPTp uptake with unit increase in age (OR = 1.134, 95% CI = 1.044 – 1.232). With reference to those who did not take IPTp dose and were not using ITN, malaria risk decreases with 13.7% among women with first pregnancy with unit increase in age (OR = 0.863, 95% CI = 0.802 – 0.928). Furthermore, with reference to 0-IPTp dose and ITN free, positive malaria risk was significantly less probable among antenatal women with partial IPTp-uptake and ITN use (OR = 48.797, 95% CI = 6.347 – 375.145).

Table 4.7: Logistic regression for multiple variables with interaction

Variables	**Estimate β**	**OR**	**95% C.I. Lower**	**Upper**	**p-value**
Age and primigravidae	-0.010	0.990	0.980	0.999	0.034*
Age, IPTp and ITN (ref. 0-dose and NO)					
1-dose and Yes	0.126	1.134	1.044	1.232	0.003*
2-dose and Yes	-0.148	0.863	0.802	0.928	<.001*

Variables	Estimate (β)	OR	95% C.I		p-value
			Lower	Upper	
IPTp and ITN (ref. 0-dose and No)					
1- dose and Yes	-3.550	0.029	0.005	0.167	<.001*
2-dose and Yes	3.888	48.797	6.347	375.145	<.001*
ITN, Primigravidae and ITN (ref. 0-dose, No and No)					
1-dose, and Yes	-1.247	0.287	0.142	0.582	0.001*
2-dose Yes and Yes	0.141	1.152	0.672	1.973	0.607
Age and livestock keeping	0.012	1.013	1.003	1.022	0.007*
Source of electricity and material for room's roof (ref. traditional source and Asbestos)					
corrugated iron/metals and electricity	0.559	1.750	1.384	2.212	<.001*
corrugated iron/metals and Generator/solar/Gas	0.243	1.276	0.843	1.931	0.250
Thatch/Grass and Electricity	-0.420	0.657	0.328	1.317	0.237
Thatch/Grass and Generator/solar/Gas	-0.057	0.945	0.397	2.250	0.898
Intercept	0.108	1.114			0.248

*p < 0.050; ref = reference/baseline category.

Furthermore, with reference to 0-IPTp dose, multigravidae and ITN free, positive malaria risk was significantly lower among primigravidae that sleep under ITN and receipt optimal IPTp- dose (OR =0.287, 95% CI = 0.142 – 0.582). Moreover, a unit increase in age of pregnant woman who is livestock keeper implies an increase in odds of positive malaria (OR = 1.013, 95% CI = 1.003 – 1.002).with reference to traditional source of lightening and Asbestos roof, positive malaria risk was significantly higher among having corrugated iron/metals roof using electricity (OR = 1.750, 95% CI = 1.384 – 2.212).

The model can be assessed through formulating the hypothesis below:

H_0: The data fits in the postulated Model

H_1: The data does not fit in the postulated Model

From Table 4.6, since the p – value = 0.107, which is greater than level of significance (α = 0.05), hence the null hypothesis was failed to be rejected (H_0) meaning that a sufficient evidence was enough to show that the data Fits in the postulated Model set used in predicting malaria among Nigerian pregnant women. Hence, this indicates that the risk factors are not significantly different from those foretold by the model and the overall model fit is clear.

Table 4.8: Assessing interacted model using Hosmer and Lemeshow Test

Chi-square	df	p-value
11.804	7	0.107

Chapter Five

Discussion, Conclusions and Recommendations

Previous research literature review was presented in Chapter 2, it presented that several factors are related with risk of malaria during antenatal period by applying suitable statistical tools as achieved by other researchers. The main idea of logistic regression analysis, variables used in the analysis and ways of assessing the model was presented in chapter 3. The application of binary logistic regression in predicting the likelihoods of positive malaria diagnosis among the antenatal women was done in chapter 4. Hence this chapter will summarize both chapter 3 and 4 of this research work, and there for discussions, conclusion would be presented, and recommendations would be suggested for further study.

5.1 Discussions

This research was conducted in the year 2013, among six states of Nigeria, in order to understand the health service quality received by antenatal women at government health facilities. Malaria related question were sought from the data base, were 1676 pregnant women responded. The study uses chi-square test, Mann Whitney u test, and generalized linear model for the statistical analysis part. The variables used were age, education, marital status, husband education, IPTp – uptake, primigravidae, use op ITN, health insurance scheme, land asset, number of rooms, family size, main source of water for drinking during dry and rainy season, main sources of energy for cooking and lightening, toilet facility, number of nets per person and livestock keeping.

Each and every variable with asymptotic significant value lower than (0.05) level of significant was regarded as significant variable. From the analysis carried out, some variables were significant in chi square, single univariate logistic regression and multivariate logistic regression while some variables were not. Age was insignificant in the chi square test, but it was a significant predictor of malaria diagnosis in both univariate and multivariate logistic regression. Education level was independently associated with malaria diagnosis, but univariate logistic regression reveals that preprimary education category was a significant predictor of malaria in pregnancy were as present of other variables in the multivariate analysis makes education an insignificant predictor of malaria risk. Marital status was also associated with malaria risk and it was not a significant predictor of both single and multiple variable logistic regression. Spouse education was also independently associated with malaria, but it was a significant single predictor in univariate logistic regression analysis, which reveals that primary, secondary, and higher education were significant categories. Both partial and optimal IPTp uptake were independently associated with malaria risk in antenatal period, they were significant predictors of both univariate and multivariate logistic regression. Primigravidae, use of ITN, source of energy for lightening and livestock keeping were independently associated with malaria risk, and they were found to be single and multiple predictor variables of malaria diagnosis among antenatal women. Health insurance scheme and main material use for room's floor were insignificant throughout the analysis. Main source of water during dry and rainy season, owning land or house by the household, main source of energy for cooking, and toilet facility were independently related with malaria incidence, and they were significant single predictors, but they were found to be insignificant using multiple predictors.

Based on the fact of these result, there was a significant relationship between the following socioeconomic factors and malaria risk in pregnancy: IPTp – uptake, use of ITN, sources of energy for lightening, main material for room's rooftop and livestock keeping. Apart from socioeconomic factors, there are demographic factors that also have significant relationship with malaria risk in pregnancy: age and primigravidae. In addition to that, there were interaction effect between socioeconomic and demographic factors that also improve malaria risk. These are interaction between Age and primigravidae; IPTp – uptake and ITN; Age, IPTp – uptake and ITN and finally the interaction between IPTp – uptake and primigravidae and ITN. It was observed from the study that, diagnosis rate of positive malaria decrease with age. Also antenatal women who received either partial or optimal IPTp- dose were less expected to be affected by malaria during the pregnancy period. Furthermore pregnant women sleeping under nets were less probable to be affected by malaria during pregnancy. Antenatal women using electricity for lightening were discovered be at lesser risk of positive diagnosis of malaria infection, as well as pregnant women using thatch/grass compared to asbestos.

Probability of positive malaria diagnosis was associated with livestock keeping. Antenatal livestock keepers were distinctly possible to be affected by malaria.

The study recommended that odds of positive malaria decreases among primigravidae with unit increase in age. Furthermore, for unit increase in age, use of ITN and partial IPTp dose was higher risk of malaria. Also odds of positive diagnosis of malaria infection decreases among primigravidae with unit increase in age. Furthermore, with reference to 0-IPTp dose and ITN free, the risk positive diagnosis of malaria infection was significantly less probable among antenatal women with partial IPTp-uptake and ITN use. Furthermore, with reference to 0-IPTp dose, multigravidae and ITN free, positive malaria risk was significantly lower among primigravidae that sleep under ITN and receipt optimal IPTp- dose. Moreover, a unit increase in age of pregnant woman who is livestock keeper implies an increase in odds of positive malaria.with reference to traditional source of lightening and asbestos roof, positive malaria risk was significantly higher among having corrugated iron/metals roof using electricity.

5.2 Conclusion

This study suggested that with the appropriate use of insecticide treated bed nets, intermitted optimal preventive treatment against malaria uptake and other protective measures, teamed with some elements such as sources of energy for lightening and main material for room’s rooftop. There was a decreased in incidence of malaria infectious disease among antenatal women. However, the research also suggested that the illiterates and poor women are less probable of using these preventive measures in other to reduce the spread of malaria disease among pregnant women and entire population as whole.

5.3 Recommendations

It was recommended that:

- Federal Ministry of Health could develop a plan of building community clinics in each and every local government or community of each state and cheap-compound health facilities. This will possibly assist in controlling the villagers residing far away around the capital to make a trip to reach the health care.

- Long waiting times and bad-mannered attitudes by health workers discourage the antenatal women from trying to present their problem and to find malaria services, and such troubles were more obvious in most tertiary and secondary health facilities in both urban and rural area.
- Guidelines and tutorials should be presented to the pregnant women tin order to create awaeareness about the risk factors and effect of malaria during antenatal period.
- Government, Nongovernmental organizations (NGOs) and other stake holders, should help with providing IPTp-doses, insecticide Treated mosquito nets and other measures that decrease the incidence of MIP among public health facilities, to help the poor people who cannot afford it.
- Nigerian health services should develop case organization at primary health facilities by ensuring encouraging the use of optimal IPTp-doses and other antimalarial drugs such as ACT rather than quinine, this will help WHO in their fight for reducing malaria mortality as whole.
- Further research could be done in this area by considering ANC malaria related data from the clinics in order to analyze the spatial variation and analyze Factors affecting optimal IPTp doses of malaria among the antenatal women in Nigeria. This would even develop upon the scope.

References

1. Adefioye, O. A., Adeyeba, O. A., Hassan, W. O., &Oyeniran, O. A. (2007). Prevalence of malaria parasite infection among pregnant women in Osogbo, Southwest Nigeria. *American-Eurasian Journal of Scientific Research*, *2*(1), 43- 45.

   Alaba, O.A., &Alaba, O.B. (2009). Malaria in rural Nigeria: implications for the Millennium Development Goals. *African Development Review*, *21*(1), 73-85.
2. Alaku, I. A., Abdullahi, A.G., and Kana, H.A., (2015). Epidemiology of Malaria Parasites Infection among pregnant women in some part of Nasarawa State, Nigeria. *Epidemiology*, *5*(2), 30-33.
3. Al-Ghamdi, A. S. (2002). Using logistic regression to estimate the influence of accident factors on accident severity. *Accident Analysis & Prevention*, *34*(6), 729-741.
4. Andrew, O. (2014). An assesment of the spatial pattern of malaria infection in Nigeria. *International Journal of Medicine and Medical Sciences*, *6*(2), 80-86.
5. Ayele, D. G., Zewotir, T. T., &Mwambi, H. G. (2012). Prevalence and risk factors of malaria in Ethiopia. *Malaria journal*, *11*(1), 1-9.
6. Bowers, D. (2008). Medical statistics from scratch: An introduction for health professionals. John Wiley & Sons
7. Butler, D., Maurice, J., & Obrien, C,. (1997). Time to put malaria control on the global agenda. *Nature*, *386*(6625), 535-536.
8. Cabrera, A. F. (1994). Logistic regression analysis in higher education: An applied perspective. Higher Education: Handbook of Theory and Research, Vol. 10, 225-256.
9. Cleary, P. D., & Angel, R,. (1984). The analysis of relationships involving dichotomous dependent variables. Journal of Health and Social Behavior; 25, 334-348.
10. Cox, D. R., & Snell, E. J,. (1989). The analysis of binary data (2nd ed.). London: Chapman and Hall.
11. Daniel, W. W., and Wayne, W. D,. (1995). Biostatistics: a foundation for analysis in the health sciences.
12. Dawson, B., Trapp, R. G., & Trapp, R. G,. (2004). *Basic & clinical biostatistics* (Vol. 4). New York: Lange Medical Books/McGraw-Hill.

13. De Beaudrap, P., Turyakira, E., White, L. J., Nabasumba, C., Tumwebaze, B., Muehlenbachs, A., &Piola, P,. (2013). Impact of malaria during pregnancy on pregnancy outcomes in a Ugandan prospective cohort with intensive malaria screening and prompt treatment. *Malaria journal*, *12*(1), 1.
14. Efron, B. (1975). The efficiency of logistic regression compared to normal discriminant analysis. Journal of the American Statistics Association, 70, 892-898.
15. Elston, R.C., &Johnson, W.D, (2008). *Basic biostatistics for geneticists and epidemiologists: a practical approach*. John Wiley & Sons
16. Exavery, A., Mbaruku, G., Mbuyita, S., Makemba, A., Kinyonge, I. P., &Kweka, H. (2014). Factors affecting uptake of optimal doses of sulphadoxine-pyrimethamine for intermittent preventive treatment of malaria in pregnancy in six districts of Tanzania. *Malaria journal*, *13*(1), 1.
17. Faraway, J. J. (2014). *Linear models with R*. CRC Press.
18. Florey, L. (2013). Preventing malaria during pregnancy in sub-Saharan Africa: Determinants of effective IPTpdelivery.
19. Garcia, C. R., Markus, R. P., & Madeira, L. (2001). Tertian and quartan fevers: temporal regulation in malarial infection. *Journal of biological rhythms*, *16*(5), 436-443.
20. Gill, C. J., Macleod, W. B., Mwanakasale, V., Chalwe, V., Mwananyanda, L., Champo, D.,&Hamer, D. H. (2007). Inferiority of single-dose sulfadoxine-pyrimethamine intermittent preventive therapy for malaria during pregnancy among HIV-positive Zambian women. *Journal of Infectious Diseases*, *196*(11), 1577-1584.
21. Hartman, T.K., Rogerson, S.J., & Fischer, P.R. (2012). The impact of maternal malaria on new born". Annals of Tropical paediatrics 30(4), 271-82.
22. Harvey, M. (1995). Intuitive biostatistics. Oxford University Press, Inc .
23. Kirkwood, B.R and Sterne A.C; 2003 *Essential Medical Statistics: second edition*; Blackwell Science Ltda Blackwell Publishing company.Malden, Massachusetts 02148–5020, USA
24. Kleinbaum, D., Kupper, L., Nizam, A., & Muller, K. (2007). *Applied regression analysis and other multivariable methods*. Cengage Learning.
25. Landau, S., &Everitt, B. (2004). *A handbook of statistical analyses using SPSS* (Vol. 1). Boca Raton, FL: Chapman & Hall/CRC.

26. Luxemburger, C., McGready, R., Kham, A., Morison, L., Cho, T., Chongsuphajaisiddhi, T., &Nosten, F. (2001). Effects of malaria during pregnancy on infant mortality in an area of low malaria transmission. *American journal of epidemiology*,*154*(5), 459-465.
27. Miller, L. H., Good, M. F,.&Milon, G. (1994). Malaria pathogenesis. *Science*, *264*(5167), 1878-1883.
28. Nchinda, T. C. (1998). Malaria: a reemerging disease in Africa. *Emerging infectious diseases*, *4*(3), 398.
29. Olasehinde, G. I., Ajay, A. A., Taiwo, S. O., Adekeye, B. T., &Adeyeba, O. A. (2010). Prevalence and management of falciparium malaria among infants and children in Ota, Ogun State, Southwestern Nigeria. *African Journal of Clinical and experimental microbiology*, *11*(3), 159-163.
30. Oyewole, I. O., Ogunnowo, A. A., Ibidapo, C. A., Okoh, H. I., Awolola, T. S., &Adedayo, M. A. (2011). Epidemiology of malaria and insecticide resistance burden in Nigeria. *Journal of public health and epidemiology*, *3*(1), 6-12.
31. Peng, C. Y. J., Lee, K. L., & Ingersoll, G. M. (2002). An introduction to logistic regression analysis and reporting. *The journal of educational research*, *96*(1), 3-14.
32. Press, S. J., &Wilson, S. (1978). Choosing between logistic regression and discriminant analysis. *Journal of the American Statistical Association.* 73, 699-705.
33. Raimi, O. G., &Kanu, C. P.(2010). The prevalence of malaria infection in pregnant women living in a suburb of Lagos, Nigeria. *African Journal of Biochemistry Research*, *4*(10), 243-245.
34. Ramachandran, K.M &Tsokos,C.P. (2009). *Mathematical statistics with applications*. Elsevier Academic Press.
35. Rogawski, E. T., Chaluluka, E., Molyneux, M. E., Feng, G., Rogerson, S. J., &Meshnick, S. R. (2012). The effects of malaria and intermittent preventive treatment during pregnancy on fetal anemia in Malawi. *Clinical infectious diseases*, cis597.
36. Tabachnick, B. G., &Fidell, L. S. (2001). Using multivariate statistics (4th ed.). *Needham Heights,* MA: Allyn& Bacon.
37. Unicef. (2000). Malaria prevention and treatment, *UNICEF's Programme Division in cooperation with the World Health Organization, 1-16*

38. Usman, A. (2014) Statistical methods for biometric and medical research. *Millennium Printing and Publishing Company Limited, Kaduna, Nigeria*, 486-495.

39. World Health Organization. (2001). "WHO recommended Strategies for the prevention and control of communicable diseases", WHO/CDLS/CPE/SMT/2001, 13:107-110

40. Yoriyo, Kennedy P. &Hafsat B. (2014) Prevalence of Malaria Infection among Pregnant Women Attending Antenatal Clinics in Gombe State. *International journal of entrepreneurial development, education and science research*, 2(1), 214-220.

41. Zar, J. H. (1999). Biostatistical analysis. *Pearson Education India*.