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The Efficiency of Malaria Drugs on Children of Different Gender under Age Five in Abia State Nigeria

Acha Chigozie Kelechi*

Department of Statistics, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.

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ABSTRACT

This study investigates the effects of malaria drugs on children of different gender under the age of five in Nigeria (Umuahia in Abia State as a case study). It was carried out by applying descriptive statistical methods and Poisson log linear regression model on different malaria drugs. To achieve this, five age groups in months (<12, 12-23, 24-35, 36-47, 48-59) and gender (male and female) were used. Secondary datasets were collected from Nigeria Demographic and Health Survey (NDHS) 2013 and department of Health and Human Services, Abia State University, Uturu. The result shows that the rate of usage of all malaria drugs considered in this study is similar for all age groups. However more males than females received Artemisinin-Based Combination Therapy (ACT). The only significant difference found is between the Amodiaquine and Chloroquine, The study therefore concludes that the effect of malaria drugs is dependent on age and gender. Apart from all the main effects of all the variables being significant, there is also a statistically significant interaction between gender, age and drug, p = 0.00134. The poissson regression result predict that in the last 12months, there is a 4.9% and 6.7% increase in the number of gender and drugs respectively considered yearly with (95% CI. 0.281 to 1.678 and 0.006 to 1.033), and also a statistical significant results, P-value = 0.010 & 0.004 respectively.

1. Introduction

Plasmodium's life cycle is very complex as it lives in both humans and mosquitoes. The parasite moves to the salivary glands of an infected mosquito. Once the mosquito bites a human, the parasite is injected into the blood stream and quickly reaches the liver cells, where it rapidly reproduces asexually, creating thousands of new parasites that move into red blood cells, their favorite food source.

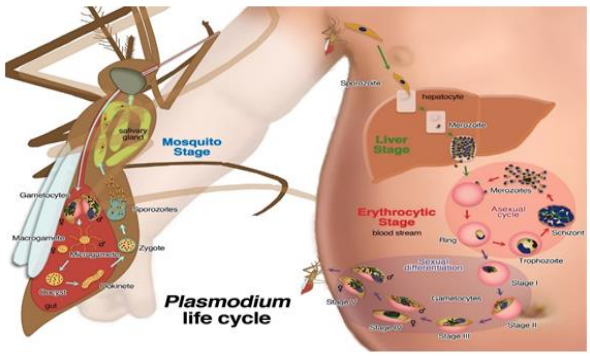

Figure 1: Multifunctional Autophagy Pathway in the Human Malaria Parasite, Plasmodium Falciparum.
Source: Jeanette Marantos, (2010).

Malaria is an intermittent and remittent fever caused by Plasmodium falciparum (>95%) and it is responsible for most forms of the severe disease [Nigeria MIS Final Report (2010), Mouzin (2012) and Marantos (2010)]. The other types found are Plasmodium malariae and Plasmodium ovale (Mouzin (2012)). Malaria transmission intensity, duration and seasonality vary among the country's five ecological strata (mangrove swamps, rain forest, guinea savannah, Sudan savannah and Sahel savannah) that extend from south to north, (Nigeria MIS Final Report (2010)).

From the Nigeria Malaria Fact, Sheet United States Embassy in Nigeria (2011); Malaria is a major public health problem in Nigeria where it accounts for more cases and deaths than any other country in the world. Malaria is a risk for 97% of Nigeria's population. The remaining 3% of the population live in the malaria free highlands. There are an estimated 100 million malaria cases with over 300,000 deaths per year in Nigeria. This compares with 215,000 deaths per year in Nigeria from HIV/AIDS. Malaria contributes to an estimated 11% of maternal mortality. Malaria accounts for 60% of outpatient visits and 30% of hospitalizations among children under five years of age in Nigeria. It has the greatest prevalence, close to 50%, in children age 6-59 months in the South West, North Central, and North West regions. Malaria has the least prevalence, 27.6 percent, in children age 6 to 59 months in the South East region.

In 2011 United States Embassy in Nigeria also reported that an estimated 65% of Nigeria's population lives in poverty and poverty is a major factor in malaria prevention and treatment. Malaria is one of the major Public Health problems in Nigeria and causes death and illness, especially in children under age five. The early diagnosis and prompt treatment with effective antimalarial drugs remains a vital component of the malaria control strategies. Malaria is a major public health problem that accounts for highest morbidity and mortality in Nigeria and the most susceptible group are children under age five, this informs this study which tries to establish whether

Tele: 08037607057
E-mail address: specialgozie@yahoo.com

the malaria drugs in use are statistically significant with respect to their efficacy to the group under consideration. Therefore, the major objective of this study is to establish whether the malaria drugs administered are statistically significant with respect to their effectiveness on different gender of children under age five. To achieve the objective above, the next section reviews the malaria literature; the third section describes the method of analysis. In the fourth section data is analyzed using the Poisson log linear regression model. This paper is summarized and concluded in the fifth section with few recommendations.

2. Literature review

The level of morbidity and mortality which is attributable to malaria annually in Nigeria has been a major concern of government and its health and development partners. This possibly explains the prominence given malaria eradication in the Millennium Development Goals (MDG). Unfortunately the MDG's goal of eradicating malaria by 2015 has not been met (Martins T. Adenipekun (2013), Kofoworola Aderogba (2013), Gyang, T. S. (2011), Acha (2009, 2014, 2015)).

Despite MDG efforts, globally, though under-5 deaths have dropped by 53 per cent, however, about 16,000 children still die every day before their fifth birthday, says a new joint report from the World Health Organization (WHO), UNICEF, the World Bank and the United Nations (UN). This disease is the most important cause of human morbidity and mortality with enormous medical, emotional and economic impact in the world as established by WHO (2005, 2009-2013), UNICEF, the World Bank and the United Nations (UN), NSHDP (2010-2015),NPC (2009), FMOH (2005-2010). Some of the leading studies on prevention of malaria transmission, prompt diagnosis and adequate treatment of clinical cases at all levels and in all sectors of health care, and prevention and treatment of malaria are; Noland, et.al (2014), Aina, et.al (2013), Udoh, et.al (2013) and Greenwood et.al (2005). With a renewed leadership system of the Federal Ministry of Health, according to its 2010 report in National Strategic Health Development Plan (NSHDP) 2010 – 2015, the health sector is poised to reposition itself to implement and institute result oriented programmes within the context of the MDG and national targets as enshrined in the National Vision 20:2020, and a new National Health Plan. In an unprecedented collaborative and fully participatory national process, key stakeholders at all levels in the health sector – Federal, States, LGAs, partners both international and domestic, civil society organizations, etc, - have evolved a uniform national health development framework thereby putting in place the first ever truly National Health Plan through an associated Results (Targets/Indicators) Framework, that is consistent and elaborate on the Vision 20:2020 Human Capital Development aspirations. This is hoped will serve as a standard against which the progress from 2010 to 2015 will be measured- in the first instance- and beyond, as we match towards Vision 20:2020 (rollback malaria).

3. Research Methodology

Data were collected from Nigeria Demographic and Health Survey (NDHS) 2013 and department of Health and Human Services, Abia State University, Uturu.

❖**Two Research Methodology**

-Descriptive statistical methods: percentages, plots and

-Inferential statistical methods: Poisson regression model or log-linear model is adopted with aid of S-Plus statistical package.

In Poisson regression model, If $\mathbf{x} \in \mathbb{R}^n$ is a vector of independent variables, then the model takes the form

$$\log(\mathrm{E}(Y \mid \mathbf{x})) = \alpha + \beta' \mathbf{x},$$

where $\alpha \in \mathbb{R}$ and $\beta \in \mathbb{R}^n$. Sometimes this is written more compactly as

$$\log(\mathrm{E}(Y \mid \mathbf{x})) = \boldsymbol{\theta}' \mathbf{x},$$

where **x** is now an $(n + 1)$-dimensional vector consisting of n independent variables concatenated to a vector of ones. Here $\boldsymbol{\theta}$ is simply α concatenated to **β**.

Thus, when given a Poisson regression model $\boldsymbol{\theta}$ and an input vector **x**, the predicted mean of the associated Poisson distribution is given by

$$\mathrm{E}(Y \mid \mathbf{x}) = e^{\boldsymbol{\theta}' \mathbf{x}}.$$

This paper assumes that Y comes from a Poisson distribution with associated probability with {0, 1, 2,…} and the predictors are one continuous and two categorical. ;

P(Y=n) = $\frac{\mu^n \exp(-\mu)}{n!}$;

$$\ln \mu = c + \alpha_1 . Age + \alpha_2 . Gender + \alpha_3 . Drugs,$$

where μ = mean of Poisson distribution.

❖**Research Design**;

-3 factors (Age (in months), Drug (%), Gender)

-12 levels; Age in months (0 to 11,12-23,24-35,36-47,48-59), Drug(ACT, Quinine, SP/Fansder, Chloroquine, Amodiaquine), Gender (male, female).

❖**Sample Size**; n = 125.

❖**Hypotheses Test**

-H_{01}: All the drugs have equal effect on the age groups.

-H_{02}: All the drugs have equal effect on the gender groups.

-H_{03}: Both groups have equal effect from the drugs.

-H_{04}: The interaction effect of the three factors is present.

4. Result Analysis and Interpretation

Table 1.Case Processing Summary

	N	Percent
Include	125	100.0%
Excluded	0	0.0%
Total	125	100.0%

Table 2. Parameter Estimates showing main effects for Drug, Age and Gender.

Parameter	B	Std Error	95% Wald Confidence Interval		Exp(B)	95% Wald Confidence Interval for Exp(B)		p-value	Status
			Lower	Upper		Lower	Upper		
Intercept	-0.078	0.3516	-1.153	1.025	0.807	0.176	2.827	.000	Significant
Gender	0.167	0.1740	-0.628	0.415	1.049	0.281	1.678	.010	Significant
Age	0.022	0.3849	0.390	1.084	0.531	1.047	1.498	.000	Significant
Drugs	0.016	0.0193	0.002	0.077	1.067	0.006	1.033	.004	Significant
Dependent Variable: PLASMODUM									

Table 3. Shows an extract of the Interaction Effects among the Factors; Drug, Gender, and Age.

Source	P value	Status
Drug*Age	0.8467 = P>0.05	Not significant
Drug*Gender	1.502e-16 = P<0.05	Significant
Age*Gender	0.9281 = P>0.05	Not Significant
Drug*Age*Gender	0.0134 = P<0.05	Significant

4.1 Summary of Findings

They drugs considered in this study are statistically significant and effective: each variable has a strong main effect; a two way interaction exists between Drug and Gender; there was a statistically significant three-way interaction between gender, age and drug, across all the conditions ACT, Fansider and Chloroquine are more effective on males than on females, if the baseline intervention coverage, technical report of drug efficacy studies and strategic plan for malaria control are put in place in Nigeria, it will go a long way to help achieve vision 20:2020.

5. Conclusion and Recommendations

The objective of this study is to enable health professionals to understand the effectiveness of malaria drugs available in Nigeria especially in Umuahia in Abia State. This will improve management of malaria cases within different health systems in the country. The review therefore looks at the following areas: clinical disease and epidemiology; the burden of malaria in Nigeria; objectives of treatment; antimalarial treatment policy; malaria diagnosis, treatment strategies/ National responses; treatment sources. Results from the analyses show that each variable has a strong main effect; a two way interaction exists between Drug and Gender. Apart from all the main effects of all the variables being significant, the poissson regression result predict that in the last 12months, there is a 4.9% and 6.7% increase in the number of gender and drugs respectively considered yearly with (95% CI. 0.281 to 1.678 and 0.006 to 1.033), and also statistically significant results, P-value = 0.010 & 0.004 respectively. Also a statistically significant interaction between gender, age and drug, p = 0.00134. This shows that there is an effective malaria treatment drugs in Umuahia to the people who need them considering their age (Children under five). Despite the National policy of ACT as the first-line treatment of uncomplicated malaria, MIS 2010 indicates that over 70% of children treated for malaria in Nigeria received chloroquine or SP, ACT and Chloroquine are statistically significant showing their efficiency and acceptability among others. It emphasizes that achievements of 2010 (Nigeria) and 2011(Abia State) should be sustained. It further recommends that other ages apart from children under five should be considered since malaria is a global problem.

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