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Prevalence of Five-Child-Killer Diseases and Under-Five Mortality in Adamawa State, Nigeria

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Abstract. This study investigates the prevalence of the five-child killer diseases and its cause effect on under-five mortality. It uses an entirely quantitative approach with secondary data between 2001 and 2015 obtained from the data bank of Adamawa State Primary Health Care Development Agency (PHCDA). Data was collected regarding the number of children immunized and number of children that were infected but later died due to Pneumonia, Diarrhoea, Measles, Tetanus, Polio and the overall under-five mortality irrespective of diseases within that time frame. The study measures prevalence rate per a thousand live birth and uses Newey-West regression tool for analysing and developing a model. The results indicate that the prevalence rates have generally been decreasing with Pneumonia recording the highest prevalence and Tetanus recording the lowest prevalence. Polio was excluded from the analysis because it did not register any incidences or deaths. The regression model shows that there is a strong positive and significant relationship between Pneumonia and under-five mortality. The model also shows a weak positive and non-significant relationship between diarrhoea and under-five mortality. Furthermore, there was a strong positive but non-significant relationship between measles and under-five mortality and a negative non-significant relationship between tetanus and under-five mortality. The child killer diseases explained 60.92 percent cause effect on overall under-five mortality and the model is statistically significant. The study recommends that government needs to implement the Global Action Plan for Pneumonia and Diarrhoea (GAPPD) as campaigned by WHO and UNICEF, adequate nutrition should be given to these children and children infected with HIV/AIDs should be given daily vaccines to reduce the risk of contracting these five-child-killer-diseases.

Keywords: Five-child killer diseases, prevalence, nutrition, mortality and under-five children.

1. Introduction

The term mortality comes from the Latin word mortalitas. Mortality rate is a parameter in epidemiology for characterizing the deaths within a given population. Under-five mortality rate is the number of deaths in children 0-5 years of age per time, usually expressed per 1,000 or 100,000 persons per year (Norman, Spilsbury & Semmens, 2011). The five child-killer diseases used in this study are pneumonia, measles, diarrhoea, polio, and tetanus. These are grouped classification of the five diseases that are frequently responsible for the death of under-five children in Yola Adamawa State, Nigeria.

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

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

Nigeria, in the past few years has experienced some worsening of under-five mortality. The under-five mortality rate was evaluated at 100 per 1000 in 2003 and at 87 per 1000 in 1990. This can be in part explained by the persisting low numbers of births occurring in health centres and the low number of births attended by trained healthcare service providers. In 2003, two third of the births in Nigeria still occurred at home. In addition only slightly more than one-third of births are attended by doctors, nurses, or midwives (Mathews & Mac Dorman, 2011).

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

2. Objective of the study

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

3. Literature Review

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

Scott *et al.* (2008) note that historically, pneumonia was the main cause of under-five mortality in developed countries, and in the United States in 1900, it is estimated that pneumonia killed 47 of every 1,000 children before the age of 5 years. In Nigeria, Esangbedo (2010) explained that pneumonia kills nearly 1.6 million children under five annually worldwide. An estimated 98 percent of children who die of pneumonia live in developing countries and according to 2008 estimates, about 177,000 children under the age of five died of pneumonia in Nigeria. This means that within an hour, 20 children across Nigeria will die from pneumonia. This number is the highest in Africa and second highest overall in the world.

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

In Nigeria a study conducted by Onyiriuka (2011), revealed that measles accounted for 3.1% of all admissions in the Paediatric Department, with different age distribution. Although 22.1% had vaccination against measles, 77.9% were not vaccinated against the disease. It was further observed that a significant number of the cases occurred in the dry season as compared to the wet season

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

4. Methods and Materials

Ex post facto design with quantitative approach was used involving the use of secondary data on five-child-killer diseases and under-five mortality across the study area from 2001 to 2015 from Adamawa State Primary Health Care Development Agency (PHCDA), Yola.

Despite the fact that preliminary investigation from descriptive statistics showed that the data is not stationary, diagnostic tests were carried out to confirm the normality, multicollinearity, homoscedasticity and auto-correlation of data to see how fit is the data for analysis. A graphical tool for assessing normality was used to test for the normality in this study. The data were entirely heteroscedastic based on the Breusch-Pagan / Cook-Weisberg test for heteroscedasticity

The method used to determine the prevalence rate of the five-child- killer diseases in the study area is given by equation (1):

$$Prevalence\ rate = \frac{Number\ of\ all\ cases\ of\ disease\ at\ time\ t}{Number\ of\ persons\ at\ risk\ at\ time\ t} \times 1000 \quad (1)$$

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

$$TDIOD_t = \alpha + \beta_1 Iml_t + \beta_2 Mea_t + \beta_3 Pne_t + \beta_4 Dia_t + \beta_5 Tt_t + \varepsilon_i \quad (2)$$

Where;

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

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

Mea_t : The deaths recorded due to Measles in the study at a time, t.

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

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

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

ε_i : The error term (stochastic)

t: the time component in the regression model

$\alpha\ and\ \beta$: These regression coefficients

STATA software was used to run the analysis.

5. Results

Table 1: Prevalence rate for the five child-killer diseases

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

Source: Researcher's Results (2017)

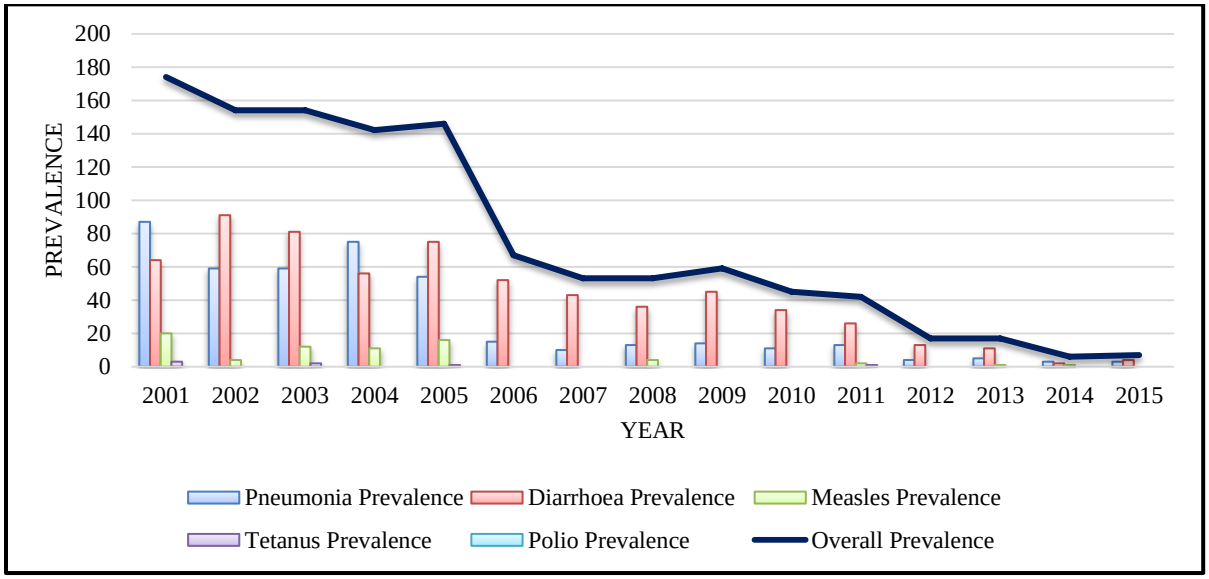

Figure 1: Prevalence rate for the five child-killer diseases
Source: Researcher's Results (2017)

Table 1 and figure 1 show the overall prevalence rate of the five child-killer diseases in Yola, Adamawa state. The data shows that the prevalence decreases throughout the 15-year period this study was carried out. There was slight decrease in the prevalence rate of the five child-killer diseases from 174 to 146 persons per thousand live births between 2001 and 2005. This was followed by a sudden decrease to 53 persons per thousand live births in 2008. Then the prevalence increased to 59 persons per thousand in 2009 and continues decreases to 2015. Individually, the largest contributor of prevalence rate among the five child-killer diseases in the data was diarrhoea with 91 persons per thousand live births in 2002, followed by pneumonia with 87 persons per thousand in 2001; measles with 20 persons in 2001, tetanus with 3 persons in 2001 and polio did not register any deaths for the 15-year period the study was conducted.

In order to examine the cause effect of the child-killer diseases on under-five mortality in Yola, a regression model that incorporates four independent variables and immunization level against the total mortality in Yola was run. In this analysis, the deaths arising from pneumonia, those arising from diarrhea, deaths arising from measles and the deaths arising from tetanus and immunization level were considered in the study. The deaths arising from polio were inherently dropped in this analysis since the data has no deaths or incidences associated with polio. However, since it was shown from the preliminary plots that most of the data for these variables is not stationary, a different form of regression, Newey-West, which adjusts the coefficients for stationarity was run to avoid over estimation of the standard errors associated with the regression model at 90% level of significance.

Table 2: Newey West regression output for five-child-killer diseases and immunization level.

Regression with Newey-West standard errors

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

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

Source: Researcher's Results (2017)

The analysis above shows that there exists a strong relationship between the deaths due pneumonia and the total under-five mortality in Yola ($\beta = 3.233, p - value < 0.1$). This results shows that such a relationship was significant enough because it was associated with a relatively low level of significance as shown in table 2. The analysis also shows that there exists a positive relationship between the deaths due diarrhea and the total under-five

mortality in Yola ($\beta = 1.038, p - value > 0.1$). This results shows that such a relationship was not significant enough because it was associated with a relatively high P- value.From the analysis there exists a strong positive relationship between the deaths due measles and the total under-five mortality in Yola ($\beta = 5.197, p - value > 0.1$). This results shows that such a relationship was not significant enough because it was also associated with a relatively high P- value.

The analysis further shows that there exists a negative relationship between the deaths due to tetanus and the total under-five mortality in Yola ($\beta = -3.505, p - value > 0.1$). This results shows that such a relationship was not significant enough because it was also associated with a relatively high P- value as shown in table 2. The analysis also shows that there exists a weak positive relationship between the immunization level and the total under-five mortality in Yola ($\beta = 0.0034, p - value > 0.1$). It shows that such a relationship was not significant as it associated with a relatively high P- value.

A closer look at the model in table 2 implies that the overall model was significant. Such a conclusion was arrived at by assessing the F-statistic ($F = 5.36, P - value < 0.1$).The result of the Newey-West regression analysis also shows that the four explanatory variables and immunization level explain at least 60.92 percent cause effect on overall under-five mortality.

Regression model for future forecast of under-five mortality

Based on Newey-West regression model in Table 2, the regression model for future prediction of under-five mortality in the study area is given by:

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

6. Discussion of Results

Prevalence rate is one of the determinants of the rate at which a given disease spreads through any given population as well as the efficacy of any sought programs to alleviate its spread. Jalal-Edden, (2014) reported that in Adamawa State, the prevalence rate of tetanus among children investigated while this study confirmed the prevalence to be 0% during the respective years. This can be acceptable due to the fact that this study considered only Yola Metropolicy city of Adamawa State, while Jalal-Edden considered the whole area of Adamawa State, Nigeria.

The finding is not in agreement with WHO(2011)which indicated that the prevalence rate of tetanus, pneumonia, and diarrhoea in 2004 among children below the age of five years are 49, 13, and 21 per 1000 live births respectively due to civil war in Somalia for many years which lead to unstably governance to fight diseases and poverty. In Yola, the prevalence of child killer disease has been decreasing irrespective of the kind of disease under consideration. The reason highlighting the explanation why Pneumonia and diarrhoea recorded the highest prevalence amongst all the other five diseases under consideration is that these diseases have strong attribution to environmental conditions for instance, diarrhoea is heavily related to hygiene and pneumonia has an association to cold climatic and whether conditions. This implies that other factors like relatively high congestion in most health centres in Yola, coupled with the high level of poverty and or inadequacy of drugs could explain such high figure recorded for Pneumonia and diarrhoea as compared to the other three diseases. For polio, the zero incidence rates across the 15-year period is due to the fact that polio is regarded as a pandemic and as such it was eliminated due to worldwide efforts to combat the disease as it has threatening effects on human growth and physical appearance.In a related study by Peter (2011), the child-killer diseases account for than 70 percent under-five mortality while this study revealed that the child-killer diseases account for at least 60.92 percent of the overall variation in the under-five mortality. This can be acceptable due to the fact that the Adamawa state government is succeeding in reducing the under-five mortality due to child-killer diseases in Yola. The overall model resulting from the overall under-five mortality due to these child-killer diseases is significant.

7. Conclusion

In Yola Adamawa State, Pneumonia, diarrhoea, measles, tetanus and polio were considered as the greatest child killers, polio needs to be excluded since the investigation showed no diseases and deaths were recorded for a period of 15 years considered by this study. The study also shows that the child-killer diseases considered in this study explain 60.92% cause effect on overall under-five mortality and it is statistically significant. The model in the study explains that at zero child-killer diseases, the under-five mortality is 32 deaths.

8. Recommendations

Based on the conclusions, the study recommends that:

(i) government needs to implement the Global Action Plan for Pneumonia and Diarrhoea (GAPPD) with immediate effect as campaigned by WHO and UNICEF.

(ii) both government and individual should promote adequate nutrition as a key factor in improving children's natural defenses against child-killer diseaseswith exclusive breastfeeding for the first 6 months of life.

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

(iv) policy makers should make adequate provision for transportation and storage of vaccines and revise the immunization policies so that a significant number of children at risk receive unexpired and genuine vaccines against the child-killer diseases for the recommended number of dosage to reduce the incidences.

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