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

PAUL I. DALATU[1], ASABE IBRAHIM[2], JOSHUA A. KWANAMU[3]
[1, 2, 3] *Department of Mathematics, Faculty of Science, Adamawa State University Mubi, Nigeria*

Abstract- ***Under-Five Mortality rate refers to the probability a new-born would die before reaching exactly 5 years of age, expressed per 1,000 or 100,000 live births. The Five Child-Killer Diseases used in this study are Pneumonia, Diarrhoea, Measles, Tetanus and Polio. The study used Ex post facto design with quantitative approach. A secondary data of the Five-Child Killer Diseases and Under-Five Mortality were obtained from the twenty-one (21) Local Government Primary Health Care Development Agency in Adamawa State between the periods of 2008 to 2022. The study measured the mortality rate due to the Five Child-Killer Diseases and its Cause-effect on the Overall Under-Five Mortality Irrespective of Diseases in the study area and then develop a model for future prediction. Based on the finding, the Overall Under-Five Mortality rate increases from 112 to 314 deaths per thousand live births between 2008 and 2012, followed by a sudden decrease from 261 to 90 deaths from 2013 to 2016 and then fluctuate throughout the rest of the period under review. Individually, the largest contributor of Under-Five Mortality among the Five Child-killer Diseases is Diarrhea with 89 deaths per thousand live births in 2011, followed by Measles with 39 deaths in the same year. The regression model revealed a positive and insignificant causal relationship between deaths due to Pneumonia, Diarrhoea and Measles on Overall Under-Five Mortality in the study area. The regression model also explained that; at zero deaths due to the Five Child-Killer Diseases, the Overall Under-Five Mortality is more than 105 deaths in the study area.***

Indexed Terms- ***Under-Five, Child-Killer, Mortality, Diseases, and Children***

I. INTRODUCTION

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). Under-Five Mortality rate refers to the probability a new-born would die before reaching exactly 5 years of age, expressed per 1,000 live births. Globally, infectious diseases, including Pneumonia, Diarrhoea and Malaria, remain a leading cause of Under-Five Mortality, along with preterm birth and intrapartum-related complications (UNICEF, 2024). The Five Child-Killer Diseases used in this study are Pneumonia, Diarrhoea, Measles, Tetanus and Polio. These are grouped classification of the five diseases that are frequently responsible for the death of Under-Five children in Adamawa State, Nigeria.

Around the world, a remarkable progress in child survival has been made in 2022 and millions of children have better survival chances than in 1990. The Under-Five Mortality rate has declined by 60 per cent, from 93 deaths per 1,000 live births in 1990 to 37 deaths per 1,000 live births in 2022. Despite this remarkable progress, improving child survival remains a matter of urgent concern. In 2022 alone, roughly 4.9 million children under 5 years of age died. This translates to 13,424 children under the age of 5 dying every day, an intolerably high number of largely preventable child deaths (UNICEF, 2024)

In 2021 alone, 5.0 million children died before reaching their fifth birthday. This is an immense, intolerable and mostly preventable loss of life. The fact that 5 million children died in 2021 before turning 5 is alarming given the availability of knowledge and interventions to prevent these deaths. Furthermore, this period saw pandemic-driven disruptions to interventions like vaccination and nutrition

programmes, the effects of which on mortality and health may not become apparent for some time. It is critical to expand coverage of interventions and improve the quality of child health services to achieve an end to preventable Under-Five Mortality (UNICEF, WHO, UN & World Bank Group (2022).

Reliable estimates of child mortality at the national, regional and global level are necessary for evidence-based policymaking to improve the survival chances of the world's children. Sustainable Development Goal 3 (SDG 3) called for an end to preventable deaths of children under 5 years of age and specifies that all countries should aim to reduce Under-Five Mortality to at least as low as 25 deaths per 1,000 live births by 2030. Given the current burden of deaths, child survival remains an urgent concern. Despite progress over the past decades, in 2017, 5.4 million children across all regions and income groups died from preventable causes before reaching their fifth birthday with 2.5 million of those children died in the first month of life (UNICEF, WHO, UN & World Bank Group, 2018)

The risk of a child dying before completing five years of age is still highest in the WHO African Region (74 per 1000 live births), about 8 times higher than that in the WHO European Region (9 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. On the other hand, 5.4 million children under the age of five die in 2017, equating to 15,000 deaths every day (WHO, 2021). However, 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 lives by ending preventable Child-Killer Diseases are significant priorities (WHO, 2015). Sub-Saharan Africa continues to confront significant challenges, as the region with the highest child mortality rates in the world with 98 deaths per 1,000 live births in 2012. All 16 countries with an Under-Five Mortality rate above 100 deaths per 1,000 live births are in sub-Saharan Africa (UN, 2013).

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 centers 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 children 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).

II. OBJECTIVES OF THE STUDY

The objectives of this study is to determine the mortality rate due to the Five Child-Killer Diseases and the Cause-effect of the deaths due to the Five Child-Killer Diseases on Overall Under-Five Mortality Irrespective of Diseases in Adamawa State.

Hypothesis

H_O: There is no Cause-effect of the deaths due to the Five Child-Killer Diseases on Overall Under-Five Mortality Irrespective of Diseases in Adamawa.

III. LITERATURE REVIEW

With shifting demographics, the burden of child deaths is heaviest in Sub-Saharan Africa. Approximately 83% of all Under-Five Mortality in the world in 2022 occurred in just two regions: Sub-Saharan Africa and South Asia with 58% and 25% respectively. Due to growing child populations and a shift of the population distribution towards high-mortality regions, the share of global under-five deaths that occurred in Sub-Saharan Africa increased from 31% in 1990 to 58% in 2022 and is expected to increase even further in the next few decades (UNICEF, 2024). Despite remarkable progress in developed countries, improving child survival remains a matter of urgent concern as the rate at which Under-

Five Mortality occurs is alarming and several studies showed significant figures of under-five mortality in the developing nations, at least 6.3 million under-five died across the globe in 2017 (UNICEF, WHO, UN & World Bank Group, 2018). In Nigeria about 2,300 Under-Five die every day, making it second largest contributor in the world (Abiola, 2015). Studies also revealed that under-five mortality is very high in Adamawa State compared to other states in Nigeria with about 31 and 147 deaths daily in 2003 and 2008 respectively (Okechukwu, Benedict, John, 2015). Based on these studies, over 11,000 die in 2003 and over 53,000 die in 2008, this indicate a high rate of under-five mortality which negatively affect the population.

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.

WHO (2011) reported that the mortality 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 the civil war in Somalia for many years which lead to unstably governance to fight diseases and poverty.

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.

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

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

Lukman & Umaru (2017), in related study explained that the five child-killer diseases which consist of pneumonia, diarrhoea, measles, tetanus and polio account for at least 60.92 percent of the overall variation in the under-five mortality in Yola, Adamawa State Nigeria. He further explained that there exists a causal relationship between the deaths due pneumonia, diarrhea, measles and tetanus on total under-five mortality with 3.233, 1.038, 5.197 and -3.505 respectively in Yola, Adamawa State Nigeria.

IV. METHODS AND MATERIALS

The study used Ex post facto design with quantitative approach. A secondary data of Five -Child Killer Diseases and Under-Five Mortality was obtained from Adamawa State Primary Health Care Development Agency between the periods of 2008 to 2022. The data obtained consist of the number of Under-Five children that were immunized, number of Under-Five children that were infected by the Five Child-Killer Diseases, deaths due to the Five Child-Killer Diseases and the

Overall Under-Five Mortality Irrespective of the Diseases (OU5MID) within the time frame.

The method used to determine the Mortality rate due to the Five Child-Killer Diseases in the study area is given by equation (1):

$$Mortality\ Rate = \frac{Number\ of\ deaths\ due\ certain\ disease\ at\ time\ t}{Number\ of\ persons\ at\ risk\ at\ time\ t} \times 100{,}000\ \ldots\ldots\ (1)$$

Further, the study used multiple regression analysis to determine the Cause-effect of the deaths due the Five Child-Killer diseases on the Overall Under-Five Mortality Irrespective of the Diseases in the study area.

The deaths arising from polio were inherently dropped in this study since the data has no mortality associated with polio. However, the deaths arising from the remaining four child- killer diseases; Pneumonia (Pne), Diarrhoea (Dia), Measles (Mea), and Tetanus (Tet) and Immunization (Imu) level after excluding polio was regressed against the Overall Under-Five Mortality Irrespective of Deaths at 95% confidence interval to determine the Cause-effect of deaths due to the Five Child-Killer diseases on the Overall Under-Five Mortality Irrespective of the Diseases in the study area. The coefficient of determination R^2 was used to determine the percentage of variation in the dependent variable that is explained by the remaining four independent variables and immunization level that were included in the model. The four independent variables, immunization level and one dependent variable were joined together in a multiple regression model as given in equation (2):

$$OU5MID_t = \alpha + \beta_1 Imu_t + \beta_2 Pne_t + \beta_3 Dia_t + \beta_4 Mea_t + \beta_5 Tet_t + \varepsilon_i \ldots\ldots\ (2)$$

Where; $OU5MID_t$: Overall Under-Five Mortality Irrespective of the Diseases at Time t, Imu_t: Immunization level of Children at Time t, Pne_t: Deaths due to Pneumonia at Time t, Dia_t: Deaths due to Diarrhoea at Time t, Mea_t: Deaths due to Measles at Time t, Tet_t: Deaths due to Tetanus at Time t, α & β: The regression coefficients and ε_i: The error term (Stochastic) StataSE 12 and Excel software were used to run the analysis.

V. RESULTS

Table 1: Mortality Rate due to the Five Child-Killer Diseases

Years	Children Immunized	Pneumonia Mortality Rate	Diarrhoea Mortality Rate	Measles Mortality Rate	Tetanus Mortality Rate	Polio Mortality Rate	Overall Mortality Rate
2008	155,123	15	29	10	2	0	112
2009	155,703	9	48	11	1	0	155
2010	156,962	10	81	22	3	0	202
2011	158,021	13	89	39	1	0	237
2012	158,888	14	69	15	1	0	314
2013	159,936	17	32	10	3	0	261
2014	166,872	7	37	26	0	0	245
2015	168,953	7	55	31	2	0	200
2016	169,887	3	29	5	2	0	90
2017	177,879	6	21	3	0	0	129
2018	189,963	9	46	7	0	0	116
2019	197,773	3	14	7	1	0	96
2020	209,996	7	20	23	0	0	162
2021	216,985	5	10	8	0	0	101
2022	224,940	1	4	5	1	0	108

Source: Researcher's Results, 2024

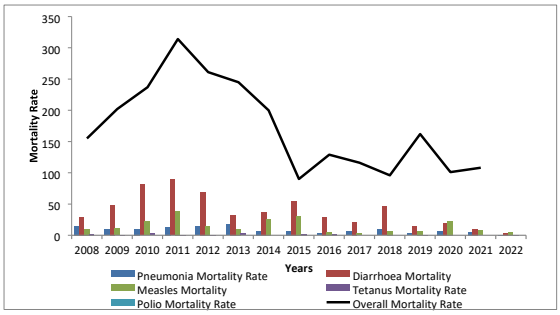

Figure 1: Mortality rate of the Child-Killer Diseases and Overall Mortality rate

Source: Researcher's Results, 2024

Table 1 and Figure 1 above revealed the Under-Five Mortality rate due to the Five Child-Killer Diseases in the study area. The Overall Under-Five Mortality rate increases from 112 to 314 deaths per thousand live births between 2008 and 2012. This was followed by a sudden decrease from 261 to 90 deaths per thousand live birth from 2013 to 2016 and then fluctuate throughout the rest of the period under review. Individually, the largest contributor of Under-five Mortality among the Five Child-killer Diseases is Diarrhea with 89 deaths per thousand live birth in 2011, followed by Measles with 39 deaths per thousand live birth in the same year 2011; Pneumonia with 17 deaths per thousand live birth in 2013, Tetanus with 3 deaths per thousand live birth in 2010 and 2013 respectively and Polio did not register any death within the period under review.

Table 2: Regression Output of Deaths due to Five Child-Killer Diseases, Immunization

Level and Overall Under-Five Mortality Irrespective Diseases (OU5MID)

Source	SS	df	MS		Number of obs =	15
					F(5, 9) =	2.02
Model	77836.1663	5	15567.2333		Prob > F =	0.1702
Residual	69509.5671	9	7723.28523		R-squared =	0.5283
					Adj R-squared =	0.2662
Total	147345.733	14	10524.6952		Root MSE =	87.882

ou5mid	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
immunization	.0001582	.001578	0.10	0.922	-.0034116	.0037279
pneumoniadth	6.460339	4.194879	1.54	0.158	-3.029136	15.94981
diarrhoeadth	.2709934	1.032357	0.26	0.799	-2.064359	2.606346
measlesdth	2.379124	1.716373	1.39	0.199	-1.50358	6.261829
tetanusdth	-6.561852	15.96223	-0.41	0.691	-42.67093	29.54723
poliodth	0	(omitted)				
_cons	105.7381	345.789	0.31	0.767	-676.4909	887.9672

Source: Researcher's Results, 2024

From the table above, it shows that there exists a positively strong causal relationship between deaths arising from Pneumonia and Under-Five Mortality in the study area with β = 6.468 and P-value $>$ 0.05. This result shows that such a relationship is insignificant enough since it associated with a relatively high level of significant.

The above table also shows that there exists a positively weak relationship between deaths due to Diarrhoea and Under-Five Mortality in the study area with β = 0.271 and P-value $>$ 0.05. Such a relationship is also insignificant since it associated with a relatively high level of significant.

From table 2 above, the results revealed that, there exists a positively relationship between deaths arising from Measles and Under-Five Mortality in the study area with β = 2.379 and P-value $=$ 0.199. This relationship is also insignificant enough since it associated with a P-value $>$ 0.05.

The results from table 2 above also shows that, there exists a negatively strong causal relationship between deaths arising from Tetanus and Under-Five Mortality in the study area with $\beta = -6.562$ and P-value $>$ 0.05. Such a relationship is also insignificant since it associated with a relatively high level of significant.

Based on the above table 2, the Immunization level has a negligible causal relationship with
Under-Five Mortality in the study area since it associated with β = 0.0002 and P-value $>$ 0.05.

Regression Model for Future Prediction or Forecast of Under-Five Mortality

Form Table 2 above, the regression model for future prediction or Forecast of Under-Five Mortality in the study area is given as:
$OU5MID_t = 105.74 + 0.0002Imu_t + 6.46Pne_t + 0.27Dia_t + 2.38Mea_t - 6.56Tet_t + \varepsilon_i$. . . (3) Where: ε_i, the stochastic error term is used to represent all the variables that were not captured due to the scope of the study (access to health service, demographic and social factors which might have influenced the study)

The regression model explained that; at zero deaths due to the Five Child-Killer Diseases, the Under-Five Mortality is more than 105 deaths in the study area.

Hypothesis

H_O: There is no Cause-effect of the deaths due to the Five Child-Killer Diseases on Overall Under-Five Mortality Irrespective of Diseases in Adamawa.

From the above table 2, the results of model show that; the deaths due the Five Child-Killer Diseases has a Cause-effect of 26.6% on Overall Under-Five Mortality in Adamawa State. This implies that the results have no substantial percentage of variation on Under-Five Mortality in the study area. The results of the model summary also revealed that the Cause-effect is statistically insignificant, since it associated with F-value = 2.02 and P-value $>$ 0.05.

VI. DISCUSSION OF FINDINGS

In a related study by Lukman & Umaru (2017), the Five Child-Killer Diseases account for 60.92 percent Under-Five Mortality in Adamawa State Nigeria, while this study revealed that the deaths due to Five Child-Killer Diseases account for 26.6 percent of the overall variation in the Under-Five Mortality. This implies that the two studies have a great variation. The variation in these two studies might be due time difference and the scope of data collection.

Similarly, Orubuloye and Caldwell (2011) in a related study revealed that the Child-Killer Diseases account for than 70 percent Under-Five Mortality, while this study revealed that the Child-Killer Diseases account for 26.6 percent of the overall variation in the Under-Five Mortality. This can be acceptable due to the fact that; may be Adamawa state government is succeeding in reducing the Under-Five Mortality due to Child-Killer Diseases by timely and adequately provision of vaccine, well trained health personnel, encouraging sanitation and good hygiene in the State.

Lukman & Umaru (2017), also explained that there exists a causal relationship between the deaths due pneumonia, diarrhea, measles and tetanus on Under-Five Mortality with 3.233, 1.038, 5.197 and -3.505 respectively in Adamawa State Nigeria, while this study revealed that the causal relationship between the deaths due pneumonia, diarrhea, measles and tetanus on Under-Five Mortality with 6.46, 0.27, 2.38 and -6.56 respectively. The two studies are in agreement with positive causal relationship between the deaths due pneumonia, diarrhea, measles and negative causal relationship between the deaths due tetanus on Under-Five Mortality.

Jalal-Eddeen (2014), investigated that the Under-Five Mortality due tetanus infection in Adamawa State were found to be 4% in 2008, 8% in 2009 and 12% in 2013, this study reported that the Under-Five Mortality to tetanus infection are 0% in 2020, 0% in 2021 and 9% in 2022.

WHO (2011) reported that the mortality 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, while this study investigated that the Under-Five Mortality due to tetanus, pneumonia and diarrhoea 2020 are 0, 7 and 20 respectively. The higher variation in Somalia might be due to the civil war for many years which lead to unstably governance to fight the diseases and poverty.

CONCLUSION

Polio needs to be excluded from the Five Child-Killer Disease since the investigation shows that no deaths associated with polio disease for the period under review in the study area.

Based on findings, the deaths due to the Five Child-Killer Diseases considered in this study contributed 26.6% on the overall Under-Five Mortality and the contribution is also statistically insignificant. This implies that there is an extraneous variable that are influencing the UnderFive Mortality in the study area. The regression model for future Prediction/forecast of Under-Five Mortality in the study area is statistically insignificant. The model also explained that; at zero deaths due to the Five ChildKiller Diseases, the Under-Five Mortality is more than 105 deaths in the study area.

Despite the number of immunization levels are increasing year by year, the model also revealed that; the immunization level has a negligible and insignificant relationship on Under-Five Mortality in the study area.

RECOMMENDATIONS

Since the study has revealed that; Pneumonia and Diarrhoea associated insignificantly with Under-Five Mortality, Adamawa State Government need to implement the Global Action Plan for Pneumonia and Diarrhoea (GAPPD) with immediate effect as campaigned by WHO and UNICEF.

Both government and individual should promote adequate nutrition as a key factor to improve children's natural defenses against Child-Killer Diseases, starting with exclusive breastfeeding for the first 6 months of life.

Adamawa State Primary Health Care Development Agency (PHCDA), whose primary responsibility among orders is to curb and reduce the spread of Child-Killer Diseases among vulnerable children of age; needs to revise and strategies their act plans, despite fact that the Cause-effect of deaths due to the Five Child-Killer Diseases on Under-Five Mortality is low.

Addressing environmental factors such as air pollution, encouraging sanitation and good hygiene in crowded area would be an ideal solution to reduce the outbreak of the Child-Killer Diseases in the study area. Children infected with HIV/AIDs should be given daily medication to reduce the risk of contracting the Child-Killer Diseases.

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