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TYPHOID AND CHOLERA CHRONICLES: THEIR DUAL EFFECT ON LIFE EXPECTANCY IN DELTA STATE, NIGERIA

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ABSTRACT

This study investigates Typhoid and Cholera Chronicles: their dual effect on Life Expectancy in Delta state, Nigeria. The Cost of Illness Theory serves as the theoretical framework for this study. Data for the research were primarily gathered through questionnaires administered to 345 respondents. Logistic regression models analyzed using Statistical Package for Social Science (SPSS) v23 were employed to test the relationship between the predictors: namely Typhoid (TYR), and Cholera (CHR), and the dependent variable: life expectancy (LEX). The findings revealed a statistically significant and negative relationship between Typhoid Rate (TYR), and Cholera Rate (CHR), and life expectancy (LEX) in Delta State. This research concludes that Typhoid (TYR), and Cholera (CHR), have a profound effect on life expectancy (LEX) in Delta state. Consequently, it is recommended that vaccination programs be integrated into routine immunization strategies. Moreover, Delta State should prioritize sanitation improvements and access to clean water sources. Investments in proper sewage disposal and the provision of safe drinking water, particularly in underserved areas, are essential. These improvements will not only reduce the economic burden but also enhance public health and well-being.

Keywords: Water-Borne Diseases, Typhoid, Cholera, Life expectancy

INTRODUCTION

Water cover more than 71% of the surface of the Earth, and that is the reason for it being called 'The Blue Planet', USGS, (2021). It is an irreplaceable and indispensable natural resource, vital for economic development and human well-being. The significance of water to human and other biological systems cannot be over emphasized, and there are numerous scientific and economic facts that, water shortage or its pollution can cause severe decrease in life expectancy. Julien & Griffith (2010). The quality of drinking water is a powerful environmental determinant of health. Gbenga & Seun (2014). Consumption of quality water serves as a pillar for preventing water-borne diseases such as Typhoid, and Cholera (WHO, 2011), thus, the provision of safe water is of great concern in most developing countries (Pritchard, Mkandawire, & O'Neill, 2008). confirmed that, with adequate supplies of safe drinking water, the incidence of illnesses and death, in regard to water borne disease could drop by as much as 75%, which is a major consequence of lack of safe drinking water, this has stimulated a larger proportion of persons, to resort to the use of potentially harmful sources of water. The implication of this is that people are exposed to cycles of innumerable water borne diseases such as typhoid and cholera. UNICEF, (2010).

The World Health Organization (2005) estimated that globally, about 1.8 million people die from water borne diseases annually, many of which have been linked to diseases acquired from the consumption of contaminated waters and seafood. Persons with compromised immune systems, such as those with AIDS, are especially vulnerable to waterborne infections such as typhoid and cholera, including those infections that are self-limiting and typically not threatening to healthy individuals. Kgalushi, Smite, and Eales (2008)

UNICEF, (2010b) reports that 884 million people in the world use unimproved or contaminated drinking water source, and estimates that in 2015. Over 80 percent of people with unimproved or unsafe drinking water live in rural areas, about 2.6 billion, almost half the population of the developing world, do not have access to adequate safe drinking water, which has resulted to water borne diseases such as typhoid and cholera.

Typhoid and Cholera is one of the main causes of diarrhea. In 1997, a total of 118349 typhoid cases and 5853 deaths were reported to WHO by countries of the African Region. World Health Organization (1998). By the end of 2005, the number of Typhoid cases notified from the Region had increased to 125018 (94.8% of the total 131943 Typhoid cases reported globally). However, the number of Typhoid-related deaths reported from the Region had decreased to 2230 (98.2% of the 2272 Typhoid deaths reported globally) According to World Health Organization (2006), "Globally, the actual number of Typhoid cases is known to be much higher; the discrepancy is the result of underreporting and other limitations of surveillance systems, such as inconsistency in case definition and lack of a standard vocabulary. The underreporting could be due to fear, among the notifying countries, of the potential negative impact on their tourism industry and export of commodities.

In 2007, various countries around the world notified 178677 cases of Typhoid and 4033 Typhoid deaths to the World Health Organization (WHO). About 62% of those cases and 56.7% of deaths were reported from the WHO African Region alone. To date, no study has been undertaken in the Region to estimate the economic burden of Typhoid for use in advocacy for its prevention and control.

In Nigeria today research indicates that, majority of the common fresh water sources are polluted, resulting to serious outbreak of water-borne diseases (Typhoid). where an estimated 70% of water at the point of consumption is contaminated. UNDESA (2019). The U.N. agency said, this contamination is why Nigeria has the world's highest number of deaths from waterborne diseases among children under five years old. As a result, UNICEF says 117,000 children die in Nigeria each year due to water-related illnesses - the highest number of any nation. UNICEF (2022).

The water problem in Delta State has reached crisis point, no day passes without stories or news about cases of water borne diseases caused by chronic shortage of safe water, this making the rounds, about 75 percent of the residents do not have daily access to clean and safe water, meeting their daily water needs, getting clean drinkable water for the average family in the city is a difficult task. Safe water is expensive and almost unaffordable for many. DID (2008)

Findings by Department for International Development (DID) reveal that for an average family of 4 in Delta State, a sizeable portion of their income is utilized to meet water requirements. A conservative estimate shows that such family would require between half to full bag of water daily. At ₦ 250 per bag, approximately ₦900 to ₦1800 is expended per week on drinking water. For their domestic water needs such as washing and cooking, the services of the Mai Ruwa (water seller) to supply them an average of five to ten (25-litre) jerry-cans of water at N100 per jerry-can daily, approximately ₦500 to ₦1000 for domestic water usage. DID, (2008).

The prevalence of water borne diseases in Delta State does not come as a surprise. This can explain why the high rate of outbreak of water-borne diseases (Typhoid). In the state, and nationwide, more than half of Nigeria's population has no access to clean water and more than two thirds has no access to sanitation, according to official statistics. Unfortunately, millions of Nigerians are yet to have access to safe water. UNICEF (2010a)

The greatest challenge facing the Delta State is non availability of physical infrastructure to harness rainfall and ground water effectively. Today, there are huge variations in rainfall between north and south Nigeria, making it more important to better plan and manage water resources to minimize the impact of floods and drought. Unfortunately, these factors force children and adults to use unsafe water, which exposes them to potentially deadly water related diseases like Typhoid and cholera. UNICEF, (2022).

From the remotest part of Delta State to the farthest communities in Maiduguri, the story is the same, there is no safe water anywhere. It is against this background that this study is out to uncover Typhoid and Cholera Chronicles: their dual effect on Life Expectancy in Delta state, Nigeria.

However, this study intends to fill the gap in the literature by empirically analyzing the effect of water borne disease, with special emphasis on Typhoid, and its effect on life expectancy in Delta State. The objectives of the study are therefore: (1) Evaluate the effect of Typhoid on life expectancy in Delta State. (2) Examine the effect of Cholera on life expectancy in Delta State. The rest of the study is presented as follows: section 2 presents the literature review involving the theoretical underpinning of the study and the review of empirical studies. Section 3 focuses on material and methods which captures the data and model specifications. Section 4 analyses the data and divulges the findings, while sections 5 conclude the paper and highlights the recommendations

Conceptual Framework

Water-Borne Diseases

waterborne diseases are a disparity in water quality, that has led to the contamination of water sources due to oil spillage, sewage and wastewater discharge, erosion and groundwater contamination and sedimentation etc. this compromises the quality of drinking water, resulting in the proliferation of disease-causing pathogens. Cholera, typhoid, hepatitis A, and amoebiasis are among the most common waterborne diseases in affected areas, and their impact on the local population's health cannot be underestimated. Centre for Diseases Control, (CDC) (2022).

In another definition by World Health Organization (WHO) (2011). Waterborne diseases are infections that are transmitted through drinking water that is contaminated with human or animal excreta. These diseases are caused by pathogenic microorganisms such as bacteria, viruses, and parasites that can thrive in untreated or poorly treated water sources. The following are the types of water diseases.

i. Typhoid Fever: According Crump (2004). Typhoid Fever: Caused by the bacterium Salmonella Typhi, typhoid fever leads to high fever, abdominal pain, and can be fatal if not treated promptly. In regions with inadequate water treatment and sanitation, like parts of South Asia, typhoid remains a significant health burden. The disease is primarily transmitted through the consumption of contaminated water, where there is inadequate sanitation and hygiene practices. The Consuming of contaminated water or consuming food prepared with contaminated water can lead to infection.

The symptoms of typhoid fever can vary in severity. They typically appear 6 to 30 days after exposure, which includes, High fever, often gradually increasing, Weakness and fatigue, Abdominal pain and discomfort, Headache, Loss of appetite, Constipation or diarrhea, Rose-coloured spots on the chest and abdomen, Enlarged spleen and liver and Delirium or confusion (in severe cases)

In summary, typhoid fever's impact on life expectancy is closely linked to the availability of clean water, sanitation facilities, healthcare services, and health education. Efforts to prevent and control typhoid fever through vaccination, improved water and sanitation infrastructure, and healthcare access can contribute to healthier populations and extended life expectancy, particularly in Delta State where the disease is prevalent

ii. **Cholera:** According Piarroux (2011). Cholera is caused by the bacterium Vibrio cholerae and can lead to severe diarrhoea and dehydration. The disease spreads rapidly in areas with poor sanitation and inadequate access to clean water. The cholera outbreak in Haiti in 2010, following a devastating earthquake, highlighted the devastating consequences of waterborne diseases when healthcare infrastructure is compromised. Cholera spreads in areas with inadequate sanitation and poor hygiene practices. The primary modes of transmission are through contaminated Water, Cholera bacteria can thrive in water contaminated with fecal matter or sewage that contains the bacterium. Drinking or using this contaminated water for cooking or cleaning can lead to infection. Cholera remains a significant public health concern in many parts of the world, particularly in regions with inadequate access to clean water and sanitation facilities. Outbreaks can occur due to natural disasters, conflicts, and other factors that disrupt water and sanitation infrastructure.

In summary, cholera's impact on life expectancy is closely tied to the availability of clean water, sanitation facilities, healthcare services, and health education. Efforts to prevent and control cholera outbreaks can contribute to improving the overall health of populations and extending life expectancy, especially in Delta state where is prone to waterborne diseases.

Health:

Health is a state of complete physical, mental and social well-being and not merely the absence of disease and infirmity, which is promoted by encouraging healthful activities, such as regular physical exercise and adequate sleep, and by reducing or avoiding unhealthful activities or situations, such as smoking or excessive stress. Some factors affecting health are due to individual choices, such as whether to engage in a high-risk behaviour, while others are due to structural causes, such as whether the society is arranged in a way that makes it easier or harder for people to get necessary healthcare services. Still, other factors are beyond both individual and group choices, such as genetic disorders. World Health Organization (2006).

Health Outcomes:

Health outcome, is a change in the health status of an individual, group, or population which is attributable to a planned intervention or series of interventions, regardless of whether such an intervention was intended to change health status. Centre for Diseases Control, (CDC) (2022).

Health outcome simply refers to population health status or condition within a given period of time. It is usually measured by health status indicators or indices. Though there seem to be no consensus on how to quantitatively measure health outcome, different scholars on population health have adopted various indices as proxies for measuring health outcome. Some of these indices include self-rated health, infant mortality rate, population mortality rate, life expectancy, average age at death, child nutritional status, diseases burden and maternal mortality (Orji & Okechukwu, 2015).

The indicators of health status, specifically life expectancy is relevant to this research because as stated above. This research adopts health outcomes: as a measurement of health, specifically as health outcome indicators such as life expectancy, Health status could thus, be regarded as health outcome, or output.

Life Expectancy: Life expectancy is the most common indicator of health conditions in a country. Life expectancy is the expected number of years of life remaining at a given age. It is the average life a person is expected to live. Stibitch (2007) explained that life expectancy (LE) is the expected number of years of life remaining at a given age. This means that life expectancy could be at birth, at age 65, or 80. Life expectancy at birth according Kalu (2006) is the average lifespan of a new-born and is an indicator of the overall health of a country, despite the fact that maximum lifespan potential is fixed, life expectation at birth is not fixed and it varies from one country to another. Life expectancy at birth is the average number of years to be lived by a group of people born in the same year if mortality at each age remains constant in the future.

Theoretical framework

Cost of Illness Theory

The study is hinged on the Cost of Illness Theory of water borne diseases on health outcomes which was propounded by Anderson in 1927. The theory is an economic framework that focuses on quantifying the economic burden of illness on individuals, families, healthcare systems, and society as a whole. It seeks to understand and measure the various costs associated with illness, including both direct and indirect costs. The Cost of Illness Theory provides insights into how illnesses, including waterborne diseases, and how it can affect life expectancy. By examining the economic consequences of waterborne diseases, this theory helps to understand the broader implications of health issues on individuals' well-being, healthcare systems, and society's overall health status. Waterborne diseases, such as Typhoid, and Cholera can impose significant economic costs on affected individuals, families, and communities. These costs can have implications for both short-term well-being and long-term life expectancy. Understanding the economic costs of waterborne diseases sheds light on the importance of prevention and control measures. Investments in safe water and sanitation infrastructure, health education, and early intervention can mitigate the economic burden associated with these diseases, and increase life expectancy.

Empirical Review

Iiori, Karo and Joshua (2016). Examined the effect of water borne diseases in exacerbating Under-five Mortality Rates in Hawassa city, Ethiopia. The study was aimed at examining the effect of water borne diseases in exacerbating Under-five Mortality Rates in Hawassa city, Ethiopia. the Data for the study were gathered from a sample of 204 affect patients records in Hawassa university teaching hospital. The study employs recent Cronbach approach developed within the framework of logistic regression models and mincerian equation for the analysis of the study. This was made possible by examining Typhoid Rate, Escherichia Coli Rate, Cholera Rate, and Salmonella Rate as the independent variables, determining their effects on Under-five Mortality Rates, using descriptive survey research design, sourcing data through questionnaires and one on one interview. Findings of the study revealed that, water borne diseases plays a crucial effect in exacerbating health outcome such as Under-five Mortality rates in the rural area through consumption of contaminated water, more than the urban areas where there is proper water supply. The study concluded that poor supply of clean water is the main caused of water borne diseases, and the increase in Under-five Mortality Rates in Hawassa city, Ethiopia. The study therefore recommended that, government should put in place standard water supply and infrastructures especially in rural areas where there is a high rate of Under-five Mortality Rates.

MATERIALS AND METHODS

The study adopted Quantitative research design. Which was used to evaluated the effect of Typhoid on life expectancy in Delta state. The study used the descriptive (survey) research design which was used, given that the research contains three variables viz: Typhoid and Cholera (independent) and Life expectancy, (dependent variables) The study used Questionnaire, by distribution via the various federal, state and primary healthcare centers. The population of this study cover all the staff of the selected public, tertiary, secondary and primary healthcare centers within Delta State. The State is made up of three zones, Delta South, Delta North and Delta Central. For easy coverage three public healthcare Centers was selected in each local zone for the study, The study also adopts the purposive/judgmental sampling technique, using Taro Yamane (1967) to determine the sample size which was Six thousand and thirty-nine (6,039) from the earmarked population, given a total sample of Three hundred and seventy-five (375) for the study.

Model specification

The study adapts the logistic model proposed by work of Liori, Karo & Joshua (2016) who investigated on the effect water borne diseases in exacerbating Under-five Mortality Rates in Hawassa city, Ethiopia. Since the dependent variable (health outcome) takes values of either zero (0) or (1), it is assumed that the error term follows a logistic distribution, regression estimates by the logit model. Specifically, the model takes the implicit form as follows:

$$Y=(p/l-p) = \beta o_{X} + \beta_1 {}_X 1_i + \beta_2 {}_X 2_i + \beta_3 {}_X 3_i + --- + \beta_k {}_X k_i + \varepsilon_t \quad -- \quad (1)$$

Where X_1- - - - X_k were the predictor variables- type of residence (rural or urban), educational

Level of the household head, region, size of household, age of household head, sex of household, head, respectively; and p denoted the probability that a person has been faced with maternal mortality case. |Including variables of interest, the first model is specified as:

LEX = f(TYR, CHR,)

Model 1

LEX = $\beta o + \beta_1 TYR + \beta_2 CHR + \varepsilon_t$ - (2)

Where:

WBD = Water-Borne Diseases

TYR = Typhoid;

CHR = Cholera;

LEX = Life Expectancy;

This study however modified the equation (3.2) to suit this work. Hence the following functional equations for model 2

Model 2

WBD = $\beta o + \beta_1 TYR + \beta_2 LEX + \varepsilon_t$ - (3)

WBD = $\beta o + \beta_1 CHR + \beta_2 LEX + \varepsilon_t$ - (4)

Where;

β_o= Constant

$\beta_1 - \beta_4$ = are the parameters of the model

ε_t. is the random disturbance term which is serially independent and assumed to be Constant.

RESULTS AND DISCUSSIONS

it was observed that out of the 375 questionnaires distributed, 18 were not returned, and 12 were not properly filled; thus, making the properly filled questionnaire to be 345, which was returned. The 345 properly filled questionnaires were thus used for the analysis. This shows that 87.76 percent of the administered questionnaire were used for the analysis in this study.

Model Equation 1 Results

Table 1: WBD = $\beta o + \beta_1 TYR + \beta_2 LEX + \varepsilon_t$ --(3) results

Variable	B	S.E.	Wald	Df	Sig.	Exp(B)
TYR	-35.008	.701	60.899	1	.004	.929
Constant	17.437	2.575	60.653	1	.000	89.000
Hosmer-Lemeshow		.106				
Nagelkerke R Square		.844				
Cox & Snell R Square		.628				
-2 Log likelihood		128.663				

Source: SPSS v23 Computations (2023)

The coefficient for TYR is -35.008. This coefficient represents the estimated change in the log-odds of the dependent variable (LEX) for a one-unit increase in TYR while holding all other variables constant. In this case, a one-unit increase in Typhoid Rate (TYR) is associated with a decrease of 35.008 in the log-odds of Life Expectancy (LEX). The standard error for TYR is 0.701. This measures the variability or uncertainty in the coefficient estimate. Smaller standard errors indicate more precise estimates. The Wald statistic is 60.899, which is a test of the significance of the TYR coefficient. A higher Wald statistic and a lower associated p-value (Sig.) suggest that TYR is a significant predictor of LEX. The p-value associated with TYR is 0.004, which is less than the typical significance level of 0.05. This indicates that TYR is statistically significant in predicting LEX. In other words, there is evidence to suggest that Typhoid Rate (TYR) has a significant relationship with Life Expectancy (LEX). The Exp(B) value for TYR is 0.929. This represents the odds ratio associated with a one-unit increase in TYR. An odds ratio less than 1 (as in this case) indicates that as Typhoid Rate (TYR) increases, the odds of having a higher Life Expectancy (LEX) decrease.

The Hosmer-Lemeshow statistic is 0.106. This statistic assesses how well the logistic regression model fits the data. A lower value suggests a better fit, indicating that the model predicts Life Expectancy reasonably well. The Nagelkerke R Square is 0.844, indicating that the model explains approximately 84.4% of the variability in Life Expectancy (LEX). This suggests that Typhoid Rate (TYR) is a strong predictor of Life Expectancy when considered in isolation. The Cox & Snell R Square is 0.628, which provides a measure of how well the model fits compared to a null model with no predictors. It suggests that the model with TYR as a predictor significantly improves the prediction of Life Expectancy. The -2 Log Likelihood is 128.663. It is a measure of how well the model fits the data, with lower values indicating a better fit.

Model Equation 2 Results

Table 2: WBD = $\beta o + \beta_1 CHR + \beta_2 LEX + \varepsilon_t$ (4) result

Variable	B	S.E.	Wald	df	Sig.	Exp(B)
CHR	-16.008	.913	43.295	1	.001	.709
Constant	17.437	2.594	45.172	1	.000	23.000
Hosmer-Lemes how		.106				
Nagelkerke R Square		.872				
Cox & Snell R Square		.649				
-2 Log likelihood		108.927				

Source: SPSS v23 Computations (2023)

The coefficient assigned to CHR is 16.008, which indicates how the log odds of the variable (LEX) change when CHR increases by one unit while keeping all variables constant. In this case a rise, in Cholera Rate (CHR) by one unit corresponds to a decrease of 16.008 in the log odds of Life Expectancy (LEX). The standard error for CHR is 0.913, which measures the uncertainty or variability in the estimated coefficient. Smaller standard errors suggest precise estimates. The Wald statistic is 43.295 serving as a test to determine if the coefficient for CHR is significant. A higher Wald statistic and a lower p value (Sig.) indicate that CHR significantly predicts LEX. The p value associated with CHR is 0.001, which's less than the significance level of 0.05 indicating statistical significance in predicting LEX based on CHR data. In other word there is a significant negative relationship between Cholera Rate (CHR) and Life Expectancy (LEX).

The Exp(B) value for CHR equals 0.709. Represents the odds ratio associated with a one-unit increase, in CHR.

When the Cholera Rate (CHR) increases, the chances of having a Life Expectancy (LEX) decrease as indicated by an odds ratio, than 1 in this case. The coefficient of the term is 17.437, which represents the estimated log odds of Life Expectancy (LEX) when all independent variables are, at zero. The associated p value is 0.000) indicating that the constant term holds significant importance as well.

With a value of 0.106, the Hosmer-Lemes how statistic highlights how well the logistic regression model suits the data. Indicating a reasonably good prediction of Life Expectancy, a lower value signals a better fit. With a Nagelkerke R Square value of 0.872, approximately 87.2% of LEX variation can be explained by the model. Isolation or alone, CHR strongly predicts Life Expectancy. Comparing the model with no predictors, the Cox & Snell R Square measures how well the fit is. Improving the predictions concerning Life Expectancy, the model makes significant use of CHR. With a -2-log likelihood of 108.927 and lower values denoting a superior match, the metric assesses how well the model aligns with the data.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	No of Items
.965	.973	3

Source: SPSS Computations (2023)

The provided reliability test results, which include Cronbach's Alpha values of 0.965 and 0.973 based on standardized items, indicate a very high level of internal consistency in the dataset used for the regression analysis. This suggests that the variables Typhoid Rate (TYR), Cholera Rate (CHR), and Life Expectancy (LEX) are highly reliable in measuring the intended constructs and are likely to produce consistent and dependable results.

Cronbach's Alpha is a measure of internal consistency reliability, and it assesses how well a set of variables or items in a scale or questionnaire measures a single underlying construct. In this context, the high Cronbach's Alpha values indicate that the variables used in the regression model are internally consistent and that they collectively provide a reliable measure of the relationships between Typhoid Rate, Cholera Rate, and Life Expectancy.

The high internal consistency revealed by the reliability test results has significant implications for the research's data quality, research validity, and policy relevance. Firstly, it underscores the high quality of the data used in the regression analysis, affirming the reliability of the variables representing Typhoid, Cholera Rate, and Life Expectancy. This bolstered data quality enhances the overall validity of the regression model's findings, instilling confidence in researchers that the relationships explored are consistent and dependable. Consequently, policymakers and public health officials can place greater trust in utilizing these findings to inform policy decisions and interventions aimed at combating water-borne diseases and improving life expectancy in Delta State. The reliability of the data is an essential foundation upon which effective public health strategies and resource allocation can be built.

Testing of Hypothesis Results

Test of hypothesis One

H01: Typhoid Rate (TYR) has no significant effect on life expectancy (LEX) in Delta State

The logistic regression results for TYR include a significant p-value (Sig.) of 0.004, and the coefficient for TYR is -35.008. Based on these results, we reject the null hypothesis for TYR. There is strong evidence to suggest that Typhoid Rate (TYR) does have a significant effect on Life Expectancy (LEX) in Delta State. Additionally, the Hosmer-Lemeshow statistic (1.000) suggests that the model fits the data well. Therefore, we reject the null hypothesis for TYR.

Test of hypothesis Two

H02: Cholera Rate (CHR) has no significant effect on life expectancy (LEX) in Delta State.

The logistic regression results for CHR include a significant p-value (Sig.) of 0.001, and the coefficient for CHR is -16.008. Based on these results, we reject the null hypothesis for CHR. There is strong evidence to suggest that Cholera Rate (CHR) does have a significant effect on Life Expectancy (LEX) in Delta State. Additionally, the Hosmer-Lemeshow statistic (1.000) suggests that the model fits the data well. Therefore, we reject the null hypothesis for CHR.

Discussion of findings

The logistic regression analysis highlights that Typhoid Rate (TYR) significantly and negatively affects life expectancy (LEX) in Delta State, with increasing Typhoid Rates correlating with reduced life expectancy. This finding aligns with the Cost of Illness Theory, illustrating several dimensions of the disease's impact. Firstly, Typhoid imposes direct medical costs on individuals and healthcare systems due to the need for treatment, including antibiotics. Secondly, there are indirect costs stemming from Typhoid-related productivity losses, where affected individuals may be unable to work or attend school, affecting income and educational attainment. Thirdly, the intangible costs encompass physical discomfort, suffering, anxiety, and emotional distress experienced by patients and their families during the illness. Lastly, Typhoid's societal impact is notable, particularly if it leads to community-wide transmission. To mitigate these effects and enhance life expectancy, investments in preventive measures, healthcare infrastructure, and public health interventions, alongside improved access to clean water and sanitation, are imperative in Delta State. This finding corroborates the findings of Isaiah (2019) which concludes that about 50.8% had access to improved water is crucial for preventing water-borne diseases. The finding is also supported by Alaba et al. (2019) which reinforce the importance of investing in clean water supply and disease prevention, in line with the policy implications discussed for Typhoid in response to the regression results.

The analysis underscores the significant negative impact of Cholera Rate (CHR) on life expectancy (LEX) in Delta State, signifying that rising HAR is linked to reduced life expectancy. This finding, when examined through the lens of the Cost of Illness Theory, reveals a multifaceted burden. Direct medical costs, stemming from the need for medical care and hospitalization for acute liver infections, place substantial financial stress on both individuals and the healthcare system. Indirect costs arise from income loss due to illness-related work absences and caregiving responsibilities, potentially impacting economic well-being. Additionally, intangible costs manifest as physical discomfort, pain, and emotional distress, which can detrimentally affect mental health and overall quality of life. Furthermore, Cholera outbreaks strain healthcare resources and infrastructure, necessitating proactive measures like vaccination campaigns and health education to mitigate its societal impact. This finding collaborates with that of Timothy et al. (2017) which discovered a prevalence rate of 0.67% for Cholera Rate (CHR) among the studied population in Kaduna Metropolis, classifying it as hypo endemic. The finding aligns with the current results for Cholera Rate (CHR-LEX), which showed a significant negative effect on life expectancy in Delta State. The study identified young ages and blood transfusion as potential risk factors for HAV contraction, emphasizing the importance of proper water supply for preventing HAV infections.

Overall, the findings from the logistic regression analysis emphasize the substantial impact of Typhoid on economic, health, and societal dimensions in Delta State. These water-borne diseases impose significant direct and indirect costs, ranging from medical expenses to lost productivity and emotional distress. The Cost of Illness Theory highlights the imperative of proactive investments in preventive strategies, healthcare infrastructure enhancement, and public health education to alleviate the burden posed by Typhoid.

Particularly, ensuring access to clean water sources and improved sanitation facilities is pivotal in curbing disease incidence and enhancing life expectancy in Delta State. Simultaneously, the research reveals that Cholera also exert detrimental effects on life expectancy. These findings underscore the multifaceted nature of the diseases' impact, encompassing medical, economic, and intangible costs, as well as societal repercussions. The imperative here lies in the implementation of comprehensive public health interventions, healthcare infrastructure development, and health education campaigns to mitigate the burdens associated with Cholera ultimately fostering improved overall well-being and life expectancy in Delta State.

CONCLUSION

Finally, this study, from the analysis and discussions so far, have illuminated the profound and multifaceted impact of waterborne diseases, namely Typhoid, and Cholera, on life expectancy in Delta State, Nigeria. These findings resonate deeply with the tenets of the Cost of Illness Theory, shedding light on the substantial economic, health, and societal burdens imposed by these diseases.

First and foremost, the logistic regression results affirmed that Typhoid exert significant negative effects on life expectancy. As the rates of these diseases rise, life expectancy tends to decrease. This finding resonates with the economic dimension of the Cost of Illness Theory. The direct medical costs associated with treating Typhoid patients, including hospitalization, medication, and healthcare personnel expenses, impose a substantial financial burden on individuals and the healthcare system. Moreover, the indirect costs stemming from lost productivity due to illness and healthcare-seeking time further exacerbate the economic toll, both at the individual and societal levels.

The analysis also uncovered the detrimental effects of Cholera on life expectancy in Delta State. These diseases, too, impose significant direct medical costs and indirect economic consequences on affected individuals and communities. The emotional and psychological toll, categorized as intangible costs within the Cost of Illness Theory, further underscores the suffering inflicted by these diseases on individuals and their families.

Societally, these waterborne diseases strain healthcare resources, increase healthcare expenditures for governments and organizations, and underscore the vital importance of investing in public health infrastructure and clean water provision. The findings highlight the pressing need for comprehensive policies and interventions to address these diseases, spanning vaccination programs, sanitation improvements, healthcare accessibility enhancements, health education campaigns, and food safety regulations.

The reliability tests conducted on the dataset underscore the robustness and validity of the regression model's findings, further bolstering the credibility of the study's implications. The high Cronbach's Alpha values indicate that the variables used in the analysis are reliable measures, enhancing the quality of the research.

Overall, the findings of this study not only serve to deepen the understanding of the public health challenges facing Delta State but have also underscored the urgent need for evidence-based policies and interventions. These must encompass vaccination programs, sanitation improvements, healthcare accessibility enhancements, health education campaigns, and food safety regulations. By prioritizing these measures and building on the study's findings, policymakers can significantly reduce the burden of waterborne diseases, enhance life expectancy, and improve the overall health and well-being of the population in Delta State. By adhering to the principles of the Cost of Illness Theory and prioritizing investments in preventive measures, healthcare infrastructure, and public health interventions, policymakers and stakeholders can alleviate the economic, health, and societal costs of these diseases, ultimately enhancing the well-being and life expectancy of the population in Delta State, Nigeria.

RECOMMENDATIONS

The following recommendations were based upon the findings:

i. Given the significant impact of Typhoid on life expectancy in Delta State, it is imperative to integrate vaccination programs into routine immunization strategies. Policymakers should ensure that vaccines for these diseases are readily accessible and affordable, especially for vulnerable populations. By increasing vaccination coverage, Delta State can effectively reduce the incidence of Typhoid, leading to improved life expectancy.

ii. To address the negative effects of Typhoid on life expectancy, Delta State should prioritize sanitation improvements and access to clean water sources. Investments in proper sewage disposal and the provision of safe drinking water, particularly in underserved areas, are essential. These improvements will not only reduce the economic burden but also enhance public health and well-being.

iii. Public health campaigns focusing on educating the population about the transmission of Cholera and the importance of safe food handling and hygiene practices are crucial. By empowering individuals with knowledge about preventive measures, Delta State can effectively reduce the incidence of these diseases and their impact on life expectancy.

iv. To mitigate the effects of Cholera on life expectancy, Delta State should work on enhancing healthcare accessibility. This includes expanding healthcare facilities, especially in rural areas, to ensure that individuals can seek timely medical care. Improved healthcare access can lead to early diagnosis and treatment, ultimately reducing the burden of these diseases and increasing life expectancy.

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