RESPONSE OF MATERNAL AND CHILD HEALTH OUTCOMES TO COUNTERFACTUAL SHOCKS IN MALARIA PREVALENCE AND NEGLECTED TROPICAL DISEASES IN SUB-SAHARAN AFRICA

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ABSTRACT

This study examined the response of maternal and child health outcomes to counterfactual shocks in malaria prevalence and neglected tropical diseases in Sub-Saharan Africa. The study was motivated by the persistence of high maternal and infant mortality in the region despite global health commitments and policy interventions aimed at improving health equity. Specifically, the study focused on maternal mortality ratio and infant mortality rate as the main health outcomes, while malaria incidence and neglected tropical diseases were treated as disease-burden shocks that could worsen or improve health outcomes depending on their direction. The analysis was anchored on the social determinants of health theory, which explains health outcomes as a function of socioeconomic conditions, environmental factors, public health interventions, and institutional capacity. The study used annual panel data for 19 Sub-Saharan African countries covering 1990 to 2023. The selected countries included Nigeria, Ghana, Kenya, South Africa, Ethiopia, Uganda, Tanzania, the Democratic Republic of Congo, Cameroon, Senegal, Zambia, Malawi, Mozambique, Zimbabwe, Rwanda, Côte d'Ivoire, Burkina Faso, Madagascar, and Benin. The dynamic autoregressive distributed lag model was employed to examine the short-run and long-run responses of maternal and infant mortality to positive and negative counterfactual shocks in malaria and neglected tropical diseases. Descriptive statistics and panel unit root tests were also used to establish the basic properties of the data. The results showed that positive shocks in malaria prevalence and neglected tropical diseases increased maternal and infant mortality, while negative shocks reduced both mortality outcomes over time. The descriptive evidence also showed high average maternal mortality, high infant mortality, high malaria incidence, low physician density, low health expenditure, undernourishment, and uneven immunization coverage across the selected countries. The study concluded that maternal and child health outcomes in Sub-Saharan Africa are shaped not only by the direct burden of infectious diseases but also by social determinants such as health expenditure, nutrition, education, immunization, and health worker availability. The study recommended stronger malaria and neglected tropical disease control, increased health financing, improved maternal and infant health services, better sanitation, and integrated disease surveillance.

KEYWORDS: Maternal health; Child health; Malaria; Neglected tropical diseases; Sub-Saharan Africa.

INTRODUCTION

Maternal and child health remains a central development concern in Sub-Saharan Africa because the welfare of women and children reflects the capacity of health systems to protect the most vulnerable groups. The health of pregnant women and infants is especially important because adverse outcomes in these groups often reveal wider social and institutional weaknesses. Within the Sustainable Development Goals, maternal and child health is located at the center of the global

health agenda through the call to ensure healthy lives and promote well-being for all. In this study, this concern is reflected in the emphasis on reducing maternal mortality and ending preventable child deaths, especially in regions where poverty, weak healthcare systems, inadequate healthcare personnel, and governance constraints continue to undermine health outcomes (World Health Organization, 2023; Blumenberg et al., 2023; Lee & Lee, 2024).

Sub-Saharan Africa continues to bear a disproportionate burden of maternal and infant mortality. The evidence indicates that maternal mortality in the region remains high, while infant mortality also represents a major public health challenge. These outcomes are not isolated from the broader social environment in which people live. They are connected with poverty, poor sanitation, undernourishment, low health expenditure, insufficient skilled healthcare personnel, and limited access to essential health services. The situation is complicated by the fact that health outcomes are not determined by medical care alone; rather, they are shaped by the social conditions that influence disease exposure, treatment access, nutrition, immunization, and healthcare-seeking behavior.

Within this context, communicable diseases remain a powerful channel through which maternal and child health outcomes deteriorate. Malaria and neglected tropical diseases are particularly relevant because they are widespread in the region and affect vulnerable populations. Neglected tropical diseases such as schistosomiasis, lymphatic filariasis, onchocerciasis, and soil-transmitted helminthiasis are linked with poverty, low sanitation, environmental exposure, and weak health systems. They are described as neglected because they receive comparatively limited policy attention, funding, and intervention coverage despite their strong effects on poor households and vulnerable communities (World Health Organization, 2022; Annadurai, 2023; Gyorkos & Rojas, 2023).

Malaria remains one of the most persistent disease burdens in Sub-Saharan Africa. The study reports that malaria affects pregnant women and children in severe ways by increasing risks of maternal anemia, low birth weight, stillbirth, and child mortality. Although several interventions have been implemented, including insecticide-treated nets, indoor residual spraying, and access to antimalarial drugs, malaria incidence continues to persist because of drug resistance, limited healthcare access, and environmental conditions that sustain mosquito breeding (Oladipo & Orok, 2022; Opigo & Guyer, 2023; Nnaji & Ozdal, 2023; Patel et al., 2024).

The combined burden of malaria and neglected tropical diseases creates a complex public health problem because these diseases can interact with poverty, malnutrition, and limited healthcare access. Pregnant women exposed to malaria and neglected tropical diseases may experience complications that increase the risk of maternal mortality, while infants and children may suffer growth impairment, cognitive delays, and increased vulnerability to infections. Such outcomes imply that disease shocks are not merely short-term medical events but long-run determinants of population health. The economic burden associated with these diseases also worsens health disparities because households may incur healthcare costs and productivity losses that reinforce poverty and reduce the ability to seek timely care.

A distinctive contribution of this study lies in its focus on counterfactual shocks. Rather than examining malaria and neglected tropical diseases only as static explanatory variables, the study analyses how maternal and infant mortality respond to positive and negative shocks in disease prevalence. A positive shock refers to an increase in the disease burden, while a negative shock refers to a reduction in disease prevalence. This approach is important because health systems in

Sub-Saharan Africa are exposed to dynamic risks such as climate change, economic instability, and global health disruptions, all of which can alter disease patterns and health outcomes. Understanding the direction and magnitude of these responses provides evidence for adaptive public health planning (Amaya, 2022).

The study therefore contributes to the literature by linking maternal and child health outcomes to the dynamic behavior of malaria and neglected tropical diseases across 19 Sub-Saharan African countries from 1990 to 2023. Its emphasis on dynamic autoregressive distributed lag modeling allows the analysis to capture both short-run and long-run adjustments. This is particularly useful in public health research because disease shocks may not immediately translate into mortality outcomes; instead, their effects may unfold gradually as healthcare systems, households, and communities respond.

Literature Review

Maternal and Child Health in Sub-Saharan Africa

The study presents maternal and child health as outcomes shaped by social, environmental, and health-system determinants. Maternal mortality and infant mortality are not only indicators of individual health conditions but also measures of institutional effectiveness. In regions where health infrastructure is weak, women and infants face greater exposure to preventable death. The descriptive statistics in the study indicate that maternal mortality and infant mortality remained high across the selected Sub-Saharan African countries, suggesting that the region still faces substantial health challenges despite the global effort to reduce preventable deaths.

The persistence of poor maternal and child health outcomes is explained by structural vulnerabilities. Limited access to skilled birth attendants, inadequate public health expenditure, low physician density, food insecurity, and uneven immunization coverage create conditions under which disease shocks become more damaging. According to the reviewed literature, these conditions are central to the interpretation of maternal and infant mortality in the region. This position is consistent with the social determinants of health perspective, which considers health outcomes as reflections of broader social and economic systems rather than solely clinical factors.

Health disparities in maternal and child health also vary across countries because the selected Sub-Saharan African countries differ in healthcare provision, social and economic conditions, disease prevalence, and institutional capacity. The wide variation in maternal mortality ratio and infant mortality rate reported in the descriptive statistics suggests that some countries experience more severe health burdens than others. This variation makes panel analysis appropriate because it allows the study to observe both cross-country and time-related patterns in health outcomes.

Neglected Tropical Diseases and Maternal Health

Neglected tropical diseases have been recognised in the study as important contributors to maternal health challenges in Sub-Saharan Africa. Their effects are particularly severe where access to quality healthcare is limited and where sanitation, nutrition, and preventive health systems are weak. NTDs such as schistosomiasis, soil-transmitted helminth infections, onchocerciasis, lymphatic filariasis, and human African trypanosomiasis increase disease vulnerability and may worsen pregnancy-related outcomes. The burden of these diseases is

reinforced by poverty, environmental exposure, and poor healthcare delivery (World Health Organization, 2022; Abd El Wahed et al., 2024).

The empirical section of the study shows that a positive shock in neglected tropical diseases was associated with a sustained upward trajectory in maternal mortality. In contrast, a negative shock in neglected tropical diseases produced a declining pattern in maternal mortality. This result suggests that controlling neglected tropical diseases can improve maternal survival in the long run. The public health implication is that NTD control should not be treated as a separate disease-specific intervention but as part of a broader maternal health strategy.

The literature reviewed in the reviewed literature also connects neglected tropical diseases with broader vulnerability. Duffey et al. (2022) associated displacement, overcrowding, poor sanitary conditions, and infectious disease exposure with adverse health implications for women and girls. Similarly, Gyorkos and Rojas (2023) linked the global burden of neglected tropical diseases with maternal and child health implications. These perspectives support the study's argument that neglected tropical diseases affect health through both direct biological channels and indirect socioeconomic pathways.

Malaria, Pregnancy and Infant Survival

Malaria remains a major health challenge in Sub-Saharan Africa and is particularly dangerous for pregnant women and infants. The study explains that malaria can contribute to maternal anaemia, low birth weight, stillbirth, and increased child mortality. In malaria-endemic settings, pregnant women and children under five face heightened exposure because of biological vulnerability and limited capacity to withstand infection. The evidence in the document therefore positions malaria as a key disease burden that directly affects maternal and child health outcomes (Oladipo & Orok, 2022; Kolawole et al., 2023).

The study's results show that positive shocks in malaria incidence increased maternal mortality and infant mortality, while negative shocks produced downward movement in both outcomes. This finding indicates that malaria reduction has long-run health benefits. It also suggests that interventions such as prevention, treatment access, disease surveillance, and malaria control programmes can help reduce mortality outcomes if they are sustained over time. The dynamic response patterns reported in the figures show that the effects become more visible after some periods, meaning that public health benefits may require time to materialize.

The study also highlights that malaria control remains difficult because disease prevalence is influenced by environmental conditions, healthcare access, and policy implementation. Nnaji and Ozdal (2023) connected environmental factors with malaria transmission, while Opigo and Guyer (2023) and Patel et al. (2024) discussed malaria control measures and future strategies. These studies collectively support the argument that malaria is not only a medical problem but also a public health governance challenge requiring continuous intervention.

Empirical Evidence and Research Gap

The empirical literature provides evidence that malaria, neglected tropical diseases, healthcare capacity, sanitation, and public health interventions are important to maternal and child health. Lingani et al. (2024), for example, reported a high burden of anaemia among pregnant women in rural Burkina Faso and found that anaemia prevalence correlated with malaria. This suggests that malaria exposure may indirectly worsen pregnancy outcomes through maternal anaemia. The evidence supports the need for integrated maternal and malaria control policies.

The document also presents evidence on health professional knowledge and institutional readiness to manage neglected tropical diseases. It reports that inadequate knowledge among health professionals and the shortage of essential medicine can limit effective management of NTDs. Such findings matter because disease burden cannot be reduced without adequate institutional capacity. In public health systems with limited resources, the ability to detect, treat, and prevent disease depends strongly on training, funding, and supply availability.

Although prior studies have examined malaria, neglected tropical diseases, and maternal or child health outcomes, the study identifies the need to understand dynamic responses to disease shocks. Many studies focus on prevalence, associations, or disease-specific risk factors, but fewer assess how mortality outcomes adjust over time when disease burden increases or decreases. This study fills that gap by applying dynamic ARDL to analyse positive and negative counterfactual shocks. The approach provides clearer policy insight because it distinguishes between the health effects of worsening disease prevalence and the benefits of disease reduction.

Theoretical Framework and Methodology

Social Determinants of Health Theory

This study is anchored in the Social Determinants of Health Theory. The theory explains that health outcomes are shaped by the conditions in which people are born, grow, live, work, and age. It moves health analysis beyond biological and clinical factors by emphasising income, education, sanitation, healthcare access, nutrition, public policy, and public health interventions. In the context of Sub-Saharan Africa, this theoretical position is relevant because maternal and infant mortality are influenced by disease exposure as well as by the social and institutional environment within which households seek care.

This study applies the Social Determinants of Health framework to explain the interaction between malaria, neglected tropical diseases, and maternal and child health. Disease burden is treated as a shock that affects mortality outcomes, while health expenditure, physician availability, immunisation, undernourishment, and female secondary school enrolment represent broader social determinants. This framework is appropriate because it recognises that the effect of malaria and neglected tropical diseases may be stronger where health systems are weak, nutrition is poor, and access to maternal and infant healthcare is limited.

The theory also supports policy interpretation. If maternal and child health outcomes are determined by social and disease-related factors, then health improvement cannot depend only on treating diseases after they occur. It requires preventive disease control, stronger health financing, improved sanitation, better education, and wider access to physicians and maternal health services.

Therefore, the Social Determinants of Health theory provides the conceptual basis for linking disease-control strategies with long-term health equity.

Model Specification

The study employed the Dynamic Autoregressive Distributed Lag model to examine the response of maternal mortality ratio and infant mortality rate to counterfactual shocks in malaria incidence and neglected tropical diseases. The model was suitable because the variables exhibited a mixture of integration orders, with some stationary at level and others becoming stationary after first differencing. The use of Dynamic ARDL also allowed the study to analyse both short-run and long-run dynamics, which is important because mortality outcomes may respond gradually to changes in disease prevalence.

Two broad models were specified in the study. The first model examined maternal mortality ratio as a function of malaria incidence, neglected tropical diseases, health expenditure, number of physicians, prevalence of undernourishment, female secondary school enrolment, and immunisation. The second model used infant mortality rate as the health outcome with the same explanatory and control variables. In simplified form, the dynamic relationship can be expressed as follows:

$$MMR_{it} = f(NTD_{it}, IOM_{it}, CHE_{it}, NOP_{it}, POU_{it}, SSE_{it}, IMU_{it})$$

$$IFM_{it} = f(NTD_{it}, IOM_{it}, CHE_{it}, NOP_{it}, POU_{it}, SSE_{it}, IMU_{it})$$

In the equations, MMR represents maternal mortality ratio, IFM represents infant mortality rate, NTD represents the neglected tropical diseases proxied by human African trypanosomiasis, IOM represents incidence of malaria, CHE represents current health expenditure, NOP represents number of physicians, POU represents prevalence of undernourishment, SSE represents the female secondary school enrolment, and IMU represents the immunisation coverage. The DARDL framework then permits the analysis of how positive and negative changes in NTD and IOM influence MMR and IFM over time.

The counterfactual shock analysis in the study is important because it separates the impact of worsening disease prevalence from the effect of disease reduction. A positive shock captures an increase in disease burden, while a negative shock captures a reduction. This distinction gives the model greater policy relevance by showing both the potential damage from rising disease prevalence and the health gains associated with successful disease-control interventions.

Data Scope and Variables

The study used annual panel data for 19 Sub-Saharan African countries from 1990 to 2023. The countries included Nigeria, Ghana, Kenya, South Africa, Ethiopia, Uganda, Tanzania, Democratic Republic of Congo, Cameroon, Senegal, Zambia, Malawi, Mozambique, Zimbabwe, Rwanda, Cote d'Ivoire, Burkina Faso, Madagascar, and Benin. The selection of these countries provided a regional basis for examining how maternal and child health outcomes respond to disease shocks within diverse Sub-Saharan African contexts.

The dependent variables were maternal mortality ratio per 100,000 live births and infant mortality rate per 1,000 live births. The key disease variables were incidence of neglected tropical diseases and malaria incidence per 1,000 population at risk. Other variables included immunisation coverage for DPT, current health expenditure as a percentage of GDP, number of physicians per

1,000 people, female secondary school enrolment, and prevalence of undernourishment. These variables are consistent with the study's theoretical framework because they capture both disease burden and social determinants of health.

Results and Discussion

Descriptive Statistics

The descriptive statistics show that maternal and infant mortality remained important health concerns among the selected Sub-Saharan African countries. The average maternal mortality rate was 616 deaths per 100,000 live births, while infant mortality averaged 75 deaths per 1,000 live births. These values indicate that women and infants still faced high mortality rates during the study period. The wide differences between minimum and maximum values also indicate that countries differed substantially in their health outcomes, which may reflect differences in healthcare access, disease burden, nutrition, and public health capacity.

The descriptive evidence also shows the high burden of malaria and neglected tropical diseases. Malaria incidence averaged 326 cases per 1,000 population at risk, while the NTD proxy showed wide variation. Current health expenditure remained low on average, physician availability was very limited, and undernourishment remained prevalent. Immunisation coverage averaged 67%, which was relatively encouraging but still uneven. Overall, the descriptive statistics support the argument that maternal and child health outcomes in Sub-Saharan Africa are influenced by both infectious disease exposure and weak social determinants of health.

Table 1: Descriptive statistics of study variables

	MMR	IMR	NTD	IOM	CHE	NOP	POU	SSE	IMU
Mean	616	75	716	326	6	0	28	32	67
Median	532	71	32	339	4	0	23	26	71
Maximum	2564	162	26318	652	70	2	273	297	99
Minimum	80	28	0	27	0	1	1	2	15
Std. Dev.	387	29	2658	131	9	0	26	29	20
Skewness	2	0	6	0	4	3	5	3	0
Kurtosis	6	2	45	3	24	19	40	21	2
Jarque-Bera	551	31	52021	5	14527	7780	39199	9259	41
Probability	0	0	0	0	0	0	0	0	0

Source: Researcher, 2024 computed from data obtained from WDI and WHO

Panel Unit Root Test

The panel unit root test was conducted to determine the stationarity properties of the study variables and to avoid spurious regression results. The study used the Im, Pesaran and Shin unit root test and reported the CIPS test statistics at level and first difference. The results revealed a mixed order of integration. Neglected tropical diseases, number of physicians, prevalence of undernourishment, and immunisation were stationary at level, while maternal mortality ratio, infant mortality rate, incidence of malaria, current health expenditure, and female secondary school enrolment became stationary after first differencing.

The mixture of I(0) and I(1) variables justified the use of the Dynamic ARDL approach. This is because the method can accommodate variables with different stationarity properties, provided that the variables are not integrated beyond the first difference. The unit root results therefore supported the appropriateness of the selected estimation strategy and strengthened the reliability of the dynamic response analysis.

Table 2: Panel unit root test

Variable	Level	1st Difference	Order
MMR	4.107 (1.000)	-7.156*** (0.000)	I(1)
IFM	2.561 (0.995)	-1.983** (0.024)	I(1)
NTD	-1.763** (0.039)		I(0)
IOM	0.837 (0.798)	-6.469*** (0.000)	I(1)
CHE	-0.568 (0.285)	-14.079*** (0.000)	I(1)
NOP	-2.729*** (0.003)		I(0)
POU	-2.362*** (0.009)		I(0)
SSE	2.804 (0.998)	-7.991*** (0.000)	I(1)
IMU	-3.702*** (0.000)		I(0)

*Note: *** and ** denote significance at 1% and 5%, respectively.*

Response of Maternal Mortality to NTD Shocks

The response of maternal mortality to shocks in neglected tropical diseases shows that the disease worsens maternal health outcomes. Following a positive shock in NTD prevalence, maternal mortality continued to rise. The predicted value was initially around 1.4 and remained relatively stable in the short run, but after the seventh period, it began to rise, exceeding 1.6 around period 12 and moving close to 1.9 in the long run. This pattern implies that an increase in NTD prevalence had a persistent adverse effect on maternal survival.

The negative shock response produced the opposite pattern. When NTD prevalence declined, maternal mortality followed a downward trajectory. The predicted values started at about 3.98 and gradually declined to around 3.94 by period 20. This indicates that a reduction in neglected tropical

diseases contributed to improved maternal health. The implication is that NTD control programmes can generate long-run gains in maternal survival, especially when combined with health system strengthening and improved access to maternal care.

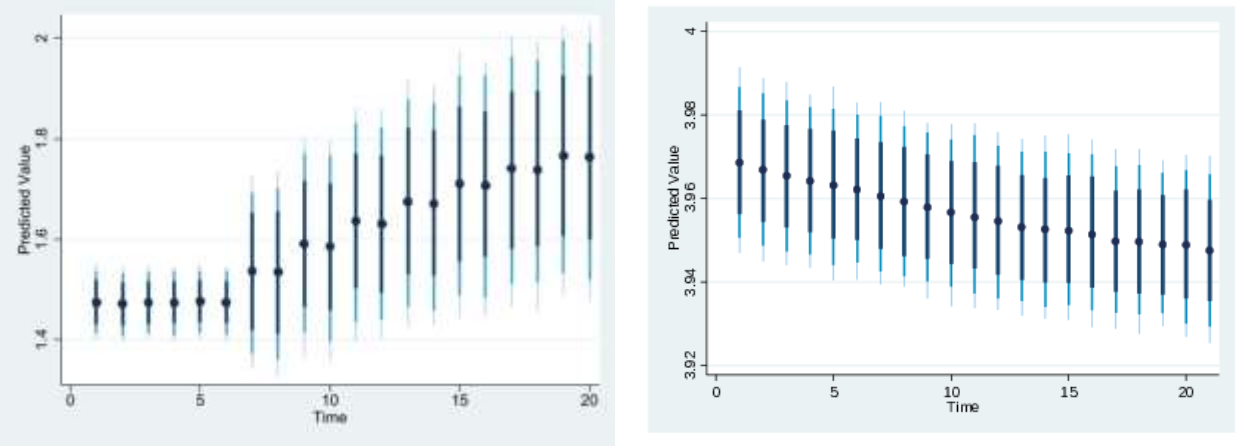

Figure 1: Predicted impact of positive and negative shocks of NTD to MMR in SSA

Response of Maternal Mortality to Malaria Shocks

The response of maternal mortality to shocks in malaria incidence also confirmed the damaging effect of disease prevalence. A positive shock in malaria incidence initially left maternal mortality relatively stable at about 4.35. However, around period 9, maternal mortality began to rise. It reached about 4.40 and later increased to nearly 4.50 by period 20. The widening confidence bands suggest increasing uncertainty over time, but the direction of the response remained adverse. This implies that higher malaria incidence increased maternal mortality risks in the selected Sub-Saharan African countries.

The negative shock scenario showed a sustained decline in maternal mortality when malaria incidence reduced. After initial stability, maternal mortality began to decline around period 9, fell to approximately 4.30, and continued downward to nearly 4.20 by period 20. This pattern indicates that malaria control has significant potential to improve maternal survival. The finding supports the need for sustained malaria prevention and treatment strategies as part of antenatal and maternal health programmes.

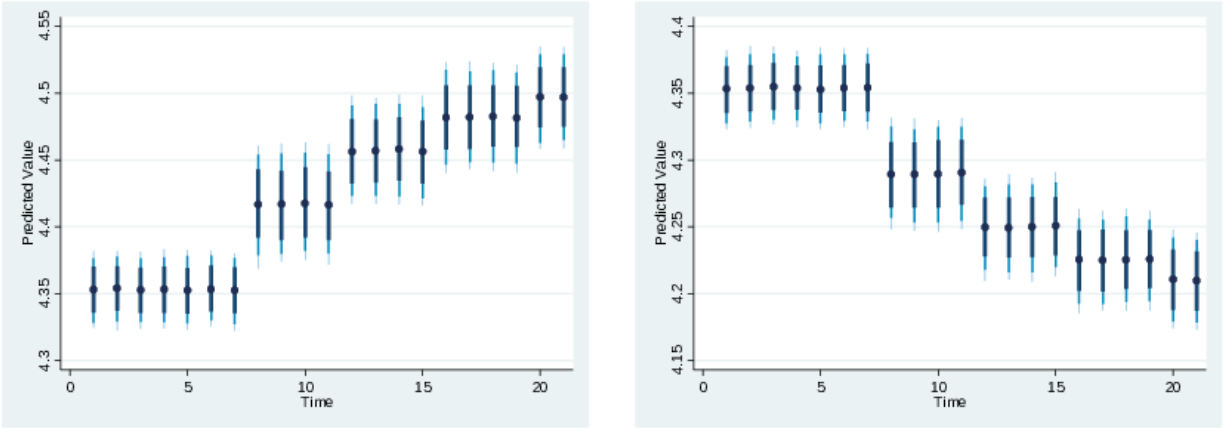

Figure 2: Predicted impact of positive and negative shocks of malaria incidence to MMR in SSA

Response of Infant Mortality to NTD Shocks

The predicted response of infant mortality to shocks in neglected tropical diseases revealed that infants are highly vulnerable to disease-burden changes. Under a positive shock in NTD prevalence, infant mortality increased from around 4.00 in the short run to about 4.20 in the long run. This upward trend indicates that an increase in neglected tropical diseases produced sustained deterioration in infant survival. The widening confidence intervals further suggest that the long-run effect becomes more uncertain as the time horizon expands.

The negative shock response showed that a reduction in neglected tropical diseases lowered infant mortality over time. The predicted values declined from approximately 4.00 in the short run to around 3.80 in the long run. Economically and medically, this indicates that reducing neglected tropical diseases can improve infant survival and reduce pressure on health systems. The finding highlights the need to integrate NTD control into child health strategies, especially in rural and poor communities where exposure to sanitation-related diseases is more likely.

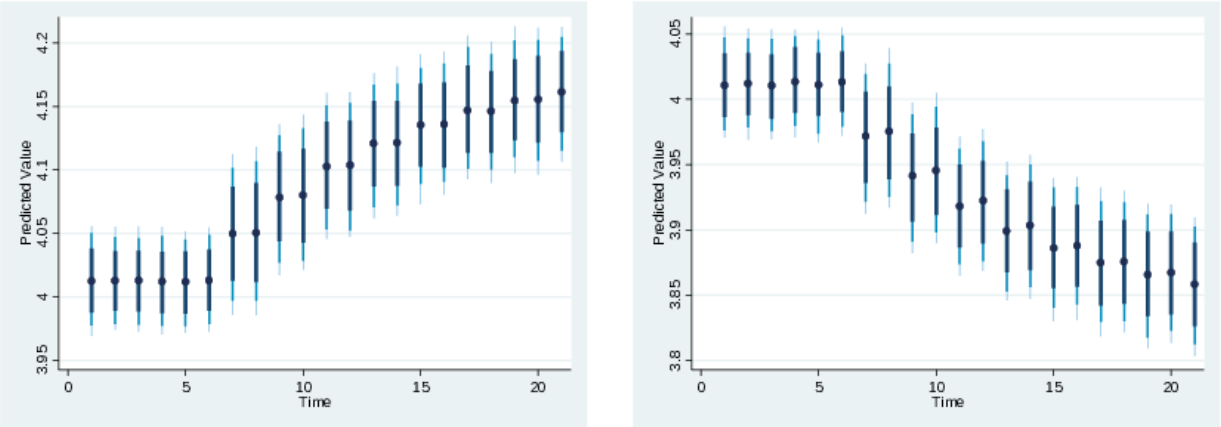

Figure 3: Predicted impact of positive and negative shocks of NTD to IFM in SSA

Response of Infant Mortality to Malaria Shocks

The response of infant mortality to malaria shocks followed a pattern similar to that of maternal mortality. Under a positive shock in malaria incidence, the predicted values of infant mortality remained initially stable around 4.34 but increased after approximately period 8. The response rose to about 4.45 by period 12 and continued to a sustained long-run level of around 4.50 by period 20. This result indicates that an increase in malaria incidence led to higher infant mortality over time.

In the negative shock scenario, infant mortality gradually declined when malaria incidence reduced. The predicted values began around 4.35, then decreased after period 8 to about 4.25 by period 12 and to about 4.18 by period 20. The sustained downward adjustment implies that malaria reduction can produce long-run gains in child survival. This finding is important because infants and young children are among the groups most exposed to malaria-related mortality risks.

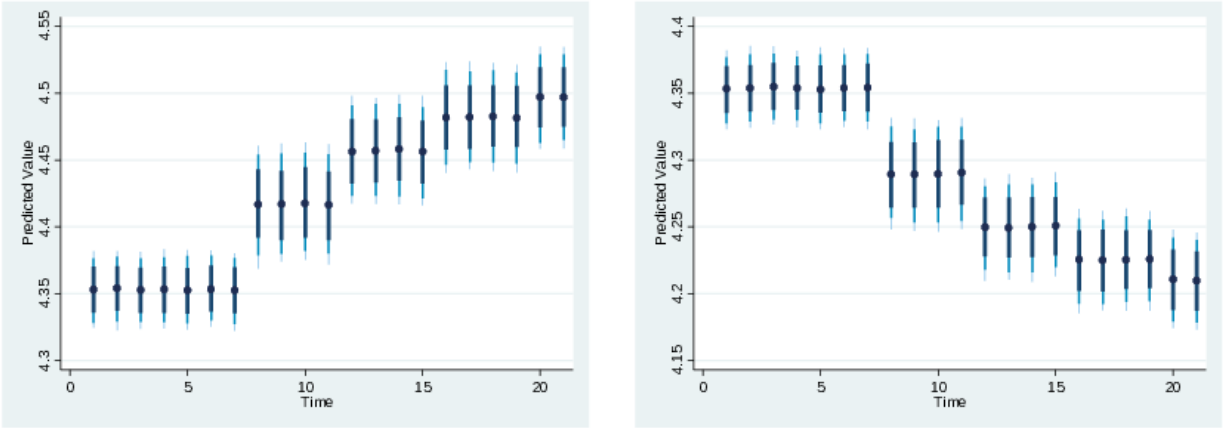

Figure 4: Predicted impact of positive and negative shocks of malaria incidence to IFM in SSA

DISCUSSION OF FINDINGS

The results establish that malaria prevalence and neglected tropical diseases significantly determine maternal and child health status in Sub-Saharan Africa. The direction of the shock matters. Positive shocks in disease prevalence worsened maternal and infant mortality, while negative shocks improved health outcomes. This means that disease reduction has measurable public health benefits, and disease resurgence can reverse progress in maternal and child survival. The findings therefore demonstrate the importance of sustained health interventions rather than one-time programmes.

The first major finding is that neglected tropical diseases contribute to maternal mortality. This is important because NTDs are often underprioritised compared with other infectious diseases, yet the dynamic response shows that increases in NTD prevalence can produce sustained increases in maternal mortality. The result aligns with the argument that NTDs worsen health outcomes through poverty, poor sanitation, weak healthcare access, and long-term morbidity (World Health Organization, 2022; Annadurai, 2023; Gyorkos & Rojas, 2023). For maternal health, this means that NTD control should be incorporated into reproductive health programmes.

The second major finding is that malaria incidence increases maternal mortality over time. Malaria in pregnancy can affect maternal survival through anaemia, complications, and weakened immunity. The observed upward response to positive malaria shocks confirms that malaria control remains central to maternal health policy. Conversely, the negative shock result shows that when malaria incidence declines, maternal mortality also declines. This means that malaria prevention, early treatment, and antenatal integration can reduce maternal mortality in the long run (Oladipo & Orok, 2022; Kolawole et al., 2023).

The third finding is that neglected tropical diseases increase infant mortality. This result reflects the vulnerability of infants and children to infectious disease environments. Where NTD burden is high, children may be exposed to poor sanitation, malnutrition, and recurrent infection, all of which can worsen survival prospects. The decline in infant mortality following negative NTD shocks indicates that disease-control programmes can support child survival. This is important for public health planning because infant mortality is often reduced most effectively when disease prevention, nutrition, immunisation, and sanitation improvements are combined.

The fourth finding is that malaria incidence increases infant mortality. This is consistent with the health logic that malaria poses severe risks to infants, particularly in environments where prevention and treatment are inadequate. The gradual rise in infant mortality after a positive malaria shock indicates that the effect may accumulate over time. The negative shock result shows that a reduction in malaria incidence improves infant survival. These patterns underline the importance of continuous malaria control, especially in areas where climate and environmental conditions favour mosquito transmission (Nnaji & Ozdal, 2023; Opigo & Guyer, 2023; Patel et al., 2024).

Beyond disease burden, the descriptive statistics show that social determinants of health remain critical. High maternal mortality, high infant mortality, low physician availability, low health expenditure, undernourishment, uneven immunisation, and education inequality suggest that disease shocks occur within fragile systems. In such contexts, the same increase in malaria or NTD prevalence may have stronger mortality effects because households and health systems have limited capacity to respond. This supports the Social Determinants of Health Theory, which emphasises that health outcomes are shaped by the broader conditions in which people live.

The combined evidence implies that disease-specific interventions must be embedded within wider health-system and social policies. Malaria and NTD control can reduce mortality, but the magnitude and sustainability of the gains depend on health expenditure, physician availability, maternal services, immunisation coverage, food security, and education. Therefore, a narrow disease-control approach may produce limited outcomes if the underlying structural determinants remain weak.

CONCLUSION AND POLICY IMPLICATIONS

This study examined the response of maternal and child health outcomes to counterfactual shocks in malaria prevalence and neglected tropical diseases in Sub-Saharan Africa. The findings revealed that positive shocks in malaria prevalence and neglected tropical diseases increased maternal and infant mortality, while negative shocks reduced these mortality outcomes. The implication is that disease prevalence remains a central determinant of maternal and child health, and reductions in malaria and neglected tropical diseases can produce long-run survival gains.

The study concluded that maternal and child health outcomes in Sub-Saharan Africa are shaped by both disease burden and the social determinants of health. Although malaria and neglected tropical diseases directly influence mortality, the descriptive results show that weak health expenditure, low physician availability, undernourishment, uneven immunisation, and education-related disparities also define the health environment. Therefore, maternal and child health improvement requires more than disease treatment; it requires a comprehensive public health approach that strengthens the conditions under which people can avoid disease, access treatment, and recover from health shocks.

The policy implication is that governments and health ministries in Sub-Saharan Africa should strengthen malaria and NTD control programmes. Such programmes should include mass drug administration, distribution of insecticide-treated nets, indoor residual spraying, improved sanitation, immunisation campaigns, and disease surveillance systems. These interventions are particularly important for pregnant women and infants because they face high vulnerability to infectious disease shocks.

The study also recommends higher health expenditure and greater access to physicians and maternal health services. Low healthcare capacity can magnify the effect of disease shocks; therefore, investments in skilled health workers, rural health facilities, essential medicine, and antenatal care are necessary. Malaria and NTD control initiatives should also be integrated into antenatal and infant health programmes so that disease prevention becomes part of routine maternal and child healthcare.

Finally, social determinants of health should be addressed through policies that improve girls' education, food supply, public health awareness, sanitation, and rural healthcare delivery. Female education and nutrition are especially important because they can improve health-seeking behaviour, reduce vulnerability, and strengthen household capacity to protect mothers and infants. The evidence from the study shows that reducing disease prevalence is essential, but sustainable health improvement depends on strengthening the social and institutional foundations of health.

CONTRIBUTION TO KNOWLEDGE

This article contributes to knowledge by shifting the analysis of maternal and child health from static disease association to dynamic counterfactual shock response. By showing how maternal mortality and infant mortality respond to positive and negative shocks in malaria and neglected tropical diseases, the study provides a more policy-relevant interpretation of disease burden. It demonstrates not only that disease prevalence matters but also that worsening and improvement in disease conditions have different dynamic effects over time.

The study also contributes by applying the Social Determinants of Health theory to a dynamic panel context involving 19 Sub-Saharan African countries from 1990 to 2023. This allows the research to connect infectious disease prevalence with broader social determinants such as health expenditure, physician availability, undernourishment, immunization, and education. The integrated framework provides a useful basis for understanding why disease shocks have severe consequences in environments with weak social and health systems.

Methodologically, the use of dynamic ARDL strengthens the analysis by capturing short- and long-run adjustments. Maternal and child health outcomes do not always respond immediately to disease shocks. The dynamic modeling approach, therefore, allows the study to observe how mortality outcomes change over time, making the findings more informative for policy planning and timing health interventions.

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