*Review Article*

# Analytical Study of Prevalence, Mortality and Risk Factors of Epidemic Malaria

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## Abstract

Malaria is one of the infectious diseases caused by a parasite from the bite of a mosquito carrying the infection. This disease spreads in tropical and subtropical countries, and the lack of early diagnosis and treatment may lead to death.

This study aims to analyze and compare the indicators of malaria as prevalence and mortality, while estimating the possible cases in future periods using statistical measures. Publications for the year 2024 on the incidence and mortality of malaria epidemic in global regions were used, with a comparison made by regions and finding their indicators, illustrated with graphs.

The results of the data analysis showed that there were no cases of incidence or mortality in the malaria epidemic on the continent of Europe, as well as in the Americas, it was very limited, the highest was in the continent of Africa, where the death rate was (96%) of the total global deaths (627000) persons.

Conclusion: The fifteen countries with the most deaths from the malaria epidemic were all on the continent of Africa except, India which recorded a death rate of (3%), the highest countries in Africa were Nigeria, followed by Congo, Uganda, and least of all Guyana.

**Keywords:** Epidemic, Malaria, Risk Factors.

## Introduction

Malaria is a major global health challenge, with an estimated 229 million infections reported in 2019 alone. Approximately 94% of these cases occurred in the African region. To date, around 200 protozoan species have been identified, and at least 13 of them are known to cause disease in humans (1). Malaria spreads when mosquitoes are infected with the

disease and bite another uninfected person, and the infection is transmitted to the liver and red blood cells and can be transmitted during pregnancy or through blood transfusion or participation in needle glaucoma. Its symptoms include fever, chills, headache, nausea, vomiting, abdominal and joint pain, fatigue, rapid breathing with heartbeat, and cough. Complications can occur for the affected person and may lead to death when swelling occurs in the brain because of blockage of blood cells connecting to it, or fluid accumulation in the lungs, difficulty breathing, kidney, spleen, and liver damage, resulting in an acute shortage of red blood cells accompanied by low blood sugar (2, 3).

The symptoms of malaria begin within a few weeks of the bite of the infected mosquito, and the diagnosis is made by laboratory examination through the presence of a parasite in the blood, confirming the presence of infection with the appearance of symptoms and health complications. The treatment is through medical prescriptions from the specialist doctor using medical drugs, especially at the beginning of the diagnosis of the disease, to avoid its complications (4, 5). This paper sheds light on one of the most widespread epidemics in third world countries, especially the continent of Africa, namely malaria, with the analysis of its results and findings the necessary comparisons using statistical measures and figures.

## Methodology

WHO publications from 2024 on the prevalence and mortality of the malaria epidemic in various parts of the world provided the data for this study (6-29).

Multiple comparisons utilizing one-way ANOVA and paired sample t tests were used using SPSS software and Microsoft Excel to elucidate group differences based on statistical significance. A cutoff point of $p < 0.05$ was established for statistical significance.

## Results

Table (1) shows the prevalence and mortality cases for the time series (2010-2022), according to the regions and observed the absence of any case in the continent of Europe and that all regions have a decline in prevalence cases accompanied by deaths for the time series, and strangely enough, the Middle East Region witnessed a significant increase in the number of prevalence and mortality, the reason is due to the lack of security and political stability accompanied by weakness in the health care sector in this region during The period studied. Table (1) also shows there is no incidence and deaths were reported in the continent of Europe, the most deaths were in the continent of Africa, which is considered the main habitat of the epidemic and accounted for a high percentage of deaths, followed by the Middle East and least of all the Americas.

The African continent occupied the highest number of countries with the highest mortality for the year (2021), the highest African countries fourteen countries were, Nigeria (227529), followed by Congo (62359), Uganda (45361), the lowest African countries were Guyana (12583). India ranked eleventh among the fifteen countries with the highest mortality globally (16917), despite its huge population, but it seems that the development of its health sector in the fight against this epidemic was at a high level, Table (2), Figure (1).

The mortality of children less than five years of age was the highest, as usual, the continent of Africa (416879), accounted for (69%) of the total mortality of Africa, followed by Asia (6989), the lowest child mortality in North America (85) deaths. At the income level, the lowest-income countries had the highest mortality (217589), accounted for (35%) of the total global mortality, table (3). The countries with the highest child mortality were all from Africa, the highest countries were Nigeria (30%), followed by Congo (11%), and least of all, Benin (2%), table (4), Figure (3).

**Table 1**: Malaria Incidence (000) & Mortality, by regions (2010 – 2022).

| Years | Africa | | South East Asia | | Eastern Mediterranean | | Western Pacific | | Americans | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Incidence | Mortality | Incidence | Mortality | Incidence | Mortality | Incidence | Mortality | Incidence | Mortality |
| **2010** | 216000 | 652000 | 23900 | 38000 | 4500 | 8600 | 1671 | 3500 | 818 | 492 |
| **2011** | 214000 | 621000 | 20600 | 32000 | 4600 | 7800 | 1418 | 3000 | 615 | 459 |
| **2012** | 213000 | 580000 | 17700 | 27000 | 4300 | 7900 | 1693 | 3500 | 585 | 425 |
| **2013** | 212000 | 558000 | 13200 | 20000 | 4200 | 7500 | 1753 | 4000 | 576 | 467 |
| **2014** | 210000 | 553000 | 12800 | 23000 | 4000 | 7500 | 2011 | 3800 | 457 | 346 |
| **2015** | 211000 | 551000 | 13300 | 24000 | 4300 | 8200 | 1245 | 2400 | 573 | 385 |
| **2016** | 211000 | 545000 | 13700 | 25000 | 5400 | 9500 | 1471 | 3000 | 688 | 523 |
| **2017** | 219000 | 548000 | 10300 | 18000 | 5400 | 10200 | 1575 | 3000 | 946 | 665 |
| **2018** | 216000 | 555000 | 7500 | 11000 | 5600 | 11200 | 1692 | 3000 | 929 | 572 |
| **2019** | 218000 | 552000 | 6400 | 9000 | 5700 | 11900 | 1433 | 2600 | 897 | 510 |
| **2020** | 230000 | 604000 | 5800 | 10000 | 5900 | 12700 | 1650 | 3200 | 646 | 415 |
| **2021** | 230000 | 584000 | 5900 | 10000 | 6200 | 13400 | 1427 | 2600 | 603 | 331 |
| **2022** | 233000 | 580000 | 5200 | 8000 | 8300 | 15900 | 1853 | 3600 | 552 | 343 |

**Table 2:** Highest malaria deaths by countries 2021.

| Country | Deaths | Country | Deaths |
|---|---|---|---|
| *Nigeria* | 227529 | *Mali* | 23815 |
| *Congo* | 62359 | *Angola* | 18396 |
| *Uganda* | 45361 | *India* | 16917 |
| *Burkina Faso* | 35963 | *Ghana* | 15734 |
| *Niger* | 33664 | *Benin* | 15654 |
| *Cameron* | 28946 | *Burundi* | 13547 |
| *Cote D'Ivoire* | 27763 | *Guinea* | 12583 |
| *Mozambique* | 27423 | | |

**Table 3**: Death for childhood malaria deaths aged (<5) by regions 2021

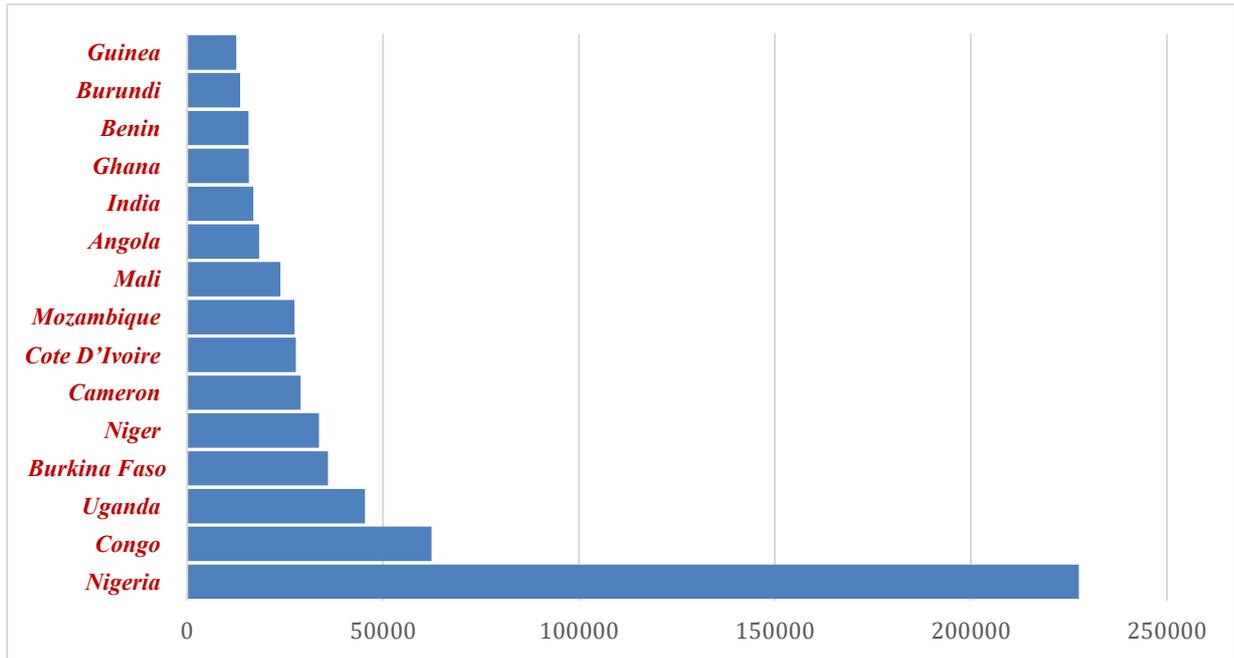| Country | Deaths | Country | Deaths |
|---|---|---|---|
| *North America* | 85 | *Eastern Mediterranean* | 4551 |
| *America* | 165 | *South East Asia* | 5188 |
| *Latin America & Caribbean* | 165 | *South Asia* | 6657 |
| *Middle East & North Africa* | 172 | *Asia* | 6989 |
| *Oceania* | 251 | *Low Middle Income* | 205896 |
| *East Asia & Pacific* | 429 | *Low Income* | 217589 |
| *Upper Middle Income* | 799 | *Africa* | 416879 |

**Figure 1:** Highest malaria deaths by countries 2021

**Table 4:** Highest malaria deaths for childhood (<5) by countries 2021

| Country | Deaths | Country | Deaths |
|---|---|---|---|
| Nigeria | 125696 | Cote D'Ivoire | 13238 |
| Congo | 47816 | Tanzania | 11449 |
| Uganda | 33277 | Mozambique | 10818 |
| Burkina Faso | 22455 | Burundi | 10113 |
| Niger | 20807 | Angola | 10110 |
| Mali | 16952 | Benin | 9076 |
| Cameron | 13805 | | |
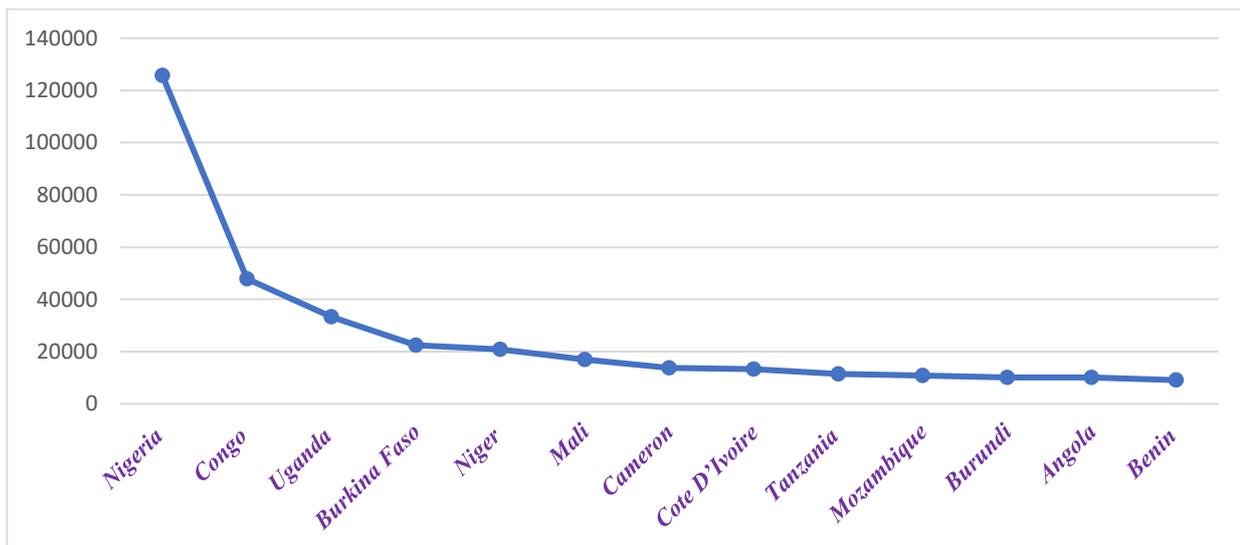


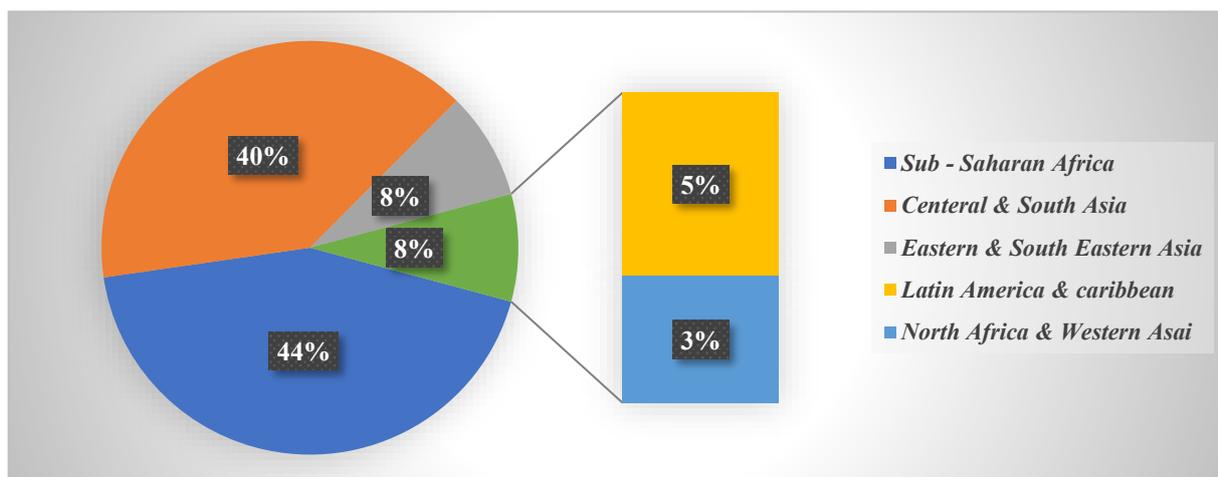**Figure 2:** Highest malaria deaths for childhood (<5) by countries 2021

**Figure 3**: Total global infections of Malaria

The most dangerous cases of the malaria epidemic occur when it affects pregnant women because of its impact on the fetus and childbearing. The most widespread regions were in the Sub Saharan African (52395400), followed by central and South Asia (47849200), East and Southeast Asia (10090300), Latin America and the Caribbean (5979000), North Africa and West Asia (4131700). The total pregnancies at risk were (120445600) ranking (48%) of the total global infections, figure (3).

$$\hat{Y}_{Incidence} = 234911 + 370\ t$$
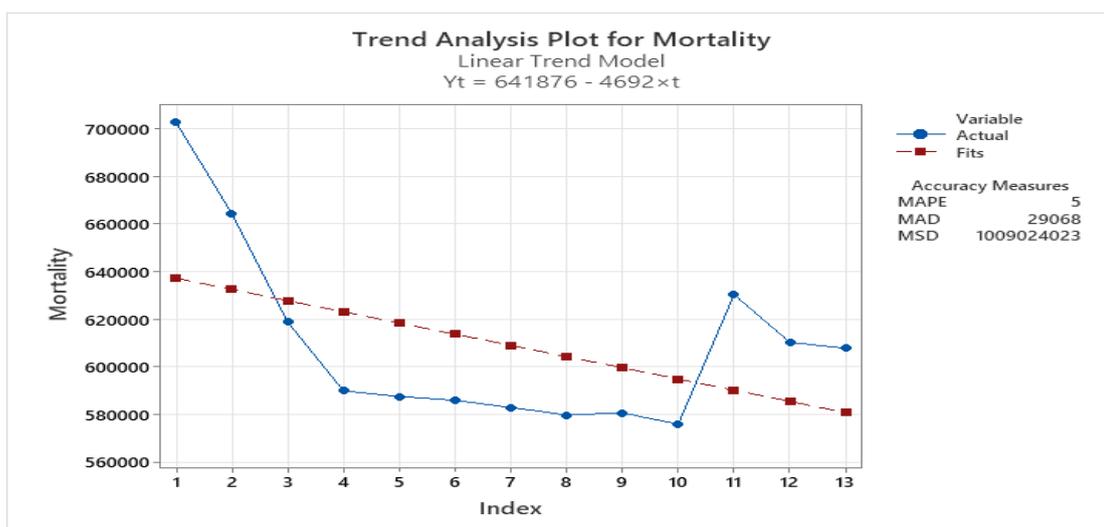$$\hat{Y}_{Death} = 641876 - 4692\ t$$



**Figure 4**: Analysis plot for mortality of malaria

In this paragraph we will discuss malaria secular trends using (Minitab Statistical Program), for total malaria, according to the equations of the secular trend (using Minitab Statistical Program), it is also noted that the total number of incidence were increasing by (370) case per year, but deaths decreases by (- 4692), this indicates that there is a global health care for this epidemic, which has led to a decrease in the number of deaths despite a slight increase in cases of spread, figures (4 & 5).
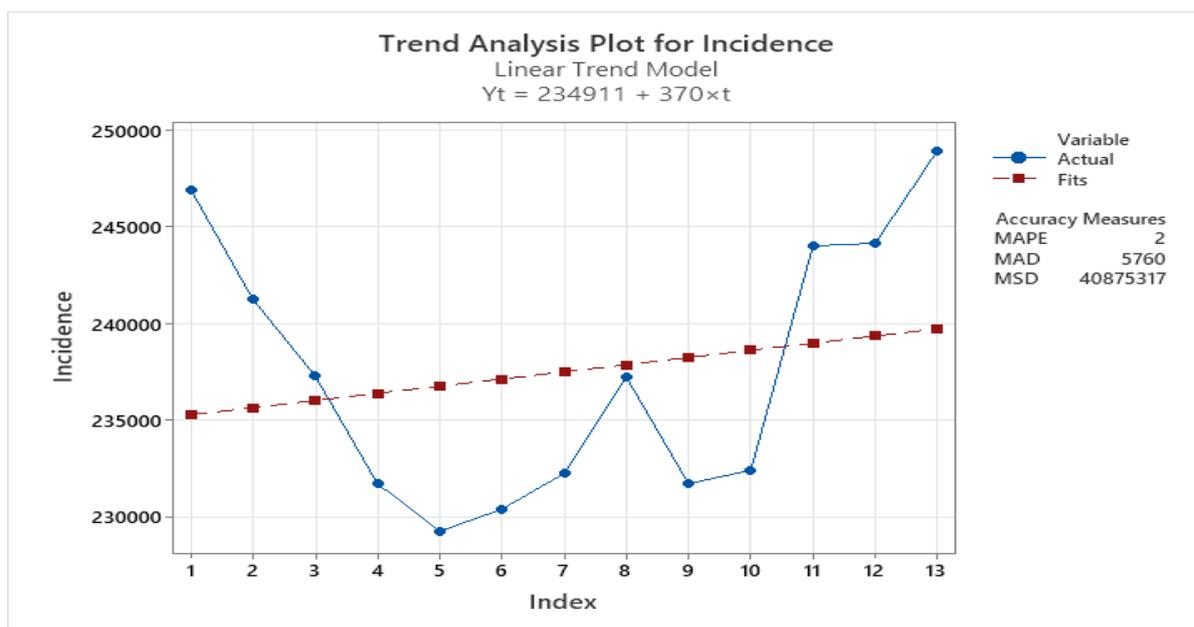


**Figure 5**: analysis plot of incidence of malaria

Figures (6-10) indicate that the general trend of deaths was negative for all regions, and this indicates the seriousness of countries in combating this epidemic and providing the necessary health care to reduce its incidence and impact on the health of citizens. Except for the Middle East, the general trend of deaths was positive, this is due to the turbulent situation in the region, political and security fluctuations, conflicts, and disputes existing, which negatively affected the provision of the required care not only for the malaria epidemic, but on the scale of other diseases, especially cancer diseases that spread due to the remnants of these conflicts. The secular trends equations are;

$$\hat{Y}_{Africa} = 596308 - 2956\ t$$

$$\hat{Y}_{Asia} = 35808 - 2313\ t$$
$$\hat{Y}_{Mediterranean} = 5808 + 624.2\ t$$
$$\hat{Y}_{Western\ Pacific} = 3469 - 42.9\ t$$
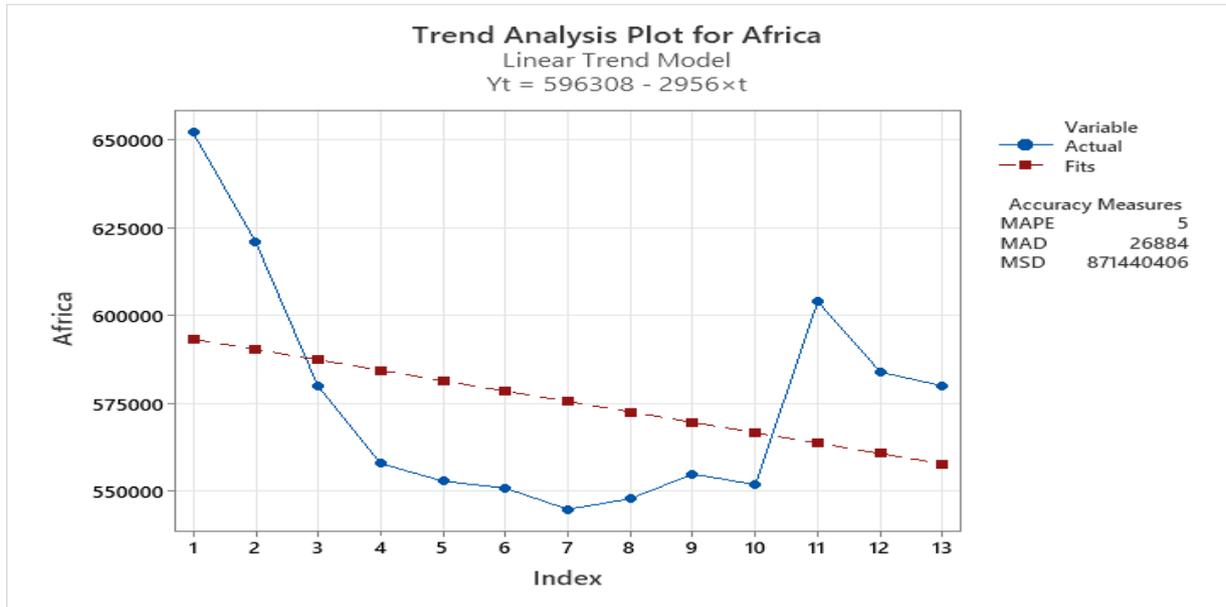$$\hat{Y}_{Americans} = 483.8 - 3.92\ t$$
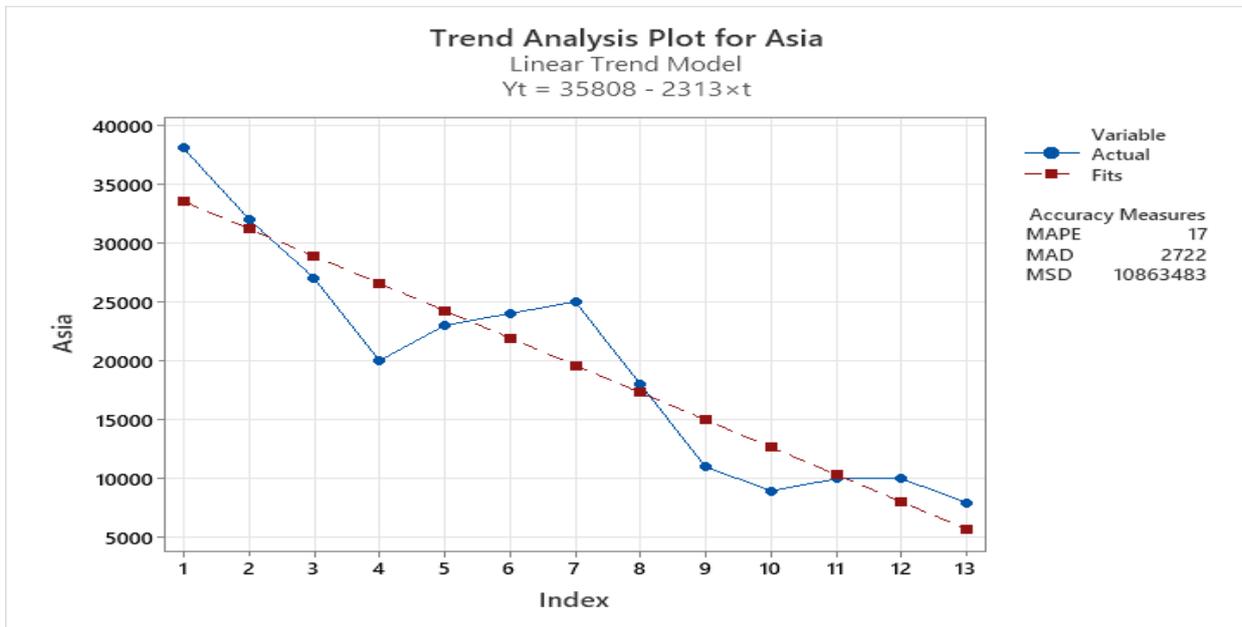


**Figure 6:** Analysis plot for Africa



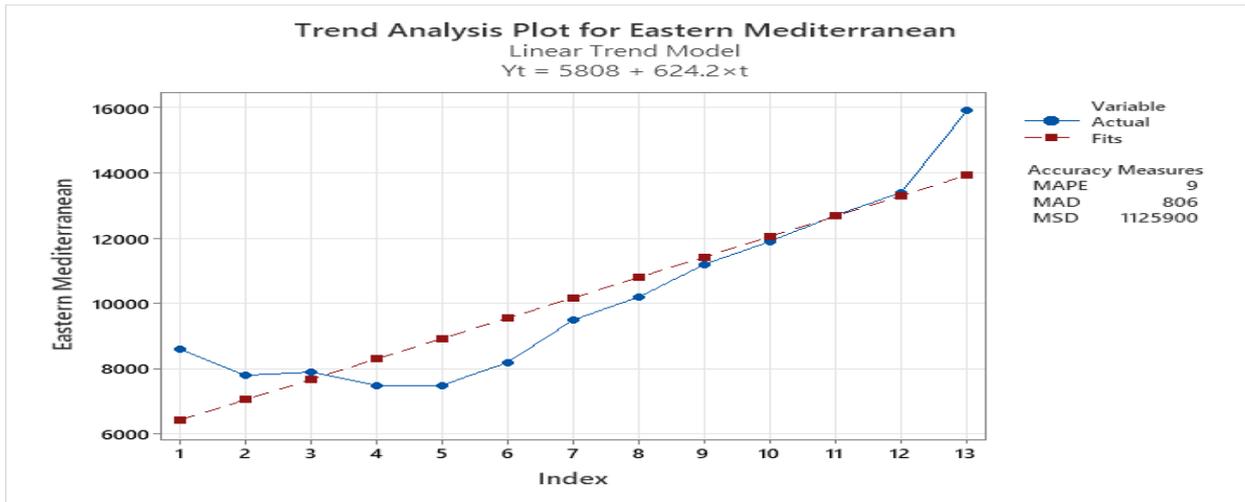**Figure 7**: Analysis plot for Asia

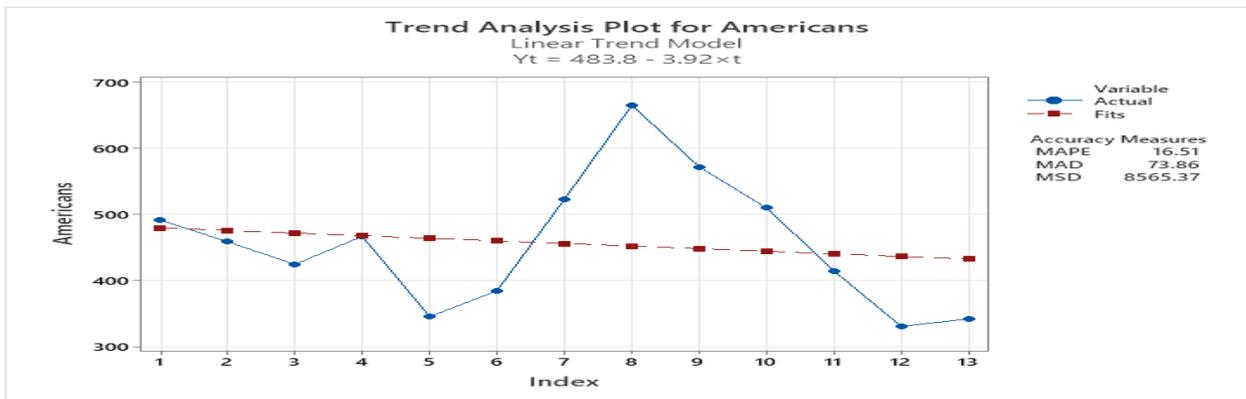**Figure 8**: Analysis plot for Eastern Mediterranean
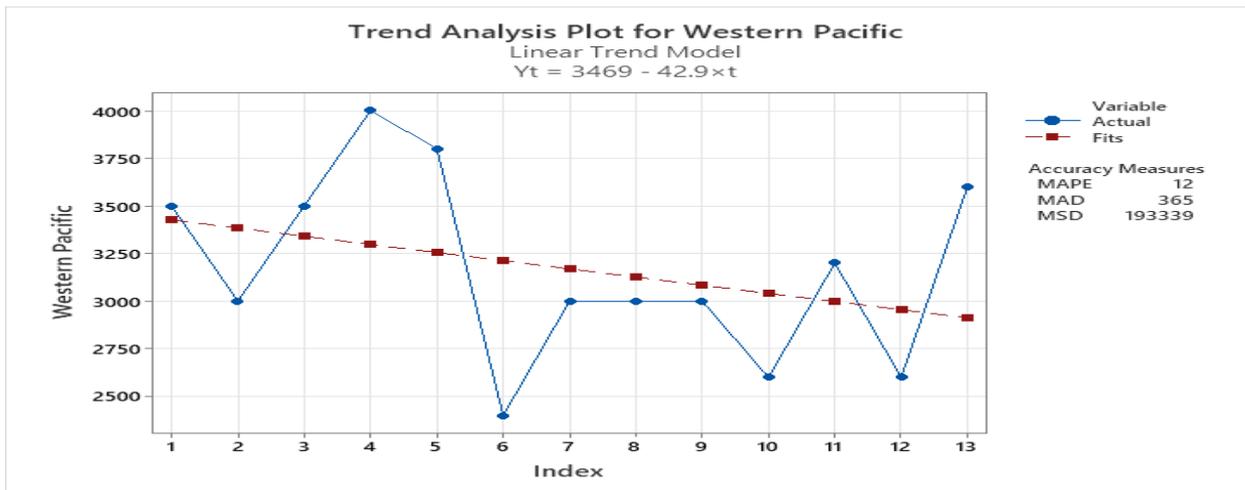


**Figure 9**: Analysis plot for Western Pacific



**Figure 10**: Analysis plot for Americans

## Discussion

For Malaria incidence and mortality Europe consistently reported no cases or deaths, indicating either the absence of local transmission, effective control measures, or low exposure risk. The majority of other regions, on the other hand, showed a general decrease in prevalence and mortality over time, which is indicative of advancements in surveillance, prevention, and treatment approaches worldwide (30).

In comparison to high-burden African nations, India's relative position indicates that improved healthcare infrastructure and persistent efforts to control malaria have helped to moderate mortality despite its large population. The mortality rate for children under five is still a serious issue. As anticipated, all of the nations with the highest under-five mortality rates were found in Africa, which also had the highest number of deaths in this age group (31,32).

These trends highlight young children's ongoing vulnerability, especially in areas with limited access to timely diagnosis, efficient treatment, and preventive measures like insecticide-treated nets. Malaria outcomes are further shaped by socioeconomic circumstances. The world's highest death rates were found in low-income nations. These high death rates are caused by a lack of health resources, a weak infrastructure for disease control, and obstacles to preventive interventions. The Middle East, however, is a prominent exception to this trend (33,34).

It demonstrated a significant increase in both prevalence and mortality rather than a decline. This rise might be explained by persistent issues in the area, such as flaws in the healthcare system during the years under investigation. The countries of the Middle East should have higher care because the trend of the general epidemic was positive and they have more additional tasks than African countries to address the situation, as the results indicated the presence of high rates of infections in pregnant women, which affects the health status of the child at birth (35, 36).

## Conclusion:

The data analysis showed that this epidemic is spreading mainly in the continent of Africa due to the incubating environment of the mosquito insect, and the weak health care in these countries led to several deaths due to this epidemic and the African countries to resolutely address this epidemic, although the general trend of the epidemic was negative.

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