Review Article

Al-Iraqia Medical College Journal (AIMCJ)
ISSN (Online): 3104-4565
ISSN (Print): 3104-4557

OPEN ACCESS

ARTICLE INFO
Received: 24/ 08 / 2025
Revised: 30/ 11/ 2025
Accepted: 2/ 12/ 2025
Publish online: 15 /12 / 2025

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CITATION
Ayat Majeed Zeadan, Baneen A MohammedAli, Sura Mouaid Abbas, Hamza Jabbar Jebour. Analytical Study of Prevalence, Mortality and Risk Factors of Epidemic Malaria. *AIMCJ.* 2025;2(3):42- 53

DOI: https://doi.org/10.58564/AIMCJ2.3.2025.233

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

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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.

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.

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

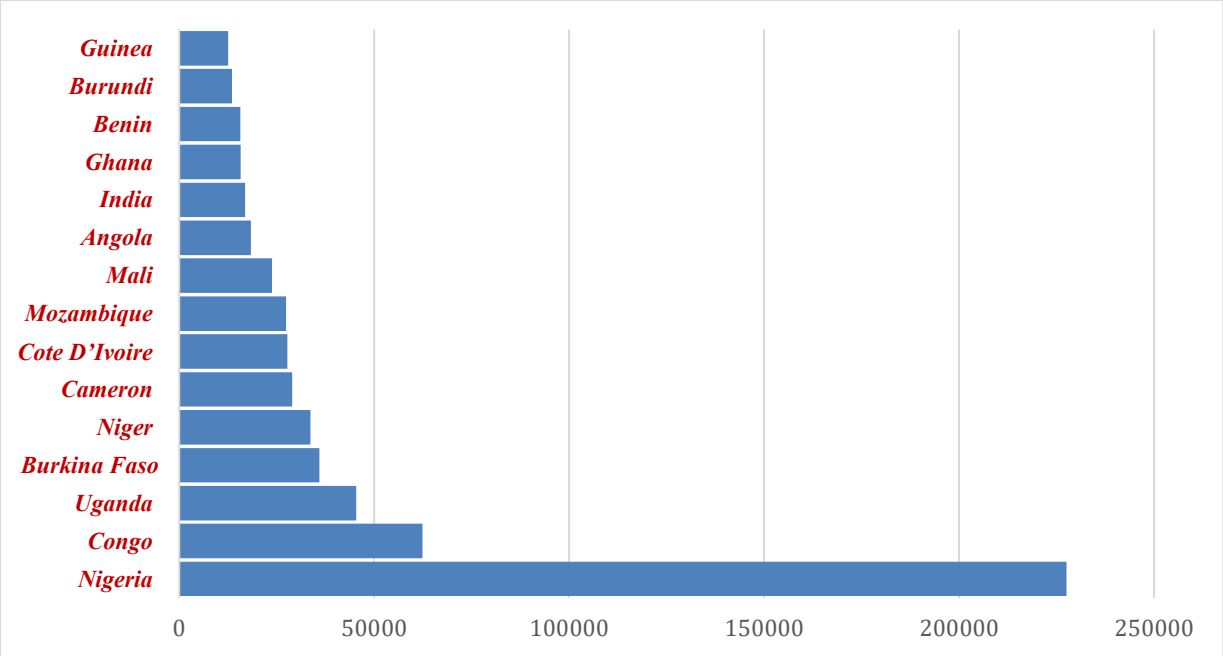

Figure 1: Highest malaria deaths by countries 2021

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		

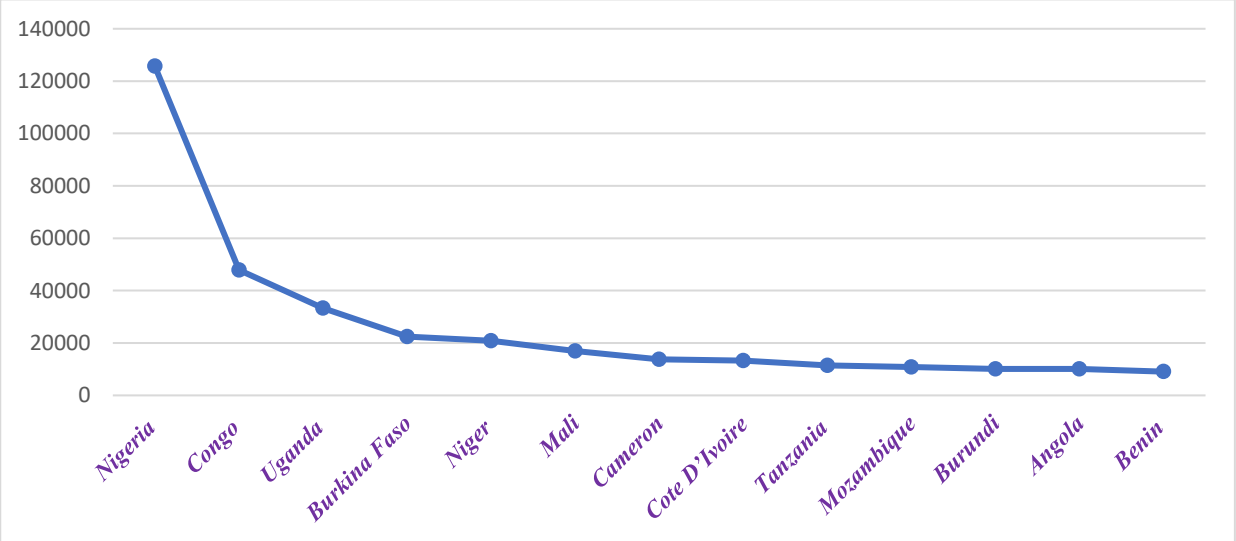

Figure 2: Highest malaria deaths for childhood (<5) by countries 2021

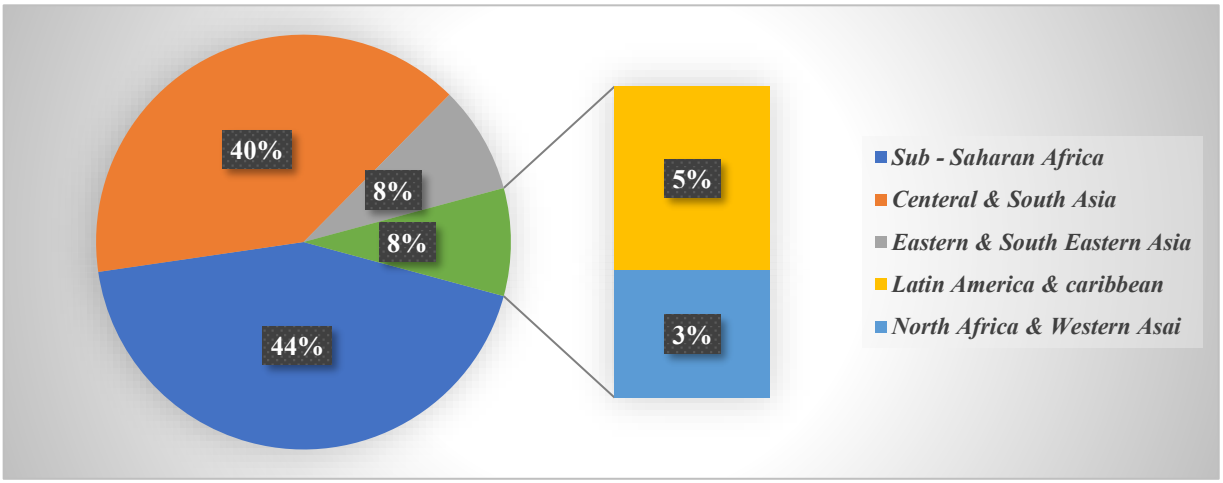

Figure 3: Total global infections of Malaria

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).

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

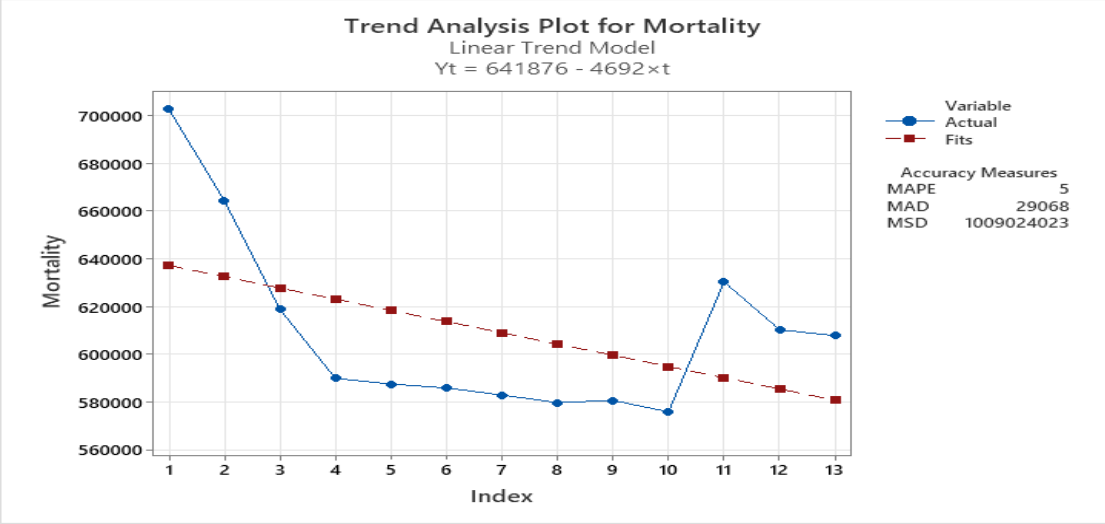

Figure 4: Analysis plot for mortality of malaria

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).

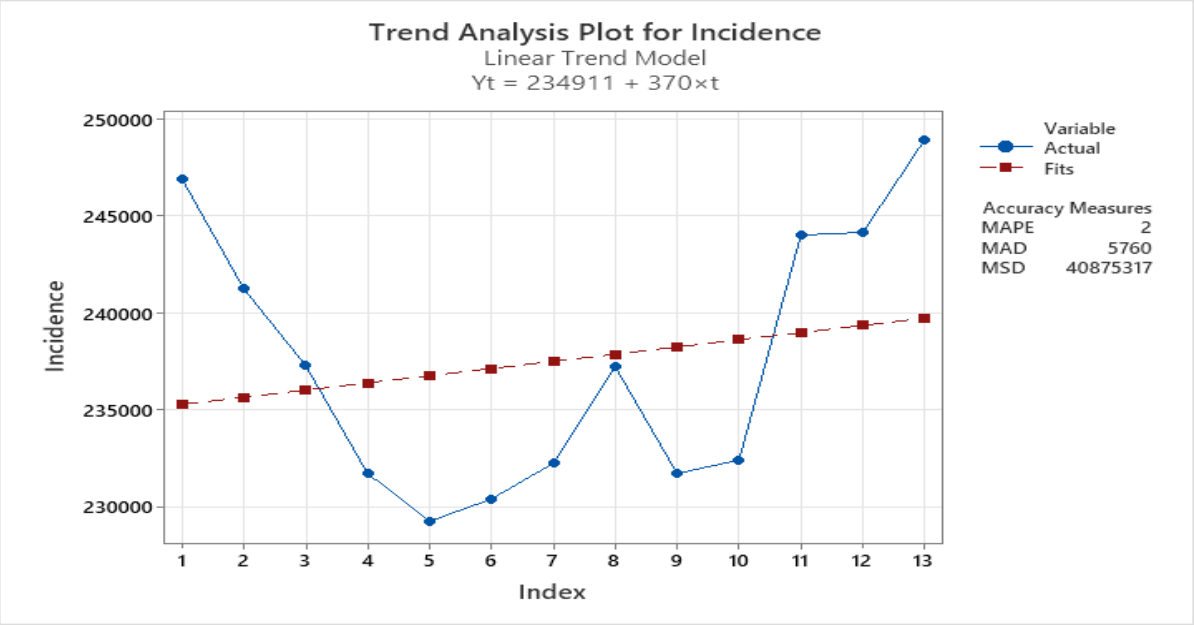

Figure 5: analysis plot of incidence of malaria

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;

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

$\hat{Y}_{Asia} = 35808 - 2313\ t$

$\hat{Y}_{Mediterranean} = 5808 + 624.2\ t$

$\hat{Y}_{Western\ Pacific} = 3469 - 42.9\ t$

$\hat{Y}_{Americans} = 483.8 - 3.92\ t$

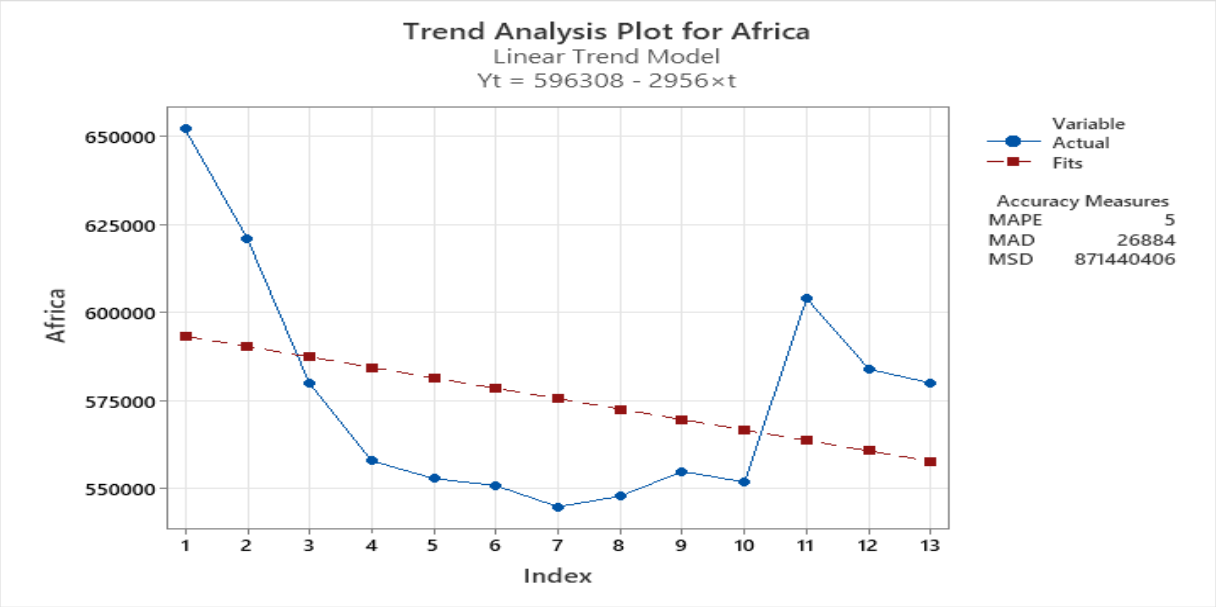

Figure 6: Analysis plot for Africa

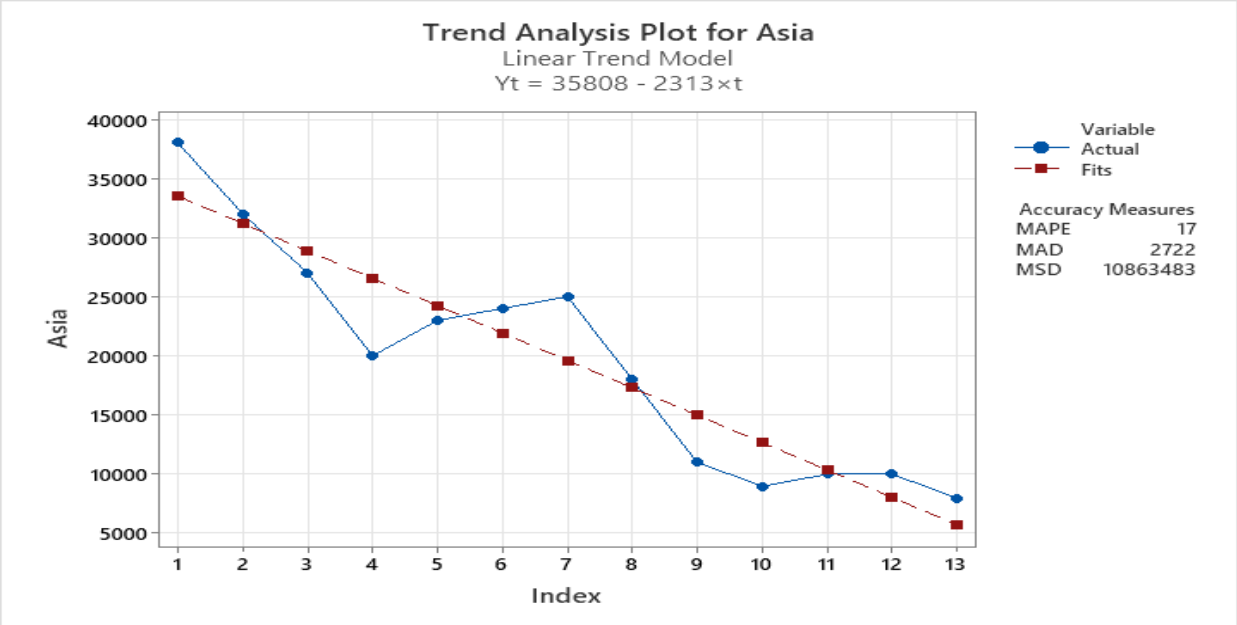

Figure 7: Analysis plot for Asia

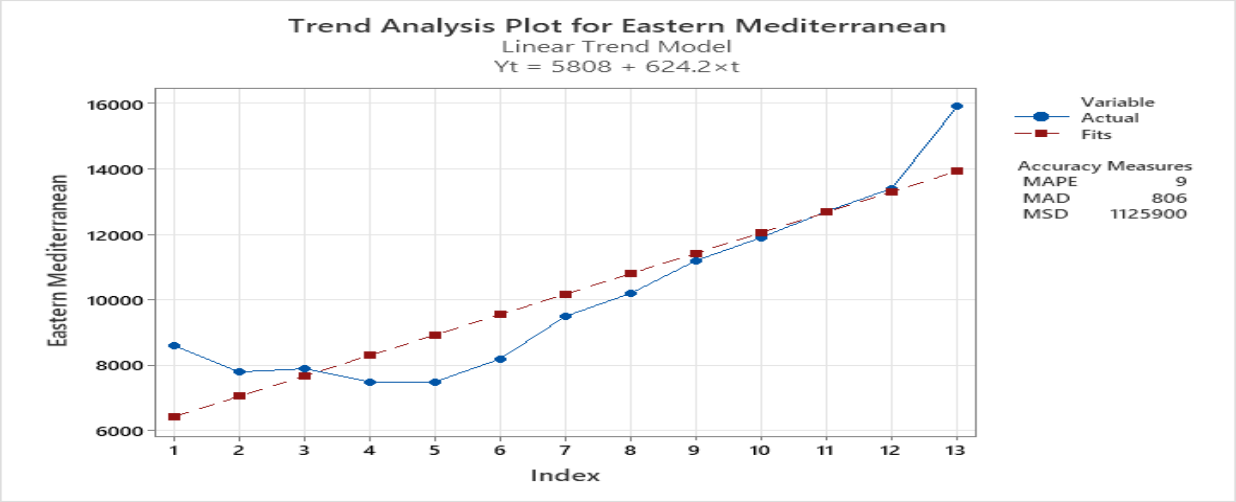

Figure 8: Analysis plot for Eastern Mediterranean

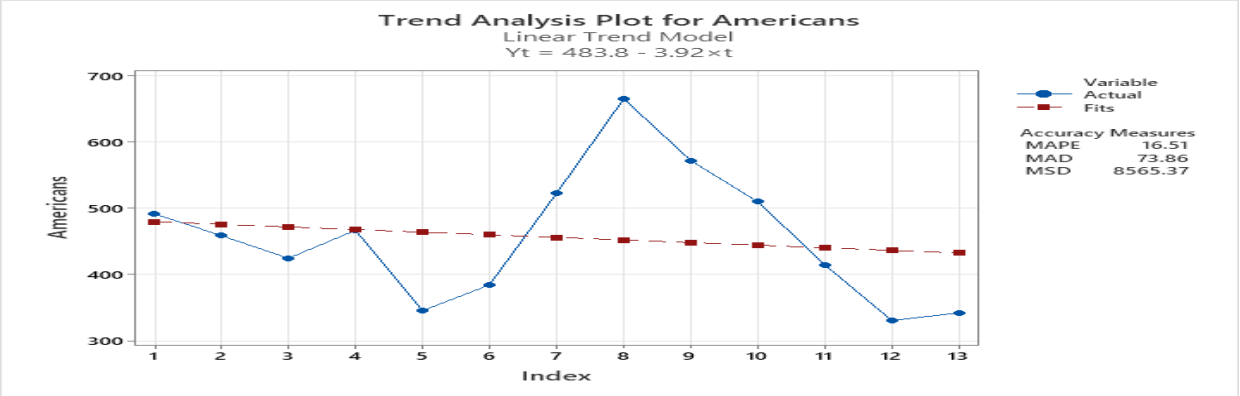

Figure 9: Analysis plot for Western Pacific

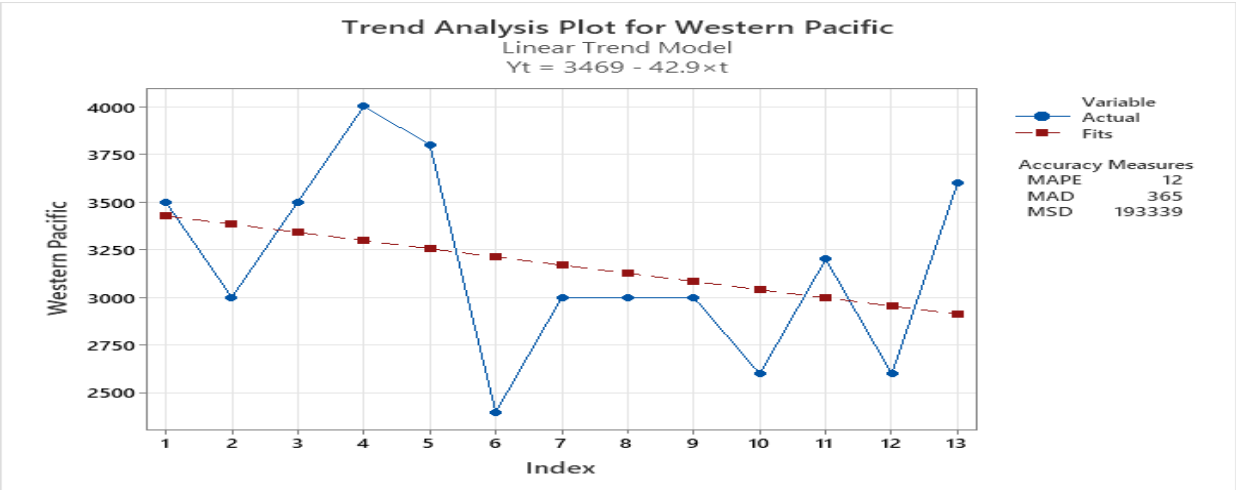

Figure 10: Analysis plot for Americans

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.

Conflict of Interest: The authors declare no conflicts of interest.

Funding: This work not need fund.

Acknowledgment

The authors would like to express sincere gratitude to all individuals and institutions who contributed to the completion of this work.

Data availability

Supplementary data can be shared with the corresponding author upon reasonable request.

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