STATISTICAL ANALYSIS OF GLOBAL GROWTH RATE

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ABSTRACT

The world population increased from (1800) million to (7.7) billion, and the population growth rate decreased from (2.2 %) annually during the last fifty years to (1.05 %). The improvement in the health situation leads to a decrease in the mortality rate, especially infant mortality, which leads to an increase in the population. The decline in population growth rate depends mainly on fertility rates. The main lesson of demographic transformations indicates that countries seek to reduce population growth rates by reducing the global fertility rate, thus the world will be in the next few decades in the end of rapid population growth. U N publications were used in this paper to analyze the challenges and transitions in various demographic data, in addition to that we use Malthusian model to get the predicting growth rate for several years. Data related to (Covid 19) epidemic, which killed millions of people and its impact on population growth, was also analyzed.

Keywords: Growth Rate, Global Population, Malthusian Growth Rate, Fertility Rate, Mortality Rate, Childbearing Rate.

INTRODUCTION

The population division of United Nations provides accurate data on population growth and demographic development in various fields in the world. United Nations statistics indicated that due to the decline in mortality rates and global health development over the past century, the world population has more than quadrupled and the impact on the natural environment, therefore, countries plan to provide sustainable resources to their countries in light of the great challenges, especially health ones.

Population growth is still rapid, especially in poor countries or third world countries with limited income. Population growth peaked at the beginning of the seventies of the last century by (2.1 %) then began to slow down until it reached approximately (1 %) annually as a result of adopting birth control policies and reducing fertility rates in many countries to control the adequacy of their economic resources. According to United Nations forecasts, the population growth rate will drop to (0.1%) at the end of this century, and no one knows what will happen after (2100).

Societies that were transformed from predominantly rural and agricultural societies to prohibitive societies in which there was a decline in fertility rates as a result of the general culture in the new society, for example, the countries of Western Europe, Soviet Union, United States, Canada and some Latin American countries, this were helped by medical technologies that got a reduction in fertility and childbearing rates. This paper is an attempt to shed light on some demographic data within United Nations publications and analyze its data statistically, in addition to using Malthus models for prediction. Moreover, discussing the impact of (Covid-19) on growth rate using updates (WHO) data for the same.

STATISTICAL INDICATORS

We will discuss and analyze some figures comes in the main data of U N publications which shown in tables below, table (1) shows that the highest population is China (1,444,500,951) ranked as (18.5%) from global population, then India with (1,392,775,219), ranked (17.9 %), from the same, that means the two countries ranked (36.4 %) from global population. The last top twenty is Thailand, which ranked (0.009 %). The population of total top twenty countries is (5,512,392,526) ranked (70.7%) from global population.

	Table 1 TWENTY HIGHEST POPULATION COUNTRIES				
	Country	**Population**		**Country**	**Population**
1	China	1,44,45,00,951	11	Japan	12,61,20,142
2	India	1,39,27,75,219	12	Ethiopia	11,77,16,155
3	U.S.A.	33,28,16,975	13	Philippines	11,09,62,347
4	Indonesia	27,62,49,643	14	Egypt	10,41,80,382
5	Pakistan	22,49,98,561	15	Vietnam	9,81,61,749
6	Brazil	21,39,74,863	16	D.R. Congo	9,22,20,564
7	Nigeria	21,10,78,301	17	Turkey	8,51,94,694
8	Bangladesh	16,62,34,138	18	Germany	8,40,33,194
9	Russia	14,59,92,401	19	Iran	8,50,10,178
10	Mexico	13,02,09,331	20	Thailand	69962738

The world population has increased during the past sixty-five years from (2,773,019,936) to (7,794,798,739) also there is a clear increase in the annual change of the population during the same period, while the rate of change was in a decreasing pattern, which shows that the high population growth is decreasing, this is reflected in the fertility rates that were in a continuous decreasing pattern. The median age is almost the same, with a slight increase. The population density (P/km2) was also increasing, but not rapidly. As for the urban population, it was constantly increasing, this indicates the large number of urbanization and migration from the countryside to the cities, Table (2) & Figures (1&2).

	Table 2 WORLD POPULATION, YEARLY CHANGE, MEDIAN AGE, FERTILITY RATE, DENSITY URBAN POPULATION (1955 - 2020)							
Year	**Population**	**Yearly change %**	**Yearly change**	**Median Age**	**Fertility Rate**	**Density (P/km2)**	**Urban Pop. %**	**Urban Population**
1955	2,77,30,19,936	1.80%	4,73,17,757	23	4.97	19	N.A.	N.A.
1960	3,03,49,49,748	1.82%	5,23,85,962	23	4.9	20	33.70%	1,02,38,45,517
1965	3,33,95,83,597	1.93%	6,09,26,770	22	5.02	22	N.A.	N.A.
1970	3,70,04,37,046	2.07%	7,21,70,690	22	4.93	25	36.60%	1,35,42,15,496
1975	4,07,94,80,606	1.97%	7,58,08,712	22	4.47	27	37.70%	1,53,86,24,994
1980	4,45,80,03,514	1.79%	7,57,04,582	23	3.86	30	39.30%	1,75,42,01,029
1985	4,87,09,21,740	1.79%	8,25,83,645	23	3.59	33	41.20%	2,00,79,39,063
1990	5,32,72,31,061	1.81%	9,12,61,864	24	3.44	36	43.00%	2,29,02,28,096
1995	5,74,42,12,979	1.52%	8,33,96,384	25	3.01	39	44.80%	2,57,55,05,235
2000	6,14,34,93,823	1.35%	7,98,56,169	26	2.78	41	46.70%	2,86,83,07,513

2005	6,54,19,07,027	1.26%	7,96,82,641	27	2.65	44	49.20%	3,21,59,05,863
2010	6,95,68,23,603	1.24%	8,29,83,315	28	2.58	47	51.70%	3,59,48,68,146
2015	7,37,97,97,139	1.19%	8,45,94,707	30	2.52	50	54.00%	3,98,14,97,663
2020	7,79,47,98,739	1.05%	8,13,30,639	30.9	2.47	52	56.20%	4,37,89,93,944
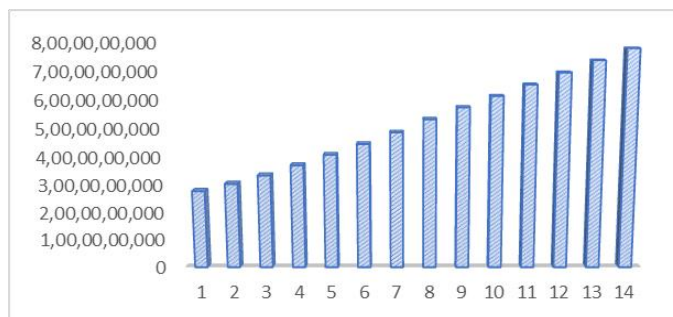
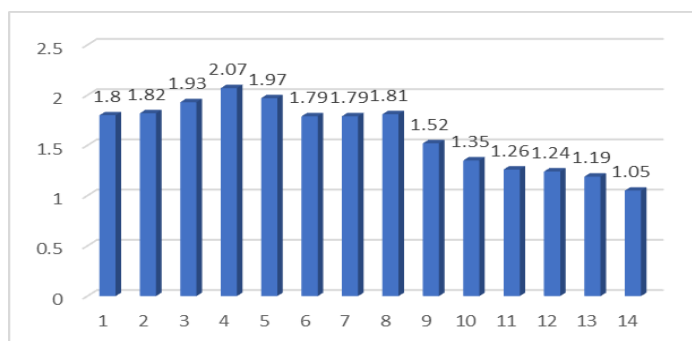**FIGURE 1**
GLOBAL POPULATION (1955-2020)

FIGURE 2
GLOBAL YEARLY CHANGE % (1955-2020)

Figure (3) below shows the secular trend (1955-2020) of global yearly change which is still positive trend as the equation shows that, where ($\hat{\beta} = 2416578$) represent the annual yearly increase (Raftery, 2012).
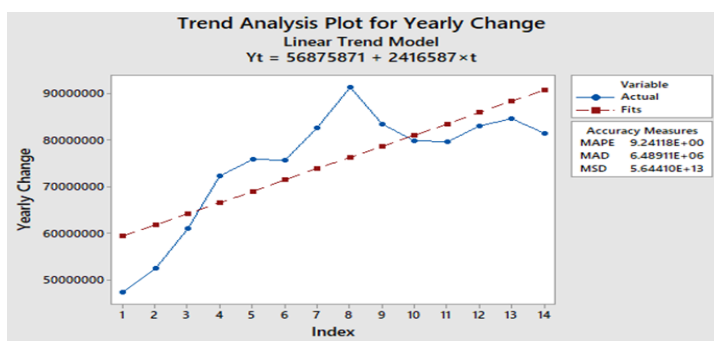
$$\hat{y}_t = 56875871 + 2416587\,t$$

FIGURE 3
SECULAR TREND OF GLOBAL YEARLY CHANGE

Table 3
FORECASTING WORLD POPULATION, YEARLY CHANGE, MEDIAN AGE, FERTILITY RATE, DENSITY URBAN POPULATION (2020 - 2050)

Year	Population	Yearly change %	Yearly change	Median Age	Fertility Rate	Density (P/km2)	Urban Pop. %	Urban Population
2020	7,79,47,98,739	1.10%	8,30,00,320	31	2.47	52	56.20%	4,37,89,93,944
2025	8,18,44,37,460	0.98%	7,79,27,744	32	2.54	55	58.30%	4,77,46,46,303
2030	8,54,84,87,400	0.87%	7,28,09,988	33	2.62	57	60.40%	5,16,72,57,546
2035	8,88,75,24,213	0.78%	6,78,07,363	34	2.7	60	62.50%	5,55,58,33,477
2040	9,19,88,47,240	0.69%	6,22,64,605	35	2.77	62	64.60%	5,93,82,49,026
2045	9,48,18,03,274	0.61%	5,65,91,207	35	2.85	64	66.60%	6,31,25,44,819
2050	9,73,50,33,990	0.53%	5,06,46,143	36	2.95	65	68.60%	6,67,97,56,162

United Nations predicted that the world population will continue to rise for the period from (2020) to (2050) to reach (9,735,033,990) person, but with decreasing annual rates of change with an increase median age as average up to (34) years with a slight increase in the fertility rate and population density and a clear rise in urbanization, table (3). The secular trend for the predicted period (2020 – 2050) is decreasing pattern in yearly change as shown in figure (4) where ($\hat{\beta} = -5367178$).
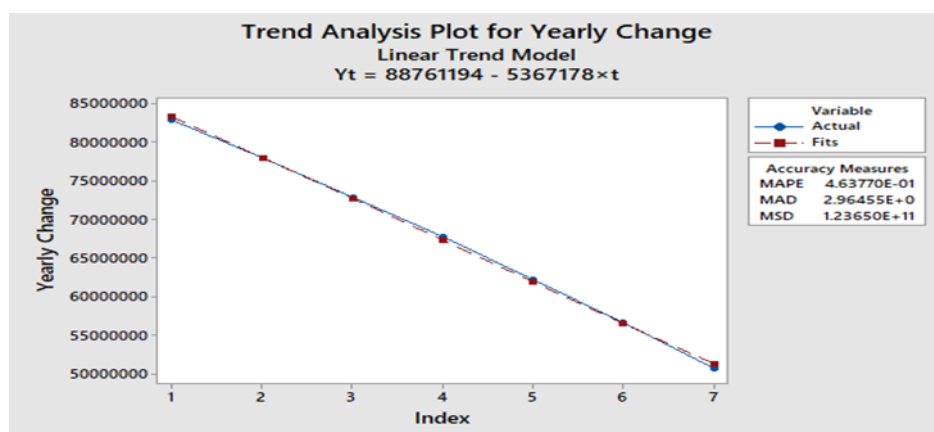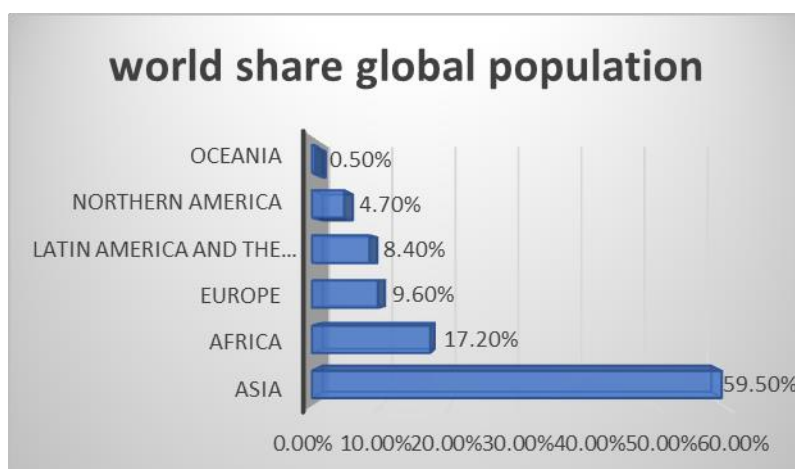

FIGURE 4
SECULAR TREND OF GLOBAL YEARLY CHANGE FOR PREDICTED PERIOD (2020 – 2050)

Table 4
GLOBAL POPULATION BY REGION

Region	Population (2020)	Yearly Change %	Density	Land Area	Fertility Rate	Med. Age	World share
Asia	4641054775	0.86	150	3,10,33,131	2.2	32	59.50%
Africa	1340598147	2.49	45	2,96,48,481	4.4	20	17.20%
Europe	747636026	0.06	34	2,21,34,900	1.6	43	9.60%
Latin America and the Caribbean	653962331	0.9	32	2,01,39,378	2	31	8.40%
Northern America	368869647	0.62	20	1,86,51,660	1.8	39	4.70%
Oceania	42677813	1.31	5	84,86,460	2.4	33	0.50%

Asia ranked the highest population with highest density, land area, and world share, while less percentage yearly change because of its policy in childbearing (Wi´sniowski, 2015), the lowest in yearly change is Europe, table (4), figure (5), gives more details for the same

FIGURE 5
PERCENTAGE OF WORLD SHARE

THE MODEL

For the technique of predicting population sizes, we will use Malthus's model, a mathematical model of population growth as follows (Singh, 2015);

$$\frac{dP}{dt} = \delta P, \ \ \delta > 0$$

$$P(t_0) = P_0 > 0 \qquad\qquad (1)$$

(δ) represents the population growth rate and it reflects a strong impact on how fast the population will grow.

$\frac{dP}{dt}$: Indicate the model population increases to infinity as time goes to infinity. Then $[P(t_0)]$

Represent the population size when ($t = t_0$).

From equation (1);

$$P^{-1}dP = \delta dt \qquad\qquad (2)$$

Integrating both sides;

$$\int_{t_0}^{t} P^{-1}dP = \int_{t_0}^{t} \delta dt$$

$$P = [P_0 e^{-\delta t_0}]e^{\delta t}$$

$$= C e^{\delta t} \qquad\qquad (3)$$

Where (C) is constant for some fixed (δ).

Equation (3) is the resolution of equation (1), it indicates an exponential function of e, and the population size grows exponentially as time (Bacaër, 2011).

For the applicability of the above formulas, we use the data shown in table (5), which express the population for the years (1990, 2000, 2010, 2020) for the global population and other six regions in addition to the population of the three levels of income and development. The results of applying table (5) to the above equations can be shown in table (6) below.

Table 5
POPULATION BY REGIONS THROUGH CENSUS DATA (MILLION), (1990 – 2019).

Region	1990	2000	2010	2019
World	5320.817	6127.7	6916.183	7713.468
More developed countries	1148.278	1193.355	1240.935	1270.63
Less developed countries	4172.538	4934.346	5675.249	6442.838
Least developed countries	509.354	663.251	838.807	1033.389
High-income countries	1154.191	1189.888	1226.688	1258.043
Middle-income countries	4394.719	4993.999	5674.999	5696.667
Low-income countries	400.877	494.91	611.55	755.85
Africa	613.385	808.304	1031.081	1308.064
Asia	3213.123	3717.372	4165.44	4601.371
Europe	725.255	729.105	740.308	747.183
Latin America	445.203	526.278	596.191	648.121
North America	282.286	315.417	346.501	366.601
Oceania	26.969	31.224	36.659	42.128

Table 6
PREDICTION POPULATION BY REGIONS FOR THE CENSUS YEARS (MILLION), (2010 & 2019).

Region	$P_0 e^{\delta t}$	2010	2019
World	$5320.817\, e^{0.0141\, t}$	7054.226	8009.488
More developed countries	$1148.278\, e^{0.0039\, t}$	1241.429	1285.777
Less developed countries	$4172.538\, e^{0.0168\, t}$	5838.795	6791.858
Least developed countries	$509.354\, e^{0.0264\, t}$	863.629	1095.256
High-income countries	$1154.191\, e^{0.003\, t}$	1225.562	1259.103
Middle-income countries	$4394.719\, e^{0.0128\, t}$	5676.890	6370.026
Low-income countries	$400.877\, e^{0.021\, t}$	610.119	737.049
Africa	$613.385\, e^{0.0276\, t}$	1065.234	1365.659
Asia	$3213.123\, e^{0.0146\, t}$	4302.703	4906.904
Europe	$725.255\, e^{0.0005\, t}$	732.544	735.848
Latin America	$445.203\, e^{0.0167\, t}$	621.745	722.581

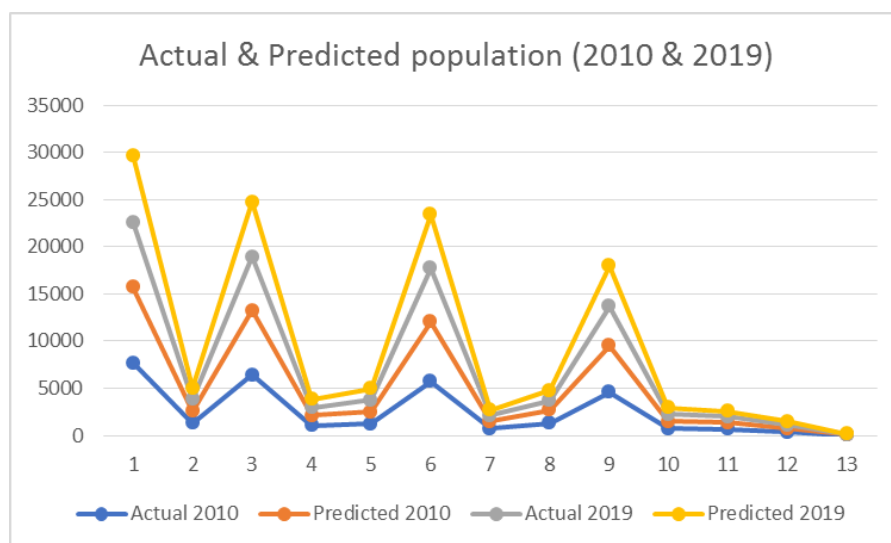| North America | $282.286\, e^{0.0111\, t}$ | 374.249 | 389.483 |
| Oceania | $26.969\, e^{0.0146\, t}$ | 36.114 | 41.186 |

FIGURE 6
ACTUAL & PREDICTED POPULATION (2010 & 2019) BY REGIONS

The applicability of the equations shows that the predicted population is slightly greater than the real population for all heads comes in table (6).

The Impact of Covid – 19 on the Growth Rate

The novel coronavirus disease (COVID-19), which began in late 2019, forced the entire world to confront one of the most difficult challenges in contemporary history, as it caused the infected of millions and the death of others, but it would be a grave mistake to describe this challenge as a health crisis only, it is a large-scale humanitarian crisis that leads to the misery and suffering of all mankind and pushes its social and economic well-being to the brink of collapse (David, 2014). It has had various economic, social and political repercussions as it paralyzed all sectors of society in all countries of the world, countries are still suffering and will continue to suffer from its effects.

In order to contain the increasing threats emanating from its spread, everyone around the world has been keen to reduce the transmission of infection and reduce the death toll. Think of others, especially the most vulnerable, and act to protect them. Corona virus knows no borders, it has severely affected the lives and livelihoods of all people, from all social and economic backgrounds (Deshotel, 2013). This is a regional emergency that calls for an emergency regional response. A response that aims not to save countries, industries or financial institutions in the region, but rather to save thousands of lives. Any rescue initiative to eradicate this epidemic must revolve around the well-being of the people and the solidarity of the pillars of society, it should enable governments to resume work in order to establish a safe, just and prosperous world that does not neglect anyone.

As usual Covid-19 by the numbers of deaths especially affected on the growth of population depending on the total death for each region which differ from region to another, we would like to analyze some data regarding the update topic, we collected a data from the U N and its organizations (up to middle of June 2021). Statistics indicate that the epidemic killed more than three million people in the world (Covid-19, 2021). In fact, the number is

higher because some deaths occurred outside the quarantine areas and were not officially registered. However, these numbers began to decline as a result of containing the epidemic and adhering to sound health instructions, in addition to the use of effective vaccines, and that most developed countries have left the impact of this epidemic on their people (Fabiano, 2017).

The number of infected people in the world (mid-June 2021) reached (174339994) (Covid-19, 2021), the total deaths due to the epidemic (3752900) constituted a percentage (0.0215) of the total infected, and a (0.0005) of the total population. If we take the scale of the regions, we find that the lowest region was Oceania with the number of infected (113233) and deaths (1893), the percentage of deaths to the number of infected (0.0167), the proportion of deaths to the total population of Oceania are almost null (Shang, 2016). Asia and Africa were the lowest, despite the population density of these two regions, where the ratio of deaths to the number of infected in Africa was (4970000), while Asia was by (52613244). Europe occupied the largest percentage in the number of infected people, despite the high health culture and environment, but the ratio of deaths to the number of infected people was (0.2304), followed by North America, then Latin America. Table (7) shows the details (Hironmoy, 2018).

| Table 7 ACTUAL POPULATION BY REGIONS, TOTAL CASES & TOTAL DEATHS (Covid-19).					
Region	Population (1)	Total cases (2)	Total deaths (3)	03/1	03/1
World	7 713 468000	174339994	3752900	0.0215	0.0005
Asia	4641054775	52613244	715022	0.0136	0.0002
Africa	1340598147	4970000	132947	0.0267	0.0001
Europe	747636026	46940024	1080408	0.2304	0.0014
Latin America	653962331	31500000	1200000	0.0381	0.0018
North America	368869647	38783363	867663	0.0224	0.0024
Oceania	42677813	113233	1893	0.0167	0.00004
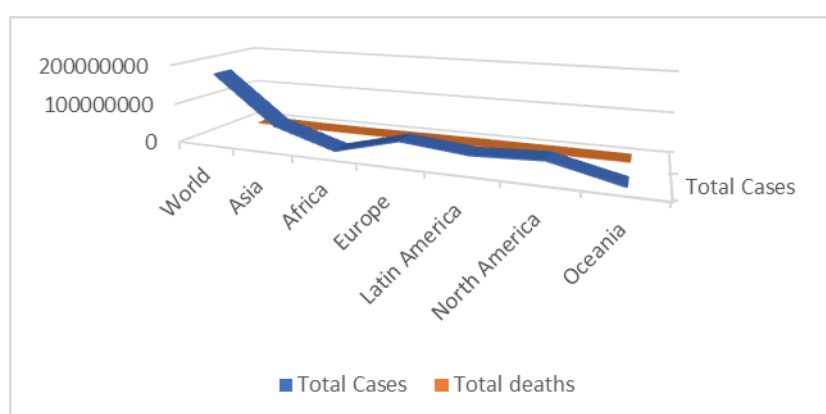
FIGURE 7
TOTAL CASES & TOTAL DEATHS BY REGIONS

The ten most populous countries in the world have fluctuated their infected and deaths in relation to the size of their population, the strange thing is that China is the most populous

country in the world, and it is the country from which the epidemic originated, the number of infected is (91300) with death (4636) ranked (0.0508) from infected and it is near to zero from total population. Other countries converged in the ratios of deaths to the number of infected according to the size of the population of each country, but Mexico had the highest death rate (228872) to the number of infected, table (8) below. The analysis of Covid-19 data, which was referred to above, clearly indicates an impact on population growth in all regions of the world (Jes´us, 2021).

Table 8 TOP TEN COUNTRIES, TOTAL CASES & TOTAL DEATHS (Covid 19).					
Region	Population (2020) (1)	Total cases (2)	Total deaths (3)	03/2	03/1
China	1439323776	91300	4636	0.0508	0
India	1380004385	28996949	351344	0.0121	0.0003
United States	331002651	34227237	612701	0.0179	0.0019
Indonesia	273523615	1875619	52181	0.0278	0.0002
Pakistan	220892340	936396	21429	0.0229	0.0001
Brazil	212559417	16985812	424614	0.025	0.002
Nigeria	206139589	166816	2117	0.0127	0
Bangladesh	164689383	812960	12869	0.0158	0.0001
Russia	145934462	5155453	124875	0.02422	0.0009
Mexico	128932753	2435443	228872	0.094	0.0018
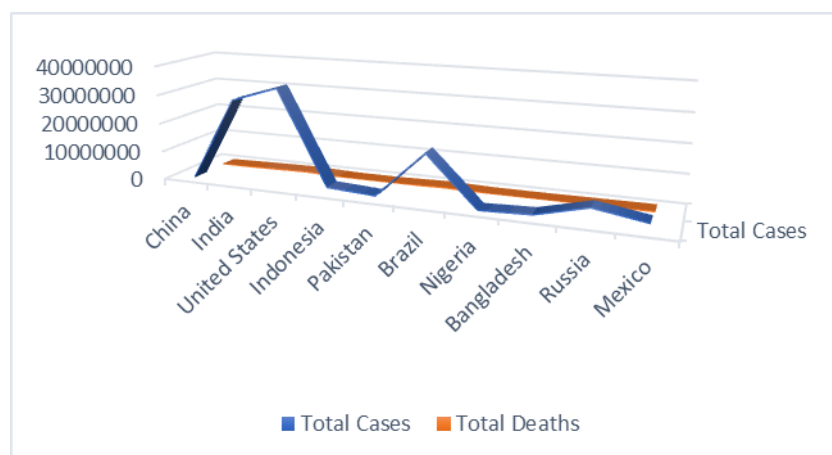
FIGURE 8
TOTAL CASES & TOTAL DEATHS (TOP TEN)

Death figures shown in tables and figures above, due to the epidemic certainly have a direct impact on growth rates, and this effect remains even when the epidemic ends.

CONCLUSION

Based on the previous analysis and discussion, we can conclude that the world will face major economic, social, and environmental problems as a result of population growth, especially in third world countries and low-income countries that do not have laws or legislation to control births, in addition to the lack of an appropriate healthy environment, thus growth will continue, but with decreasing pace in the developed countries and East Asia,

and at a slower rate of decreasing in other countries. Malthus models have been applied to the world's population and regions, as most studies have applied these models to specific countries. The population was estimated, as it was proved that the estimate according to the Malthus model is slightly higher than the real data for global population and all regions. The epidemic of the century (Covid 19), which occupied the world as a whole, was studied and its data obtained from (WHO) publications was analyzed and that the epidemic is on the way to receding due to the vaccines that were produced despite the losses caused by this epidemic, whether material, human or infrastructure losses, in addition there is a direct effect on population growth.

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