M.O.P. VAISHNAV COLLEGE FOR WOMEN
(Autonomous)

CHENNAI – 600034

(Affiliated to University of Madras and Re-accredited at

"A++" grade by NAAC)

PROJECT REPORT

Project on

"Impact of covid-19 on Natality and mortality rates of Indian population"

Done by

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&

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II B.Sc. Mathematics

Under the guidance of

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Head, Department of Mathematics
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2020-2021

CERTIFICATE

This is to certify that the project report titled **“Impact of covid-19 on Natality and mortality rates of Indian population” is** a bonafide record of work done by **Ms. Dharshini.R** & **Ms. Srivaramangai.S** during the period 2020- 2021, and the report has not formed the basis for the award of any Degree.

Dr. FERNANDES JAYASHREE
Head, Department of Mathematics
M. O. P Vaishnav College for Women,
Chennai 600 034

Place: Chennai

Date: 29.10.2021

DECLARATION

We **Dharshini.R** & **Srivaramangai.S,** hereby declare that the project report titled **"Impact of covid-19 on Natality and mortality rates of Indian population"** is a record of original work done by me during 2021-2022 under the guidance of Dr. FERNANDES JAYASHREE Head Department of Mathematics and it has not formed the basis for the award of any other degree.

Dharshini.R (2013711075017)

&

Srivaramangai.S(2013711075057)

Place: Chennai

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IMPACT OF COVID-19 ON NATALITY AND MORTALITY RATES OF INDIAN POPULATION

the data has proven that amidst the covid-19 situation the birth rates as well as death rates has been tremendously affected in a balanced manner. The report is based on how the prior covid-19 situation and after the hit of the pandemic changed the definition numerically.

INTRODUCTION

What is natality rate (birth rate)?

The birth rate in a period is the total number of live births per 1,000 population divided by the length of the period in years.

It is also known as natality rate. The birth rate (along with mortality and migration rates) is used to calculate population growth.

The natality rate can be expressed as the number of births per 1,000 individuals in a population.

Absolute natality indicates how many births there could potentially be in ideal circumstances, while realized natality reflects the number of births that take place when environmental pressures are taken into account.

Therefore, the natality rate is an issue or concern for the national policies and the government.

The calculation is done by;

Divide the number of births by the total population and multiply the quotient by 1,000.

$$\boxed{\textit{i.e.,} \quad \frac{\textit{total no of births}}{\textit{total no of population}} \times 1000 = \textit{B.R}}$$

Note that there is a lot of differences between fertility rate and birth rate but they are co-dependent on each other.

The factors affecting the birth rates

There are many factors that interact in complex ways, influencing the birth rates of a population. Developed countries have a lower birth rate than underdeveloped countries . A parent's number of children strongly correlates with the number of children that each person in the next generation will eventually have. Factors generally associated with increased fertility include religiosity, intention to have children, and maternal support. Factors generally associated with decreased fertility include wealth, education, female labour participation urban residence intelligence, increased female age, women's rights, access to family planning services and (to a lesser degree) increased male age. Many of these factors however are not universal, and differ by region and social class.

Reproductive health can also affect the birth rate, as untreated infections can lead to fertility problems.

Child custody laws, affecting fathers' parental rights over their children from birth until child custody ends at age 18, may have an effect on the birth rate.

What is mortality rate?

Mortality rate, or death rate, is a measure of the number of deaths (in general, or due to a specific cause) in a particular population, scaled to the size of that population, per unit of time.

Mortality rate is typically expressed in units of deaths per 1,000 individuals per year.

i.e.,

death rate = deaths / population * 10n

where, deaths - Deaths measured within specified time interval for a certain population; n - The exponent and gives you the answer per every 10n people.

Thus, a mortality rate of 9.5 (out of 1,000) in a population of 1,000 would mean 9.5 deaths per year in that entire population, or 0.95% out of the total.

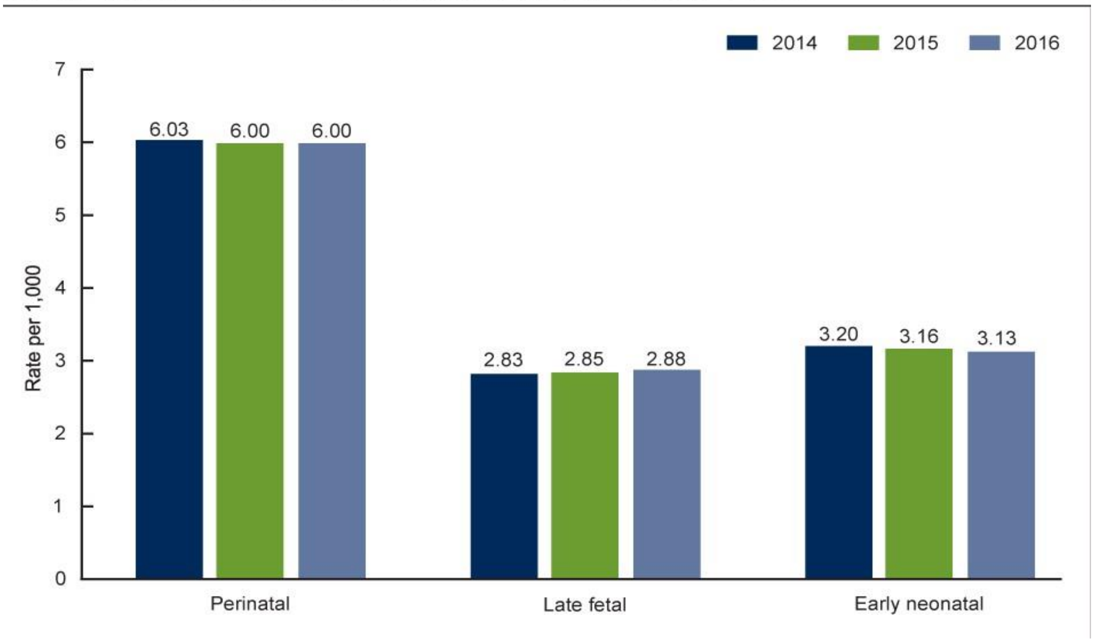
It is distinct from "morbidity", which is either the prevalence or incidence of a disease, and also from the incidence rate (the number of newly appearing cases of the disease per unit of time).

An important specific mortality rate measure is the crude death rate, which looks at mortality from all causes in a given time interval for a given population.

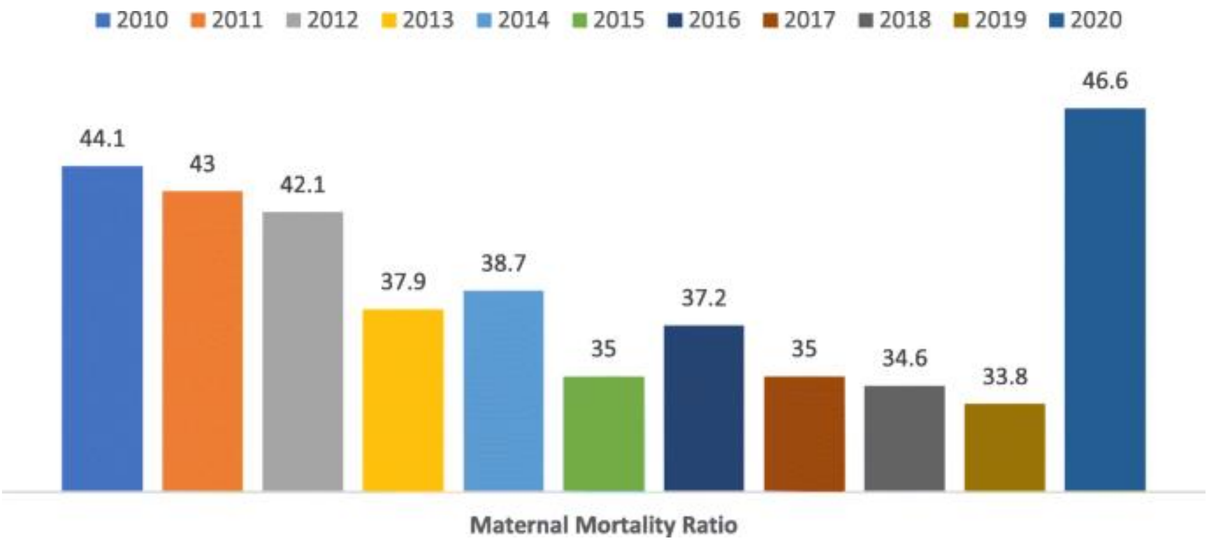
Types of mortality rate:

- **Perinatal mortality rate:** Perinatal mortality (PNM) refers to the death of a foetus or neonate and is the basis to calculate the perinatal mortality rate. Variations in the precise definition of the perinatal mortality exist, specifically concerning the issue of inclusion or exclusion of early foetal and late neonatal fatalities. The World Health Organization defines perinatal mortality as the "number of stillbirths and deaths in the first week of life per 1,000 total births, the perinatal period commences at 22 completed weeks (154 days) of gestation, and ends seven completed days after birth"

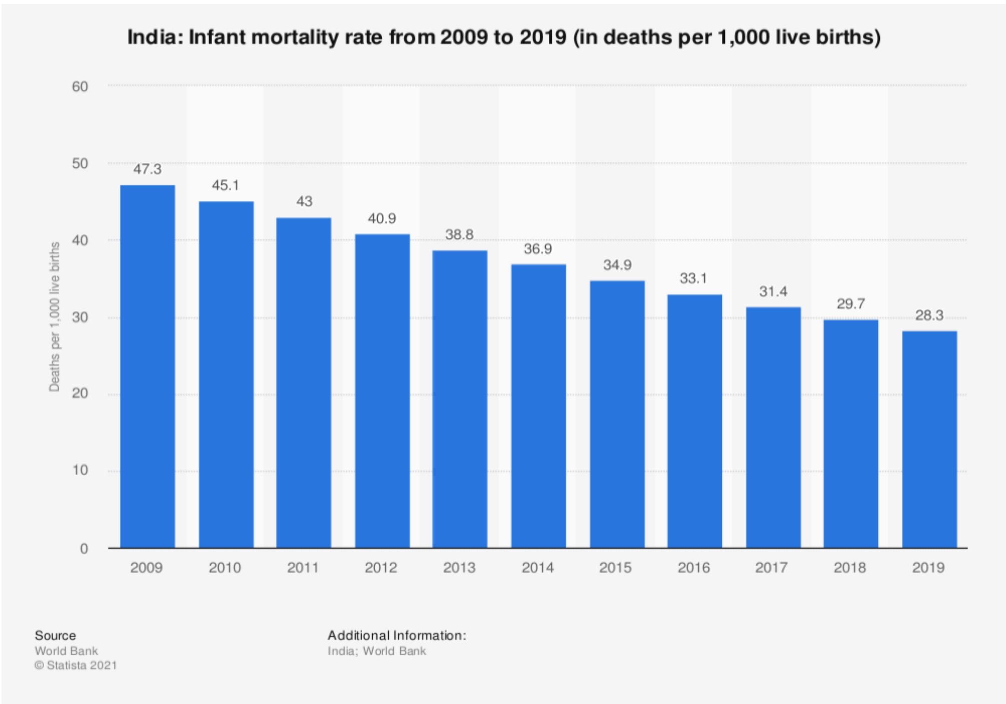
igure 1. Perinatal, late fetal, and early neonatal mortality rates: United States, 2014–2016



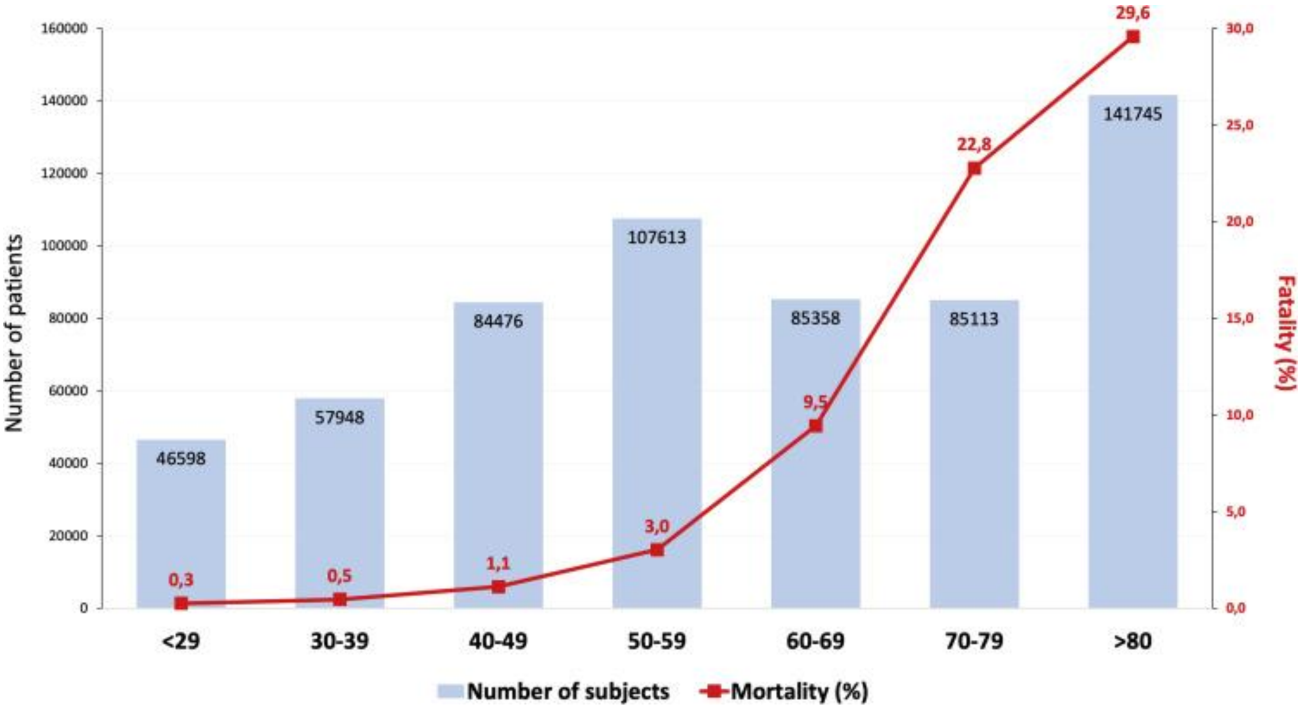
- **Maternal mortality rate:** Maternal death or maternal mortality is defined in slightly different ways by several different health organizations. The World Health Organization (WHO) defines maternal death as the death of a pregnant person due to complications related to pregnancy, underlying conditions worsened by the pregnancy or management of these conditions.



- **Infant mortality rate:** Infant mortality is the death of young children under the age of 1. This death toll is measured by the infant mortality rate (IMR), which is the probability of deaths of children under one year of age per 1000 live births. The under-five mortality rate, which is referred to as the *child mortality rate*, is also an important statistic, considering the infant mortality rate focuses only on children under one year of age



- **Age-specific mortality rate (ASMR):** The total number of deaths per year at a specific age, divided by the number of living persons at that age (e.g., age 62 at last birthday). An age-specific mortality rate is a mortality rate limited to a particular age group. The numerator is the number of deaths in that age group; the denominator is the number of persons in that age group in the population.



The graph represents the Effect of Age on Mortality in Patients With COVID-19.

- **Case fatality rate (CFR):** In epidemiology, case fatality rate (CFR) – or sometimes more accurately case-fatality risk – is the proportion of people diagnosed with a certain disease, who end up dying of it. Unlike a disease's mortality rate, the CFR does not take into account the time period between disease onset and death. A CFR is generally expressed as a percentage. It represents a measure of disease lethality and may change with different treatments. CFRs are most often used for diseases with discrete, limited-time courses, such as acute infections.

CONTRASTING STUDY BETWEEN NATALITY AND MORTALITY RATES

- Both death rate and birth rate are species specific and death rate is sex specific too.
- Natality can be positive or zero but never negative.
- Under ideal conditions the mortality rate will be the lowest. The highest possible natality, that can be visualized under ideal conditions is known as potential natality.
- Whereas, the lowest possible death rate that can be expected under most ideal conditions is called potential mortality. Both potential mortality and natality occurs very seldom.

- The actual birth rate under normal natural conditions is known as realized natality, also the actual death rate under normal natural conditions is called realized mortality. They both vary with populations and environmental conditions.
- In general, realized natality is always less than potential natality and realized mortality is higher than potential mortality.
- Females have an edge over males in having lower mortality and higher mean duration of life. In the case of human beings, there is an inherent biological difference between males and females which favours lower mortality in females.
- Under normal natural conditions, natality and mortality will be delicately balanced in order to maintain the steady state density of population. But, when natality supersedes mortality, population size and density increase abnormally. Also, when mortality overrides natality, population size and density decrease very much.

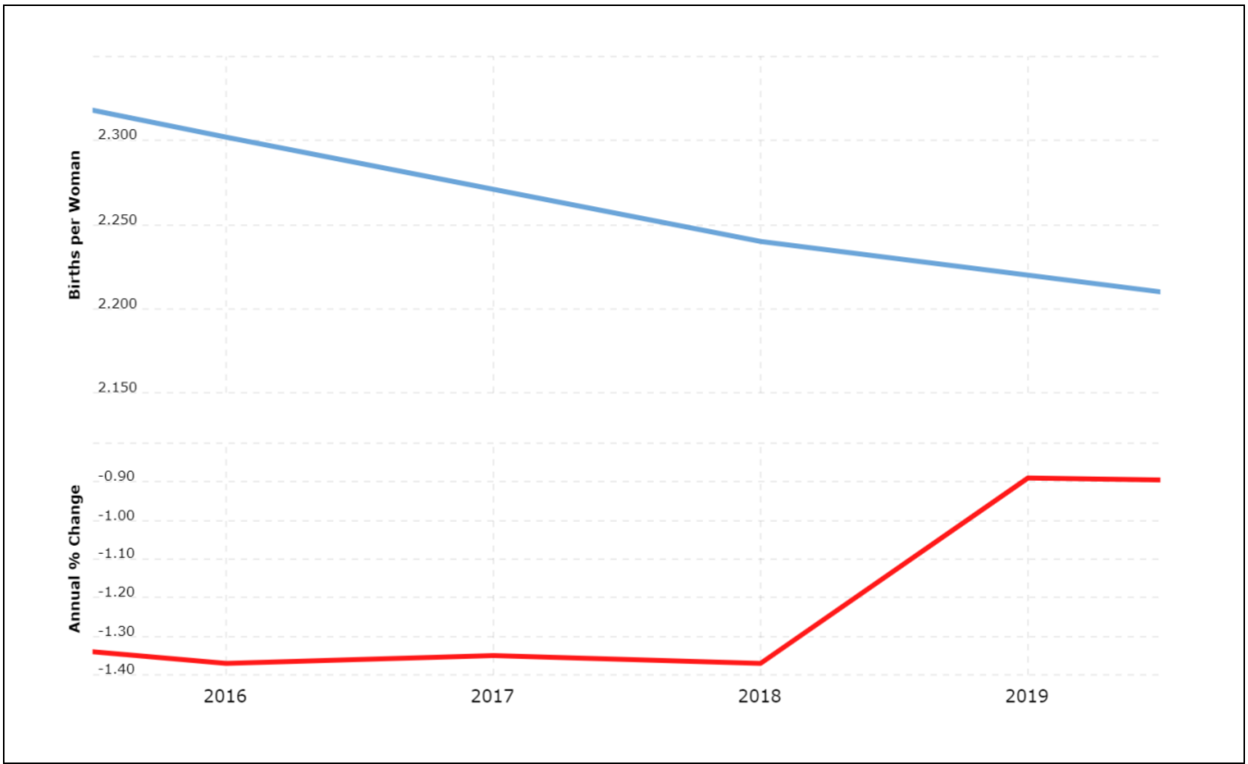
COMPARISON STUDY OF NATALITY AND MORTALITY RATES BETWEEN THE TERMS OF PRE- COVID AND POST-COVID SITUATIONS

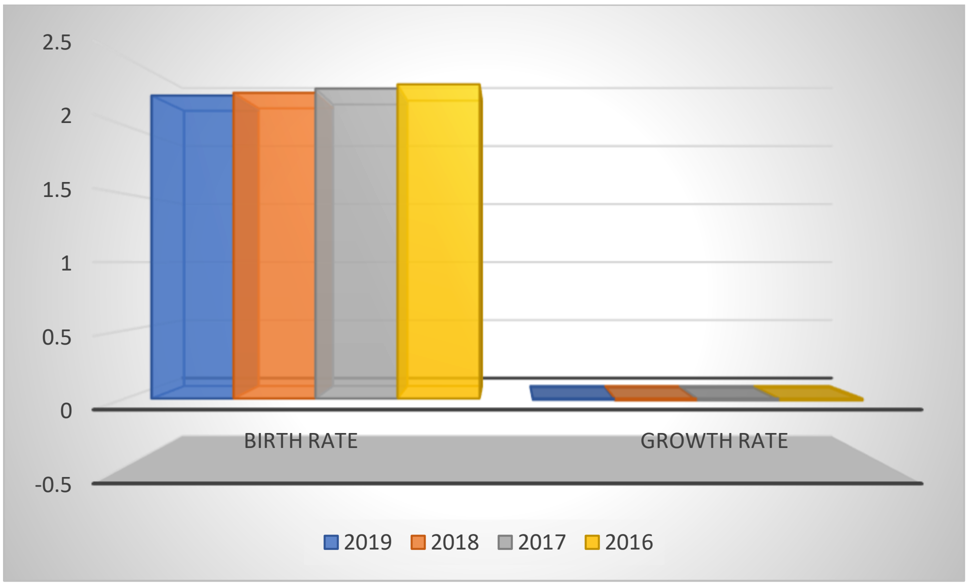
The world has been affected by the covid-19 pandemic disturbing the economy as well as the demographical features i.e., birth rates, death rates, literacy rate, etc. the given below data is the detailed study of the birth as well as the death rates taken between the years 2016-2021.

NATALITY RATES BETWEEN THE YEARS 2016-2019(PRE-COVID SCENARIO)

YEARS	BIRTH RATE	GROWTH RATE
2019	2.220	-0.890%
2018	2.240	-1.370%
2017	2.271	-1.350%
2016	2.302	-1.370%

GRAPHICAL REPRESENTATIONS OF BIRTH RATE

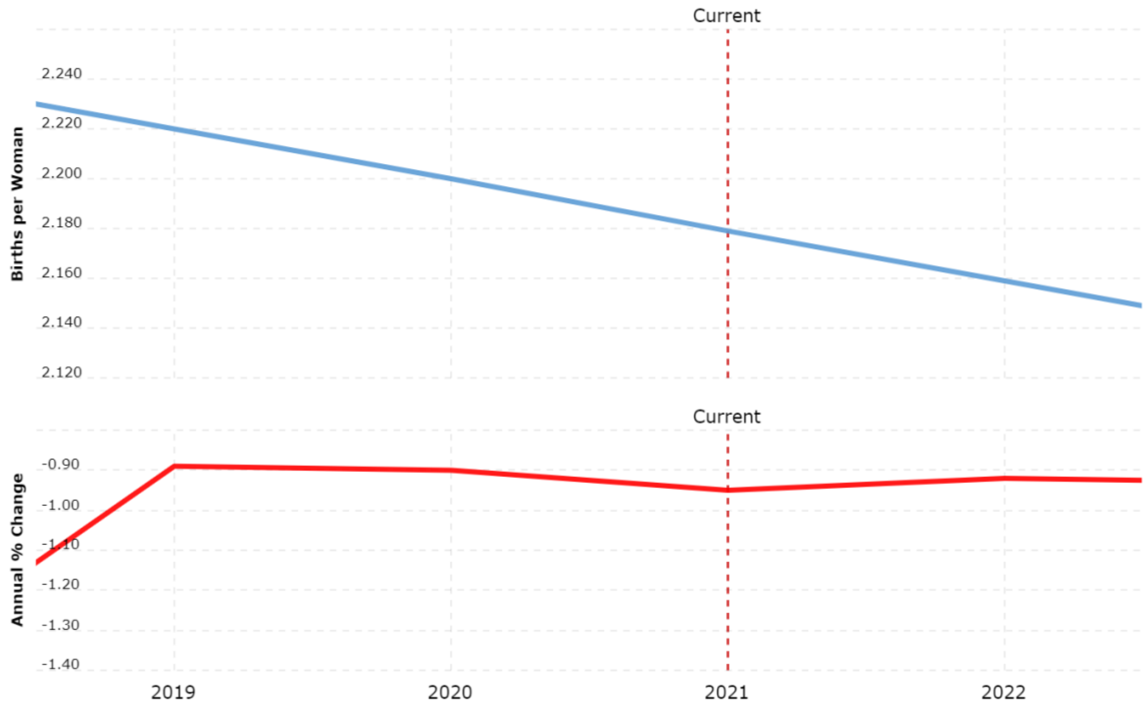


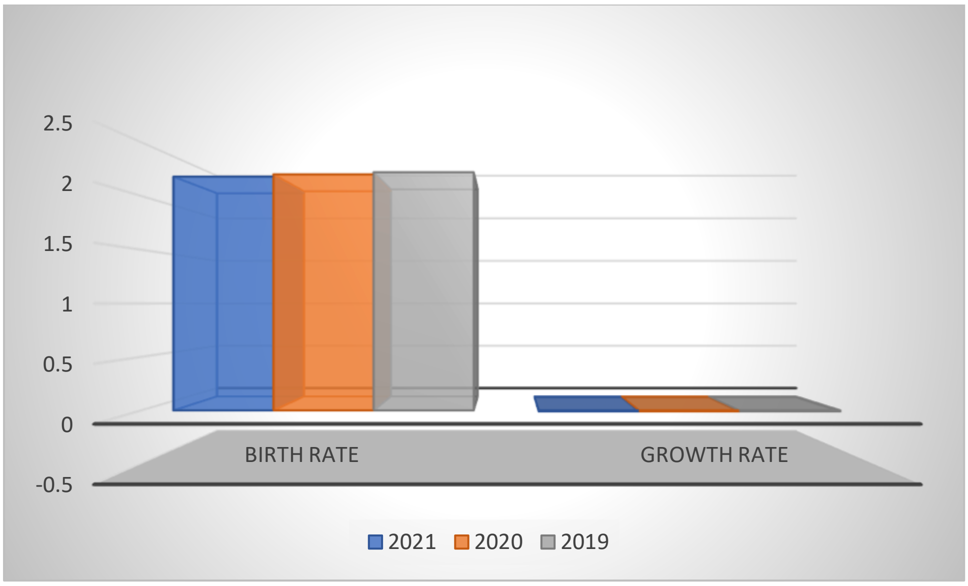


NATALITY RATES BETWEEN THE YEARS 2019-2021(POST-COVID SCENARIO)

YEARS	BIRTH RATE	GROWTH RATE
2021	2.179	-0.950%
2020	2.200	-0.900%
2019	2.220	-0.890%

GRAPHICAL REPRESENTATIONS OF BIRTH RATE





INFERENCE

- The given data can be compared using statistical formulas:

YEARS	BIRTH RATE
2021	2.179
2020	2.200
2019	2.220
2018	2.240
2017	2.271
2016	2.302

1. Let the given table values of birth rate from the year 2016-2018 be X and let the birth rates from 2019-2021 values be Y. according to correlation formula (in terms of analytical data) is

   Correl(array1: array2)

   Where array 1 is the table values of X and array 2 is the table values of Y.

   The coefficient of correlation of X and Y **0.999900867** which implies that the birth rate of the two different measures i.e., the given years are **highly positively correlated.**

<u>Test of hypothesis for large samples;</u>

2. **z-test** also can be performed for the given data. This is definitely a large sample as the population growth is taken in millions. Therefore, let mean of birth rate before covid-19 scenario (2016-2019) be X1 and let mean of birth rate after covid-19 scenario (2019-2021) be X2.

   Let **X1: 2.199666667**
   X2: 2.271

   The null hypothesis(H0) is X1=X2 i.e., the mean of birth rates has never been affected by covid-19.

   The alternate hypothesis (H1) is X1>X2 i.e., the mean of birth rates before covid is greater than after covid.

   It is a one-tailed test**.**

   According to analytical formula, the syntax goes by**,**

Z.TEST(array,[sigma])

The Z.TEST function syntax has the following arguments:

Array: Required. The array or range of data against which to test x.
here the values taken are for the overall 5 years.

x: Required. The value to test.

Sigma: The population (known) standard deviation. If omitted, the sample standard deviation is used.

The sigma/the standard deviation taken here is for sample.

Therefore,
Sigma=0.045596784
Substituting the values, we get z as **0.027680179.**
Therefore, the calculated value is **0.027680179.**

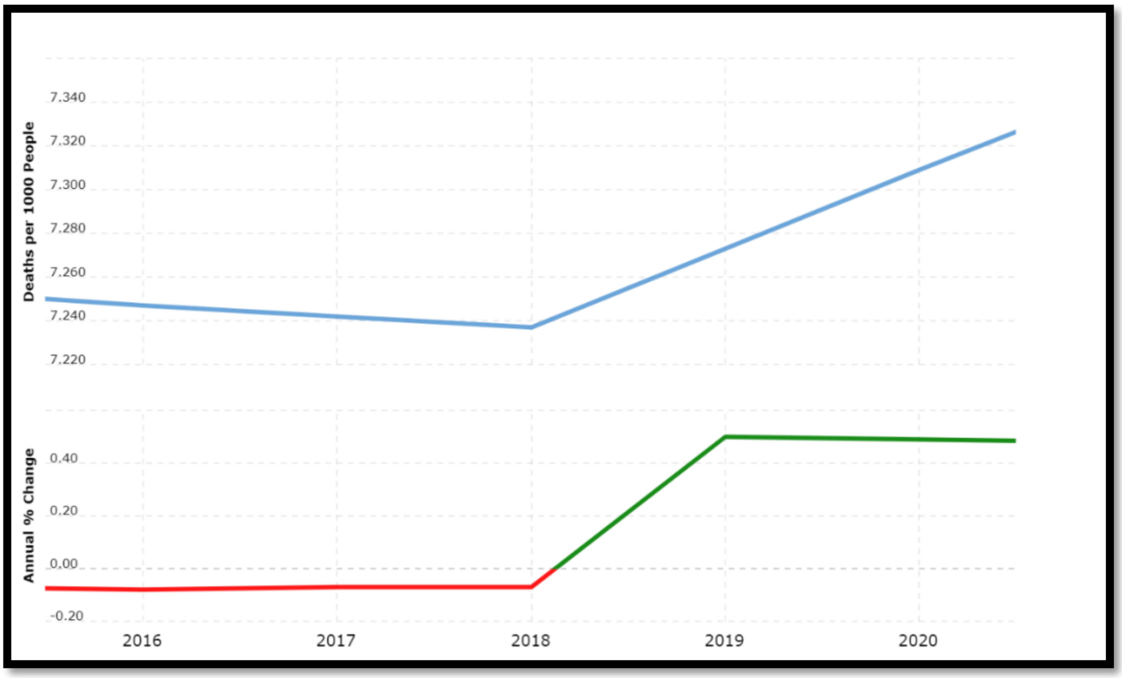
The tabulated value for level of significance 5% and one tailed is **1.76.**

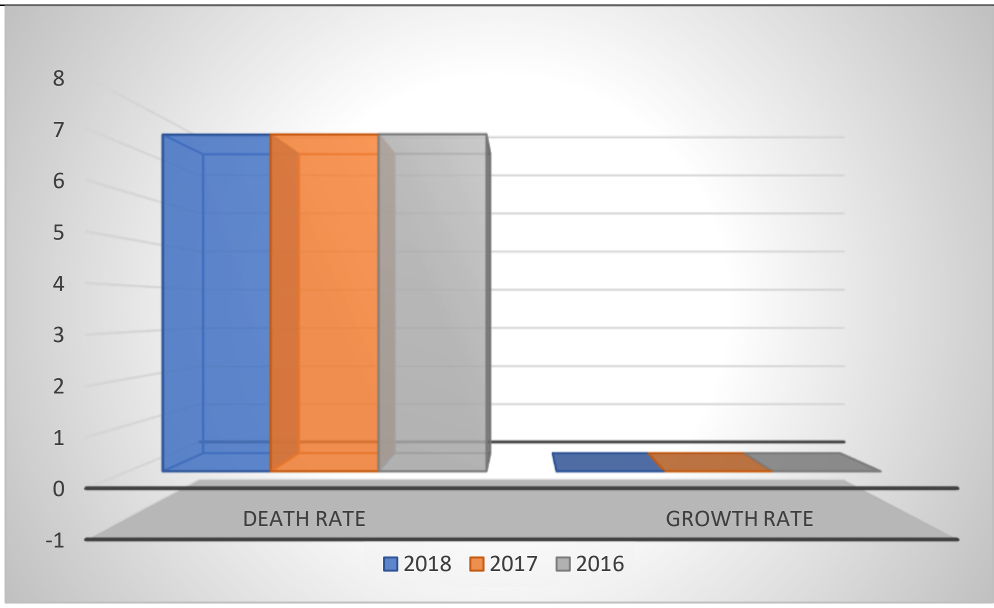
Therefore, as the calculated value is more than tabulated value, the null hypothesis is **rejected** and the alternat hypothesis is **accepted**.
Therefore X1>X2 i.e., the mean of the birth rate before pandemic is greater than post pandemic situation.

MORTALITY RATES BETWEEN THE YEARS 2016-2019(PRE-COVID SCENARIO)

YEARS	DEATH RATE	GROWTH RATE
2019	7.273	0.50%
2018	7.237	-0.07%
2017	7.242	-0.07%
2016	7.247	-0.08%

GRAPHICAL REPRESENTATIONS OF DEATH RATE

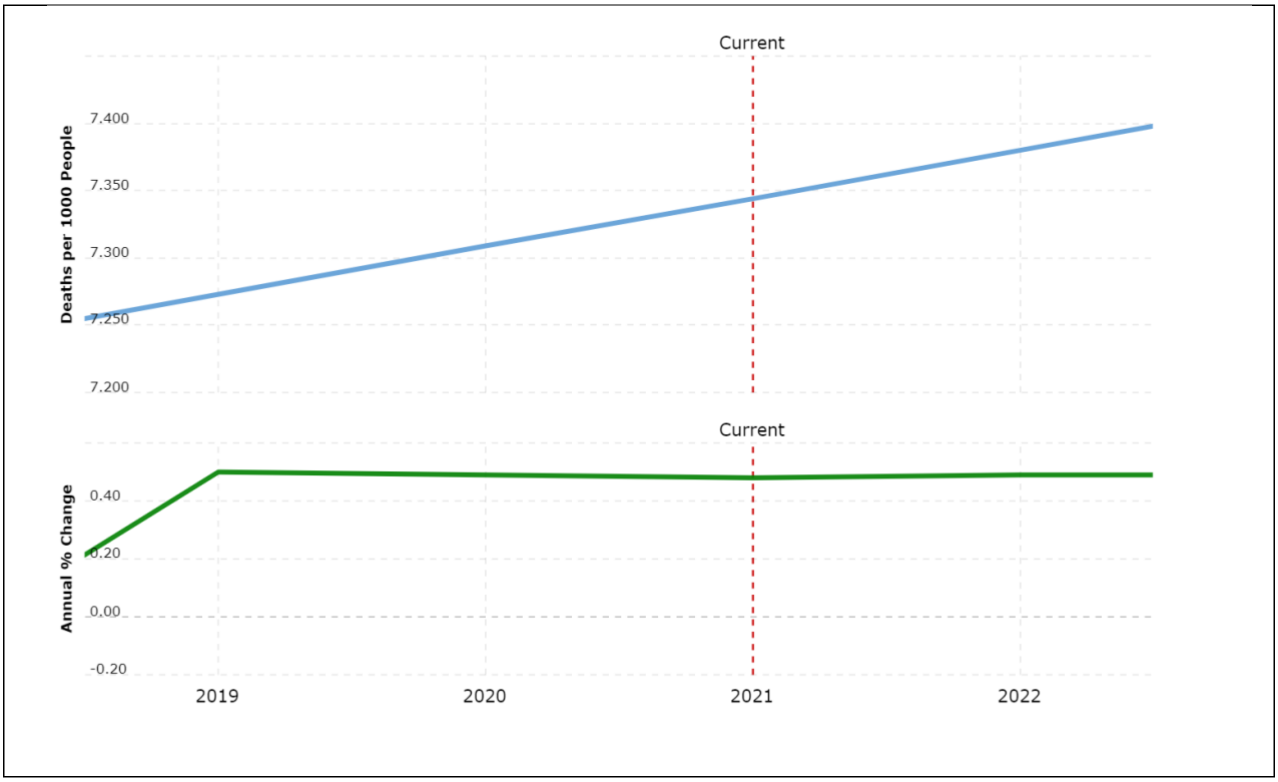


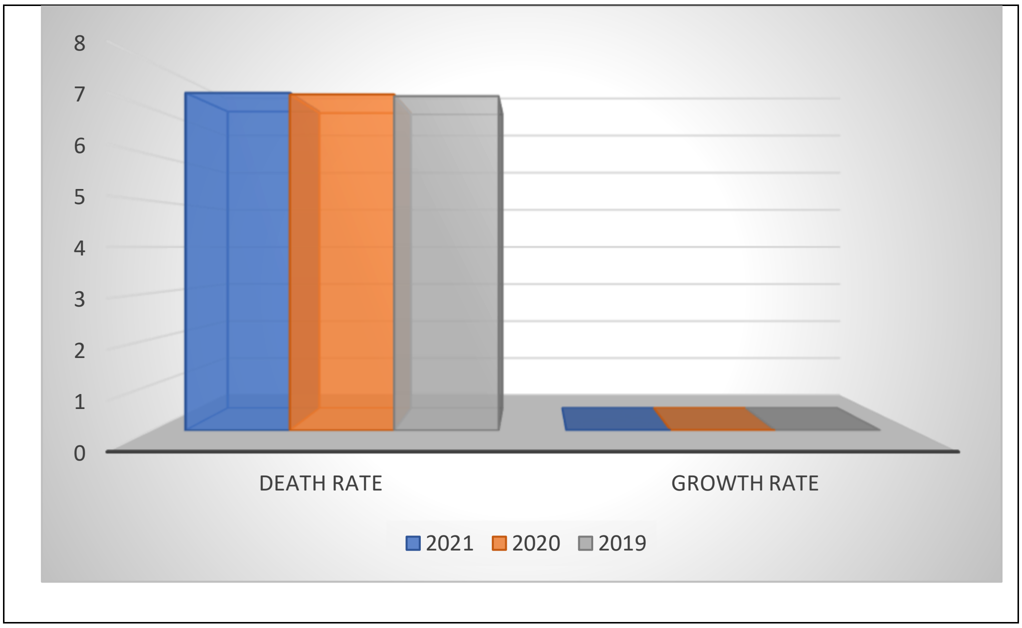


MORTALITY RATES BETWEEN THE YEARS 2019-2021(POST-COVID SCENARIO)

Year	Death Rate	Growth Rate
2021	7.344	0.48%
2020	7.309	0.49%
2019	7.273	0.50%

GRAPHICAL REPRESENTATIONS OF DEATH RATE





INFERENCE

- The given data can be compared using statistical formulas:

YEARS	DEATH RATE
2021	7.344
2020	7.309
2019	7.273
2018	7.237
2017	7.242
2016	7.247

- Let the given table values of death rate from the year 2016-2018 be A and let the death rates from 2019-2021 values be B. according to correlation formula (in terms of analytical data) is

Correl(array1: array2)

Where array 1 is the table values of A and array 2 is the table values of B.

The coefficient of correlation of X and Y **-0.999966939** which implies that the death rates taken by two different measures i.e., the given years are **negatively correlated.**

Test of hypothesis for large samples;

- **t-test** also can be performed for the given data.

This is definitely a large sample as the declination of population is taken in millions. Therefore, let sample mean of death rate before covid-19 scenario (2016-2019) be X1 and let sample mean of death rate after covid-19 scenario (2019-2021) be X2.

Let **X1: 7.242**
X2: 7.308667

The null hypothesis(H0) is X1=X2 i.e., the mean of death rate has never been affected by covid-19.

The alternate hypothesis (H1) is X1<X2 i.e., the mean of death rate before covid is greater than after covid.

It is a one-tailed test**.**

According to analytical formula, the syntax goes by**,**

Z.TEST(array,[sigma])

The Z.TEST function syntax has the following arguments:

Array: Required. The array or range of data against which to test x.
here the values taken are for the overall 5 years.

x: Required. The value to test.

Sigma: The population (known) standard deviation. If omitted, the sample standard deviation is used.

The sigma/the standard deviation taken here is for sample.

Therefore,

Sigma= 0.042982

Substituting the values, we get z as **0.028741695.**

Therefore, the calculated value is **0.028741695.**

The tabulated value for level of significance 5% and one tailed is **1.76.**

Therefore, as the calculated value is more than tabulated value, the null hypothesis is **rejected** and the alternat hypothesis is **accepted**.

Therefore X1<X2 i.e., the mean of the death rate before pandemic is lesser than post pandemic situation.

THE INTERPRETATIONS FROM THE ABOVE ASSESSMENT

- Thus, we can come to a conclusion that the birth rates and the death rates are co-dependent on each other.
- The following assumptions made in analysis resulted in proving that the pandemic had indeed affected the mortality and natality rate globally.
- The mean of the birth dates and the death rates are inversely proportional i.e., as the mean of the birth increases, subsequently the death rates gradually decrease.
- With reference to correlation analysis, we can conclude that the growth rates increases while the birth rates increases, and the death rates decreases.

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