covid19_PLP_Analysis

May 13, 2025

1 LOADING AND EXPLORING THE DATASET

[1]:

```
#Importing pandas as pd and loading the owid-covid-data.csv
import pandas as pd

try:
   df = pd.read_csv('owid-covid-data.csv')
except FileNotFoundError:
    print("Error: File not found. Please check the file path.")
except Exception as e:
    print(f"An error occurred: {e}")
```

[2]:

```
# Checking the columns
df.columns
```

[2]:

```
Index(['iso_code', 'continent', 'location', 'date', 'total_cases', 'new_cases',
       'new_cases_smoothed', 'total_deaths', 'new_deaths',
       'new_deaths_smoothed', 'total_cases_per_million',
       'new_cases_per_million', 'new_cases_smoothed_per_million',
       'total_deaths_per_million', 'new_deaths_per_million',
       'new_deaths_smoothed_per_million', 'reproduction_rate', 'icu_patients',
       'icu_patients_per_million', 'hosp_patients',
       'hosp_patients_per_million', 'weekly_icu_admissions',
       'weekly_icu_admissions_per_million', 'weekly_hosp_admissions',
       'weekly_hosp_admissions_per_million', 'total_tests', 'new_tests',
       'total_tests_per_thousand', 'new_tests_per_thousand',
       'new_tests_smoothed', 'new_tests_smoothed_per_thousand',
       'positive_rate', 'tests_per_case', 'tests_units', 'total_vaccinations',
       'people_vaccinated', 'people_fully_vaccinated', 'total_boosters',
       'new_vaccinations', 'new_vaccinations_smoothed',
       'total_vaccinations_per_hundred', 'people_vaccinated_per_hundred',
       'people_fully_vaccinated_per_hundred', 'total_boosters_per_hundred',
       'new_vaccinations_smoothed_per_million',
       'new_people_vaccinated_smoothed',
       'new_people_vaccinated_smoothed_per_hundred', 'stringency_index',
       'population_density', 'median_age', 'aged_65_older', 'aged_70_older',
       'gdp_per_capita', 'extreme_poverty', 'cardiovasc_death_rate',
       'diabetes_prevalence', 'female_smokers', 'male_smokers',
       'handwashing_facilities', 'hospital_beds_per_thousand',
       'life_expectancy', 'human_development_index', 'population',
       'excess_mortality_cumulative_absolute', 'excess_mortality_cumulative',
       'excess_mortality', 'excess_mortality_cumulative_per_million'],
      dtype='object')
```

[3]:
```python
# Preview of the rows
df.head()
```

[3]:
```
  iso_code continent     location        date  total_cases  new_cases  \
0      AFG      Asia  Afghanistan  2020-01-03          NaN        0.0   
1      AFG      Asia  Afghanistan  2020-01-04          NaN        0.0   
2      AFG      Asia  Afghanistan  2020-01-05          NaN        0.0   
3      AFG      Asia  Afghanistan  2020-01-06          NaN        0.0   
4      AFG      Asia  Afghanistan  2020-01-07          NaN        0.0   

   new_cases_smoothed  total_deaths  new_deaths  new_deaths_smoothed  …  \
0                 NaN           NaN         0.0                  NaN  …   
1                 NaN           NaN         0.0                  NaN  …   
2                 NaN           NaN         0.0                  NaN  …   
3                 NaN           NaN         0.0                  NaN  …   
4                 NaN           NaN         0.0                  NaN  …   

   male_smokers  handwashing_facilities  hospital_beds_per_thousand  \
0           NaN                  37.746                         0.5   
1           NaN                  37.746                         0.5   
2           NaN                  37.746                         0.5   
3           NaN                  37.746                         0.5   
4           NaN                  37.746                         0.5   

   life_expectancy  human_development_index  population  \
0            64.83                    0.511  41128772.0   
1            64.83                    0.511  41128772.0   
2            64.83                    0.511  41128772.0   
3            64.83                    0.511  41128772.0   
4            64.83                    0.511  41128772.0   

   excess_mortality_cumulative_absolute  excess_mortality_cumulative  \
0                                   NaN                          NaN   
1                                   NaN                          NaN   
2                                   NaN                          NaN   
3                                   NaN                          NaN   
4                                   NaN                          NaN   

   excess_mortality  excess_mortality_cumulative_per_million
0               NaN                                      NaN
```

```
1               NaN                                         NaN
2               NaN                                         NaN
3               NaN                                         NaN
4               NaN                                         NaN

[5 rows x 67 columns]
```

[4]:
```
df.info()
# Identifying the missing values
df.isnull().sum()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 350085 entries, 0 to 350084
Data columns (total 67 columns):
 #   Column                                     Non-Null Count   Dtype
---  ------                                     --------------   -----
 0   iso_code                                   350085 non-null  object
 1   continent                                  333420 non-null  object
 2   location                                   350085 non-null  object
 3   date                                       350085 non-null  object
 4   total_cases                                312088 non-null  float64
 5   new_cases                                  340457 non-null  float64
 6   new_cases_smoothed                         339198 non-null  float64
 7   total_deaths                               290501 non-null  float64
 8   new_deaths                                 340511 non-null  float64
 9   new_deaths_smoothed                        339281 non-null  float64
 10  total_cases_per_million                    312088 non-null  float64
 11  new_cases_per_million                      340457 non-null  float64
 12  new_cases_smoothed_per_million             339198 non-null  float64
 13  total_deaths_per_million                   290501 non-null  float64
 14  new_deaths_per_million                     340511 non-null  float64
 15  new_deaths_smoothed_per_million            339281 non-null  float64
 16  reproduction_rate                          184817 non-null  float64
 17  icu_patients                               37615 non-null   float64
 18  icu_patients_per_million                   37615 non-null   float64
 19  hosp_patients                              38902 non-null   float64
 20  hosp_patients_per_million                  38902 non-null   float64
 21  weekly_icu_admissions                      10205 non-null   float64
 22  weekly_icu_admissions_per_million          10205 non-null   float64
 23  weekly_hosp_admissions                     23253 non-null   float64
 24  weekly_hosp_admissions_per_million         23253 non-null   float64
 25  total_tests                                79387 non-null   float64
 26  new_tests                                  75403 non-null   float64
 27  total_tests_per_thousand                   79387 non-null   float64
 28  new_tests_per_thousand                     75403 non-null   float64
 29  new_tests_smoothed                         103965 non-null  float64
 30  new_tests_smoothed_per_thousand            103965 non-null  float64
 31  positive_rate                               95927 non-null   float64
 32  tests_per_case                              94348 non-null   float64
 33  tests_units                                 106788 non-null  object
 34  total_vaccinations                          79308 non-null   float64
 35  people_vaccinated                           75911 non-null   float64
 36  people_fully_vaccinated                     72575 non-null   float64
 37  total_boosters                              47562 non-null   float64
 38  new_vaccinations                            65346 non-null   float64
 39  new_vaccinations_smoothed                   180718 non-null  float64
 40  total_vaccinations_per_hundred              79308 non-null   float64
 41  people_vaccinated_per_hundred               75911 non-null   float64
 42  people_fully_vaccinated_per_hundred         72575 non-null   float64
 43  total_boosters_per_hundred                  47562 non-null   float64
 44  new_vaccinations_smoothed_per_million       180718 non-null  float64
 45  new_people_vaccinated_smoothed              180489 non-null  float64
 46  new_people_vaccinated_smoothed_per_hundred  180489 non-null  float64
 47  stringency_index                            197651 non-null  float64
 48  population_density                          297178 non-null  float64
 49  median_age                                  276367 non-null  float64
 50  aged_65_older                               266708 non-null  float64
 51  aged_70_older                               273597 non-null  float64
 52  gdp_per_capita                              270863 non-null  float64
 53  extreme_poverty                             174561 non-null  float64
 54  cardiovasc_death_rate                       271487 non-null  float64
 55  diabetes_prevalence                         285303 non-null  float64
 56  female_smokers                              203659 non-null  float64
 57  male_smokers                                200889 non-null  float64
 58  handwashing_facilities                      132973 non-null  float64
 59  hospital_beds_per_thousand                  239669 non-null  float64
 60  life_expectancy                             322072 non-null  float64
 61  human_development_index                     263138 non-null  float64
 62  population                                  350085 non-null  float64
 63  excess_mortality_cumulative_absolute        12184 non-null   float64
 64  excess_mortality_cumulative                 12184 non-null   float64
 65  excess_mortality                            12184 non-null   float64
 66  excess_mortality_cumulative_per_million     12184 non-null   float64
dtypes: float64(62), object(5)
memory usage: 179.0+ MB
```

```
[4]: iso_code                                     0
     continent                                16665
     location                                     0
     date                                         0
     total_cases                              37997
                                              …
     population                                   0
     excess_mortality_cumulative_absolute    337901
```

```
excess_mortality_cumulative                  337901
excess_mortality                             337901
excess_mortality_cumulative_per_million      337901
Length: 67, dtype: int64
```

2 CLEANING THE DATA

```
[5]: # Filtering countries of interest i.e. most populated country per continent
     countries = ['India', 'United States', 'Nigeria', 'Brazil', 'Germany',␣
      ↪'Australia']
     df = df[df['location'].isin(countries)]
     df.isnull().sum()
```

```
[5]: iso_code                                       0
     continent                                      0
     location                                       0
     date                                           0
     total_cases                                  185
                                                 …
     population                                     0
     excess_mortality_cumulative_absolute        7703
     excess_mortality_cumulative                 7703
     excess_mortality                            7703
     excess_mortality_cumulative_per_million     7703
     Length: 67, dtype: int64
```

```
[6]: # No rows with missing dates/critical values... Proceeding to convert the date␣
      ↪column to datetime
     df['date'] = pd.to_datetime(df['date'])
     df.head()
```

```
[6]:       iso_code continent   location       date  total_cases  new_cases  \
     18020      AUS   Oceania  Australia 2020-01-03          NaN        0.0
     18021      AUS   Oceania  Australia 2020-01-04          NaN        0.0
     18022      AUS   Oceania  Australia 2020-01-05          NaN        0.0
     18023      AUS   Oceania  Australia 2020-01-06          NaN        0.0
     18024      AUS   Oceania  Australia 2020-01-07          NaN        0.0

            new_cases_smoothed  total_deaths  new_deaths  new_deaths_smoothed  …  \
     18020                 NaN           NaN         0.0                  NaN  …
     18021                 NaN           NaN         0.0                  NaN  …
     18022                 NaN           NaN         0.0                  NaN  …
     18023                 NaN           NaN         0.0                  NaN  …
     18024                 NaN           NaN         0.0                  NaN  …

            male_smokers  handwashing_facilities  hospital_beds_per_thousand  \
18020          16.5                     NaN                        3.84
18021          16.5                     NaN                        3.84
18022          16.5                     NaN                        3.84
18023          16.5                     NaN                        3.84
18024          16.5                     NaN                        3.84

       life_expectancy  human_development_index  population  \
18020            83.44                    0.944  26177410.0
18021            83.44                    0.944  26177410.0
18022            83.44                    0.944  26177410.0
18023            83.44                    0.944  26177410.0
18024            83.44                    0.944  26177410.0

       excess_mortality_cumulative_absolute  excess_mortality_cumulative  \
18020                                   NaN                          NaN
18021                                   NaN                          NaN
18022                                 -42.7                        -1.44
18023                                   NaN                          NaN
18024                                   NaN                          NaN

       excess_mortality  excess_mortality_cumulative_per_million
18020               NaN                                      NaN
18021               NaN                                      NaN
18022             -1.44                                -1.663417
18023               NaN                                      NaN
18024               NaN                                      NaN

[5 rows x 67 columns]
```

[7]:

```
# Confirming the selected countries by checking the unique values in the␣
 ↪location column
sorted(df['location'].unique())
```

[7]:

```
['Australia', 'Brazil', 'Germany', 'India', 'Nigeria', 'United States']
```

[8]:

```
# Handling missing values using fillna()
df.fillna(0, inplace=True)  # Replaces missing values with 0
df.isnull().sum()
```

[8]:

```
iso_code                                   0
continent                                  0
location                                   0
date                                       0
total_cases                                0
                                          ..
population                                 0
excess_mortality_cumulative_absolute       0
```

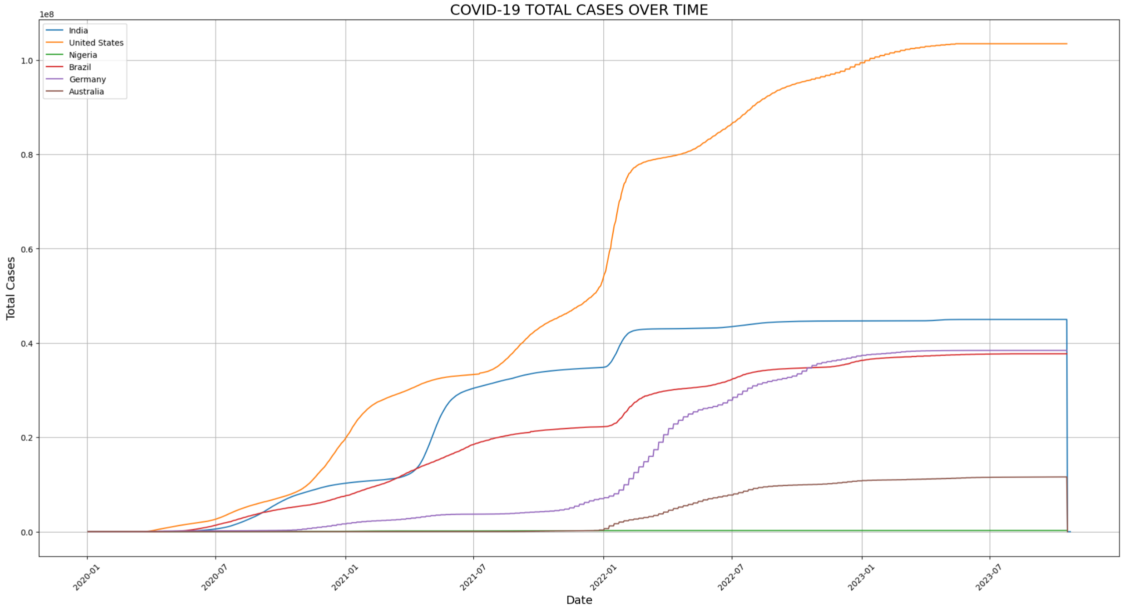
```
excess_mortality_cumulative                  0
excess_mortality                             0
excess_mortality_cumulative_per_million      0
Length: 67, dtype: int64
```

3 COVID 19 DATA ANALYSIS

3.1 Analysis of total cases over time

[10]:

```python
# EXPLORATORY DATA ANALYSIS
# Plotting a line chart of total cases over time for selected countries.
import matplotlib.pyplot as plt

# Filter data for the specified countries
df_selected = df[df['location'].isin(countries)]

plt.figure(figsize=(24, 12))  # Set figure size

# Loop through each country and plot total cases over time
for country in countries:
    subset = df_selected[df_selected['location'] == country]
    plt.plot(subset['date'], subset['total_cases'], label=country)

# Customizing the plot
plt.xlabel('Date', fontsize=14)  # Set font size and type
plt.ylabel('Total Cases', fontsize=14)
plt.title('COVID-19 TOTAL CASES OVER TIME', fontsize=18)
plt.xticks(rotation=45)  # Rotating date labels for readability
plt.legend()  # Adding legend for clarity
plt.grid(True)  # Enabling grid for better visibility
plt.show()
plt.savefig("total_cases_chart.png")
```



```
<Figure size 640x480 with 0 Axes>
```

3.1.1 Inferences

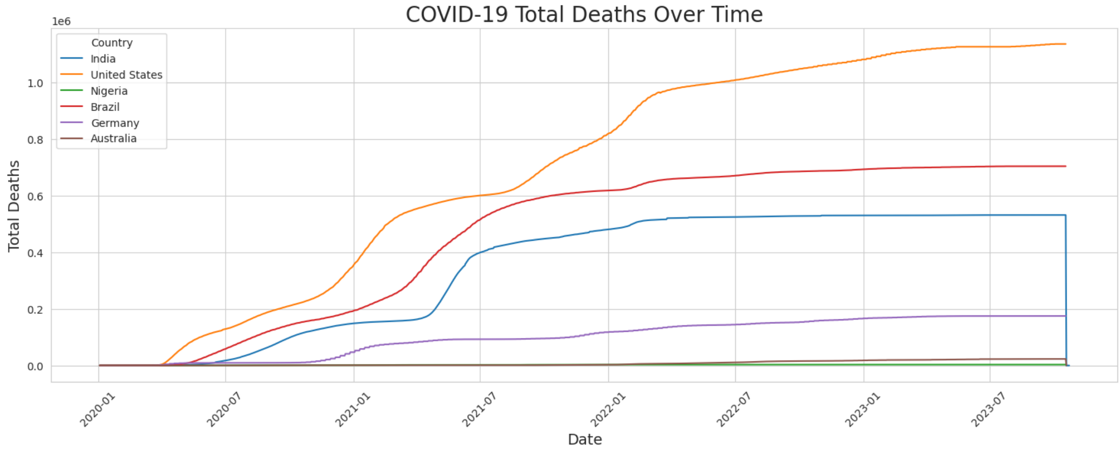
The comparative line graph of total cases against time shows that:

1. **USA** had the highest growth of COVID-19 cases over time, while **Nigeria** had the lowest
2. The total cases *increased significantly* at the beginning of the year 2022.
3. The total cases reported in **Nigeria** was considerably low. This could be attributed to poor recording or reporting mechanisms.

3.2 Analysis of Total Deaths over Time

3.2.1 Plot

[11]:
```python
import seaborn as sns
import matplotlib.pyplot as plt

# Set Seaborn style for better aesthetics
sns.set_style("whitegrid")

# Filter data for the specified countries
df_selected = df[df['location'].isin(countries)]

plt.figure(figsize=(18, 6))  # Set figure size

# Loop through each country and plot total deaths over time using Seaborn
for country in countries:
    subset = df_selected[df_selected['location'] == country]
    sns.lineplot(x=subset['date'], y=subset['total_deaths'], label=country)

# Customizing the plot
plt.xlabel('Date', fontsize=14)
plt.ylabel('Total Deaths', fontsize=14)
plt.title('COVID-19 Total Deaths Over Time', fontsize=20)
plt.xticks(rotation=45)  # Rotating date labels for readability
plt.legend(title="Country")  # Adding legend for clarity
plt.show()
plt.savefig("total_deaths_chart.png")
```



```
<Figure size 640x480 with 0 Axes>
```

3.2.2 Inferences

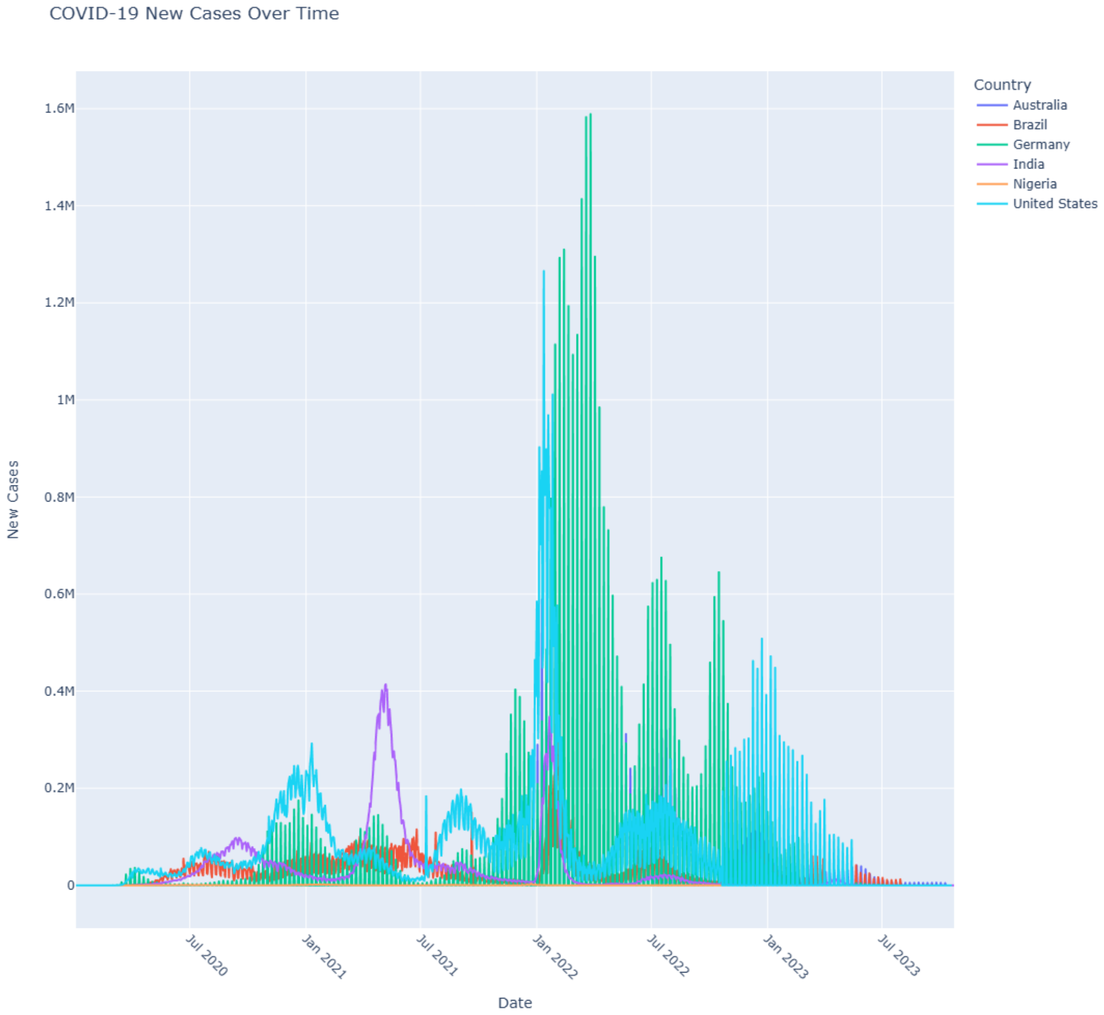
- The graph for the trend in COVID-19 deaths is almost similar to the graph for total cases against time.
- The only exception is in the trend for Brazil, which shows an increased number of deaths as compared to the total cases trend.
- *Nigeria and Australia* had a **lower growth** of total deaths, when compared to *USA, Germany, Brazil and India.*

3.3 Analysis of New Cases over Time

3.3.1 Plot

[12]:
```
import plotly.express as px

# Filter data for the specified countries
df_selected = df[df['location'].isin(countries)]
```

```
# Create an interactive line plot
fig = px.line(df_selected, x='date', y='new_cases', color='location',
              title="COVID-19 New Cases Over Time")

# Set the figure size to fullscreen
fig.update_layout(xaxis_title="Date", yaxis_title="New Cases",
                  xaxis=dict(tickangle=45),
                  legend_title="Country",
                  height=1000,  # Adjust height for fullscreen effect
                  width=1400)  # Adjust width for fullscreen effect

# Show the interactive plot
fig.show()
```



3.3.2 Inferences

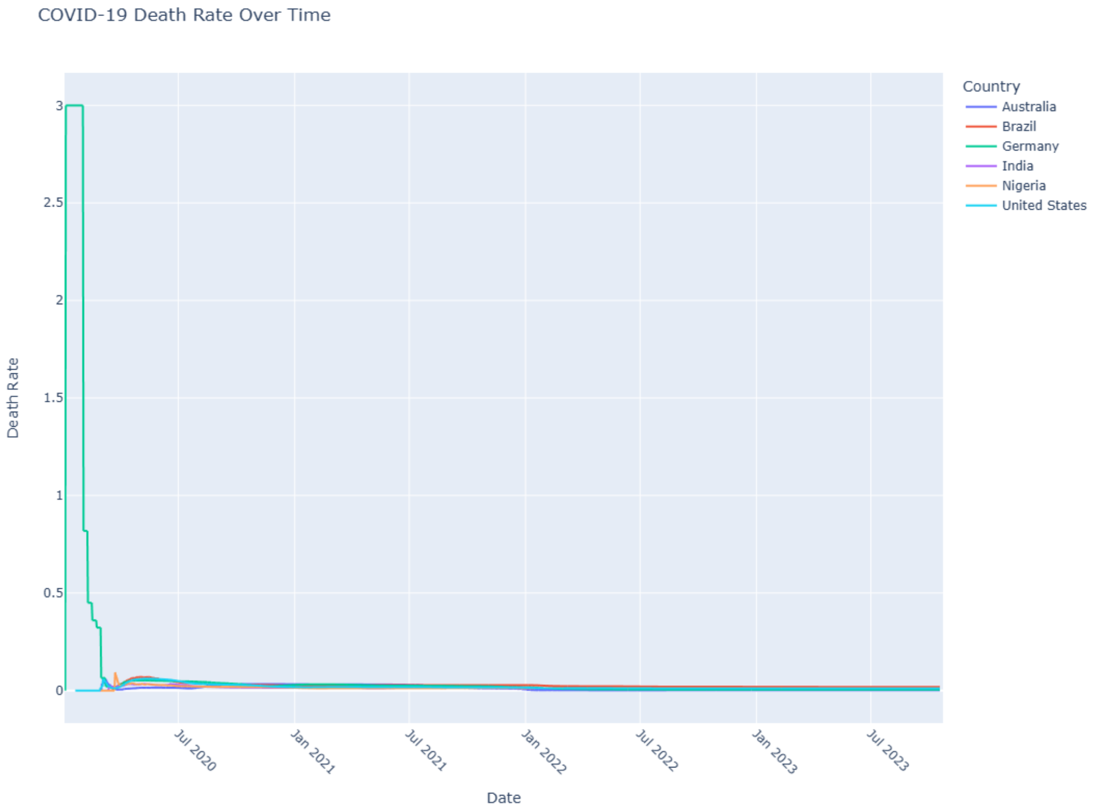
1. Germany Experienced a spike in new infections between January and June 2022.
2. India experienced a surge in infections between January and July 2021.
3. Nigeria and Australia had lower numbers of new cases when compared to the other countries.

3.4 Analysis of the Death Rate over time

3.4.1 Plot

[13]:

```python
import pandas as pd
import plotly.express as px
# Computing the death rate
df['death_rate'] = df['total_deaths'] / df['total_cases']

# Filter data for selected countries
df_selected = df[df['location'].isin(countries)]

# Create an interactive line plot
fig = px.line(df_selected, x='date', y='death_rate', color='location',
              title="COVID-19 Deaths Rate Over Time")

# Customize layout for fullscreen effect
fig.update_layout(xaxis_title="Date", yaxis_title="Death Rate",
                  xaxis=dict(tickangle=45),
                  legend_title="Country",
                  height=800, width=1400)

# Show interactive plot
fig.show()
```



3.4.2 Inferences

1. Germany had a considerably higher death rate in the beginning of January 2020.
2. The trend for the death rate shows a decrease in the deaths related to COVID-19 over the years.
3. The period between January and July 2020 experienced the highest death rate. This could possibly have resulted from the vaccinations not being rolled out yet.

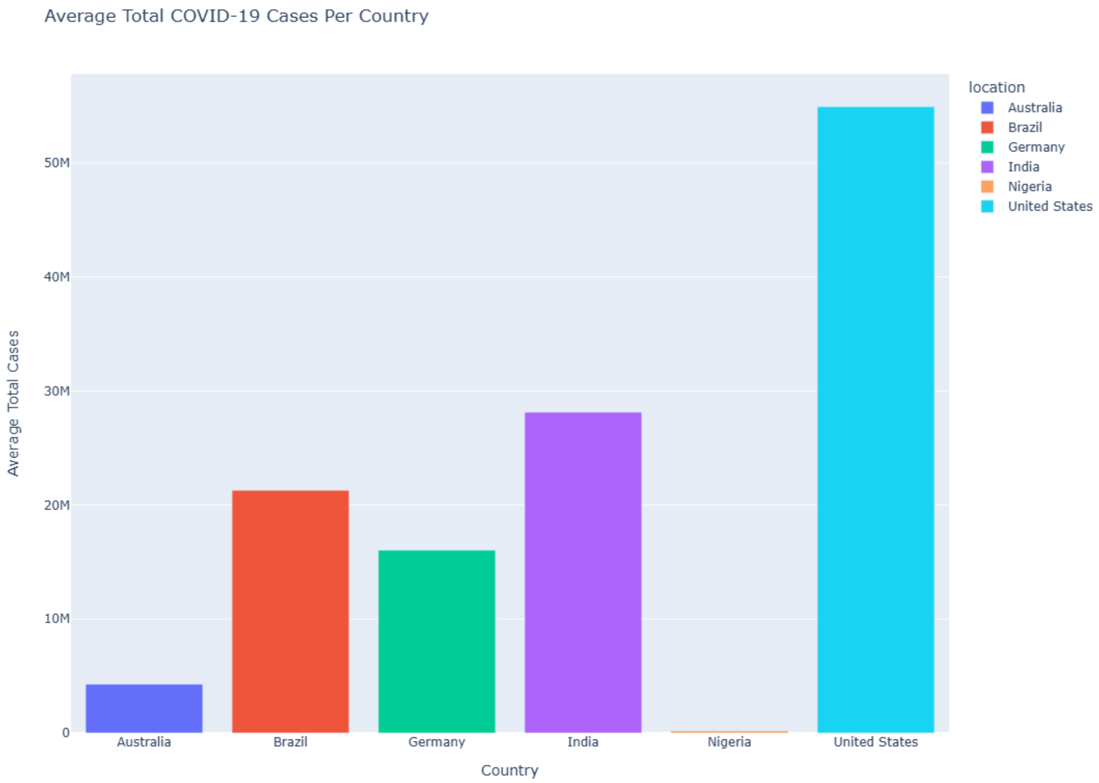
3.5 Analysis of the Average Total COVID-19 Cases Per Country

3.5.1 Plot

[14]:

```
import pandas as pd
import plotly.express as px

# Filter data for selected countries
df_selected = df[df['location'].isin(countries)]

# Group by country and calculate the average total cases
```

```
df_grouped = df_selected.groupby('location', as_index=False)['total_cases'].
  ↪mean()

# Create an interactive bar chart
fig = px.bar(df_grouped, x='location', y='total_cases',
             title="Average Total COVID-19 Cases Per Country",
             color='location')

# Customize layout for readability
fig.update_layout(xaxis_title="Country", yaxis_title="Average Total Cases",
                  height=800, width=1400)

# Show the interactive plot
fig.show()
```



3.5.2 Inferences

1. Nigeria had the lowest average total cases when compared to the other countries.
2. The United States had the highest average total cases, when compared to India, Germany, Brazil, Australia and Nigeria.

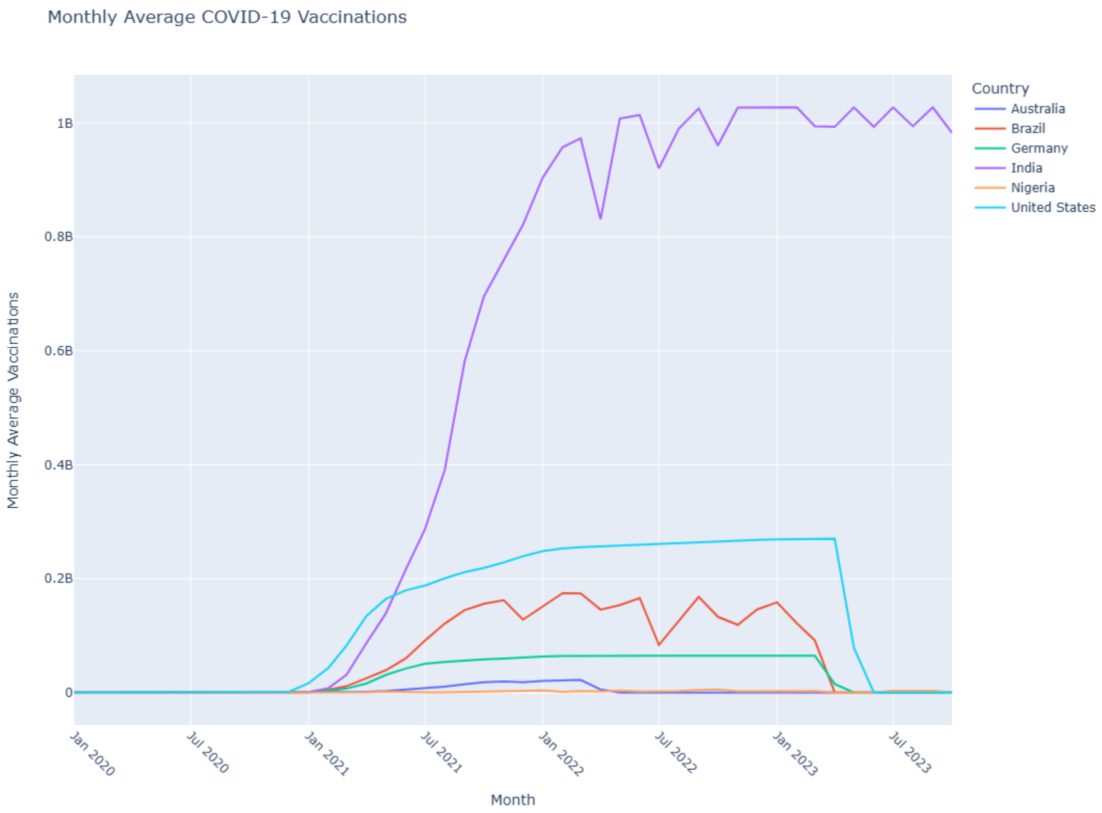
3. The high number of cases recorded in Brazil and the United States show that the COVID-19 pandemic hit the Americas quite hard.

3.6 Analysis of the people vaccinated over time

3.6.1 Plot

[15]:

```
import pandas as pd
import plotly.express as px

# Convert date column to datetime format
df['date'] = pd.to_datetime(df['date'])

# Extract year and month for grouping
df['year_month'] = df['date'].dt.to_period('M')  # Format: YYYY-MM

# Compute monthly averages for people vaccinated
df_selected = df[df['location'].isin(countries)].copy()
df_monthly_avg = df_selected.groupby(['location',␣
 ↪'year_month'])['people_vaccinated'].mean().reset_index()

# Convert 'year_month' back to a readable date format
df_monthly_avg['year_month'] = df_monthly_avg['year_month'].astype(str)

# Create an interactive line plot for monthly averages
fig = px.line(df_monthly_avg, x='year_month', y='people_vaccinated',␣
 ↪color='location',
              title="Monthly Average COVID-19 Vaccinations")

# Customize layout
fig.update_layout(
    xaxis_title="Month",
    yaxis_title="Monthly Average Vaccinations",
    xaxis=dict(tickangle=45),
    legend_title="Country",
    height=800, width=1400
)

# Show interactive plot
fig.show()
```



3.6.2 Inferences

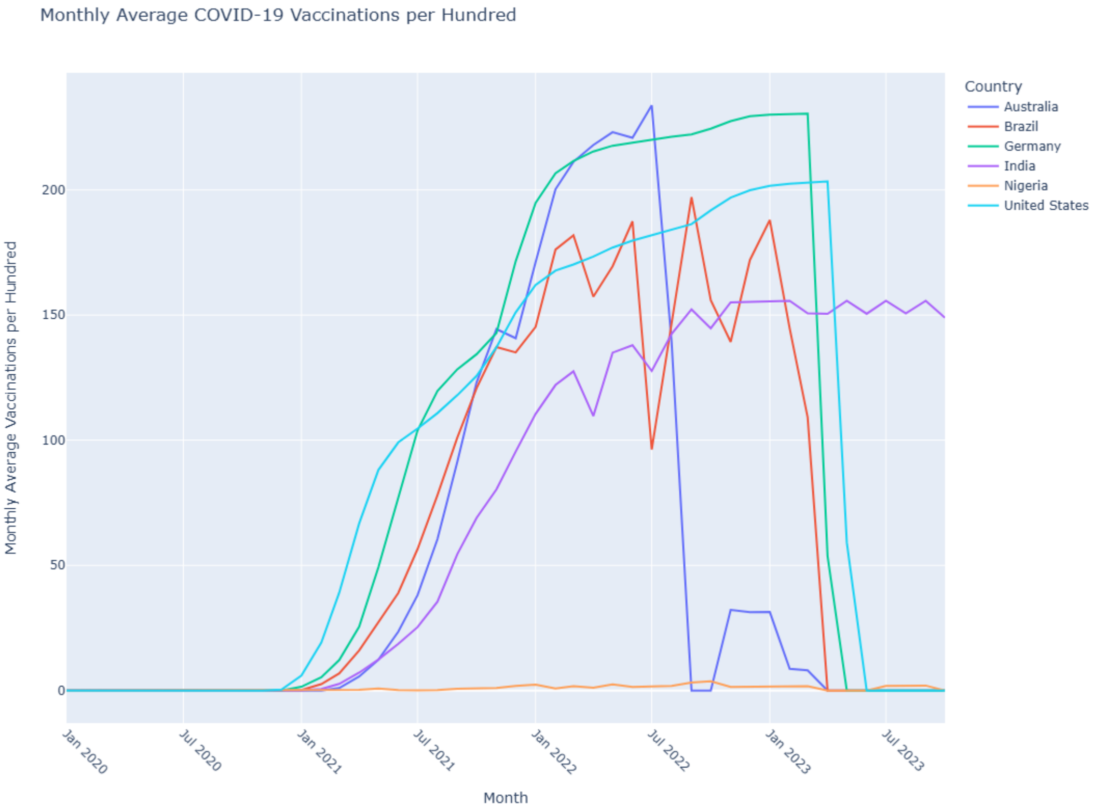
1. India had the highest number of vaccinations per month, when compared to Germany, the United States, Brazil, Nigeria and Australia.
2. Nigeria had the highest number of vaccinations per month, when compared to Germany, the United States, Brazil, India and Australia.
3. The trend shows a growth of vaccinations from January 2021 with the peak being in the year 2022.

3.7 Analysis of Monthly Average COVID-19 Vaccinations per Hundred

3.7.1 Plot

[16]:
```
import pandas as pd
import plotly.express as px

# Convert date column to datetime format
df['date'] = pd.to_datetime(df['date'])

# Extract year and month for grouping
```

```
df['year_month'] = df['date'].dt.to_period('M')  # Format: YYYY-MM

# Compute monthly averages for vaccinations per hundred
df_selected = df[df['location'].isin(countries)].copy()
df_monthly_avg = df_selected.groupby(['location',␣
 ↪'year_month'])['total_vaccinations_per_hundred'].mean().reset_index()

# Convert 'year_month' back to a readable date format
df_monthly_avg['year_month'] = df_monthly_avg['year_month'].astype(str)

# Create an interactive line plot for monthly averages
fig = px.line(df_monthly_avg, x='year_month',␣
 ↪y='total_vaccinations_per_hundred', color='location',
              title="Monthly Average COVID-19 Vaccinations per Hundred")

# Customize layout for clarity
fig.update_layout(
    xaxis_title="Month",
    yaxis_title="Monthly Average Vaccinations per Hundred",
    xaxis=dict(tickangle=45),
    legend_title="Country",
    height=800, width=1400
)

# Show interactive plot
fig.show()
```



3.7.2 Inferences

1. Australia had its highest monthly vaccination per hundred in July 2022, before the trend dipping to almost zero in September 2022.
2. Nigeria shows a generally low vaccination per hundred.
3. The vaccination trend for the United States, India, Australia, Germany and Brazil were highly unstable in the year 2022.

4 THE END