Project 1: Exploratory analysis of global health inequalities

Title: Global Health and Socioeconomic Disparities Across Countries.

Aim: to explore and analyse the relationship between socioeconomic level and global health worldwide.

Exploratory data analysis of the relationship between socioeconomic indicators and global health worldwide using Python.

Methods:

Data downloaded from https://data.worldbank.org/ as *.xlsx*

Analysis performed with Python version 3.13.7

Indicators included:

Economic Indicators

- GDP per capita (current US$).
- GNI per capita (Atlas method).
- GDP growth (annual %).
- Gini index.
- Central_government_debt,_total_(%_of_GDP)
- Current_health_expenditure_(%_of_GDP)

Health Indicators:

- Life expectancy at birth, total (years).
- Mortality rate, infant (per 1,000 live births).
- UHC Service Coverage Index.
- Maternal mortality ratio (modeled estimate, per 100,000 live births).
- People using at least basic sanitation services (% of population).
- People using at least basic drinking water services (% of population).
- Hospital beds (per 1000 people).

Human Development & Well-being Indicators:

- Human capital index (HCI) (scale 0-1).
- Unemployment, total (% of total labor force) (national estimate).
- Access to electricity (% of population).
- Internet users (% of population).
- Population total.

Results

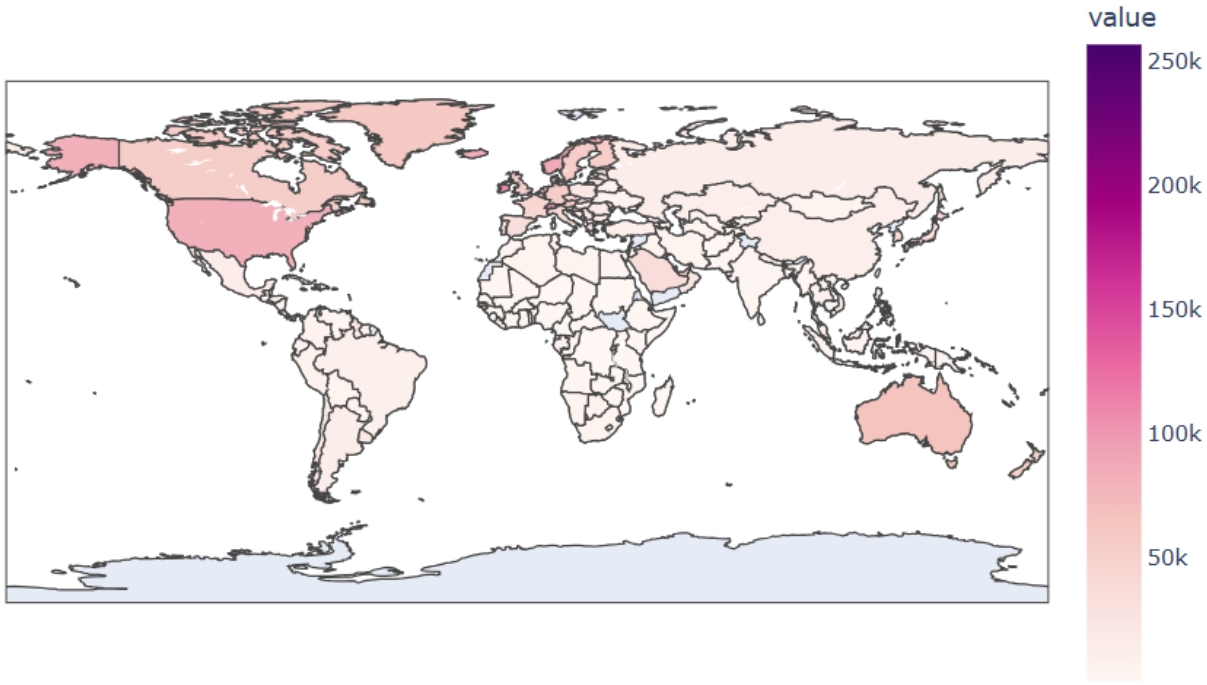
Economic Indicators:

GDP per capita (current US$)

Global map covering the years 2000 – 2024

https://mardedexo.github.io/global-health-inequalities/world_map/GDP_per_capita_current_USD_worldMap.html

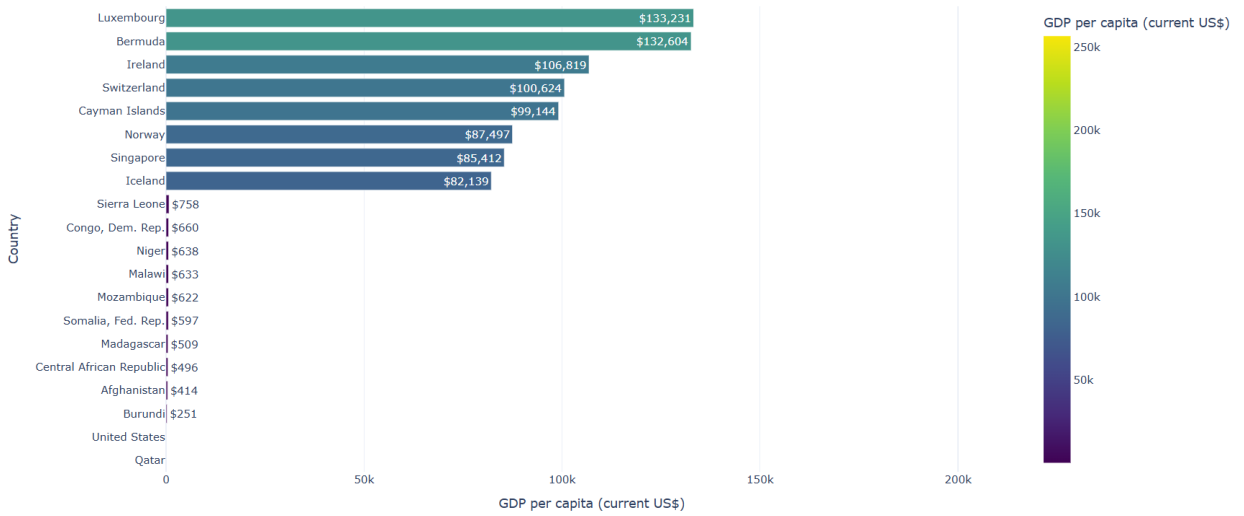
Example: year 2023



Top and bottom ten counties covering the years 2000 – 2024

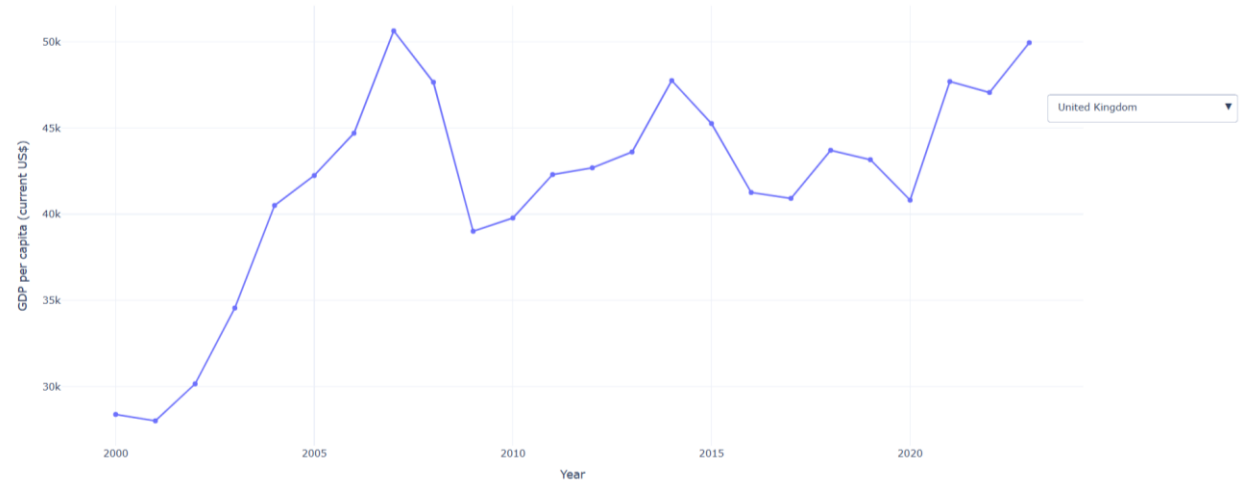
https://mardedexo.github.io/global-health-inequalities/bar_charts/GDP_per_capita_TopBottom10_Animated.html

Example: year 2023



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/GDP_per_capita_(current_US$).html

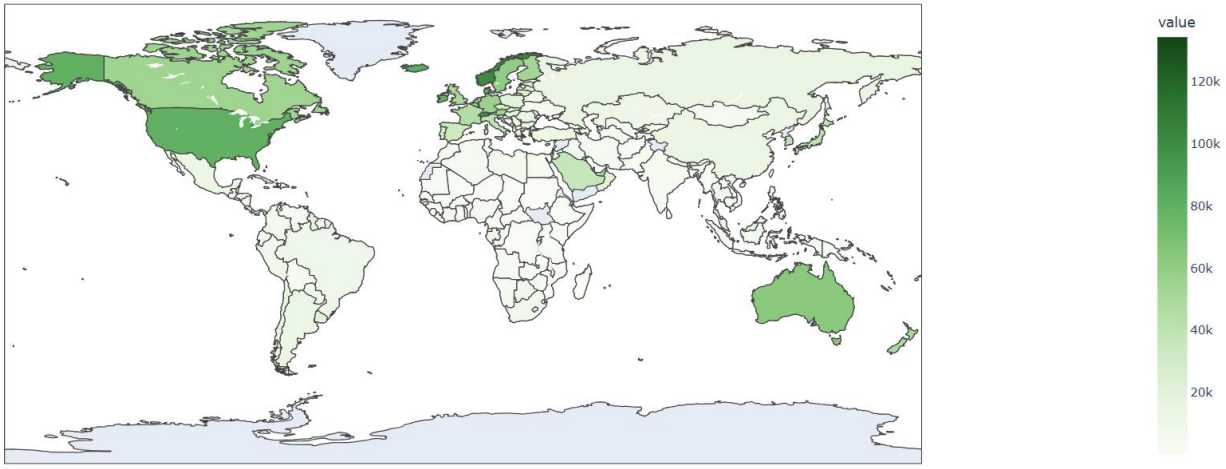


GNI per capita (Atlas method)

Global map covering the years 2000 – 2024

https://mardedexo.github.io/global-health-inequalities//world_map/Current_health_expenditure_(%_of_GDP)_worldMap.html

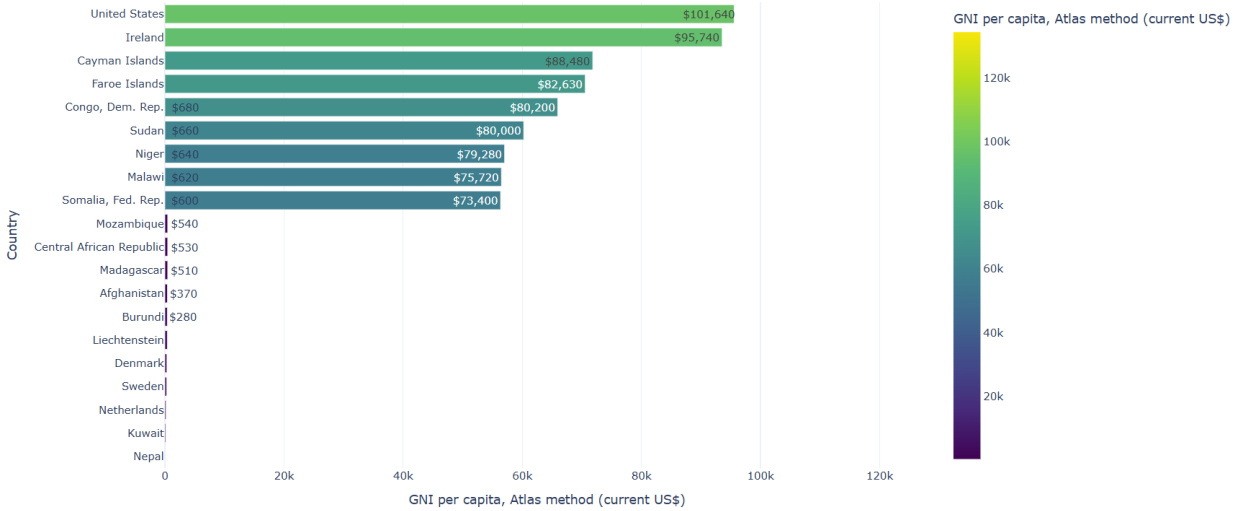
Example: year 2023



Top and bottom ten counties covering the years 2000 – 2024

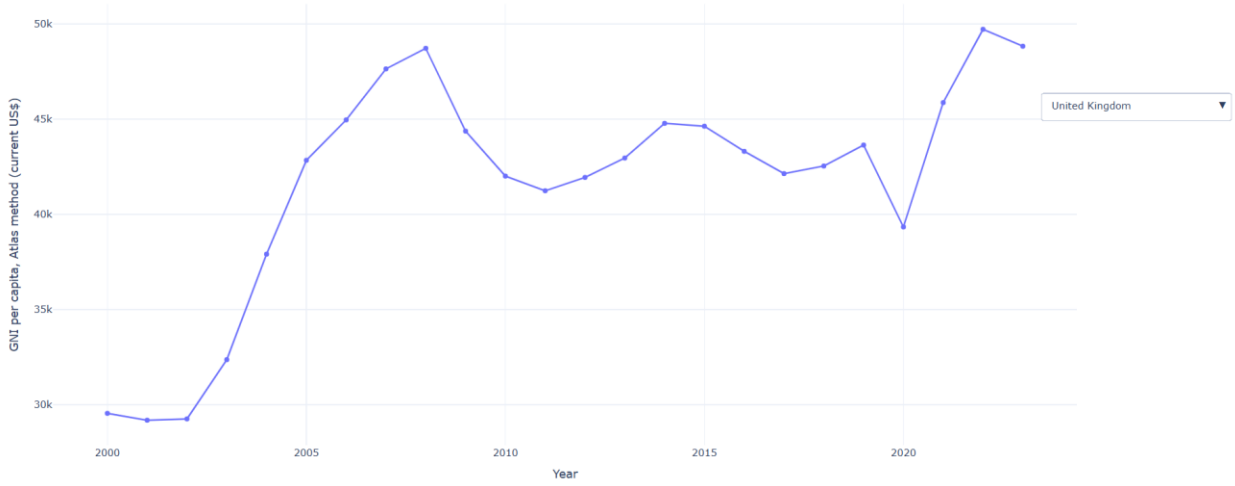
https://mardedexo.github.io/global-health-inequalities/bar_charts/GNI_per_capita_Atlas_method_TopBottom10_Animated.html

Example: year 2023



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/GNI_per_capita,_Atlas_method_(current_US$).html

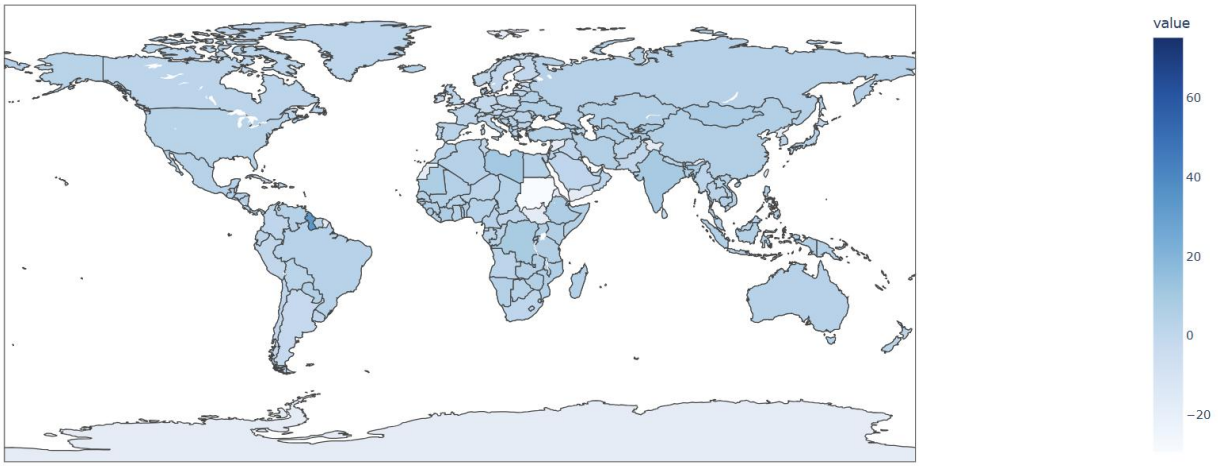


GDP growth (annual %)

Global map covering the years 2000 – 2024

https://mardedexo.github.io/global-health-inequalities/world_map/GDP_growth_map_worldMap.html

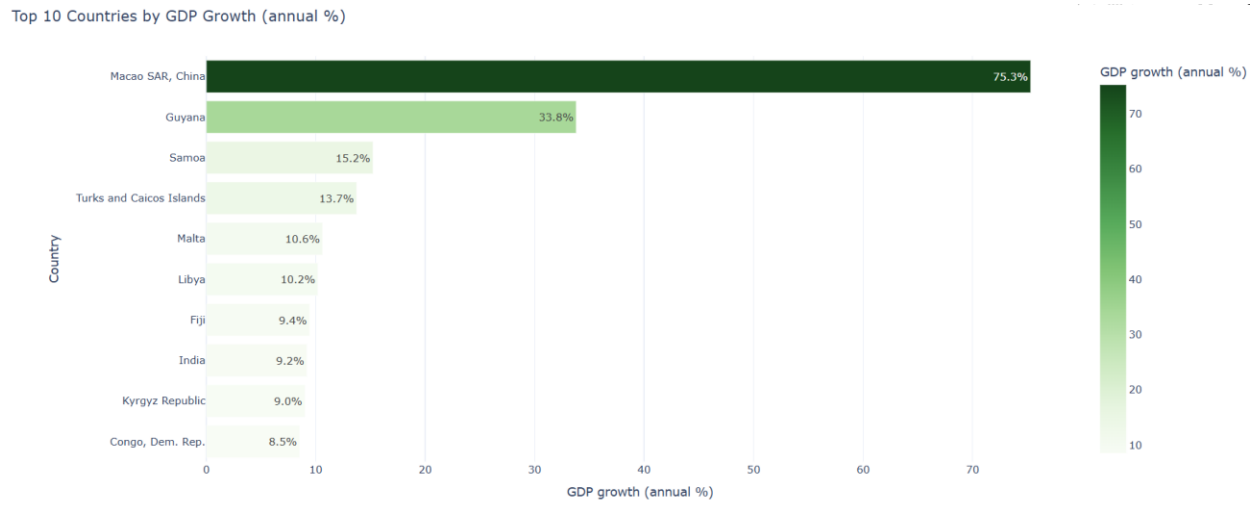
Example: year 2023



Top ten countries covering the years 2000 – 2024

https://mardedexo.github.io/global-health-inequalities/bar_charts/GDP_growth_Top10.html

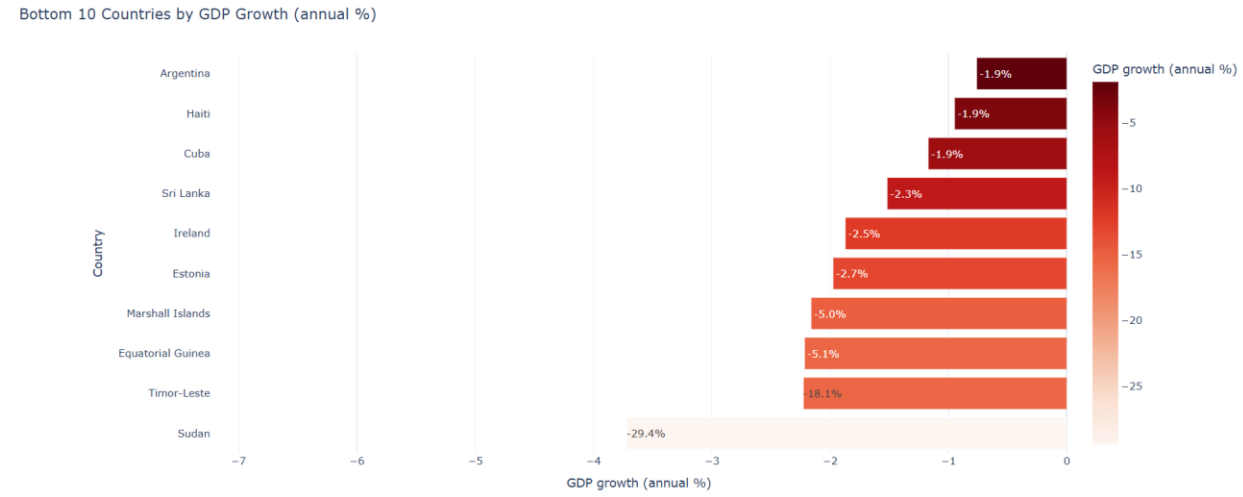
Example: year 2023



Bottom ten countries covering the years 2000 – 2024

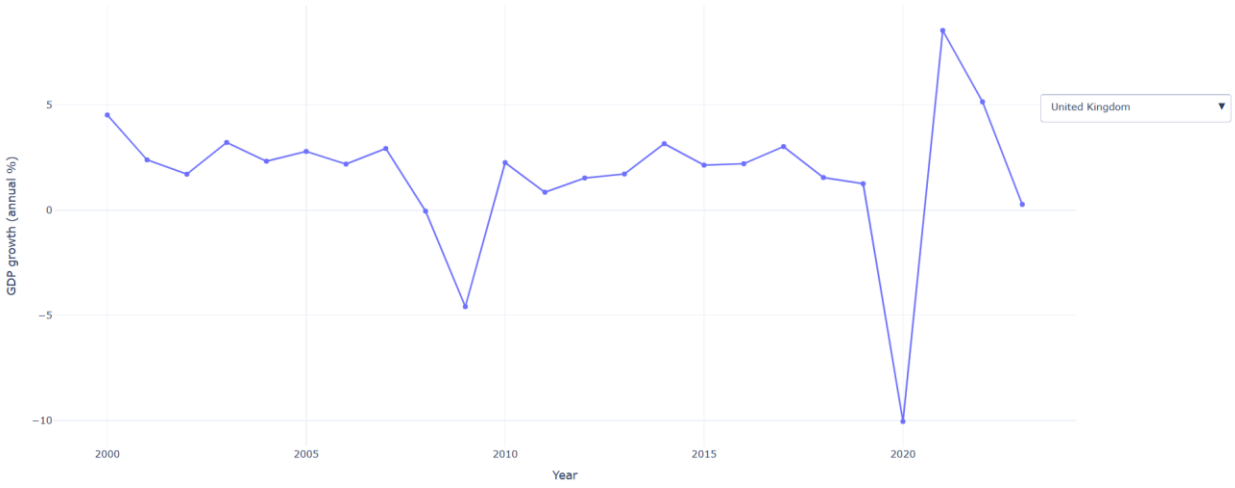
https://mardedexo.github.io/global-health-inequalities/bar_charts/GDP_growth_Bottom10.html

Example: year 2023



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/GDP_growth_(annual_%).html

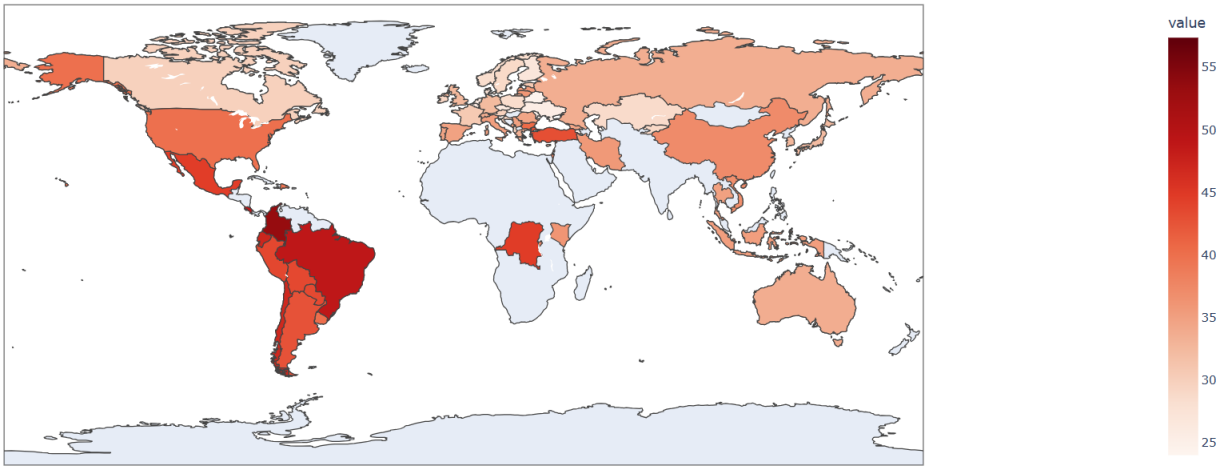


Gini index

Global map covering the years 2000 – 2024

https://mardedexo.github.io/global-health-inequalities/world_map/Gini_index_map_worldMap.html

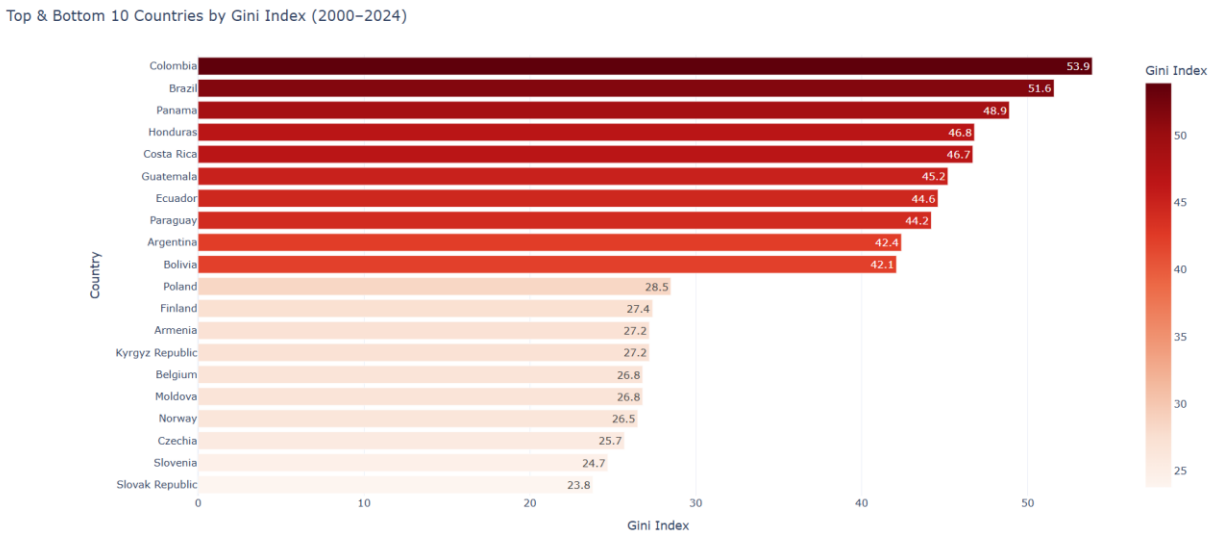
Example: year 2020



Top and bottom ten counties covering the years 2000 – 2024

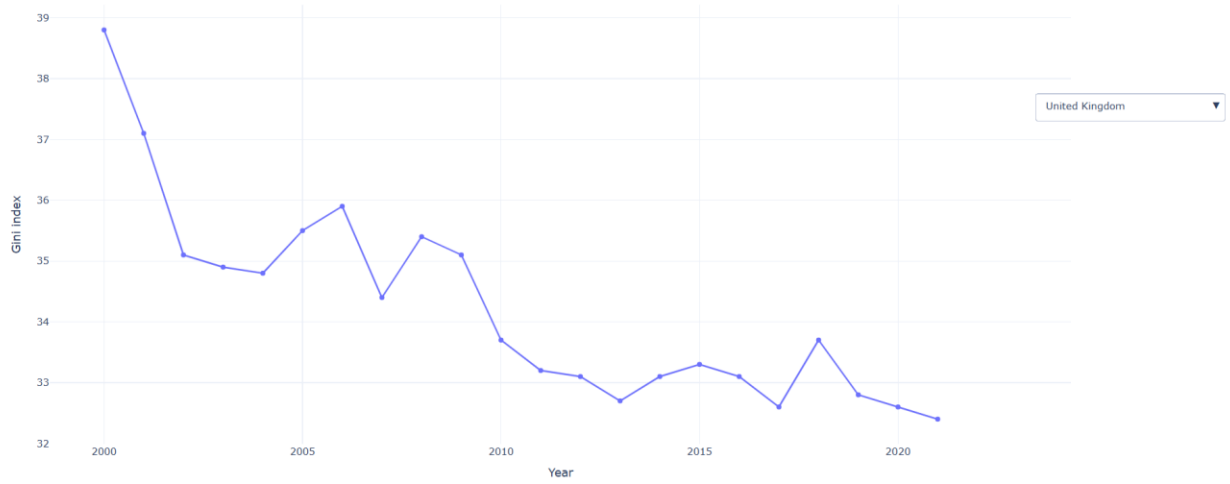
https://mardedexo.github.io/global-health-inequalities/bar_charts/Gini_index_2000_2024.html

Example: year 2023



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Gini_index.html

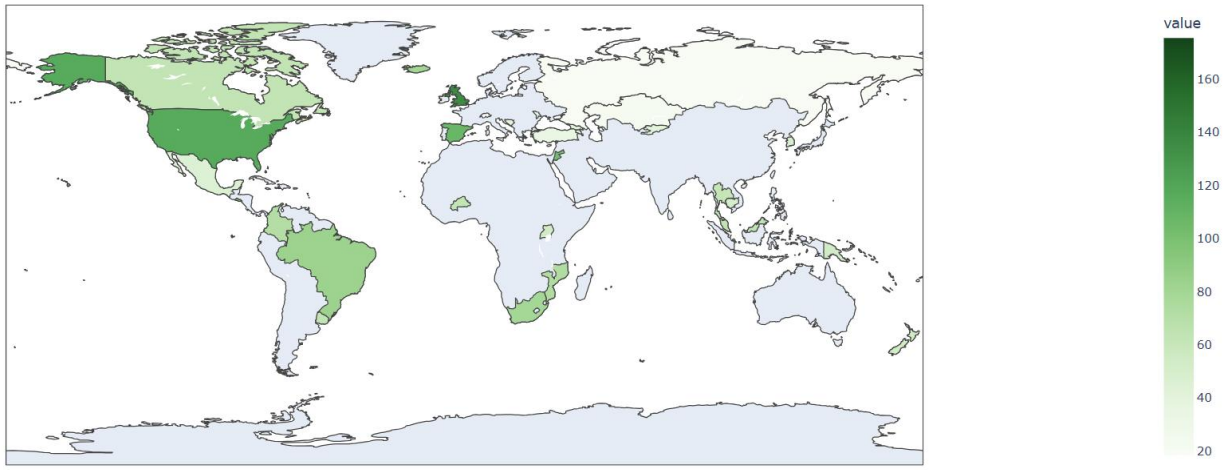


Central_government_debt,_total_(%_of_GDP)

Global map covering the years 2000 – 2024

https://mardedexo.github.io/global-health-inequalities/world_map/Central_government_debt,_total_(%_of_GDP)_worldMap.html

Example: year 2023

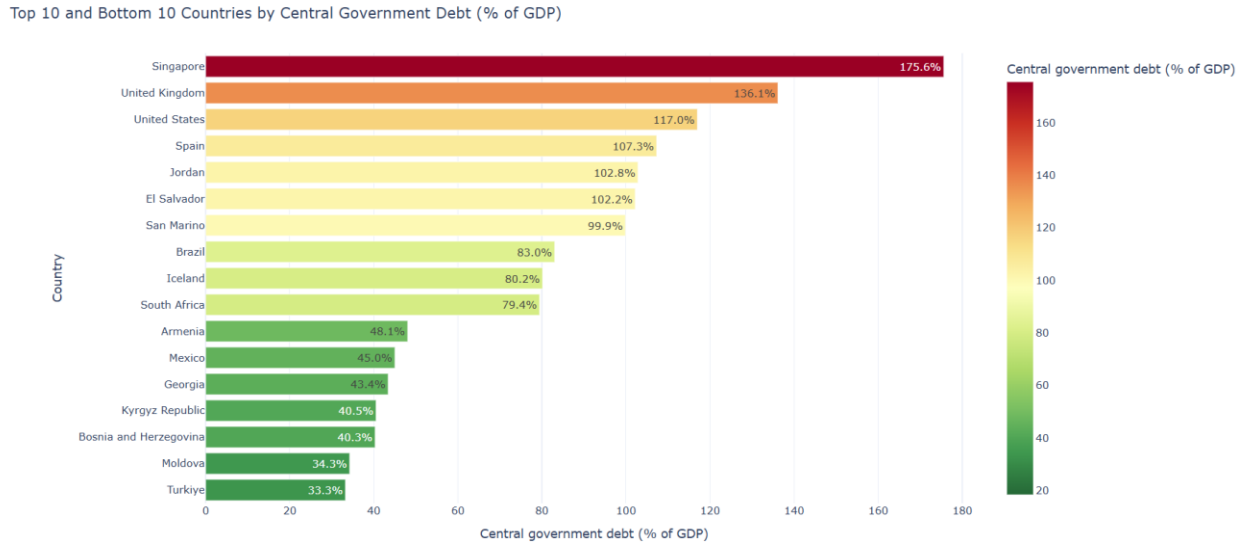


Note that there is no available data in the Worldbank for a significant number of countries in certain years

Top and bottom ten counties covering the years 2000 – 2024

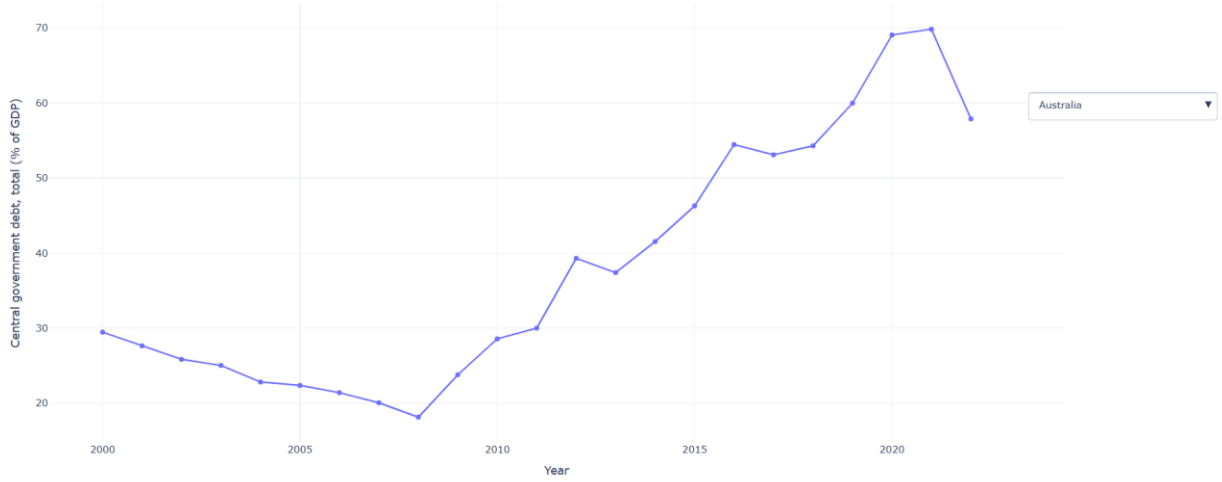
https://mardedexo.github.io/global-health-inequalities/bar_charts/Central_government_debt_percent_GDP_TopBottom10_Animated.html

Example: year 2023



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Central_government_debtTotal.html



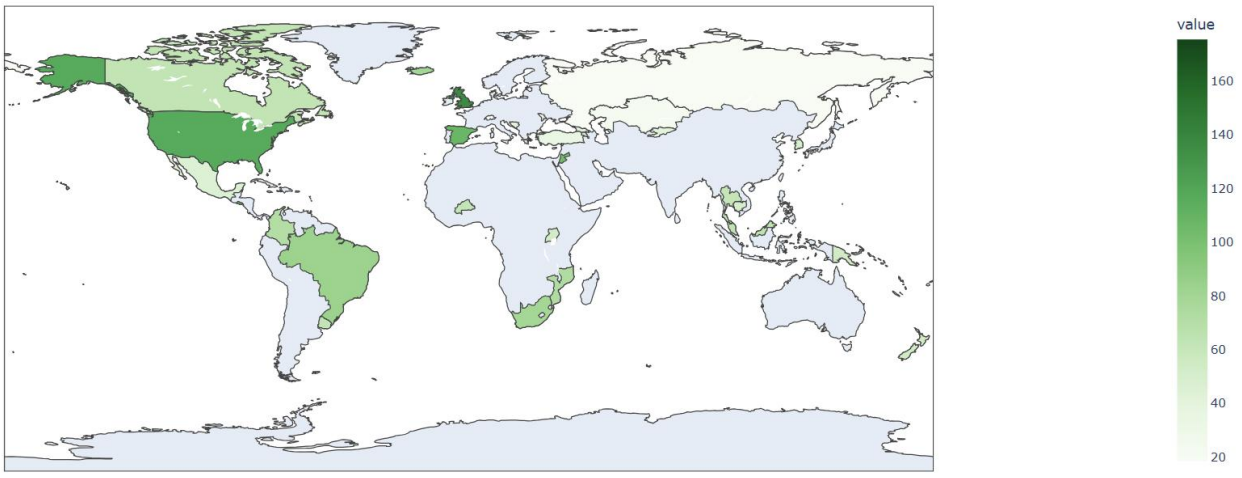
Note that not all the countries have data available for all the years in Worldbank

Current health expenditure (% of GDP)

Global map covering the years 2000 – 2023

https://mardedexo.github.io/global-health-inequalities/world_map/Current_health_expenditure_(%_of_GDP)_worldMap.html

Example: year 2023

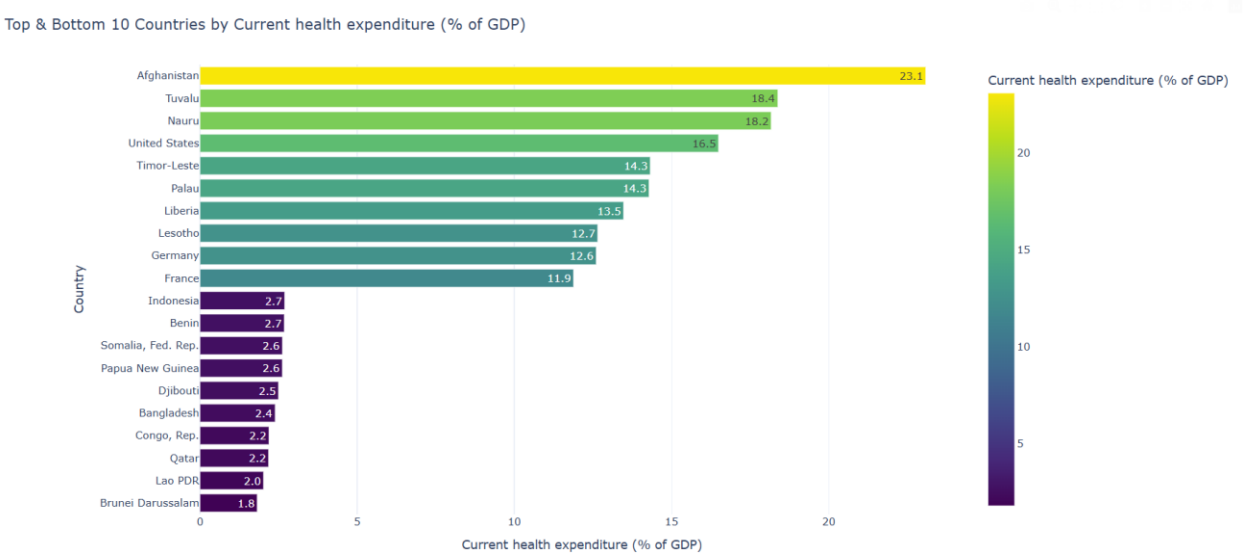


Note that not all the countries have data available for all the years in Worldbank

Top and bottom ten counties covering the years 2000 – 2023

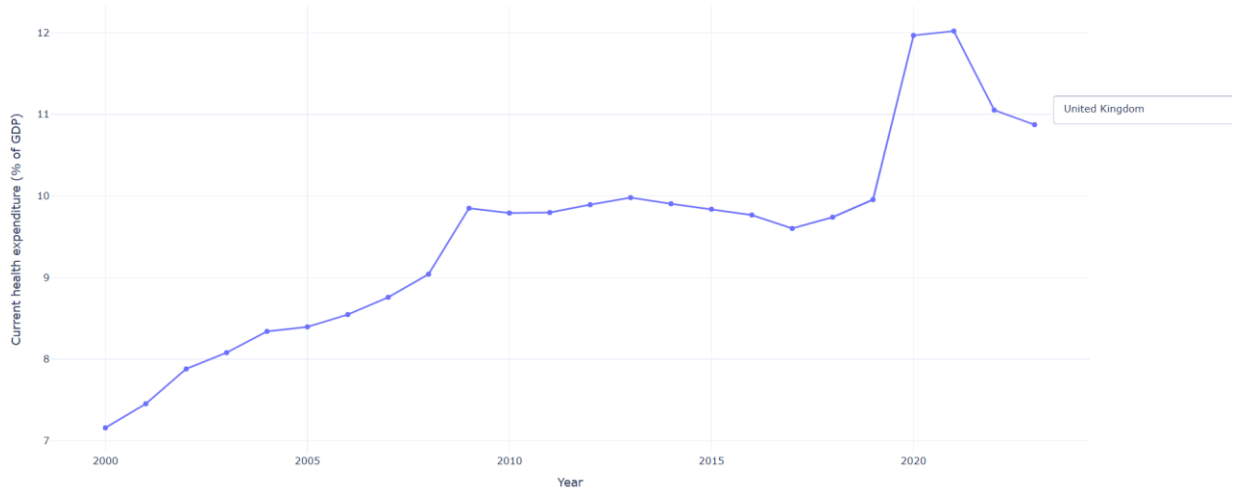
https://mardedexo.github.io/global-health-inequalities/bar_charts/Current_health_expenditure_(%_of_GDP).html

Example: year 2022



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Current_health_expenditure_(%_of_GDP).html



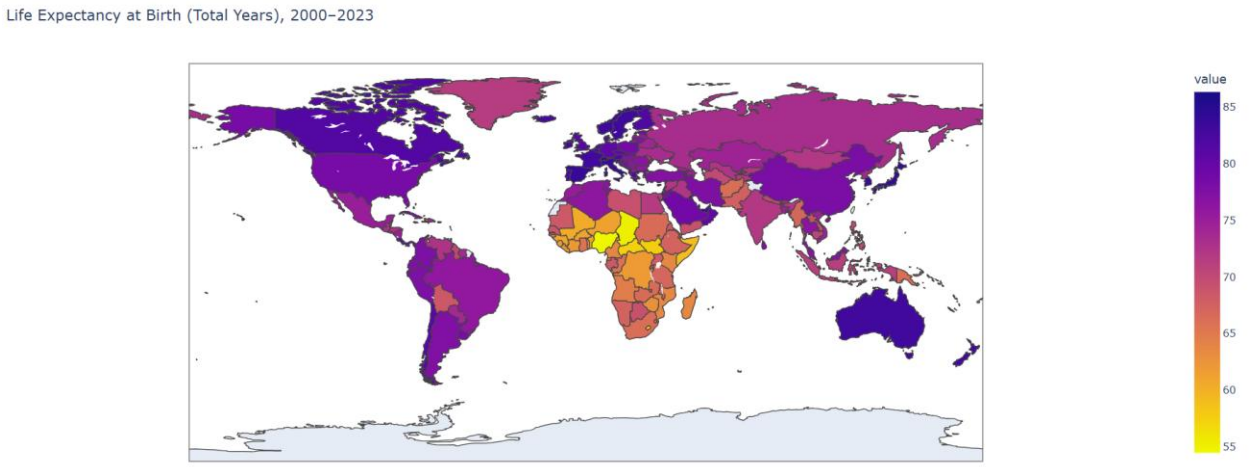
Health Indicators:

Life expectancy at birth, total (years)

Global map covering the years 2000 – 2023

https://mardedexo.github.io/global-health-inequalities/world_map/Life_expectancy_at_birth_2000_2023_worldMap.html

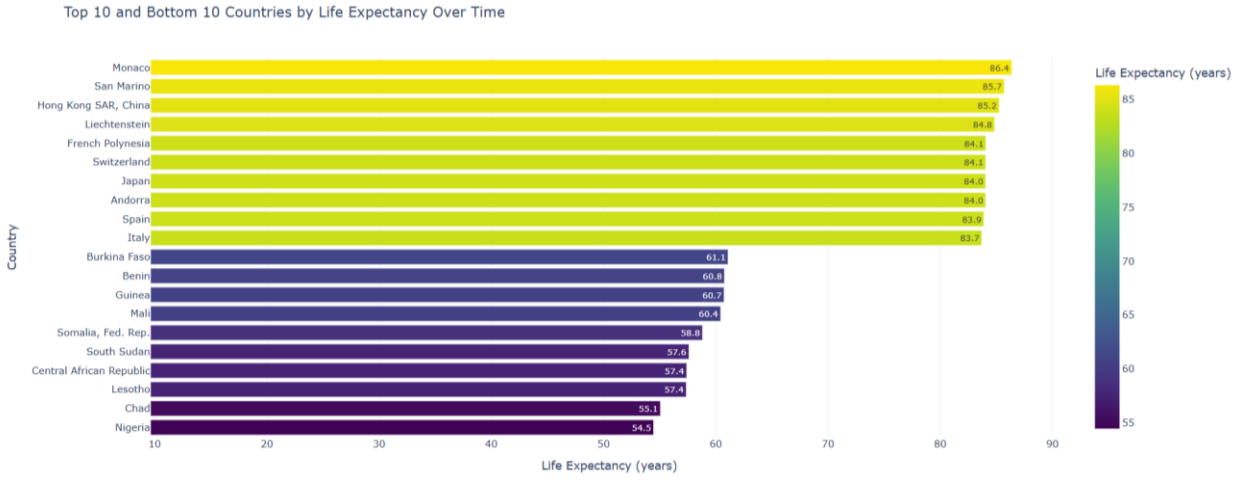
Example: year 2023



Top and bottom ten counties covering the years 2000 – 2023

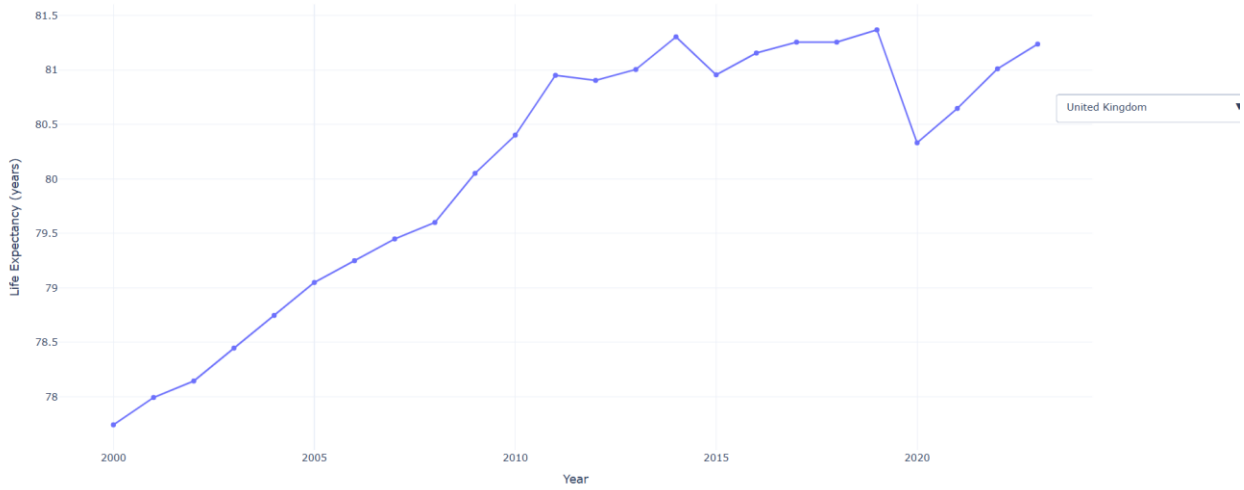
https://mardedexo.github.io/global-health-inequalities/bar_charts/LifeExpectancy_TopBottom10_Animated_1Decimal.html

Example: year 2023



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Life_Expectancy_by_Country_Dropdown.html

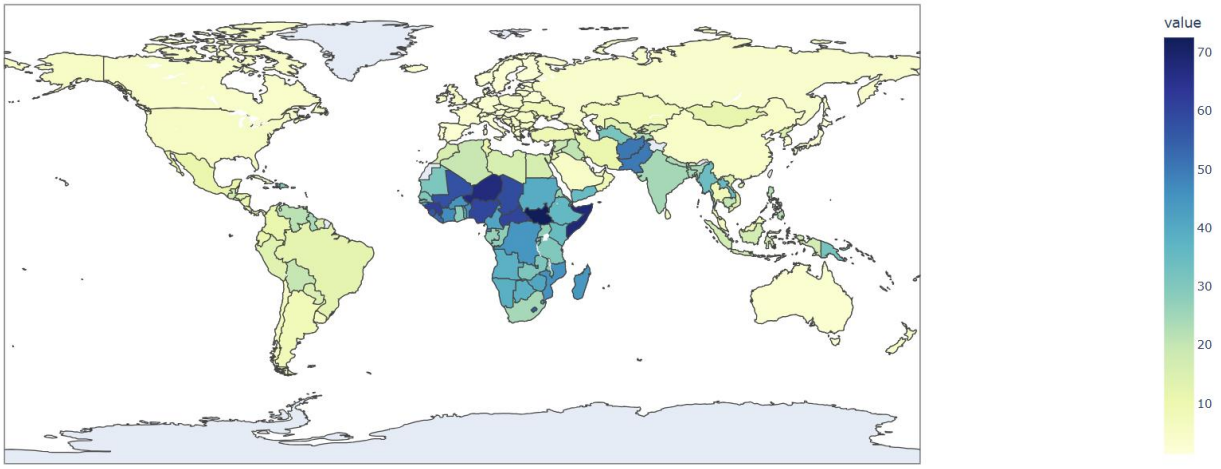


Mortality rate, infant (per 1,000 live births)

Global map covering the years 2000 – 2023

https://mardedexo.github.io/global-health-inequalities/world_map/Infant_mortality_rate_2000_2023_worldMap.html

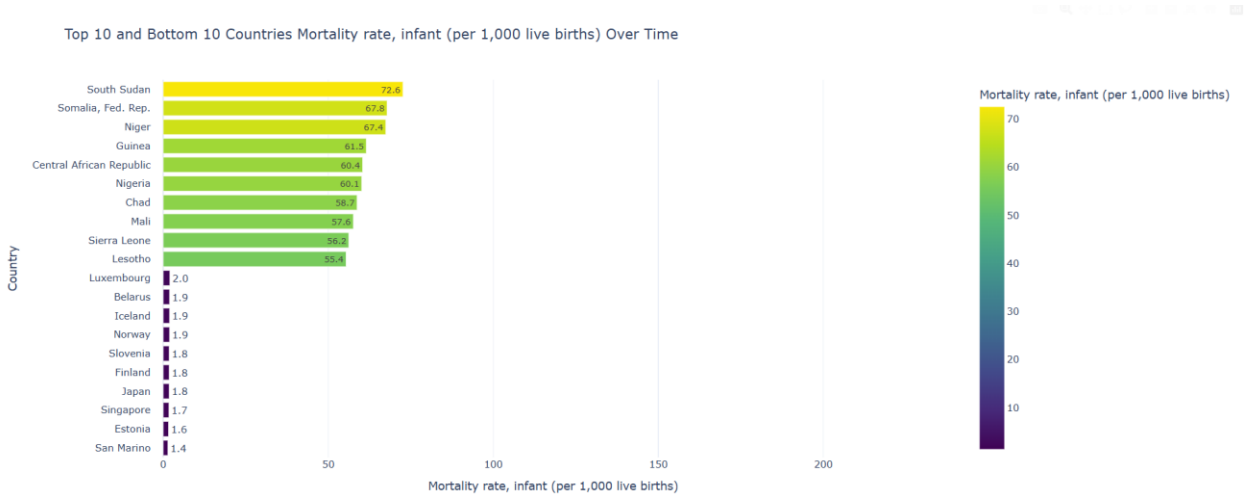
Example: year 2023



Top and bottom ten counties covering the years 2000 – 2023

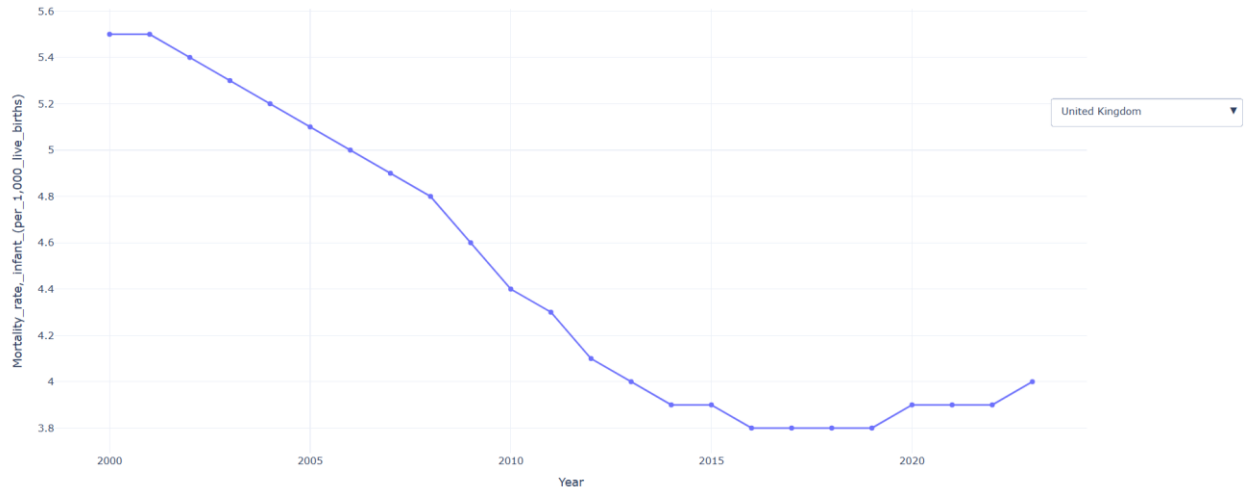
https://mardedexo.github.io/global-health-inequalities/bar_charts/Mortality_rate,_infant_(per 1,000 live births).html

Example: year 2023



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Mortality_rate,_infant_(per_1,000_live_births).html

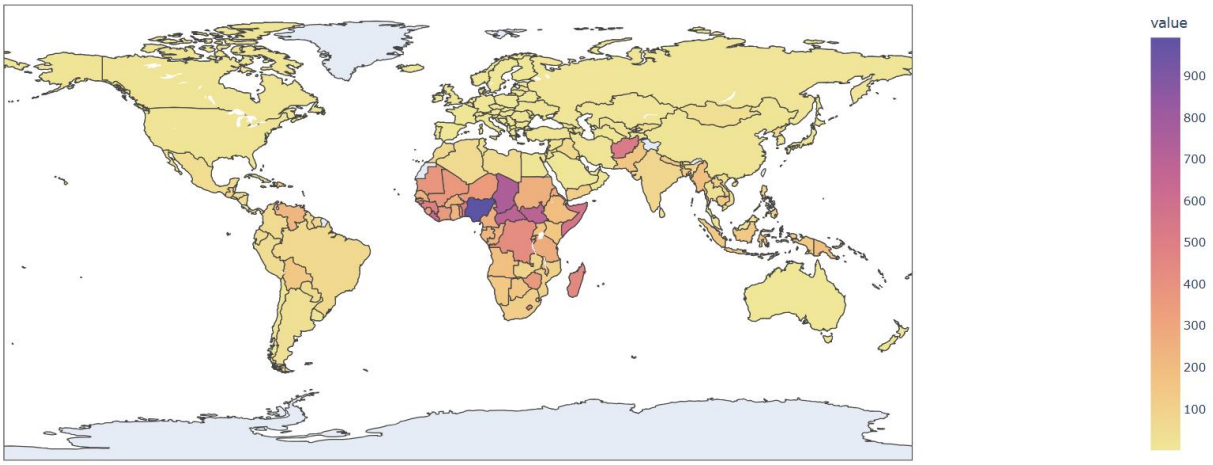


Maternal mortality ratio (modeled estimate, per 100,000 live births).

Global map covering the years 2000 – 2023

https://mardedexo.github.io/global-health-inequalities/world_map/Maternal_mortality_ratio_(modeled_estimate,_per_100,000_live_births_worldMap.html

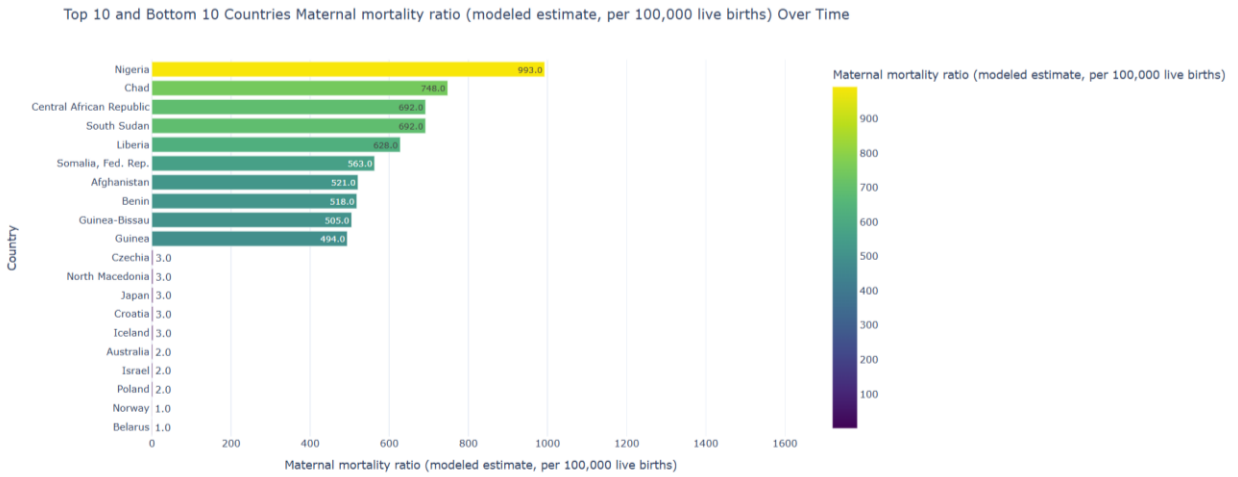
Example: year 2023



Top and bottom ten counties covering the years 2000 – 2023

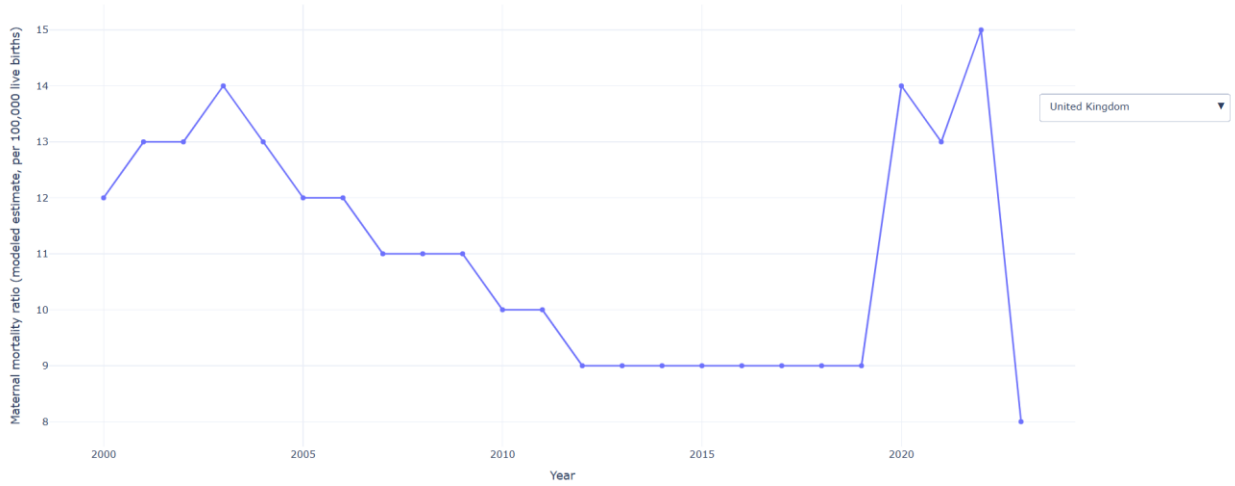
https://mardedexo.github.io/global-health-inequalities/bar_charts/Maternal_mortality_ratio_(modeled_estimate,_per_100,000_live_births)).html

Example: year 2023



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Maternal_mortality_ratio_(modeled_estimate,_per_100,000_live_births).html

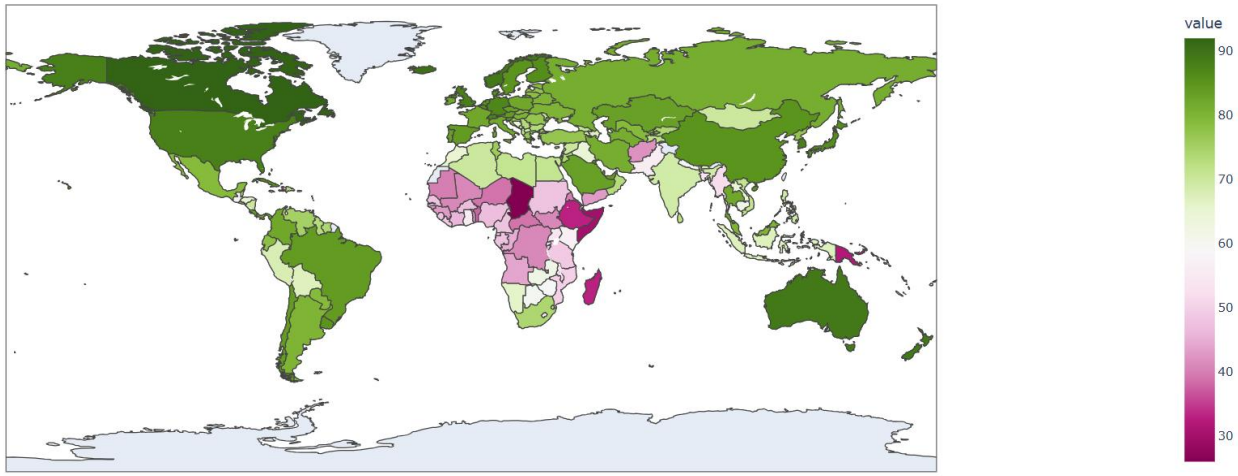


UHC Service Coverage Index

Global map covering the years 2000 – 2023

https://mardedexo.github.io/global-health-inequalities/world_map/UHC_Service_Coverage_Index_worldMap.html

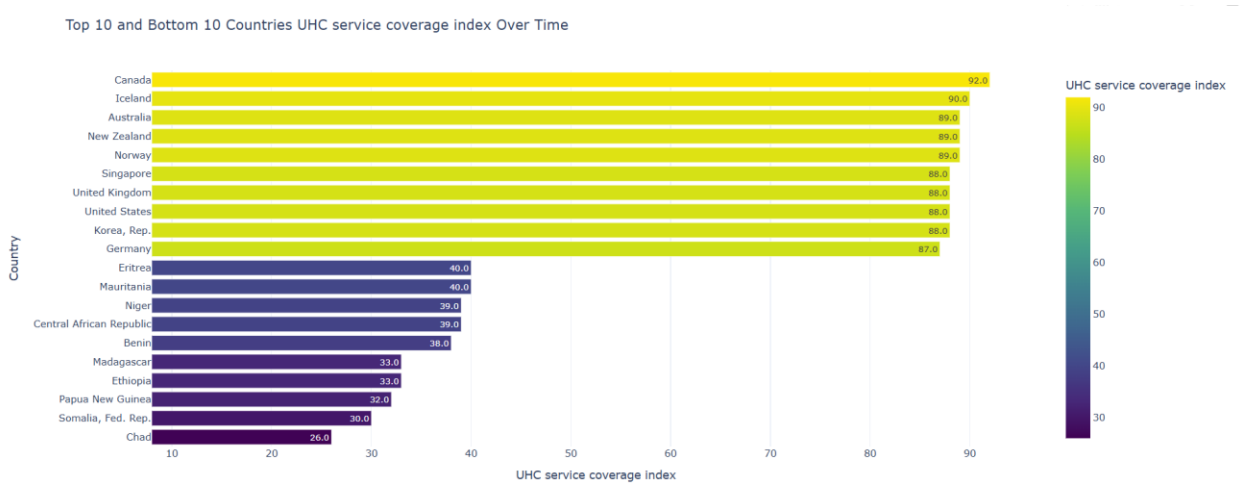
Example: year 2023



Top and bottom ten counties covering the years 2000 – 2023

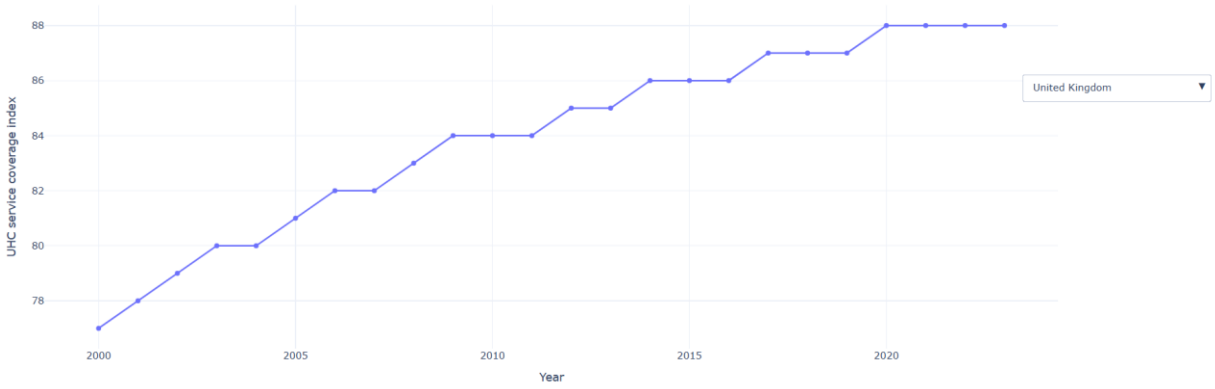
https://mardedexo.github.io/global-health-inequalities/bar_charts/UHC_service_coverage_index).html

Example: year 2023



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/UHC_service_coverag_index.html

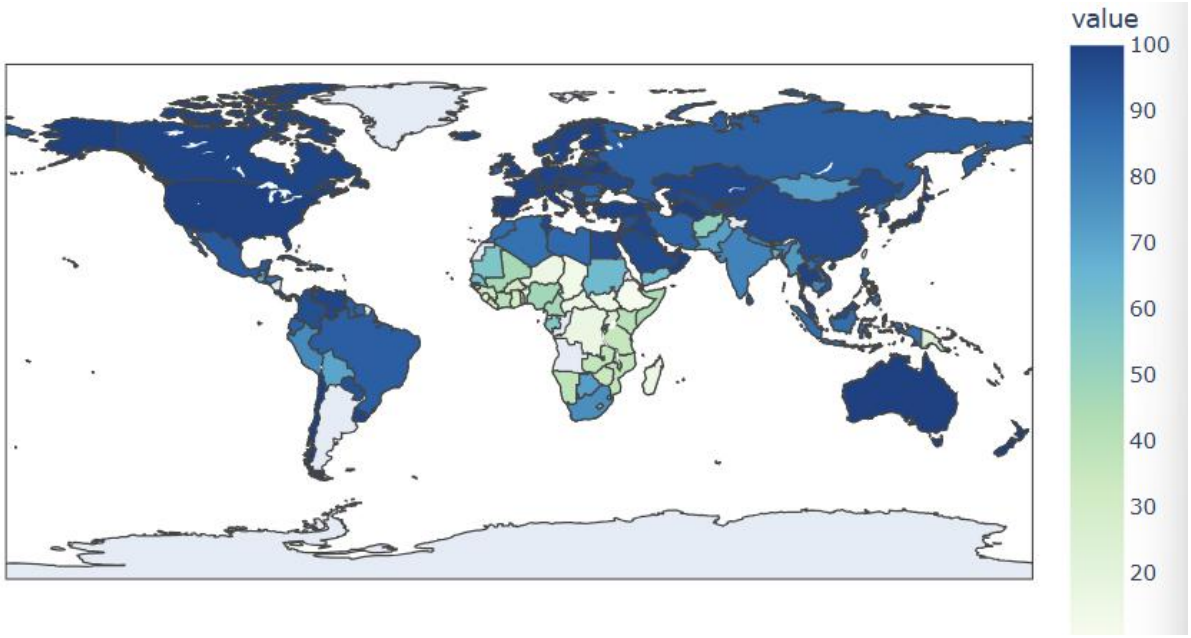


People using at least basic sanitation services (% of population)

Global map covering the years 2000 – 2023

https://mardedexo.github.io/global-health-inequalities/world_map/People%20using%20at%20least%20basic%20sanitation%20services%20(%25%20of%20population)_worldMap.html

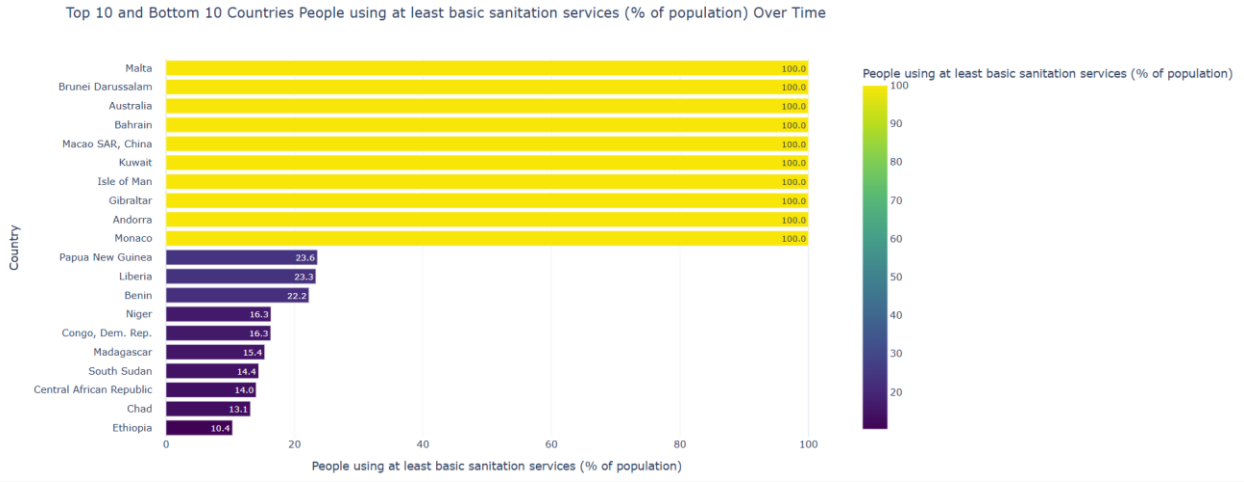
Example: year 2023



Top and bottom ten counties covering the years 2000 – 2024

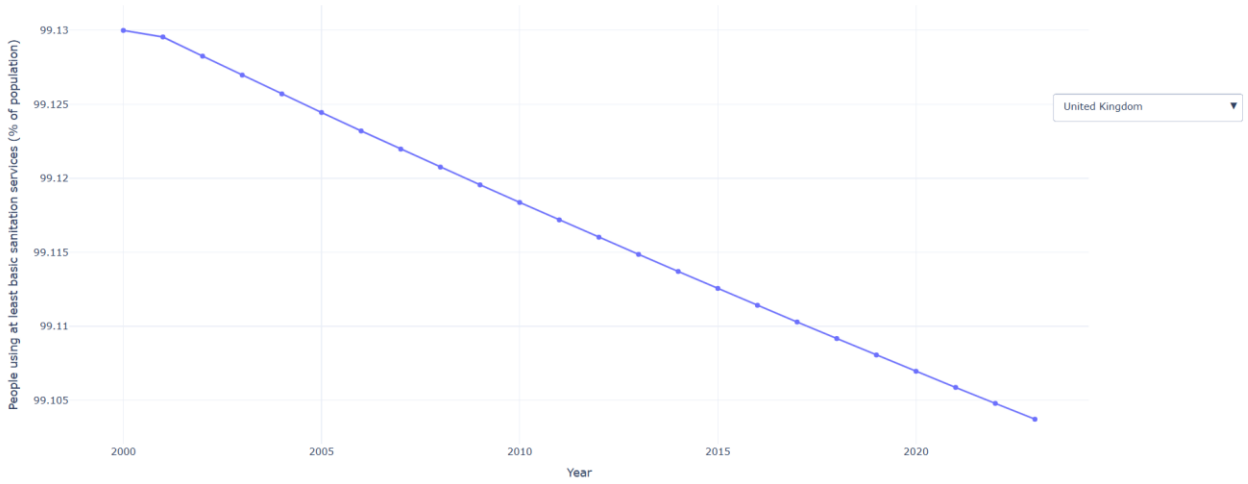
https://mardedexo.github.io/global-health-inequalities/bar_charts/People_using_at_least_basic_sanitation_services_(%_of_population).html

Example: year 2024



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/People_using_at_least_basic_sanitation_services_(%_of_population).html

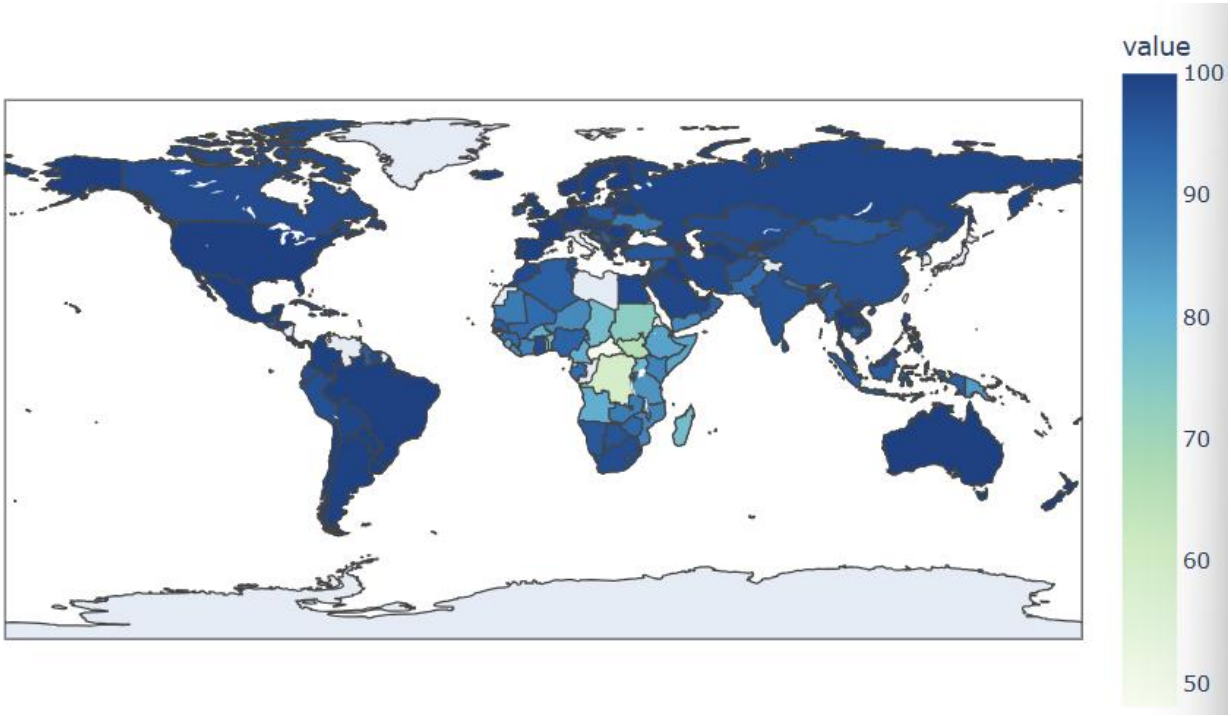


People using at least basic drinking water services (% of population)

Global map covering the years 2000 – 2023

https://mardedexo.github.io/global-health-inequalities/world_map/People%20using%20at%20least%20basic%20drinking%20water%20services,%20urban%20(%25%20of%20urban%20population)_worldMap.html

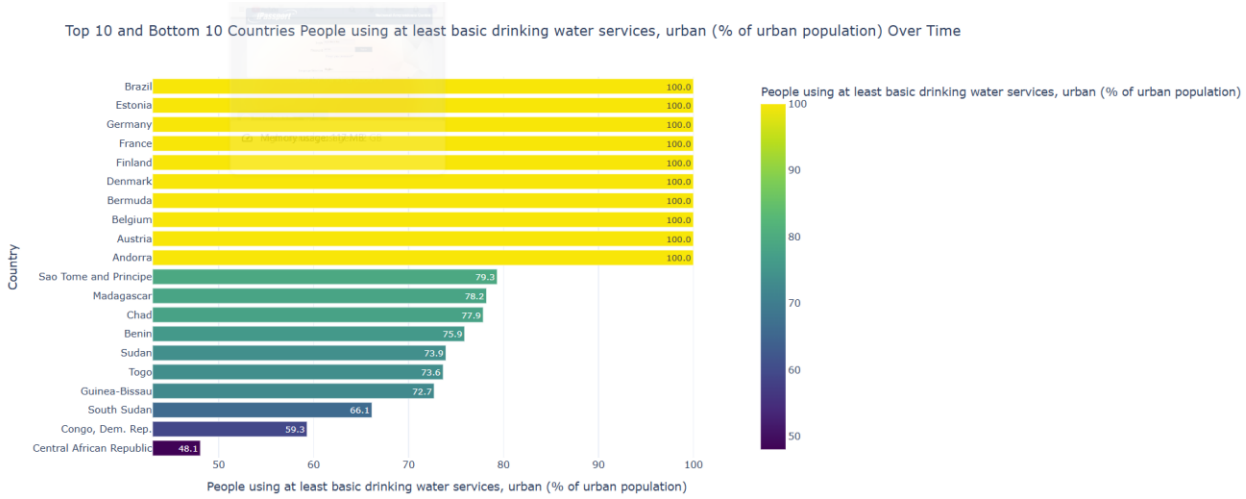
Example: year 2023



Top and bottom ten counties covering the years 2000 – 2024

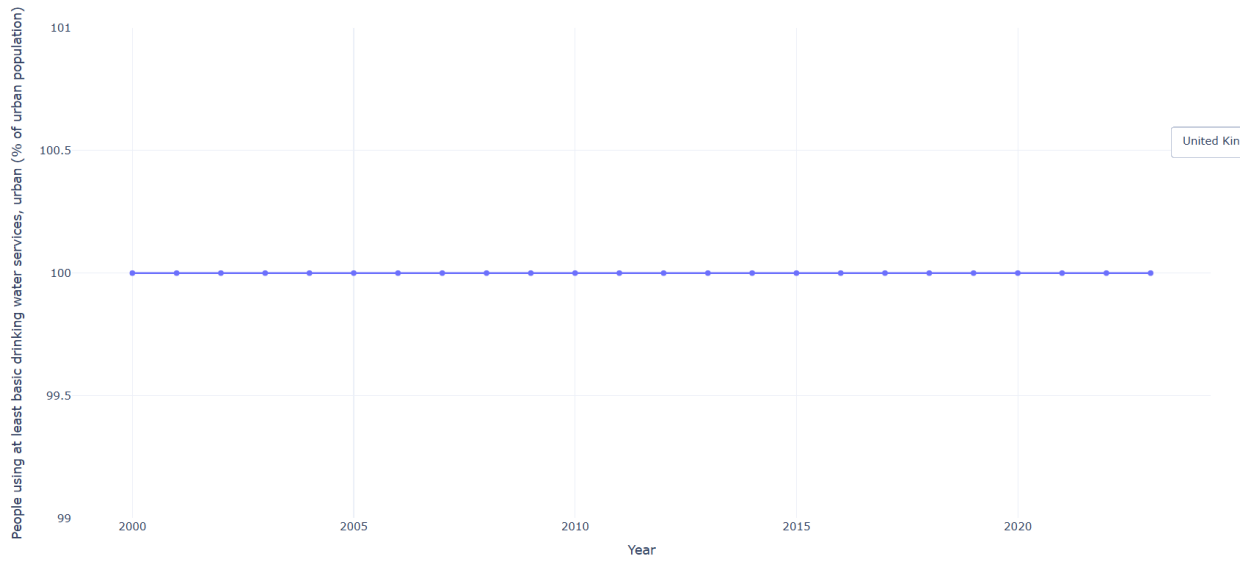
https://mardedexo.github.io/global-health-inequalities/bar_charts/People_using_at_least_basic_drinking_water_services,_urban_(%_of_urban_population)).html

Example: year 2024



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/People_using_at_least_basic_drinking_water_services,_urban_(%_of_urban_population).html

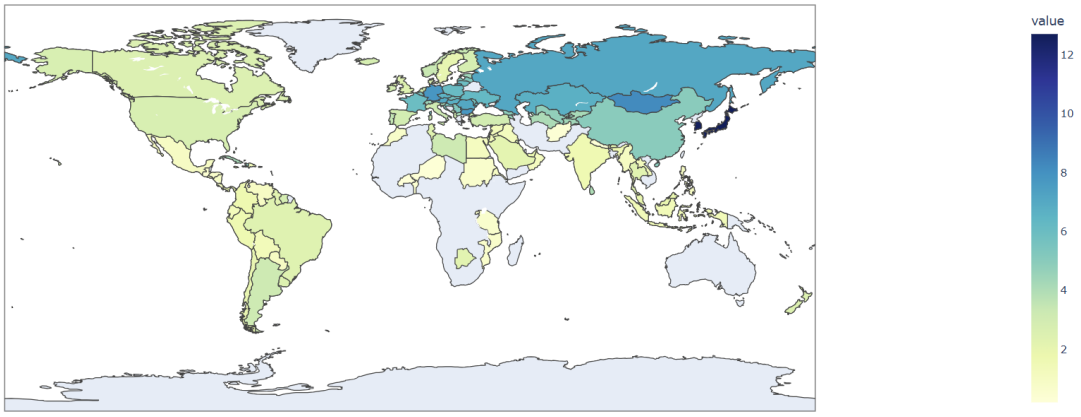


Hospital beds (per 1000 people)

Global map covering the years 2000 – 2021

https://mardedexo.github.io/global-health-inequalities/world_map/Hospital_beds_%28per_1%2C000%20people%29_worldMap.html

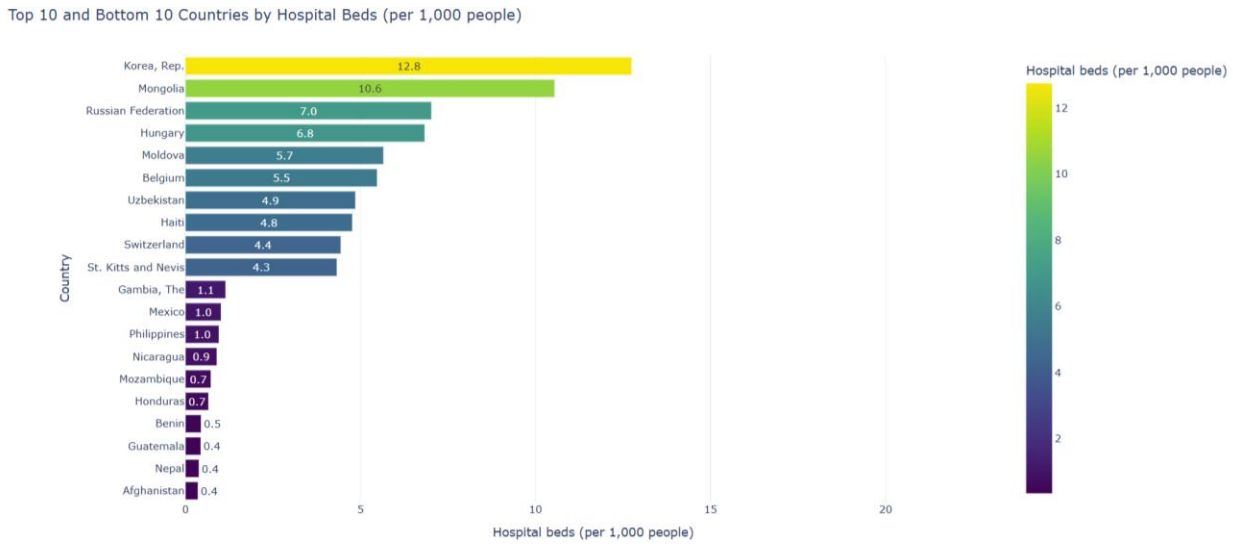
Example: year 2020



Top and bottom ten covering the years 2000 – 2021

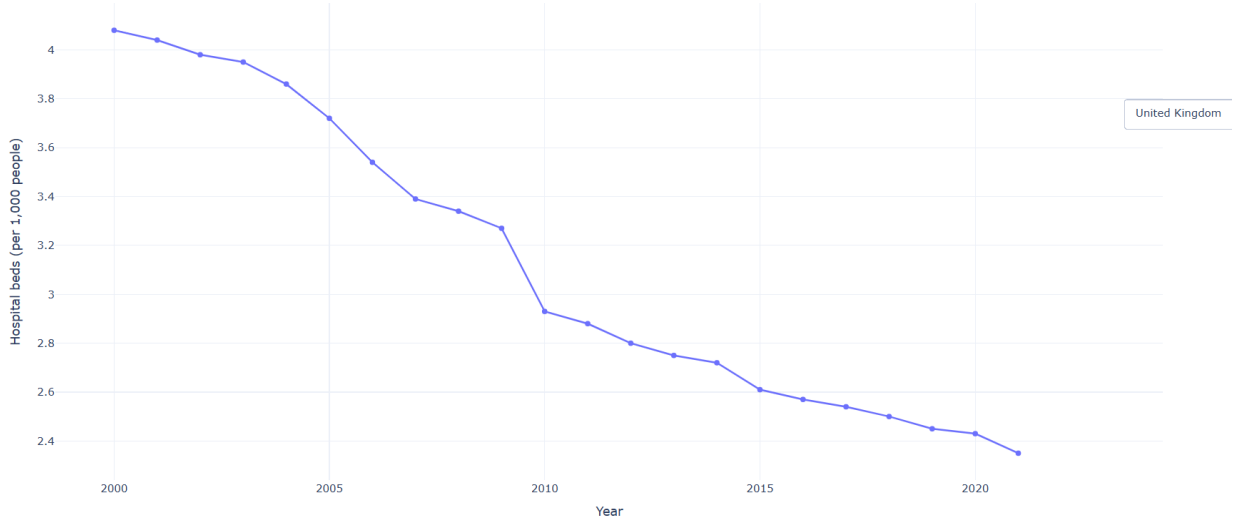
https://mardedexo.github.io/global-health-inequalities/bar_charts/Hospital_beds_per_1000_people_TopBottom10_Animated.html

Example: year 2021



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Hospital_beds_(per_1,000_people).html



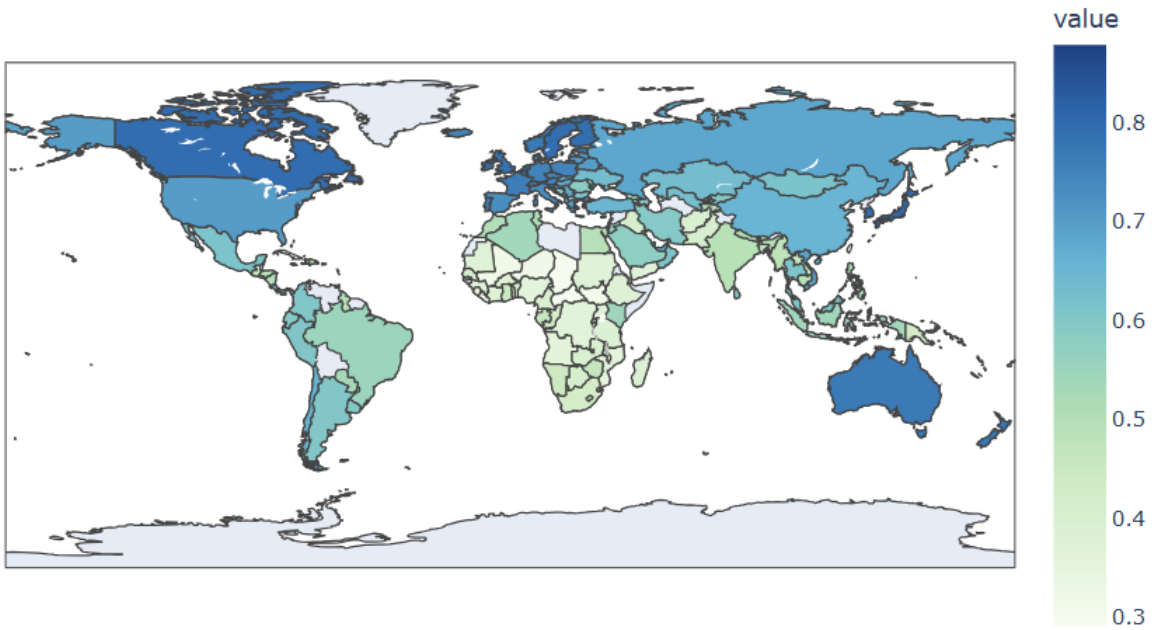
Human Development & Well-being Indicators

Human capital index (HCI) (scale 0-1)

Global map covering the years 2000 – 2020

https://mardedexo.github.io/global-health-inequalities/world_map/Human_capital_index_(HCI)_worldMap.html

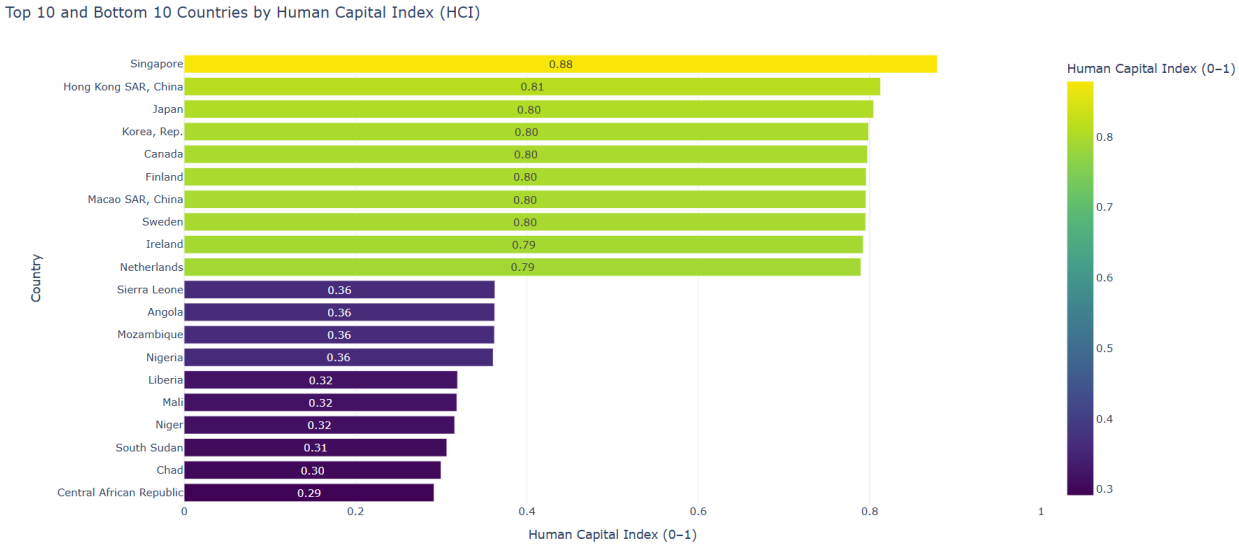
Example: year 2020



Top and bottom ten covering the years 2000 – 2021

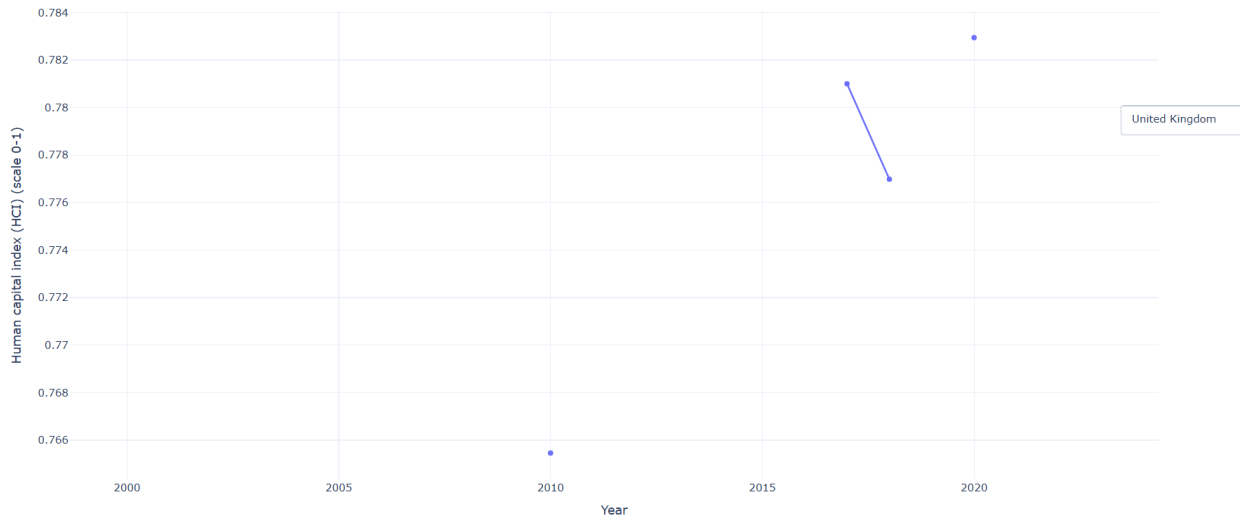
https://mardedexo.github.io/global-health-inequalities/bar_charts/Human_Capital_Index_HCI_TopBottom10_Animated.html

Example: year 2020



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Human_capital_index_(HCI)_(scale_0-1).html

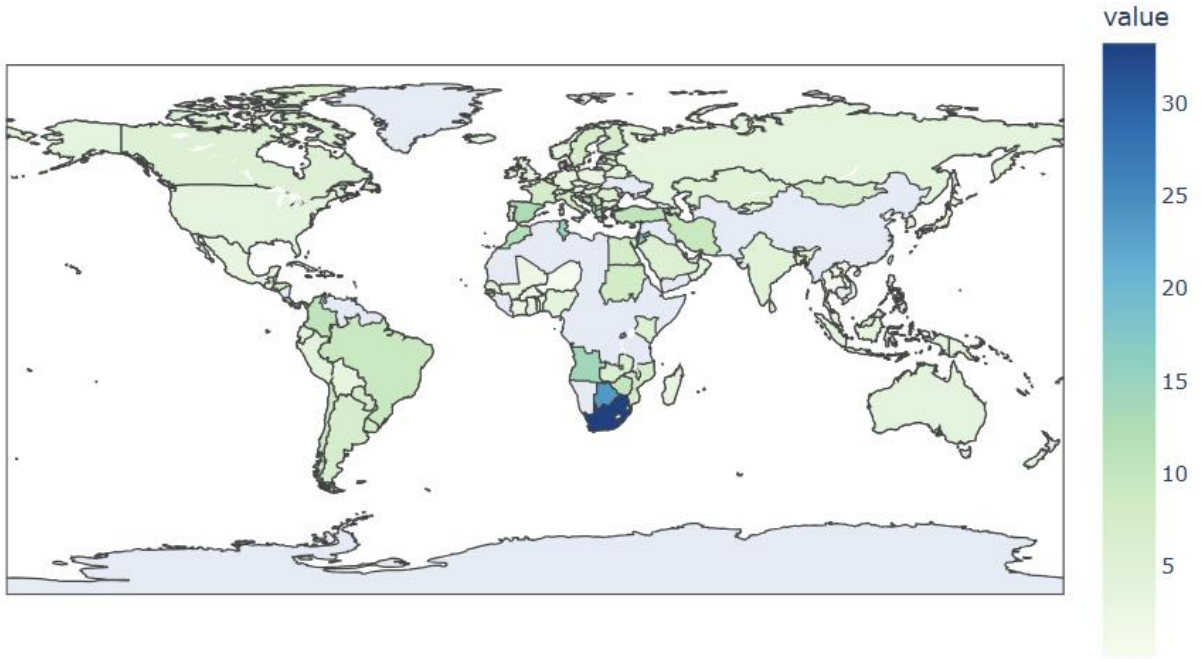


Unemployment, total (% of total labor force) (national estimate)

Global map covering the years 2000 – 2023

https://mardedexo.github.io/global-health-inequalities/world_map/Unemployment,_total_(%_of_total_labor_force)_(national_estimate)_worldMap.html

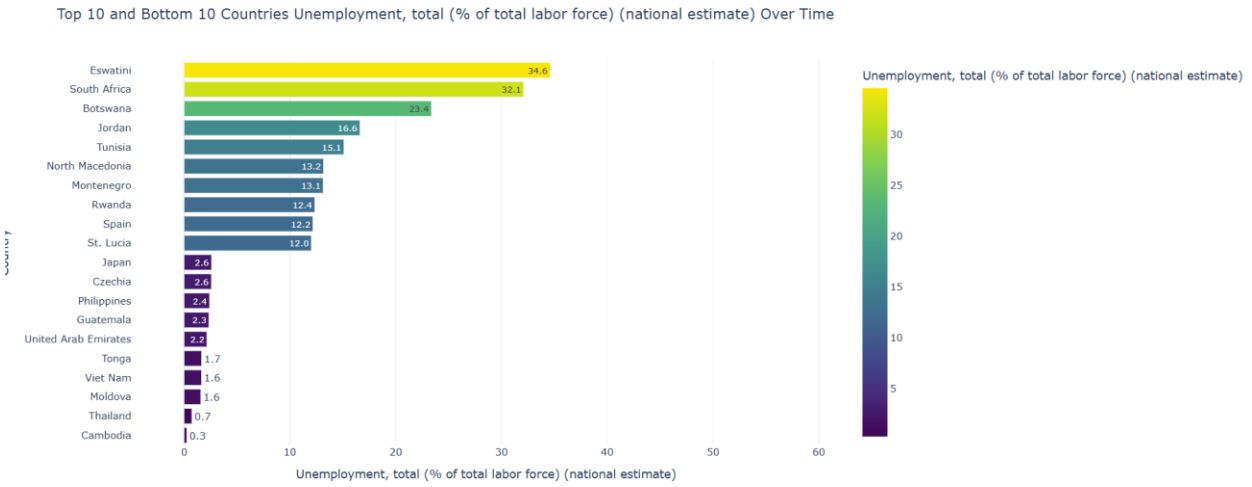
Example: year 2022



Top and bottom ten covering the years 2000 – 2024

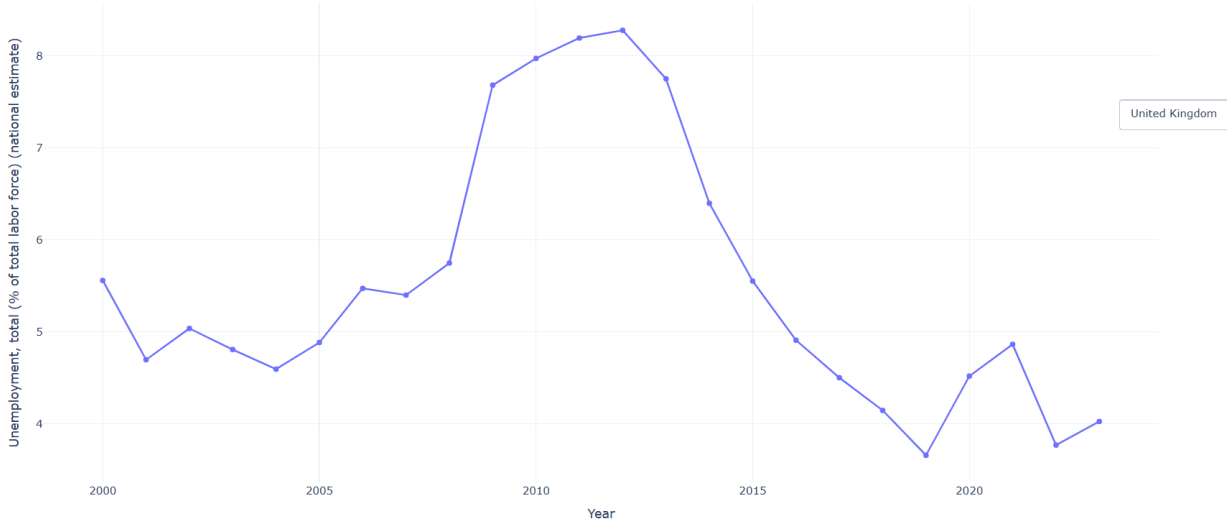
https://mardedexo.github.io/global-health-inequalities/bar_charts/Unemployment,_total_(%_of_total_labor_force)_(national_estimate)).html

Example: year 2023



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Unemployment,_total_(%_of_total_labor_force)_(national_estimate).html

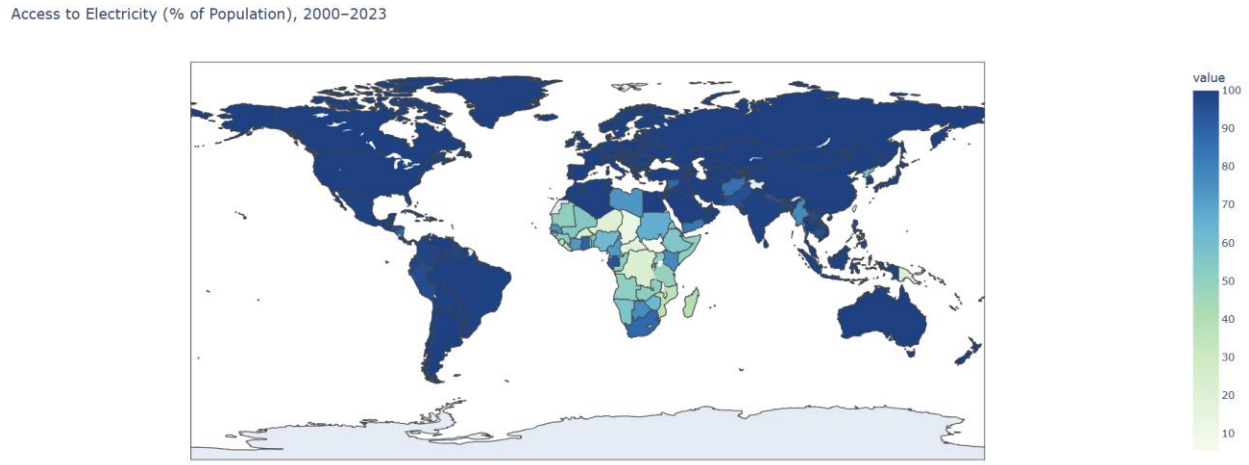


Access to electricity (% of population)

Global map covering the years

https://mardedexo.github.io/global-health-inequalities/world_map/access_to_electricity_worldMap.html

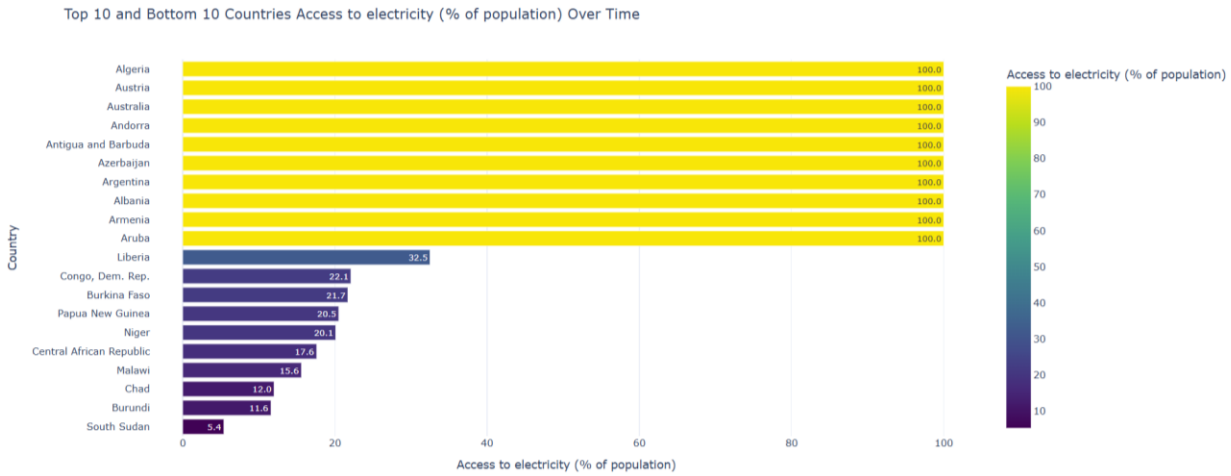
Example: year 2023



Top and bottom ten covering the years 2000 – 2024

https://mardedexo.github.io/global-health-inequalities/bar_charts/Access_to_electricity_(%_of_population).html

Example: year 2023



Overtime change for all countries

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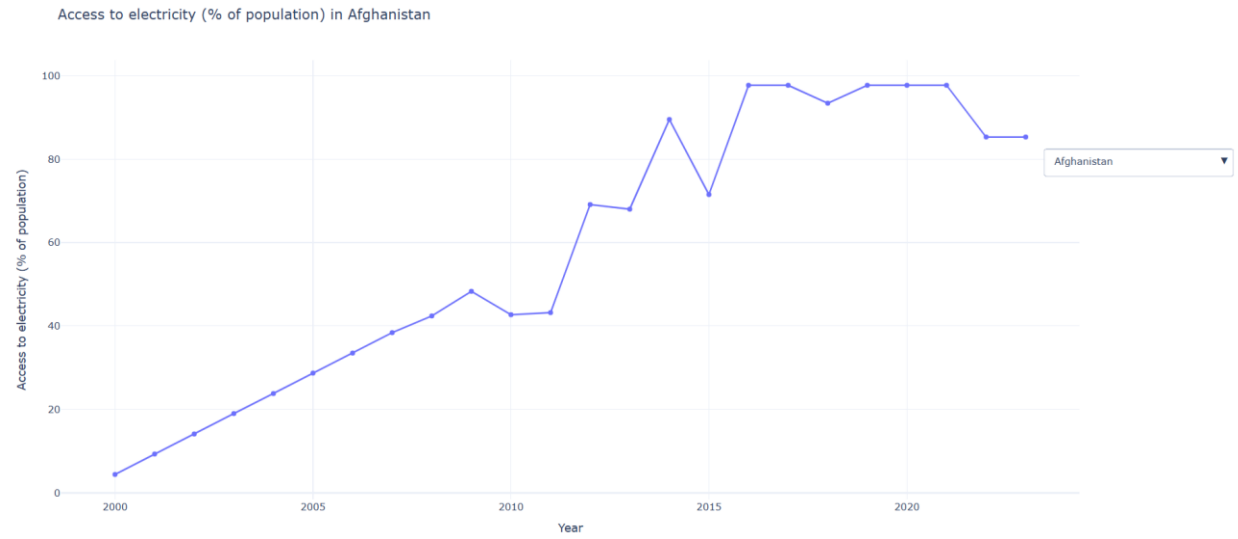
https://mardedexo.github.io/global-health-inequalities/line_graphs/Access_to_electricity.html

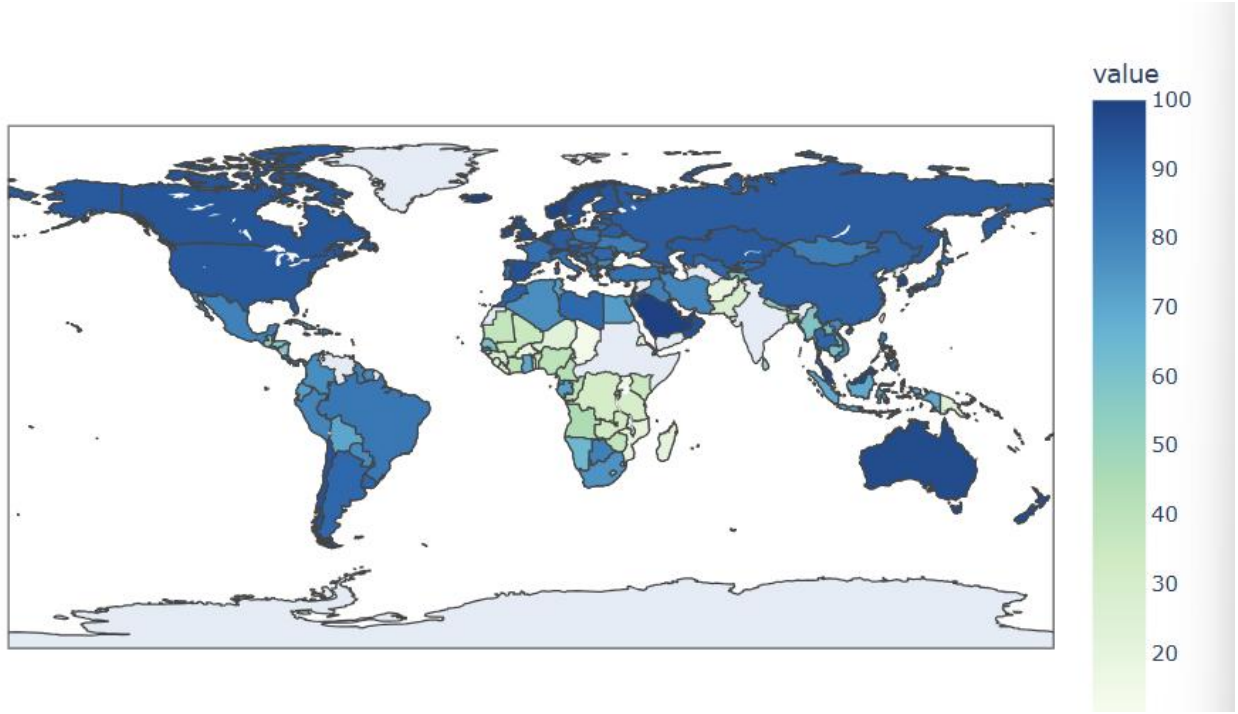


Internet users (% of population)

Global map covering the years 2000 – 2023

https://mardedexo.github.io/global-health-inequalities/world_map/Internet_users_(%_of_population)_worldMap.html

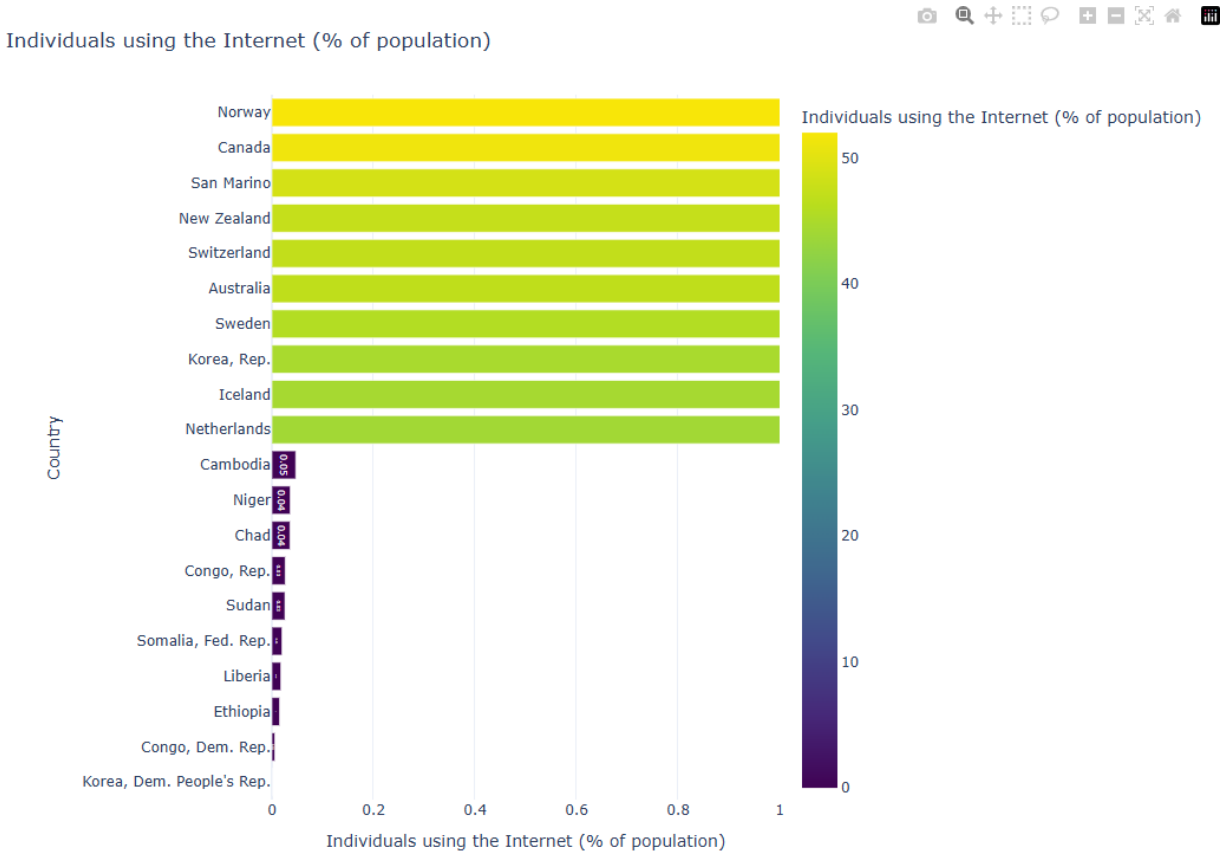
Example: year 2023



Top and bottom ten covering the years 2000 – 2024

https://mardedexo.github.io/global-health-inequalities/bar_charts/Individuals_using_the_Internet_(%_of_population).html

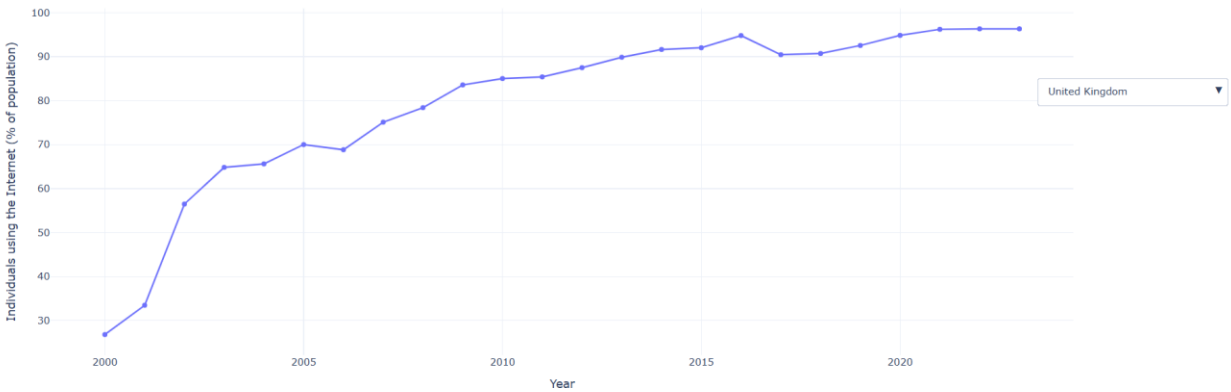
Example: year 2000



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Individuals_using_the_Internet.html

Example: year 2023

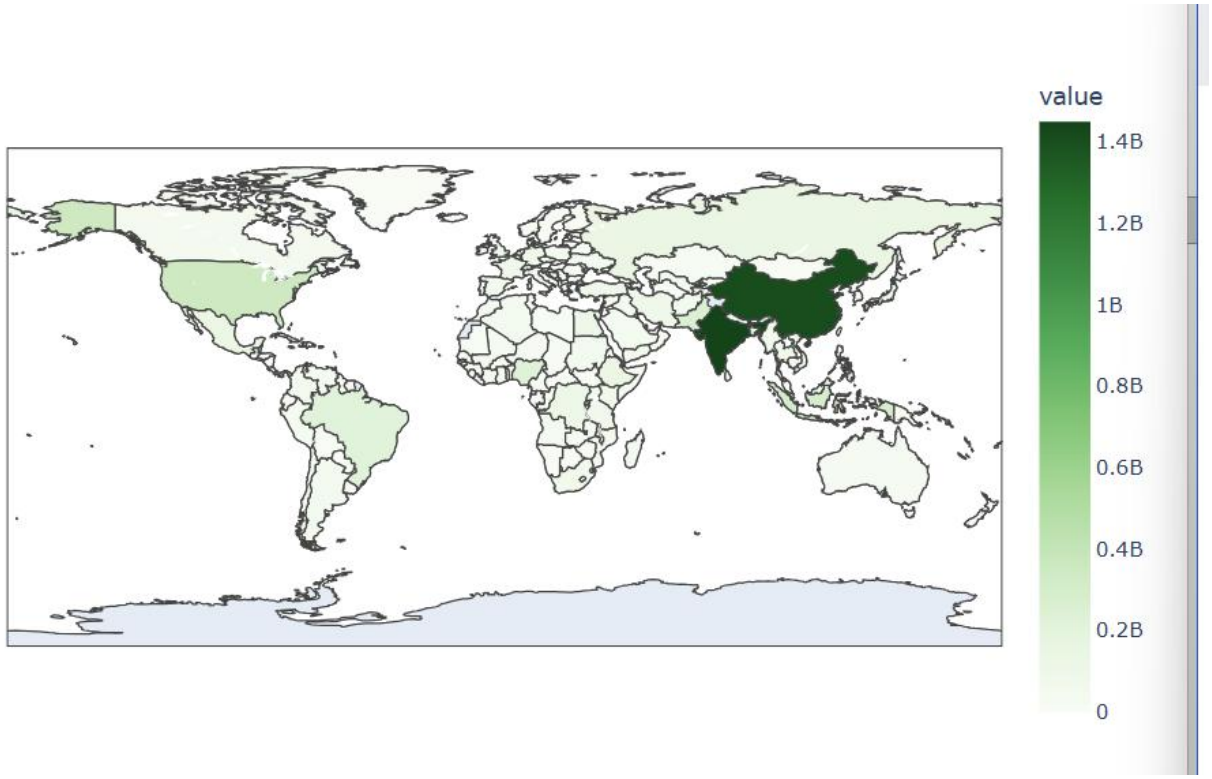


Population total

Global map covering the years 2000 – 2024

https://mardedexo.github.io/global-health-inequalities/world_map/Population_total_worldMap.html

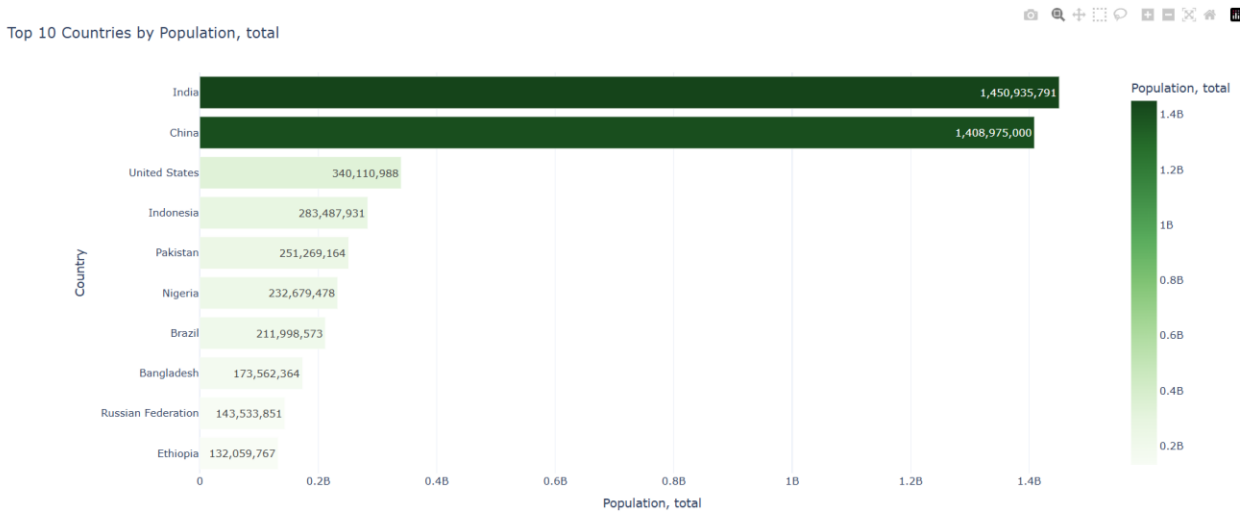
Example: year 2024



Top ten covering the years 2000 – 2024

https://mardedexo.github.io/global-health-inequalities/bar_charts/Population_total_Top10.html

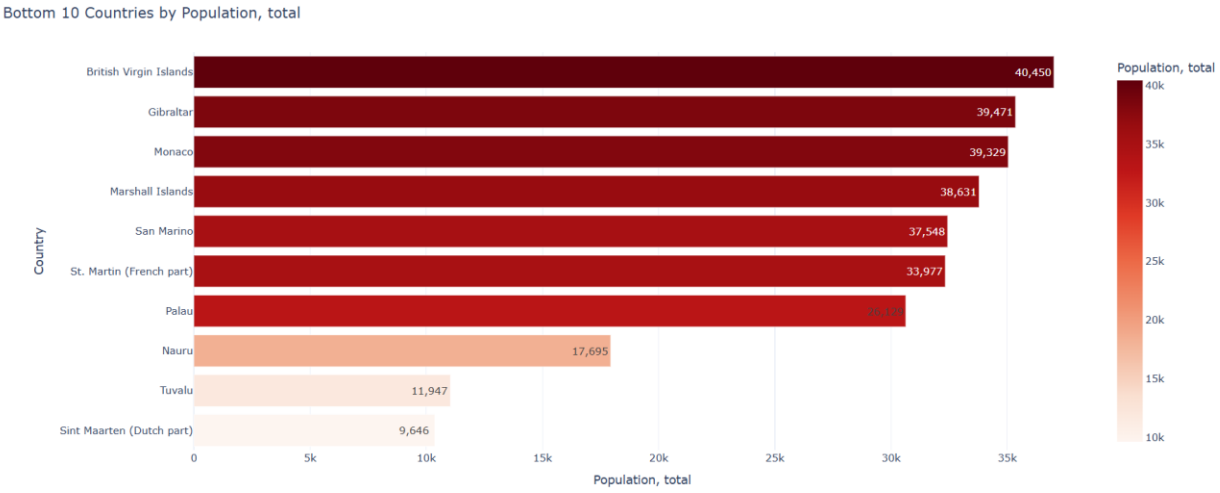
Example: year 2024



Bottom ten

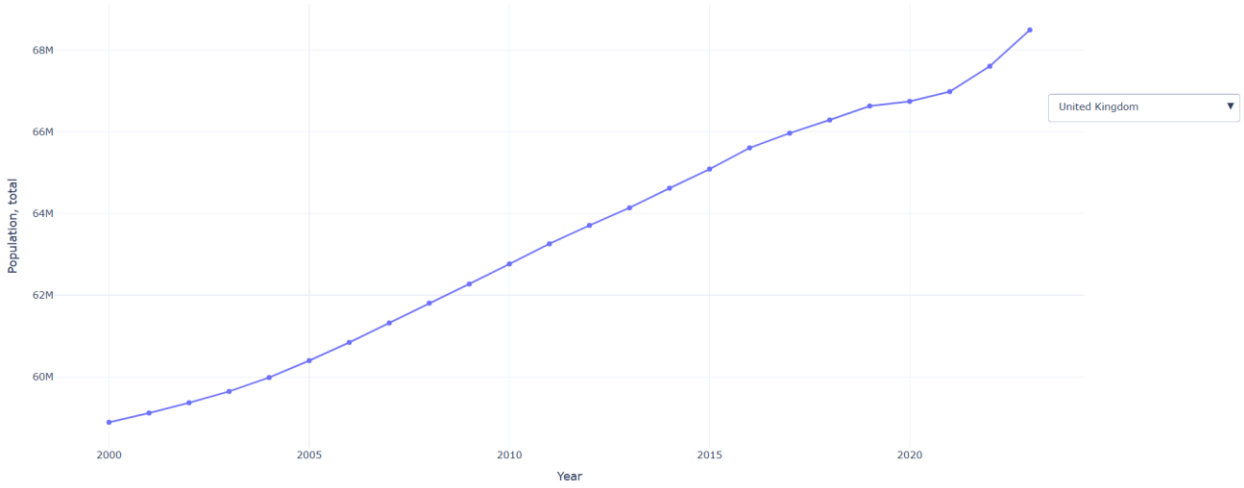
https://mardedexo.github.io/global-health-inequalities/bar_charts/Population_total_Bottom10.html

Example: year 2024



Overtime change for all countries

https://mardedexo.github.io/global-health-inequalities/line_graphs/Population,_total.html



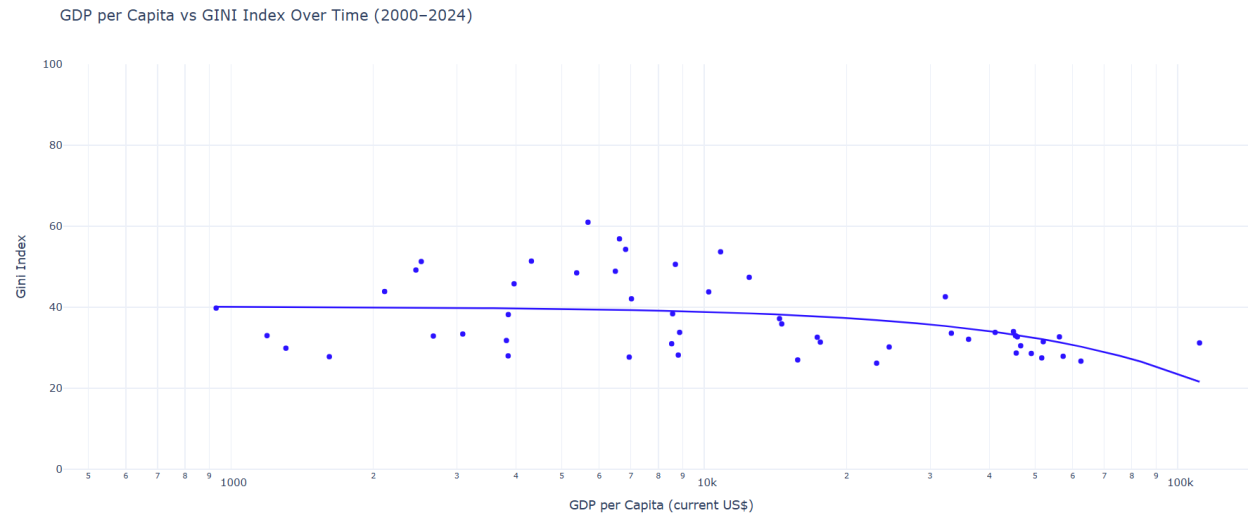
Comparative analysis

GDP per Capita vs GINI Index

Covering years 2002 – 2024

https://mardedexo.github.io/global-health-inequalities/comparative_analysis/GDP_vs_HCI.html

Example: year 2023



Interpretation:

GDP per capita indicates the average income per person.

GINI Index measures the income distribution within a country. The index goes from 0 (perfect equality - everyone earns the same) to 100 (perfect inequality - one person earns everything).

Coefficient pooled years:

	GDP_Per_Capita	GINI_Index
GDP_Per_Capita	1.000000	-0.387542
GINI_Index	-0.387542	1.000000

Coefficient year 2023 only:

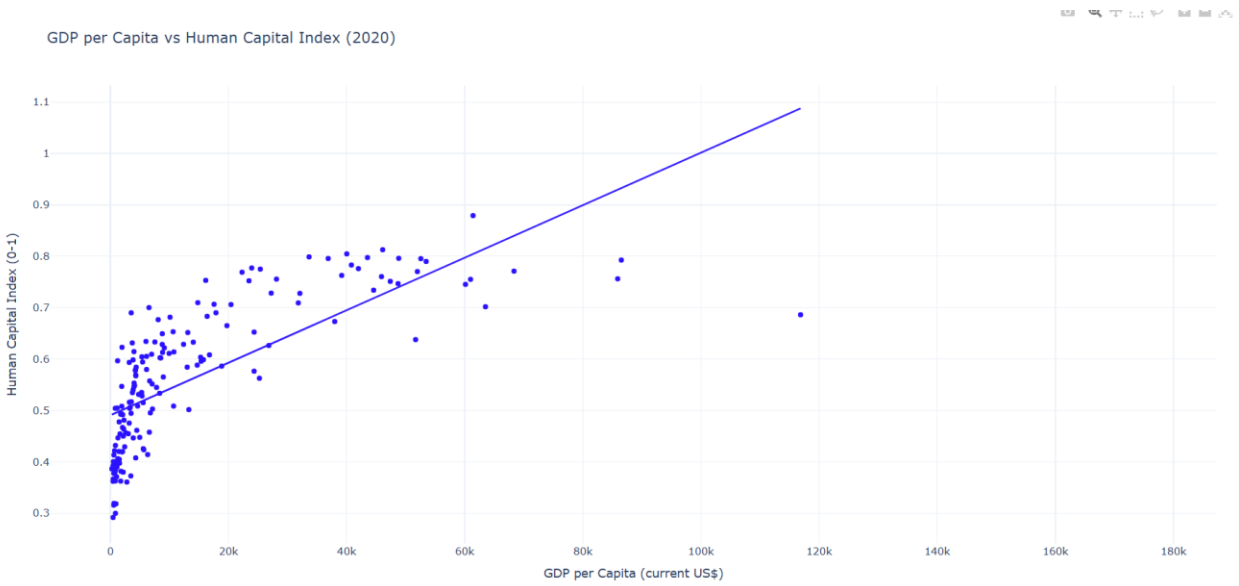
	GDP_Per_Capita	GINI_Index
GDP_Per_Capita	1.000000	-0.360573
GINI_Index	-0.360573	1.000000

The Pearson correlation coefficient of -0.36/-0.38 indicates a modest inverse association between GDP per capita and income inequality. While higher-income countries tend to exhibit lower inequality, the relationship is not strong, suggesting that income distribution is influenced by additional factors.

GDP per capita vs HCI

https://mardedexo.github.io/global-health-inequalities/comparative_analysis/GDP_vs_HCI.html

Year 2020 only



Correlation coefficient between GDP per capita and Human capital index (HCI) year 2020

	GDP_Per_Capita	HCI
GDP_Per_Capita	1.000	0.726
HCI	0.726	1.000

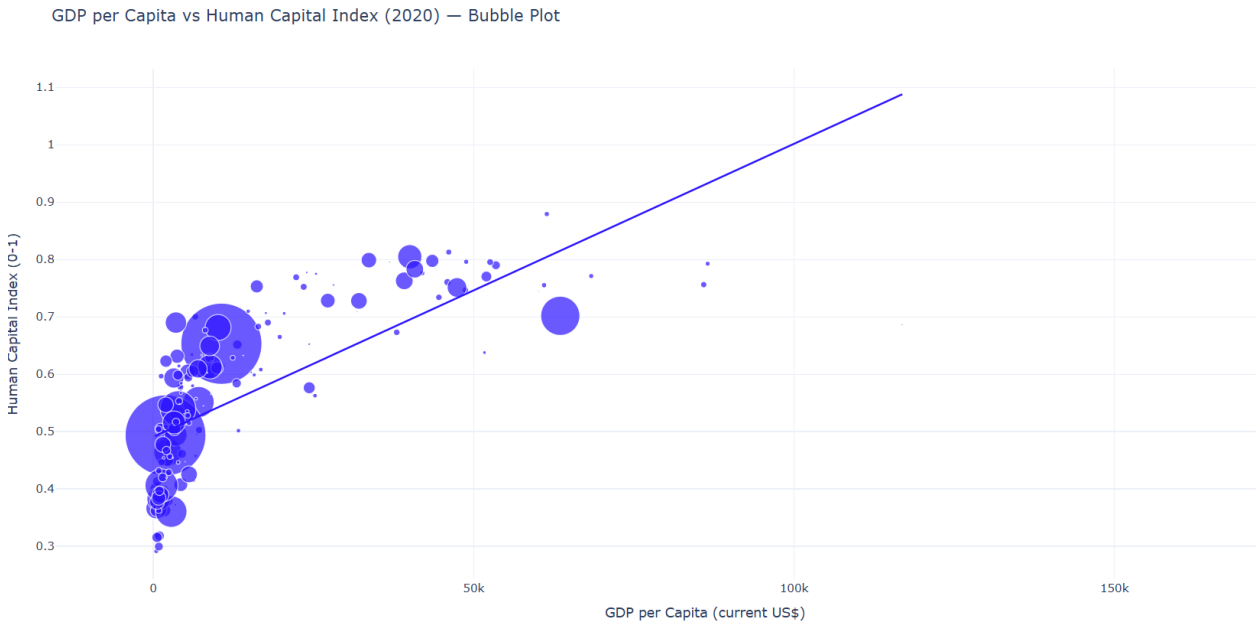
The Human Capital Index (HCI) quantifies the contribution of health, education, and survival to the productivity of the next generation of workers. In other words, HCI measures the potential a child born today can achieve in adulthood compared to a benchmark of full health and education. The index ranges from 0 to 1, where 1 represents full potential in productivity and 0 represents minimal expected productivity.

The Pearson correlation coefficient of 0.73 indicates a strong positive association between GDP per capita and HCI.

GDP_vs_HCI_PopSize

https://mardedexo.github.io/global-health-inequalities/comparative_analysis/GDP_vs_HCI_PopSize.html

Year 2020 only



Three-way Analysis

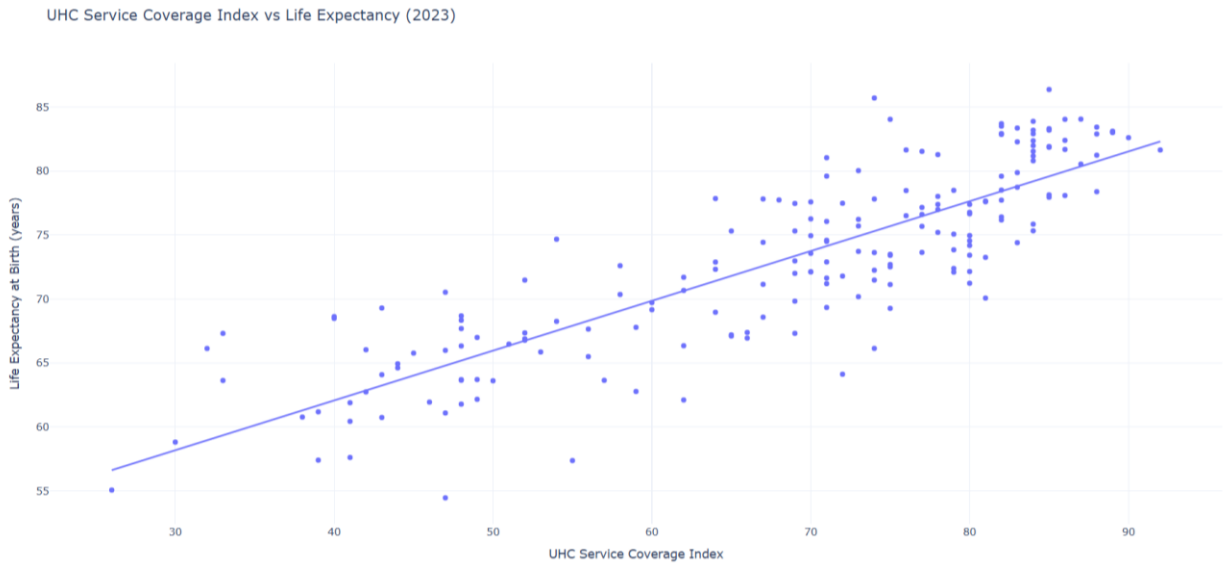
- Plotting GDP per capita (x-axis) vs HCI (y-axis) and sizing points by population can reveal clusters:
    - High GDP & High HCI: Developed economies with strong human capital.
    - High GDP & Low HCI: Wealthy countries at risk of future productivity slowdown.

- Low GDP & High HCI: Developing countries with growth potential.
- Low GDP & Low HCI: Countries facing development challenges.

UHC vs Life Expectancy

https://mardedexo.github.io/global-health-inequalities/comparative_analysis/UHC_vs_LifeExpectancy_Animated_2000_2023.html

Example: year 2023



Correlation coefficient between UHC index and life expectancy

	UHC_Index	Life_Expectancy
UHC_Index	1.000000	0.846854
Life_Expectancy	0.846854	1.000000

The Pearson correlation coefficient of 0.85 indicates a strong positive association between the UHC and life expectancy.

Correlation coefficient (r) tells you how strongly UHC and life expectancy move together:

r ~ 0.8 → strong positive

r ~ 0.5 → moderate positive

r < 0.3 → weak

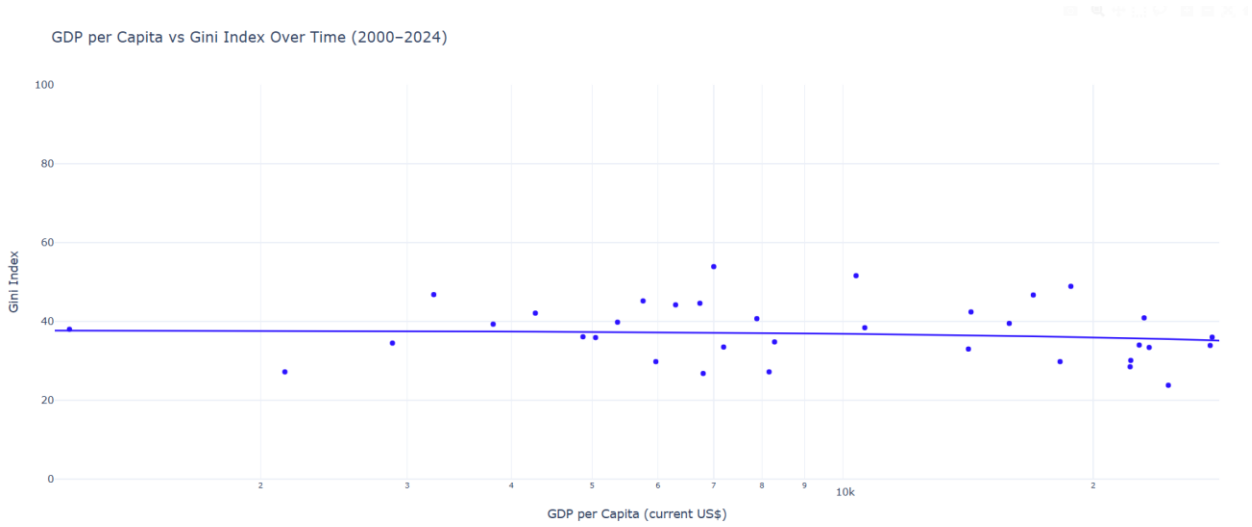
In 2023, there is a clear positive relationship between the UHC Service Coverage Index and life expectancy at birth. Countries with higher UHC scores generally enjoy longer life expectancy, highlighting the impact of access to essential health services. Some outliers are visible, suggesting that other socioeconomic, environmental, or health system factors also influence longevity. The

trendline indicates that improvements in UHC are associated with larger gains in life expectancy in countries with lower baseline coverage, while the effect diminishes at higher levels of UHC.

GDP per capita vs Gini Index

https://mardedexo.github.io/global-health-inequalities/comparative_analysis/GDP_per_Capita_vs_Gini_Animated_2000_2024.html

Example: year 2023



Correlation coefficient between GDP per capita and Gini Index for years 2000-2024

Series Name	GDP_Per_Capita	GINI_Index
Series Name		
GDP_Per_Capita	1.000000	-0.387542
GINI_Index	-0.387542	1.000000

Pearson correlation (r) across 2000–2024: -0.39

r = -0.39 → moderate negative correlation

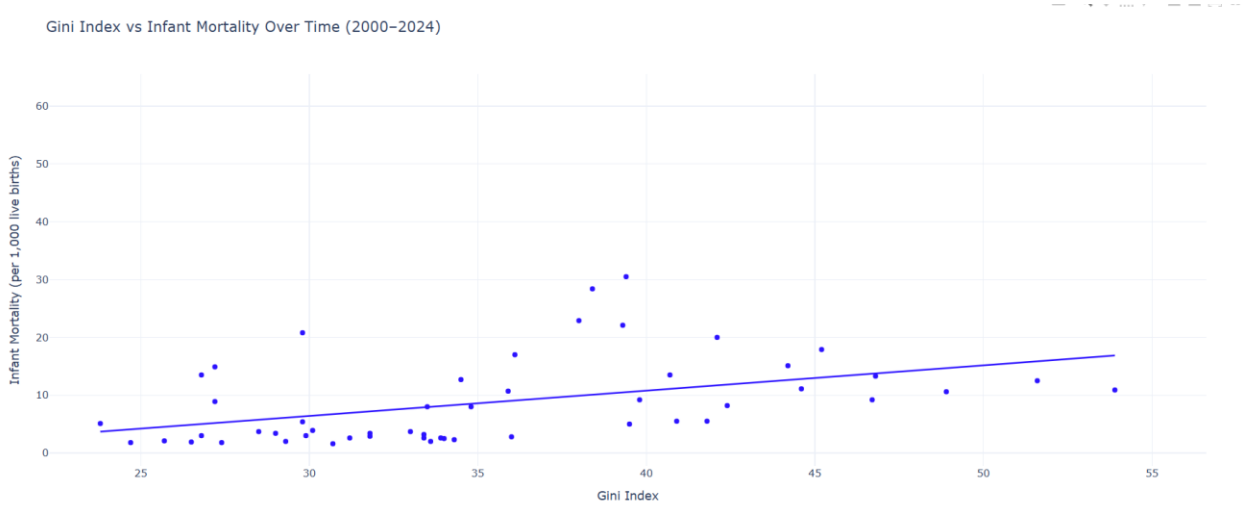
Gini Index measures income inequality (0 = perfect equality, 100 = max inequality) - the lowest the better

The Pearson correlation coefficient between GDP per capita and the Gini index is −0.39, indicating a moderate negative relationship. This suggests that countries with higher income levels tend to exhibit lower income inequality.

GINI index vs infants mortality

https://mardedexo.github.io/global-health-inequalities/comparative_analysis/Gini_vs_InfantMortality_Animated_2000_2024.html

Example: year 2023



What the comparison shows:

Overall, the plot suggests that countries with more unequal income distribution (higher Gini) tend to have higher infant mortality. In other words, inequality is associated with worse outcomes for children. However, there is variation, and not every country follows the trend exactly.

Correlation coefficient between Gini Index and Infant Mortality

	GINI_Index	Infant_Mortality
GINI_Index	1.000000	0.344631
Infant_Mortality	0.344631	1.000000

The Pearson correlation coefficient between Gini Index and Infant Mortality is 0.34, indicating a weak-to-moderate positive relationship. This suggests that counties with a higher GINI index, or in other words, with more income inequality, show a higher number of infant deaths.

GDP_vs_GINI Index vs GDP growth vs Population

https://mardedexo.github.io/global-health-inequalities/comparative_analysis/GDP_vs_Gini_vs_GDP_growth_Animated_2000_2024.html

Example: year 2022