Data Immersion Achievement 6

Levels and trends in child malnutrition

Advanced Analytics & Dashboard Design

Contents

Objective

The JME includes estimates of prevalence and numbers affected for stunting, overweight, wasting and severe wasting among children under five years of age at country, regional and global levels. Global, regional and country annual trends from 2000-2022 are available for stunting and overweight. The objective is to build an interactive dashboard that will visually showcase well-curated results of an advanced exploratory analysis conducted in Python to measure nutritional imbalance such as undernutrition (assessed from stunting, wasting and underweight) or overweight.

Why the analysis

Every child has the right to good nutrition. Well-nourished children grow and develop to their full potential. They are better equipped to lead healthy lives, to be free from poverty, to learn and participate, and to continue thriving across the life course, with benefits that continue over generations. The past decade has seen important gains in improving maternal and child nutrition, including a one-third decline in the proportion of children suffering from stunting. Yet the triple burden of malnutrition – stunting, wasting and overweight – continues to jeopardize children's ability to survive and thrive.

All forms of malnutrition are preventable. To stop malnutrition before it starts, children and their families need access to nutritious diets, essential services and positive practices to set them on the path to survival and thrive. But today, these vital pathways to good nutrition are under growing threat as many countries plunge deep into a global food and nutrition crisis fuelled by poverty, conflict, climate change and the enduring secondary effects of the COVID-19 pandemic. As the world responds to the crisis, urgent action is critical to protect maternal and child nutrition – especially in the most affected regions – and secure a future where the right to nutrition is a reality for every child.

Key Questions and Objectives

- Which countries are affected most by child nutrition?
- Identify the number of deaths and affected due to mall nutrition.
- Does progress in reducing stunting equal across regions and sub-regions?
- Find the trend in the country's income and malnutrition growth.
- SDG target by 2030, including achieving by 2025 the internationally agreed target to end all forms of malnutrition, stunting and wasting in children under five years of age. Will this target be achievable by the trends in the dataset?

Scope

SDG target by 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under five years of age.

Data source

- The UNICEF, WHO and the World Bank inter-agency team update the Joint Child Malnutrition Estimates (JME) every other year.
- The JME includes estimates of prevalence and numbers affected for stunting, overweight, wasting and severe wasting among children under 5 years of age at country, regional and global level. Global, regional and country annual trends.
- Data Source: United Nations Children's Fund (UNICEF), World Health Organization (WHO), World Bank (WB)
- Data Collection: Data is collected various national organisation's health survey departments. The list of organisations are defined here.

Source	Short source for major survey types.
DHS	Demographic and Health Survey (from the official Demographic and Health Survey Programme available at https://dhsprogram.com/)
DHS-style or MICS-style survey	Survey with MICS or DHS in the titled but which is not and official MICS or DHS/not available at the above websites
LSMS	The Living Standards Measurement Study (from official World Bank Group supported surveys available at: http://iresearch.worldbank.org/lsms/lsmssurveyFinder.htm)
MICS	Multiple Indicator Cluster Survey (from official UNICEF-supported surveys available at http://mics.unicef.org/)
NNS	National Nutrition Survey
SMART	Standardized Monitoring and Assessment of Relief and Transitions
Nutrition Surveillance	Estimates originating from nutrition monitoring and surveillance systems which are nationally representative
ONS	Other National Survey
PAPFAM	Pan Arab Project for Family Health survey

Data Contents: The JME includes estimates of prevalence and numbers affected for stunting, overweight, wasting and severe wasting among children under 5 years of age at country, regional and global level. Global, regional and country annual trends from 2000-2022 are available for stunting and overweight. Refer Data Profiling (section 1. About the data and data type) for more information.

- **Data Relevance:** The data is part UN's Sustainable Development Goals (SDG) and accurate to their standards. Data can be used for study, research and analysis. Data contains relevant columns for the analysis and meets project objectives.
    - **Objective 1**: Identify the number of deaths and affected due to mall nutrition(stunting, overweight, wasting and severe wasting).
    - **Hypothesis**: Malnutrition and mortality among children's counts reducing each year.
    - **Datasource**
        - UNICEF_Global_Databases_Mortality dataset contains mortality rate in each geographic regions with year.
            - Limitation: Data isn't recorded every year.
        - UNICEF_Global_Joint-Malnutrition-Estimates contains global stunting, wasting and overweight information.

    - **Objective 2:** Which countries are affected most by child nutrition(stunting, overweight, wasting and severe wasting)?
    - **Hypothesis**: Countries with low income have the highest child malnutrition count.
    - **Datasource:**
        - UNICEF_Global_Joint-Malnutrition-Estimates
        - UNICEF_Global_Databases_Overweight
        - UNICEF_Global_Databases_Stunting
        - UNICEF_Global_Databases_Databases_Wasting

All the above table have enough columns to find the trends in child nutrition growth in each country with period over the years.

- **Objective 3:** Does progress to reduce stunting has equal across regions and sub-regions?
- **Hypothesis**: Progress to reduce stunting has been equal across regions and sub-regions.
- **Datasource:**
  - UNICEF_Global_Joint-Malnutrition-Estimates
  - UNICEF_Global_Databases_Overweight
  - UNICEF_Global_Databases_Stunting
  - UNICEF_Global_Databases_Databases_Wasting

All the above table have enough columns to find the trends in child nutrition growth in each country with period over the years.

- **Objective 4:** Find the trend in countries income and malnutrition growth.
- **Hypothesis**: countries income and malnutrition growth worldwide affected with countries income.
- **Datasource:**

- **Objective 5:** SDG target by 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age. Will this target achievable by the trends in dataset?
- **Hypothesis**: More intensive efforts are required if the world is to achieve the global target of reducing the number of children with stunting to 89 million by 2030.
- **Datasource:**
  - UNICEF_Global_Joint-Malnutrition-Estimates
  - UNICEF_Global_Databases_Overweight
  - UNICEF_Global_Databases_Stunting
  - UNICEF_Global_Databases_Databases_Wasting

All the above table have enough columns to find the trends in child nutrition growth in each country with period over the years.

- **Data Bias and Gaps:**

{Need more analysis}

- **Completeness of Data:**
    - The data is collected from different regions with different sources. The data collection format isn't standardised.
    - Period of data collection isn't the same. Some countries have data collection every year, and some are 2 or 3 years. And countries collected the data every decade.
    - Some countrie's samples are segregated by gender, age, family status etc. Some country's observations combined result in a percentage of the total sample.
    - Malnutrition data doesn't contain all the 195 country's data.

Limitations and Ethics

- Data is collected by UN from various countries reports.
- The data could be possibly politically biased to provide countries reputation.
- Collected data have clear transparency from which organisation is collected, in which year and survey timing. And the data can be accessed by any one globally.
- The data doesn't contain any personal information or to target specific community.
- All the data is collected from the UNICEF WHO database and the data can be used to for research, study or analysis purpose.

About the data and Data Types

Wasting: Child **wasting** is the life-threatening result of poor nutrient intake and/or recurrent illnesses. Children suffering from wasting have weakened immunity, are susceptible to long-term developmental delays and face an increased risk of death, particularly when wasting is severe. Children suffering from severe wasting require early detection, timely treatment, and care to survive.
Table:

• UNICEF_Databases_Severe_Wasting • UNICEF_Global_Databases_Databases_Wasting		
Column Name	Description	Type
ISO	Three-digit alphabetical codes International Standard ISO 3166-1 assigned by the International Organization for Standardization (ISO). thttp://www.iso.org/iso/home/standards/country_codes	Characters(3), Qualitative- Nominal
Countries and areas	The UNICEF Global databases contain a set of 202 countries as reported on through the State of the World's Children Statistical Annex 2023	Characters(20), Qualitative- Nominal
UNICEF Regions	EAP: East Asia and the Pacific EECA: Eastern Europe and Central Asia ESA: East and Southern Africa LAC: Latin America and the Caribbean MENA: Middle East and North Africa NA : North America SA : South Asia WCA: West and Central Africa WE: Western Europe	Characters(4), Qualitative- Nominal
UN Regions		Characters(4), Qualitative- Nominal
WHO Regionns		Characters(4),

		Qualitative· Nominal
World Bank Income Groups		Characters(4), Qualitative· Nominal
Survey Years	Represents the year(s) in which the data collection (e.g. survey interviews) took place	Character Qualitative · Ordinal
Year	Year assigned to each survey	Number Quantitative·Continuous Time variant
Short Source	Short source for major survey types. Demographic and Health Survey (from the official Demographic and Health Survey Programme available at https://dhsprogram.com/)	Characters
Full Source Title		Characters
Latest Estimate		Characters
Estimate Type	The source of the estimate, whether as reported, reanalyzed, etc. Reanalyzed : Dataset has been obtained, standardized and reanalyzed to conform to the definition. Lower and Upper Confidence limits are based on a 95% confidence level External Reanalysis : Dataset reanalyzed by external partners Reported: Point Estimate, and when available, other information including sample size, Lower and Upper	Characters Qualitative· Nominal

	Confidence limits, are based on results from report.	

National, Sex, Residence , Age Group , Wealth Quintile Wealth Quintile Grouping, Mother's Education, Area / Wealth Quintile, Area / Wealth Quintile Grouping Sex / Age Group .Subnational Region:

The above column contains all the estimate values for the above categories, For exaple National contains records Point Esimate, Lower Limit, Upper Limit, Sample Size and foot note.

Value:

- Percentage of children under 5 years of age falling below -3 standard deviations severe wasting from the median weight-for-height of the reference population
- Percentage of children under 5 years of age falling below -2 standard deviations wasting from the median weight-for-height of the reference population

Point Estimate	The prevalence of the wasting (severe) in the population	Continuous-Discrete Time variant
Lower Limit	95% lower confidence interval of the point estimate	Continuous-Discrete Time variant
Upper Limit	95% upper confidence interval of the point estimate	Continuous-Discrete Time variant
Sample Size	The weighted sample size which the point estimate is based on	Continuous-Discrete Time variant
Footnote	A variety of notes that relate to the point estimates as follows: a: Alternate definition (Numbered footnote contains details) b: Age-adjusted estimate c: Converted estimate d: Adjusted National-Rural to National p: Age calculated using century month codes q: Oedema data were collected in the survey	Qualitative- Nominal

	r: Height/length modality (standing/lying) was not collected s : Oedema data was collected in the survey and not considered in the analysis y : Unweighted sample size is less than 25, point estimate, lower limit and upper limit have been suppressed z : Unweighted sample size is between 25 and 49	

Stunting is the devastating result of poor nutrition in-utero and early childhood. Children suffering from stunting may never attain their full possible height, and their brains may never develop to their full cognitive potential. These children begin their lives at a marked disadvantage with consequences continuing into adulthood: they face learning difficulties in school, earn less as adults, and face barriers to community participation.

Table:

- UNICEF_Global_Databases_Stunting

Column Name	**Description**	**Type**
ISO	Three-digit alphabetical codes International Standard ISO 3166-1 assigned by the International Organization for Standardization (ISO). thttp://www.iso.org/iso/home/standards/country_codes	Characters(3),Qualitative-Nominal
Countries and areas	The UNICEF Global databases contain a set of 202 countries as reported on through the State of the World's Children Statistical Annex 2023	Characters(20), Qualitative- Nominal
UNICEF Regions	EAP: East Asia and the Pacific EECA: Eastern Europe and Central Asia	Characters(4), Qualitative- Nominal

	ESA: East and Southern Africa LAC: Latin America and the Caribbean MENA: Middle East and North Africa NA : North America SA : South Asia WCA: West and Central Africa WE: Western Europe	
UN Regions		Characters(4), Qualitative- Nominal
WHO Regionns		Characters(4), Qualitative- Nominal
World Bank Income Groups		Characters(4), Qualitative- Nominal
Survey Years	Represents the year(s) in which the data collection (e.g. survey interviews) took place	Character Qualitative - Ordinal
Year	Year assigned to each survey	Number Quantitative-Continuous Time variant
Short Source	Short source for major survey types. Demographic and Health Survey (from the official Demographic and Health Survey Programme available	Characters

	at https://dhsprogram.com/)	
Full Source Title		Characters
Latest Estimate		Characters
Estimate Type	The source of the estimate, whether as reported, reanalyzed, etc. Reanalyzed : Dataset has been obtained, standardized and reanalyzed to conform to the definition. Lower and Upper Confidence limits are based on a 95% confidence level External Reanalysis : Dataset reanalyzed by external partners Reported: Point Estimate, and when available, other information including sample size, Lower and Upper Confidence limits, are based on results from report.	Characters Qualitative· Nominal

National, Sex, Residence , Age Group , Wealth Quintile Wealth Quintile Grouping, Mother's Education, Area / Wealth Quintile, Area / Wealth Quintile Grouping Sex / Age Group .Subnational Region:

The above column contains all the estimate values for the above categories, For exaple National contains records Point Esimate, Lower Limit, Upper Limit, Sample Size and foot note

Point Estimate	The prevalence of the stunting (moderate and severe) in the population Percentage of under-fives falling below minus 2 standard deviations (moderate and severe) from the median height-for-age of the reference population	Continuous-Discrete
Lower Limit	95% lower confidence interval of the point estimate Percentage of under-fives falling below minus 2 standard deviations (moderate and severe) from the median height-for-age of the reference population	Continuous-Discrete

Upper Limit	95% upper confidence interval of the point estimate Percentage of under-fives falling below minus 2 standard deviations (moderate and severe) from the median height-for-age of the reference population	Continuous-Discrete
Sample Size	The weighted sample size which the point estimate is based on	Continuous-Discrete
Footnote	A variety of notes that relate to the point estimates as follows: a: Alternate definition (Numbered footnote contains details) b: Age-adjusted estimate c: Converted estimate d: Adjusted National-Rural to National p: Age calculated using century month codes q: Oedema data were collected in the survey r: Height/length modality (standing/lying) was not collected s : Oedema data was collected in the survey and not considered in the analysis y : Unweighted sample size is less than 25, point estimate, lower limit and upper limit have been suppressed z : Unweighted sample size is between 25 and 49	Qualitative- Nominal

Overweight: Childhood **overweight** occurs when children's caloric intake from food and beverages exceeds their energy requirements. This form of malnutrition is driven by failing

food systems characterised by poor affordability and access to nutritious foods, the marketing of nutrient-poor ultra-processed foods and inadequate opportunities for physical activity.		
Table: • UNICEF_Global_Databases_Overweight		
Column Name	**Description**	**Type**
ISO	Three-digit alphabetical codes International Standard ISO 3166-1 assigned by the International Organization for Standardization (ISO). thttp://www.iso.org/iso/home/standards/country_codes	Characters(3),Qualitative-Nominal
Countries and areas	The UNICEF Global databases contain a set of 202 countries as reported on through the State of the World's Children Statistical Annex 2023	Characters(20), Qualitative- Nominal
UNICEF Regions	EAP: East Asia and the Pacific EECA: Eastern Europe and Central Asia ESA: East and Southern Africa LAC: Latin America and the Caribbean MENA: Middle East and North Africa NA : North America SA : South Asia WCA: West and Central Africa WE: Western Europe	Characters(4), Qualitative- Nominal
UN Regions		Characters(4),

		Qualitative- Nominal
WHO Regionns		Characters(4), Qualitative- Nominal
World Bank Income Groups		Characters(4), Qualitative- Nominal
Survey Years	Represents the year(s) in which the data collection (e.g. survey interviews) took place	Character Qualitative - Ordinal
Year	Year assigned to each survey	Number Quantitative-Continuous Time variant
Short Source	Short source for major survey types. Demographic and Health Survey (from the official Demographic and Health Survey Programme available at https://dhsprogram.com/)	Characters
Full Source Title		Characters
Latest Estimate		Characters
Estimate Type	The source of the estimate, whether as reported, reanalyzed, etc. Reanalyzed : Dataset has been obtained, standardized and reanalyzed to conform to the definition. Lower and Upper Confidence limits are	Characters Qualitative- Nominal

	based on a 95% confidence level External Reanalysis : Dataset reanalyzed by external partners Reported: Point Estimate, and when available, other information including sample size, Lower and Upper Confidence limits, are based on results from report.	

National, Sex, Residence , Age Group , Wealth Quintile Wealth Quintile Grouping, Mother's Education, Area / Wealth Quintile, Area / Wealth Quintile Grouping Sex / Age Group .Subnational Region:

The above column contains all the estimate values for the above categories, For exaple National contains records Point Esimate, Lower Limit, Upper Limit, Sample Size and foot note

Point Estimate	The prevalence of the wasting (severe) in the population	Continuous-Discrete
Lower Limit	95% lower confidence interval of the point estimate	Continuous-Discrete
Upper Limit	95% upper confidence interval of the point estimate	Continuous-Discrete
Sample Size	The weighted sample size which the point estimate is based on	Continuous-Discrete
Footnote	A variety of notes that relate to the point estimates as follows: a: Alternate definition (Numbered footnote contains details) b: Age-adjusted estimate c: Converted estimate d: Adjusted National-Rural to National p: Age calculated using century month codes q: Oedema data were collected in the survey	Qualitative- Nominal

	r: Height/length modality (standing/lying) was not collected s : Oedema data was collected in the survey and not considered in the analysis y : Unweighted sample size is less than 25, point estimate, lower limit and upper limit have been suppressed z : Unweighted sample size is between 25 and 49	

Data Profiling

- **Profile and clean a data set ready for analysis**
- **Improve the integrity of data in each data set**

1. Convert Excel data into CSV format and extract relevant columns that are required for analysis.
2. Data are integrated into different .csv format under 02 data/Prepared data/01 CSV/

Data Analysis Criteria for this Project:

Be open source. · source. · Include non-anonymized column names.	Data Source https://data.unicef.org/resources/dataset/malnutrition-data/
Come from an authentic/authoritative	The UNICEF, WHO and the World Bank inter-agency team update the Joint Child Malnutrition Estimates (JME) every other

	year. And the data can be used for analysis, study or the research purpose.
Include non-anonymized column names.	Databases containing national country values from survey and administrative sources, disaggregated by various background characteristics such as place of residence, geographic location, age, and sex, when available.
Be recent (ideally, no more than 3 years old. However, this factor is not essential - if you've found a perfect data set for your purposes, it could be older too, but not more than 10 years old).	The UNICEF, WHO and the World Bank inter-agency team update the Joint Child Malnutrition Estimates (JME) every other year. The data collected on **May 2023** from WHO database.
Be recent (ideally, no more than 3 years old. However, this factor is not essential - if you've found a perfect data set for your purposes, it could be older too, but not more than 10 years old).	The data contains all the essentials requirement for this course UNICEF, WHO and the World Bank inter-agency team update the Joint Child Malnutrition Estimates (JME) every other year
Contain at least 2-3 continuous variables (apart from index variables, ID variables, dates, years, etc).	Yes, the data set contains continuous variable
Contain at least 2-3 categorical variables (apart from index variables, ID variables, dates, years etc).	The table contains year and geographical information.
Contain at least 1,500 rows.	Yes
Include a geographical object of some kind: for instance, a column relating to a country, continent, or something similar. If the information from the data set refers to the US, for example, there should be a column containing the names/abbreviations of the states. Note: there should be at least a couple of different values in this column. This is important for the geospatial analysis you'll be conducting. Of course, you can also use data sets with latitude and longitude	The data is collected from worldwide and contains all regional geographical information like country and continental information.

Analysis Criteria

Data Analyst will be conducting the following analyses in this Achievement (note that not all results need to be included in the final dashboard):

- Exploratory analysis through visualizations (scatterplots, correlation heatmaps, pair plots and categorical plots)

- Geospatial analysis using a shapefile
- Regression analysis
- Cluster analysis
- Time-series analysis
- Analysis narrative and
- final results (presented in a dashboard)

Dashboard Requirements

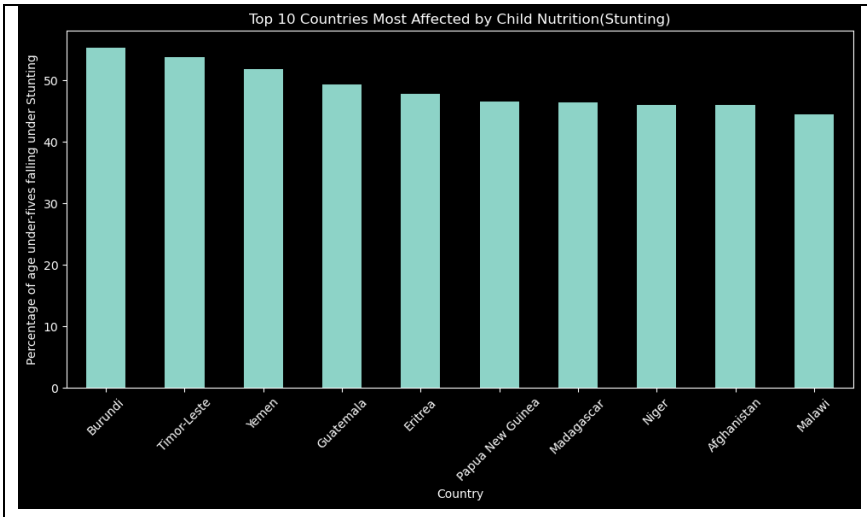
As explained above, the dashboard needs to tell the story of your analytical journey. it should contain a curation of the key results that discovered as you worked through the Achievement.

Final dashboard must: ·

- Be designed with a use-case in mind (answering key guidance questions).
- Be created in Tableau Public. · Be interactive.
- Adhere to visual design best practices.
- Include an introduction page that describes the project (data and purpose).
- Include relevant result(s) of initial visual exploratory analysis.
- Include an explanation for how the results of the exploratory analysis resulted in defining research questions and/or hypotheses.
- Contain a geospatial component.
- Address the defined questions/hypotheses using advanced analytical techniques.
- For example: · Regression analysis · Cluster analysis · Time-series analysis ·
- Include a results summary page explaining how the results do or don't address the initial research questions/hypotheses.
- It should innclude details on the limitations of the project.
- Include a proposal of next steps for further analysis.

Analysis

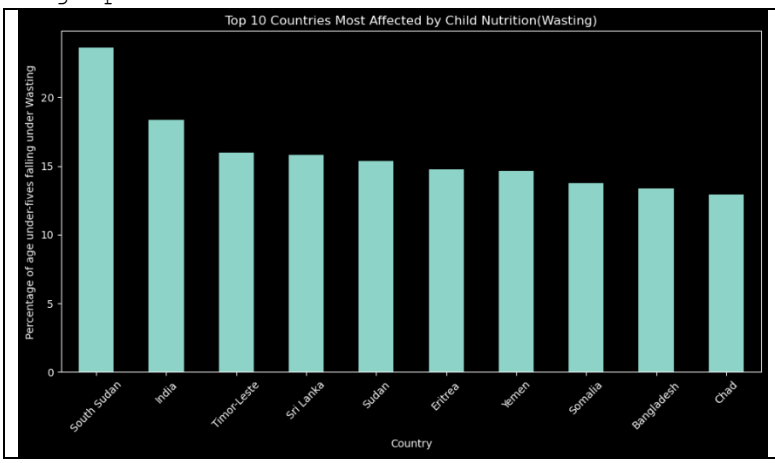
Top 10 countries that are most affected by Stunting



Burundi	55.27
Timor-Leste	53.82
Yemen	51.82
Guatemala	49.34
Eritrea	47.75
Papua New Guinea	46.53
Madagascar	46.47
Niger	46.06
Afghanistan	45.96
Malawi	44.48

Top 10 countries that are most affected by Wasting

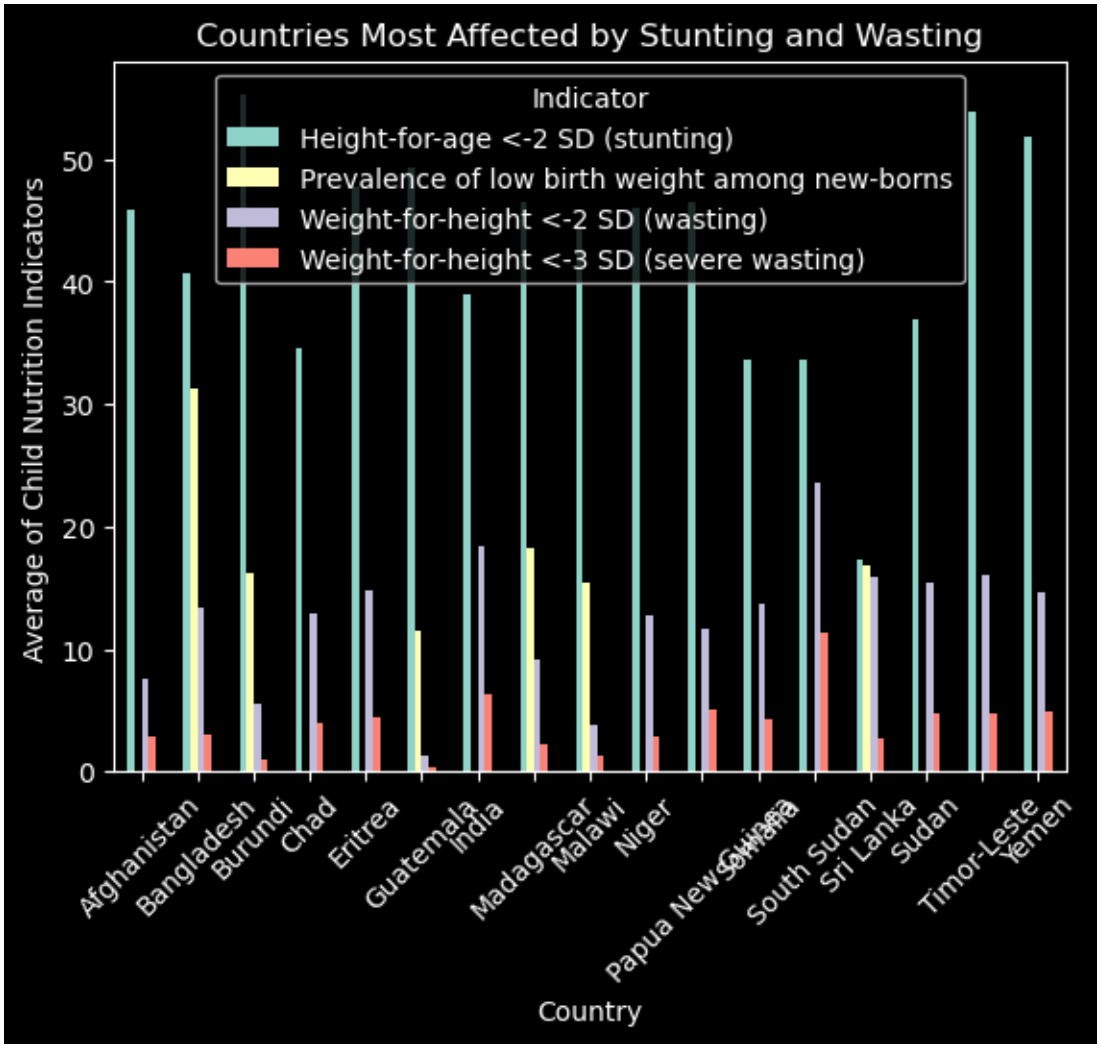
Geographic area



South Sudan	23.63
India	18.37
Timor-Leste	15.98
Sri Lanka	15.83
Sudan	15.38
Eritrea	14.77
Yemen	14.67
Somalia	13.75
Bangladesh	13.37
Chad	12.91

Top 10 countries that are most affected by Stunting and Wasting

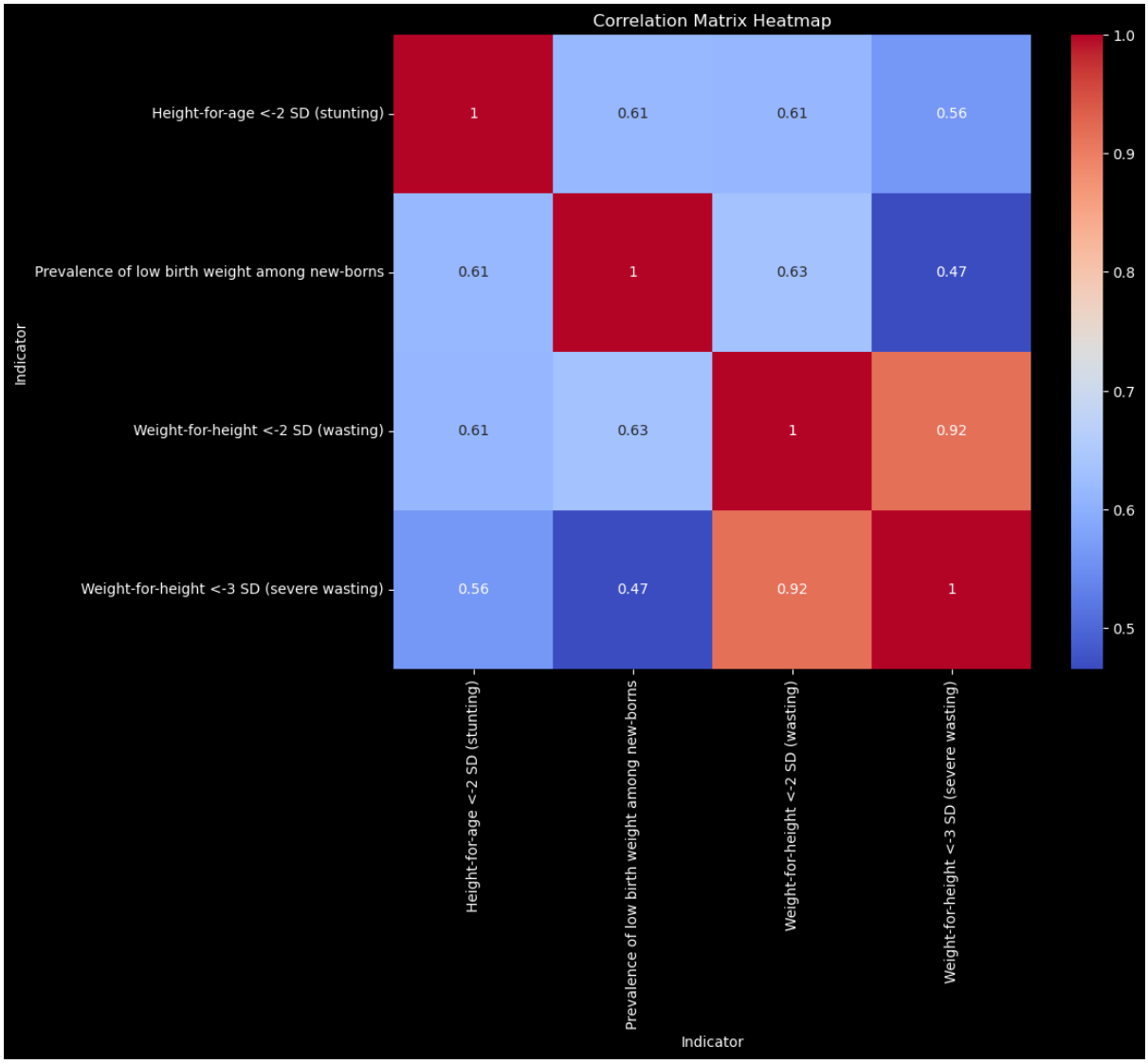
Indicator Geographic area	Height-for-age <-2 SD (stunting)	Prevalence of low birth weight among new-borns	Weight-for-height <-2 SD (wasting)	Weight-for-height <-3 SD (severe wasting)
Afghanistan	45.96	NaN	7.56	2.93
Bangladesh	40.76	31.24	13.37	3.03
Burundi	55.27	16.13	5.47	1.04
Chad	34.6	NaN	12.91	3.93
Eritrea	47.75	NaN	14.77	4.4
Guatemala	49.34	11.45	1.24	0.37
India	38.91	NaN	18.37	6.3
Madagascar	46.47	18.21	9.08	2.24
Malawi	44.48	15.47	3.86	1.34
Niger	46.06	NaN	12.75	2.86
Papua New Guinea	46.53	NaN	11.62	5.03
Somalia	33.62	NaN	13.75	4.33
South Sudan	33.7	NaN	23.63	11.4
Sri Lanka	17.3	16.86	15.83	2.77
Sudan	36.86	NaN	15.38	4.74
Timor-Leste	53.82	NaN	15.98	4.67
Yemen	51.82	NaN	14.67	4.88



Correlation between Stunting, Wasting and Prevalence of low birth weight among new-borns

Indicator	Height-for-age <-2 SD (stunting)	Prevalence of low birth weight among new-borns	Weight-for-height <-2 SD (wasting)	Weight-for-height <-3 SD (severe wasting)
Indicator				
Height-for-age <-2 SD (stunting)	1	0.61	0.61	0.56
Prevalence of low birth weight among new-borns	0.61	1	0.63	0.47
Weight-for-height <-2 SD (wasting)	0.61	0.63	1	0.92

Weight-for-height <-3 SD (severe wasting)	0.56	0.47	0.92	1



The correlation coefficients between stunting, wasting, and the prevalence of low birth weight among newborns are as follows:

Stunting (Height-for-age <-2 SD) and the prevalence of low birth weight among newborns: The correlation coefficient is 0.61. This suggests a moderate positive correlation, indicating that there is a tendency for areas with higher stunting rates to also have higher prevalence of low birth weight among newborns.

Stunting (Height-for-age <-2 SD) and wasting (Weight-for-height <-2 SD): The correlation coefficient is 0.61. This indicates a moderate positive correlation, implying that areas with higher stunting rates also tend to have higher rates of wasting.

Stunting (Height-for-age <-2 SD) and severe wasting (Weight-for-height <-3 SD): The correlation coefficient is 0.56. This indicates a moderate positive correlation, suggesting that areas with higher stunting rates are also likely to have higher rates of severe wasting.

The prevalence of low birth weight among newborns and wasting (Weight-for-height <-2 SD): The correlation coefficient is 0.63. This indicates a moderate positive correlation, implying that areas with higher prevalence of low birth weight among newborns also tend to have higher rates of wasting.

The prevalence of low birth weight among newborns and severe wasting (Weight-for-height <-3 SD): The correlation coefficient is 0.47. This indicates a moderate positive correlation, suggesting that areas with higher prevalence of low birth weight among newborns are also likely to have higher rates of severe wasting.

Wasting (Weight-for-height <-2 SD) and severe wasting (Weight-for-height <-3 SD): The correlation coefficient is 0.92. This indicates a strong positive correlation, implying that areas with higher rates of wasting are highly likely to have higher rates of severe wasting.

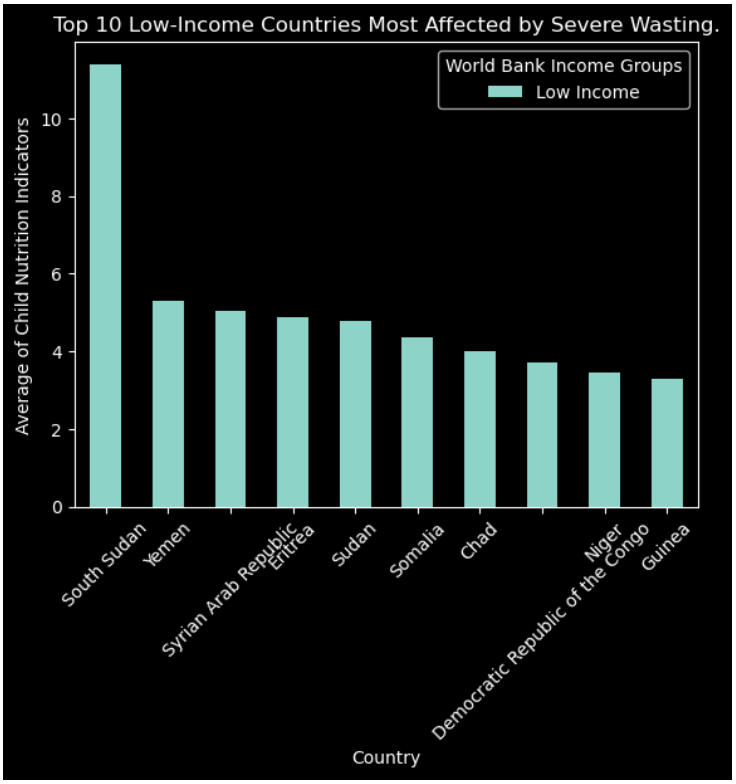
In summary, the data suggests that stunting, wasting, and the prevalence of low birth weight among newborns are positively correlated, despite the fact that to varying degrees. Higher rates of stunting are associated with higher rates of low birth weight, wasting, and severe wasting. Similarly, areas with higher prevalence of low birth weight among newborns are more likely to have higher rates of wasting and severe wasting. Additionally, wasting and severe wasting are strongly correlated, indicating that they tend to occur together.

Stunting, Wasting and Prevalence of low birth weight relationship with Income

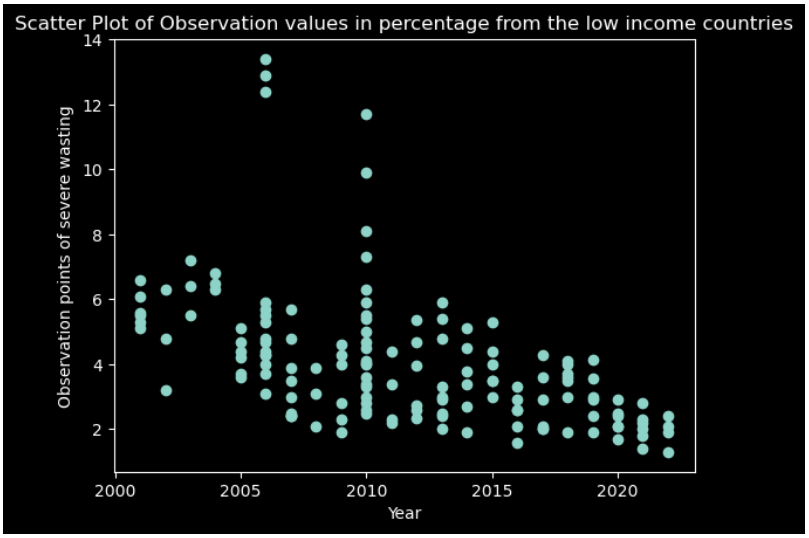
Sever wasting among children below 5 years have impacted more with countries income.

Sever wasting depending on the income

World Bank Income Groups	
Low Income	2.67
Lower Middle Income	2.23
Upper Middle Income	1.25
High Income	0.58



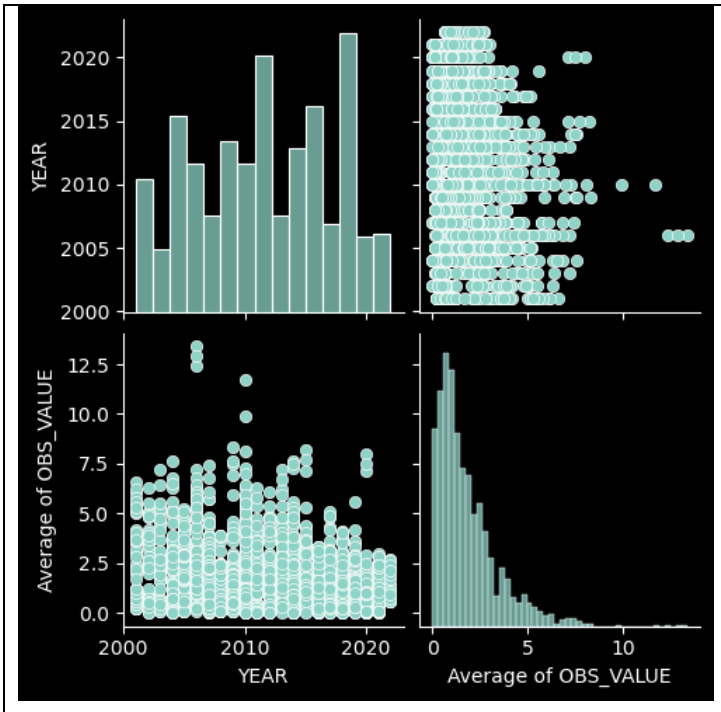
World Bank Income Groups	Low-Income Estimation value
Countries and areas	
South Sudan	11.4
Yemen	5.3
Syrian Arab Republic	5.03
Eritrea	4.87
Sudan	4.77
Somalia	4.35
Chad	4
Democratic Republic of the Congo	3.72
Niger	3.44
Guinea	3.2



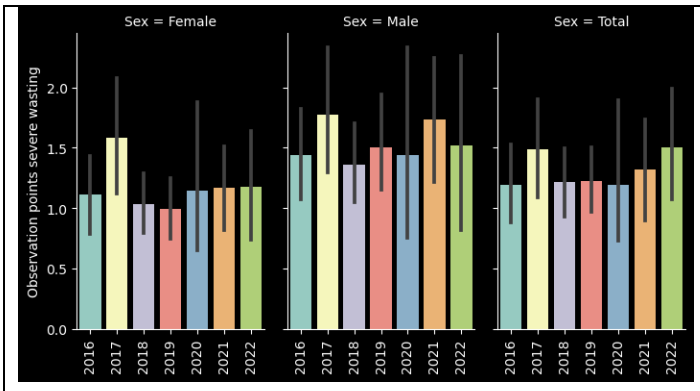
Scatter plot drawn on the countries South Sudan, Yemen, Syrian Arab Republic, Eritre, Sudan. Somalia, Chad, Democratic Republic of the Congo, Niger, Guinea.

From the Scatter plot the low-income countries stunting is gradually reducing over the past 5 years. During the 2005 and 2010 Severe wasting highly affected.

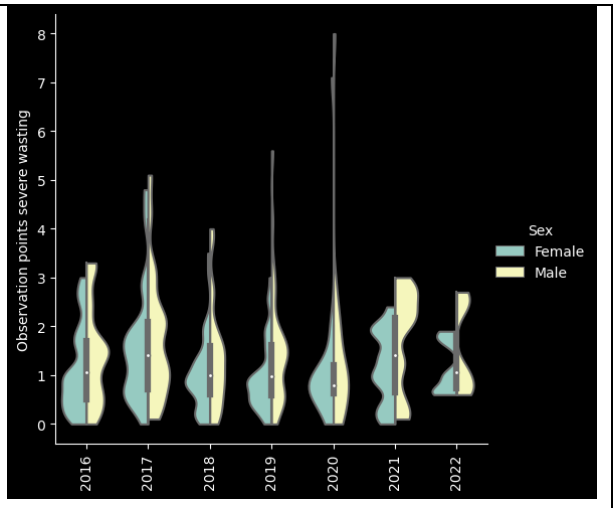
Pairplot on global severe wasting data



Categorical plot depicting the severity wasting on global data among genders and total population



Categorical plot: Severe wasting comparison between males, Females & country's total wasting records under 5-year-old infants

Categorical plot: Severe wasting comparison between genders under 5-year-old infants. The severity among male children is higher compared to female children. Severe wasting in 2022 in male children below 5 years is 3%, and females Children's highest severity is 2%	

Geospatial Analysis using Choropleth Map

In this step, geospatial analysis is made on the Stunting data.

Objective 3: Does progress to reduce stunting has equal across regions and sub-regions?

Hypothesis: Progress to reduce stunting has been equal across regions and sub-regions.

Datasource:

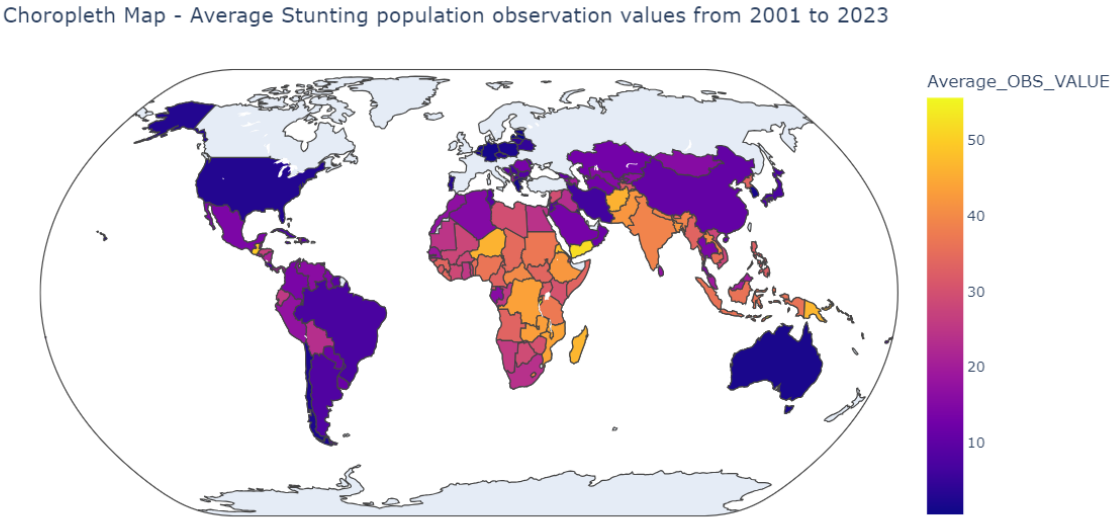
- UUNICEF_Database_wasting_stunting.csv

Geospatial Analysis on Stunting Data

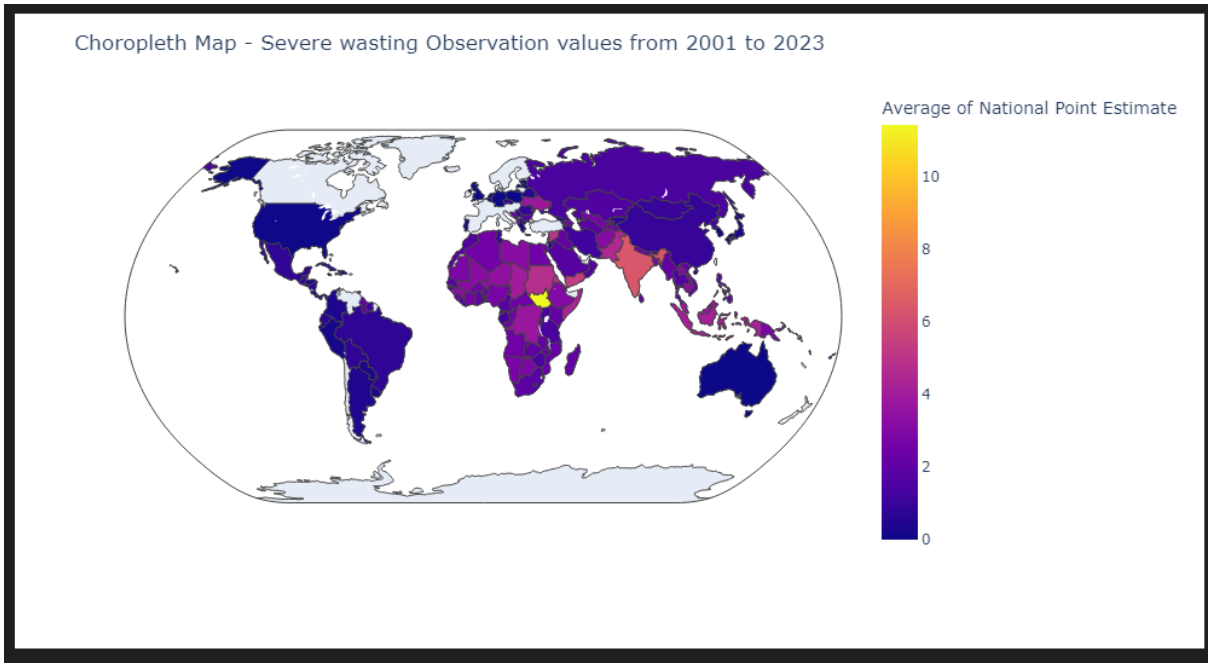
For analysis and visualisation, the Plotly library is installed. Refer to the link for the Getting Started with Plotly in Python.

Getting started with plotly in Python

Average Stunting population observation values from 2001 to 2023



Geospatial Analysis On Severe Wasting Data



From the above analysis, it is clear that nutrition deficiency isn't the same globally. One of the reasons for malnutrition is because of low-income countries and the country's financial stability.

Some of the most affected reasons due to Wasting are South Sudan, India, Timor-Leste, Sri Lanka, Sudan, Eritrea, Yemen, Somalia, Bangladesh, and Chad.

And some of the Stunting affected reasons are Burundi, Timor-Leste, Yemen, Guatemala, Eritrea, Papua New Guinea, and Madagascar.

This observation provides enough evidence to conclude that malnutrition globally isn't the same.

Supervised Machine Learning: Regression

Objective:

Identify the number of deaths and affected due to mall nutrition(stunting, overweight, wasting and severe wasting).

Hypothesis:

Malnutrition among children under the age of 5 is directly related to the mortality count in the nations.

Datasource

UNICEF_Global_Databases_Mortality dataset contains the mortality rate in each geographic region with year.

Limitation: Data isn't recorded every year.

UNICEF_Global_Joint-Malnutrition-Estimates contains global stunting, wasting and overweight information.

In regression analysis, **independent variables** are also known as explanatory variables because they help explain the trends (if any) that we see in the **dependent variable**. The dependent variable is also known as the response variable because it responds to changes in the explanatory variables.

Dependent Variables

- Stunting Observation value collected from the Sample data

Independent Variables

- Mortality rate under five years of age.

Linear Regression Analysis

1. **Data Sourcing and Data Wrangling**

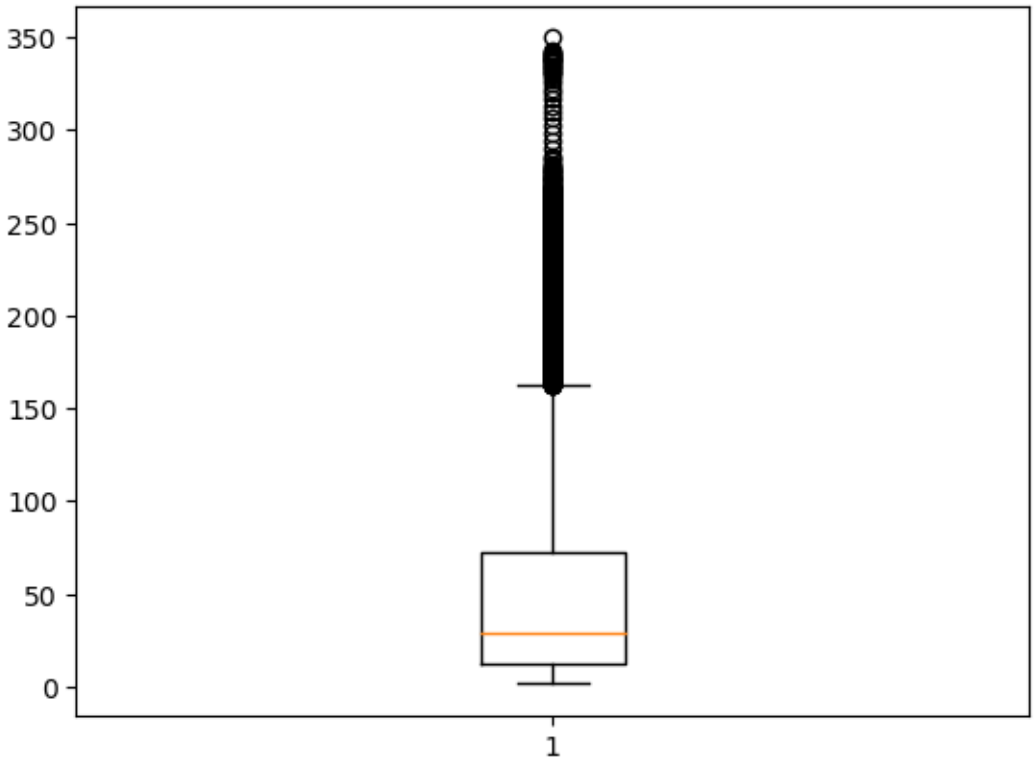
Data Source	UNICEF_Global_Databases_Mortality.csv UNICEF_Global_Databases_Stunting.xls
Filter the columns	['REF_AREA:Geographic area', 'TIME_PERIOD:Time period', 'OBS_VALUE:Observation Value']

	['REF_AREA:Geographic area', 'INDICATOR:Indicator' = 'CME_MRY0T4: Under-five mortality rate', 'TIME_PERIOD:Time period', 'OBS_VALUE:Observation Value']
Unique types in Date column	All the values are converted to year column in YYYY format
REF_AREA:Geographic area	Geographic data contains the name for different reasons. Also it has some extra character which requires to filter out.
Data type conversion	Convert the year column to an integer. Convert the OBS values to float

2. Exploratory Analysis

Performed some basic exploratory analysis on the
UNICEF_Global_Databases_Mortality.csv, UNICEF_Database_wasting_stunting.csv.

1. Removing the outliers from the dataset



2. Updating the countries name to a proper convention by removing REF_AREA

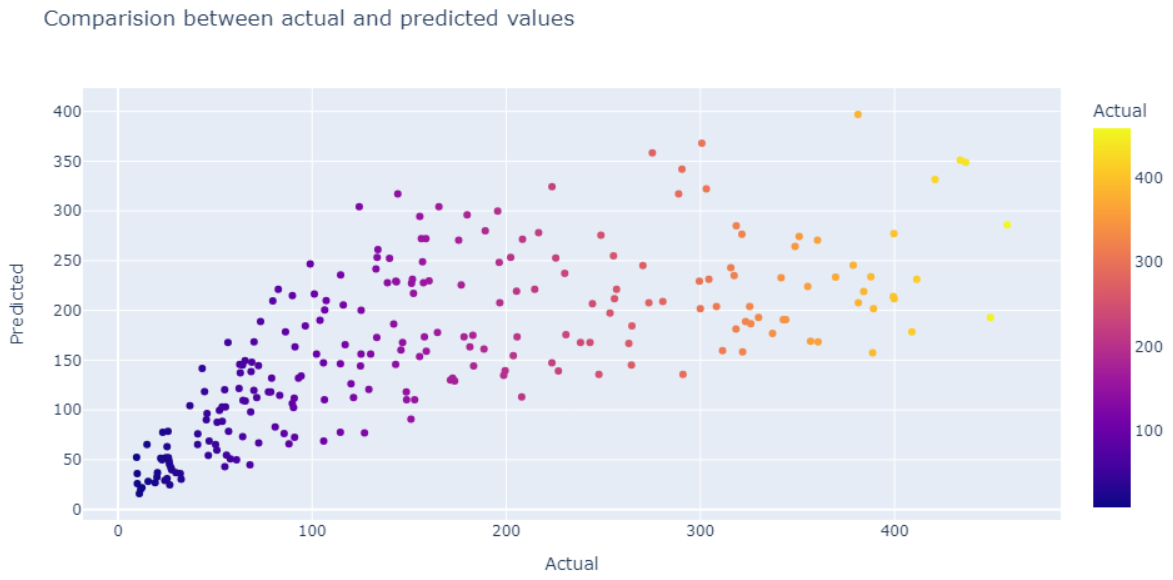
Comparison with the Stunting observation dataset with the mortality data set.

. 3. Model training and evaluation:

Coefficient
National Point Estimate 5.55

According to the above coefficient result increase in stunting observation by 5.55 increases one mortality rate.

3. Testing the Linear Regression Model.



The prediction values are almost the same as actual. But some of the values which have higher mortality rate are deviated

```
MAE: 66.28091714178167
MSE: 7137.504180438801
RMSE: 84.48375098466451
```

MAE represents the average magnitude of the errors between the predicted and actual values. It measures the average absolute difference between the predicted and actual values. the MAE is 66.28091714178167.

MSE calculates the average of the squared differences between the predicted and actual values. It gives higher weights to larger errors due to the squaring operation. In this case, the MSE is 7137.504180438801.

RMSE is the square root of MSE. It measures the typical magnitude of errors in the same units as the dependent variable. By taking the square root of MSE, RMSE cancels out the squaring operation, giving a more interpretable value. In this example, the RMSE is 84.48375098466451.

The model's predictions have less deviation from the actual values. It means the number of national mortality under age five and the stunting observation is positively correlated. An increase in stunting observation values by 5.55 increases the mortality count by 1.