

# Malnutrition in Africa – A Study

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**Abstract** – This is a study on malnutrition in African children aged between 0 - 59 months, with a focus on stunted growth. Despite the fact that chronic undernutrition is on the decline, the number of stunted children under the age of five is on the rise as a result of population growth [1]. Malnutrition plays a significant role in child mortality and morbidity. The UNICEF data revealed how the rate of malnutrition in each country has changed over time. The goal of the analysis, which was carried out on a Jupyter notebook, was to identify the factors that contribute to malnutrition in children.

**Keywords** – Malnutrition, stunting, population, point estimate, gross domestic product, income groups.

## I. INTRODUCTION

Malnutrition in children is a pathological condition caused by poor nutrition or a lack of energy intake in the form of protein and other nutrients. Stunting is caused by malnutrition, in which a child is too short for his or her age, when compared to the WHO standards and it impedes cognitive development in children. According to World Health Organization (WHO) [2] stunting is observed in 21.9 percent or 149 million children under the age of 5, and the cause of almost 45 percent of deaths in children is due to malnutrition. Sub-Saharan Africa has the highest proportion of undernourished children. According to Global nutrition report, the prevalence in stunting in Africa is 30.7 percentage which is higher than the global average of 22 percentage [3] Malnutrition in children is caused by a variety of factors such as the country's population, gross domestic product, education, and so on, the aim of the study is to identify any patterns influencing the malnutrition rate in Africa.

## II. DATA, RESEARCH QUESTION and ANALYTICAL APPROACH

### A. Data

For this study global data was collected from various sources out of which data of African countries were extracted.

For this study below datasets were used

- **Malnutrition Estimate - Country level**  
This dataset consists of records of all the countries around the world with country codes from 2000 to 2020; it consists of number of affected children aged between 0-59 months who are Stunted i.e., below height-for-age of the WHO Child Growth Standards. This dataset was extracted from UNICEF site[4]

- **Population data (2000 - 2020)**  
This dataset consists of population of all countries with country code from 2000 to 2020.
- **GDP – Country level**  
This dataset consists of GDP per capita by country for years 1990, 2000 and 2011 to 2020. GDP and Population datasets were extracted from World Data Bank[5]
- **Countries Data**  
This dataset contains African countries with country codes and information about the Income Groups to which they belong.

The COUNTRY CODE is unique to each country across the globe and was used to filter countries in Sub Sahara Africa. There are totally 54 countries in Africa that are divided into four income groups. Figure 1 shows the number of countries in each income group.

Files 1, 2, and 3 contained global data, from which African countries were extracted for analysis. Malnutrition data had three estimates on the number of affected(stunted) children for each country; a Point Estimate, Lower and Upper uncertainty bound. For this study we have used only the Point estimate i.e., an estimate parameter of the population. Similarly, Population and GDP data contains Global data out of which African countries were extracted using Country Codes.

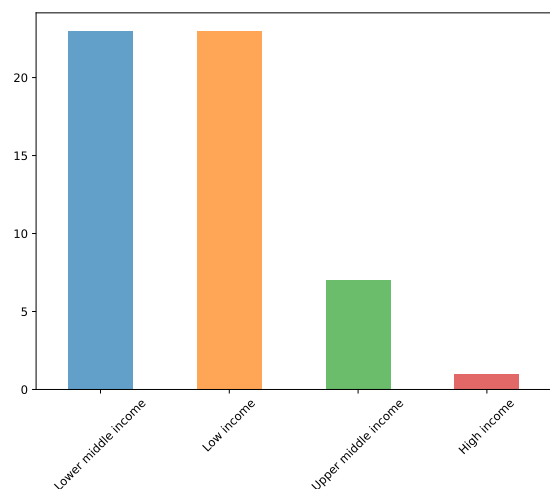


Figure 1 - Income Group classification in Africa

Few countries did not have records on Stunting numbers or GDP for certain years, these data were not included in the study.

### *B. Research Questions*

Africa is the second-largest continent in terms of both size and population, and it also has the highest proportion of undernourished children. Despite the fact that global malnutrition is decreasing, African countries continue to struggle to overcome hunger. In this study we will,

1. Determine whether population has an impact on a country's economy and whether it influences malnutrition rate.
2. Is there a relationship between a country's Gross Domestic Product (GDP) and its malnutrition rate?
3. How have the countries with the highest malnutrition rates fared over time, and has there been any progress?
4. How did the COVID 19 pandemic affect the GDP of the country?

The results aim to understand how these factors affect the rate of stunting in countries in Africa.

## III. ANALYSIS

The objective of this study is to determine the factors influencing the rate of stunting in Africa. The following strategy was devised to investigate the research questions, while the steps in this report are presented in a linear order, many of them were revisited multiple times to achieve a more comprehensive result.

1. Import malnutrition data from UNICEF, import GDP and Population data from Data Bank.
2. Import countries dataset to obtain the set of countries present in Sub – Saharan Africa.
3. The extracted datasets have global data, filter data of African countries using the country codes from country dataset
4. Perform exploratory data analysis.
5. Clean the data, merge and reshape data and handle missing values.
6. Investigate and build data to answer the research questions
7. Construct visual models/figures to analyze.
8. Repeat the above steps multiple times until the questions are answered.
9. Report the results and findings.

The metadata country dataset, which contained all the countries with country codes mapped to regions, was imported as the first step of analysis. The countries in the Sub-Saharan Africa region were filtered, using the African countries dataset, yielding 54 countries their sub region, population and their respective income groups. There were no missing values and a bar plot was plotted to show the distribution of countries and its income group.

To obtain geographical location from natural earth data, the Geopandas library was imported. This is a collection of global geolocation data from which African countries were filtered and merged using the country dataset. Following the merge, each country's income groups were mapped to the geo dataset, and a map with income group distribution and population (2019-2020) were generated.

The main dataset for analysis, the malnutrition dataset comprised of multiple sheets, out of which stunting data was imported. This data comprised of global stunting data for every year since 2000, the estimate and few other features. Unwanted columns were dropped, and the data was transformed by melting the Year columns to rows and then pivoting on the Estimates. This kind of structuring was done to make data more flexible to merge. One major step for analysis is to check and handle outliers, on visualizing a scatterplot for stunting data of each country; a few outliers were observed but however these values were practical values and were not altered, Figure 9.

An aggregate sum of stunting in Africa, that included all countries over the years were plotted to understand a general trend. For visualization purpose, a copy of the actual dataset but with a different structure is constructed. On analysis 7 countries with high stunting rate were retrieved and the change in stunting rate is visualized. GDP data was obtained from world data bank, this gave information on the GDP per capita of the country since 2000. A similar transformation like stunting data was performed to structure the data and was merged with stunting with country code and year. Multiple graphs were created to visualize how the change in GDP impacted Stunting and vice versa.

All datasets consisted of few null values and special characters representing null values, these were dropped only if it was necessary for analysis as dropping or replacing the values were not required during analysis. Columns that were not required as part of analysis were dropped. Multiple datasets were created as a part of data transformation and structuring to ease working with data.

The first research question to analyze how population play a role; population of each country was visualized generating a map that showed variation between countries of highly populated to least populated. This was compared with the plot of stunting rate in 2019 and the income group distribution map to get an idea of how population influences the malnutrition rate. The stunting map visualize the density of stunted children of each country in the year 2019. This analysis was carried out for year 2019 as the COVID 19 pandemic might hugely influence data.

The second research question of how GDP influences stunting rate or vice versa; For this study, we analyze GDP of all African countries from the year 2019 and compared it to the stunting rate for the same year, by plotting a bar chart with GDP and number affected in stunting of each country. This was achieved by merging the GDP data with stunting for that year and data was cleaned. The twin axis bar chart helped in visualizing the performance of each country and few analyses have been made with respect to the chart.

The research question of how these countries have performed over the years was analyzed by plotting a line plot of GDP change along with the stunting years for each country. As displaying 54 countries plot in this study is difficult, few countries were chosen where the trend of malnutrition changed over the last few years. This plot helped in analyzing of how malnutrition rate is related GDP change. In addition to this, a plot was created to evaluate the economy of low-income countries. These were done by transforming and binding data to obtain an analysis.

The last question of how the pandemic had an effect on the GDP; COVID 19 was an unexpected turn of events which impacted the whole world; even developed countries suffered from economic crises. Here we analyze how this affected African countries. For this, the analysis was carried out to compare 2019's GDP growth to 2020's GDP growth. Hence GDP growth from 2018 to 2019 was calculated and 2019 to 2020 was calculated. Also, to understand the change; the GDP data of countries were plotted for all three years.

#### IV. FINDINGS AND REFLECTIONS

##### A. Distribution of income groups

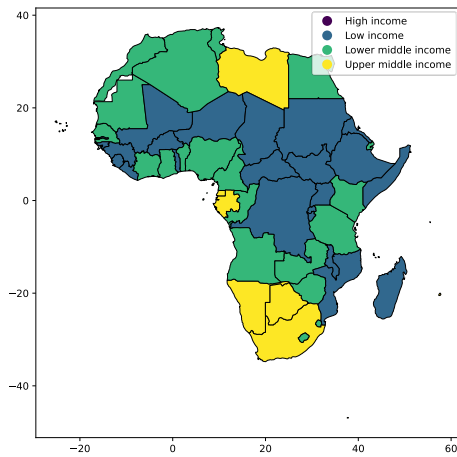


Figure 2 - Income Groups in African Countries

The first analysis was carried out to determine if there is a demographic pattern when comparing income groups. Figure 2 Majority of countries in Central Africa are in the Low-Income group. Only one country Seychelles belongs to High-Income group

##### B. Impact of Population

Africa is a densely populated region; Figure 3 depicts how the population is distributed across the continent. The hypothesis that countries with the highest stunting rates are those with the largest populations has been disproved, as the African countries with the largest populations have a moderate stunting rate.

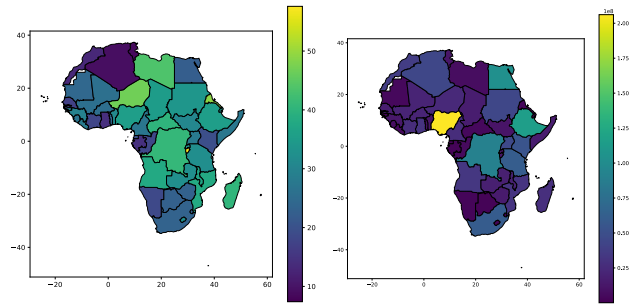


Figure 3 - Stunting 2019.

Figure 4 - Population

Figures 3 and 4 show that when compared to other African countries, the countries with the highest stunting rates are those with a smaller population but a lower income group.

##### C. Impact of GDP on Stunting rate

A country's economic status is determined by its gross domestic product (GDP). The overall GDP has increased significantly since 2000. Countries with low GDP have a higher proportion of stunted children than countries with high GDP. This is the general trend, but there are few exceptions; Nigeria has the highest GDP among all countries in 2019, but also has a moderately high stunting rate. Even though Nigeria is not a poor country, millions of children are malnourished [6]. Seychelles a high-income country, on the other hand, has a low GDP and a low stunting rate, Figure 5

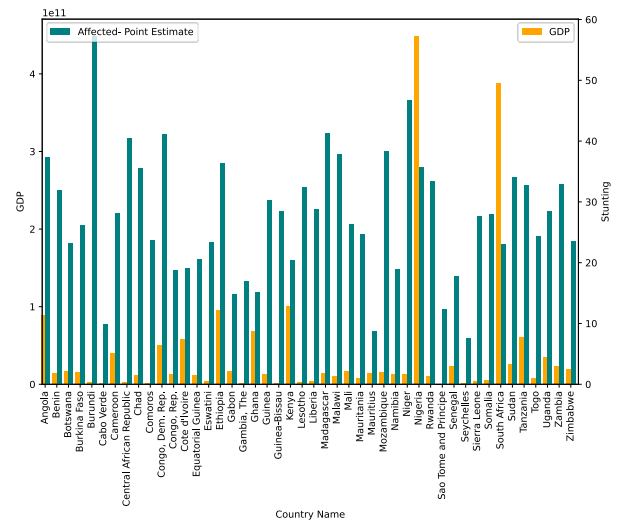


Figure 5 - Stunting affected numbers vs GDP (2019)

##### D. GDP trend over the years

Since 2011, Africa's GDP has increased. Few countries have seen their GDP fall in recent years, and this has an impact on the rate of stunting. A change in stunting can be observed in few countries when the GDP drops continuously for a few years. Four countries were chosen for the study as there was a significant change in stunting rates in the last few years.

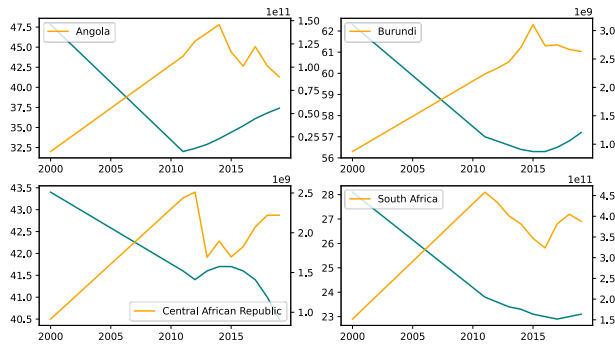


Figure 6 - Change of GDP and Stunting (2000-2019); orange line represent change in GDP; green line is change in stunting

Figure 6 shows the evolution of GDP and the stunting rate from 2000 to 2019. It has been observed that as stunting increases, GDP decreases over time. In other countries, the rate of stunting has been steadily decreasing. Malnutrition costs African economy between 3% and 16% of their GDP per year [7]. When economy is down it will lead to inadequate income leading to malnourished children; the high number of malnourished children forces the economy to invest in their improvement. Most of the developing countries have been observed to be stuck in this loop.

Figure 7 captures the change in GDP for countries in the Low-Income group, except Nigeria, Angola, and Kenya, other countries have not experienced significant GDP growth.

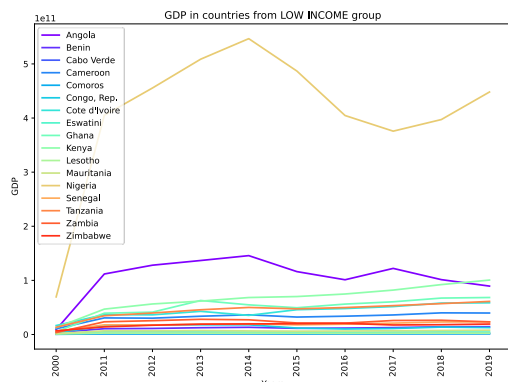


Figure 7 - GDP trend of Low Income Group from since 2010

#### E. COVID-19 pandemic's Effect on GDP

When compared to 2019, Africa's GDP for 2020 has dropped dramatically, with a GDP growth of -5.5552 percent. Figure 8 depicts how the pandemic affected low-income countries, Except for a few countries, GDP fell drastically in 2020. COVID-19 had an impact on all income groups, including Seychelles, a High-Income country saw a 33.33% drop in GDP. Table 1 shows the top 6 countries of all income groups with the highest GDP decline in 2020.

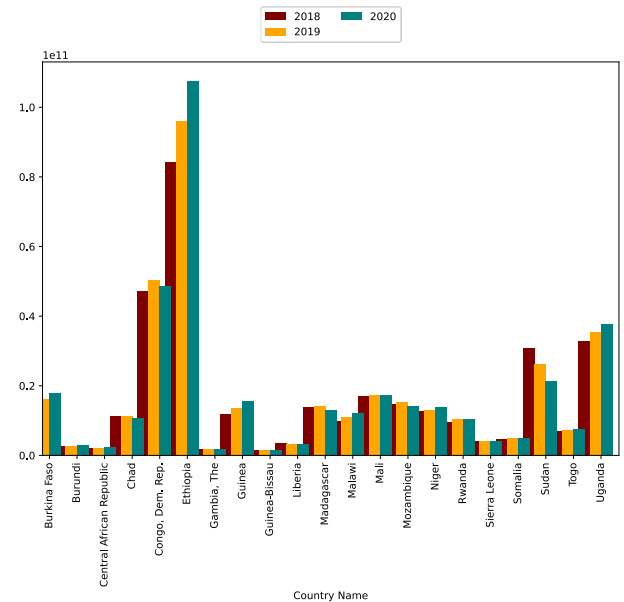


Figure 8 - GDP of Low-Income countries between 2018 - 2020

Table 1 - GDP growth in 2020

GDP Percentage change				
Country	Income Group	2019	2020	GDP % 2020
Angola	Lower middle	8.94E+10	5.84E+10	-34.715041
Seychelles	High	1.58E+09	1.06E+09	-33.03899
Zambia	Lower middle	2.33E+10	1.81E+10	-22.300873
Mauritius	Upper middle	1.40E+10	1.09E+10	-22.250072
Lesotho	Lower middle	2.37E+09	1.88E+09	-20.74984
Congo, Rep.	Lower middle	1.28E+10	1.02E+10	-20.103126

#### V. FUTURE WORK

Include more information with respect to diseases and how they affect children. Analyze the Import and Export of each country and how its contribute to the GDP influences the rate of malnutrition.

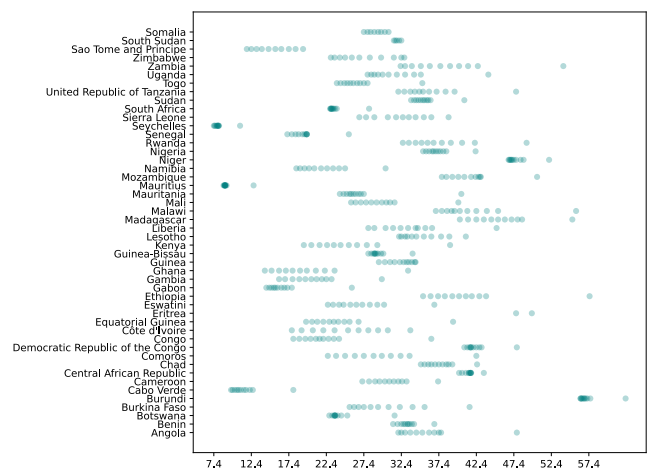


Figure 9 - Scatterplot of Stunting for each country

Table 2 - Word count of each section

Word Count			
S. No	Section	Count	Section no
1	Abstract	113	
2	Introduction	164	I
3	Data	291	II
4	Research Questions	125	II
5	Analysis	935	III
6	Findings and Reflection	547	IV
7	Future Work	32	V

## REFERENCES

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