Using Diet Analysis to Predict and Prevent Child Malnutrition

Introduction:

Child malnutrition is a persistent global concern, severely affecting the physical and cognitive development of young lives. Stunting (low height for age), Wasting (low weight for height), Underweight (low weight for age), Overweight (high weight for height), and Obese are different aspects of malnutrition that reflect the various ways inadequate nutrition can impact an individual's health and well-being. This article delves into the intricate manifestations of malnutrition, encompassing stunting, wasting, underweight, overweight, obese and micronutrient deficiencies. Leveraging the power of AI, we explore the potential of machine learning and deep learning in modeling complex dietary patterns to predict these malnutrition indicators.

Relevant Literature:

In [1], the team Seaborn used deep learning regression and also machine learning regression-based techniques such as Linear regression, Random Forest, Decision tree, Polynomial Regression, Ridge Regression, and Lasso Regression for its model buildings and testing. Their research focused on the identification and prediction of major risk factors for stunting, wasting, and underweight using ML algorithms which will aid in reducing malnutrition among children. They analysed the diet variables such as exclusive breastfeeding, early initiation, solid foods, etc. to predict the burdens of malnutrition such as stunting, wasting and overweight of children. Malnutrition can be caused by lack or excess of both macronutrients as well as the micronutrients. However, the contribution of micronutrients towards malnutrition was not considered in the work done during the previous cohort.

The Dataset

The dataset for this project was sourced from the UNICEF data warehouse. In this data warehouse, the Malnutrition data is available from the year 1970 to 2022. This data is available across 346 geographic regions and 608 indicators of Malnutrition are available for exploration. Since our study mainly focuses on diet analysis for malnutrition prediction, a customized dataset was sourced from this data warehouse containing only the Nutrition related features [2].

Methodology:

Our study utilizes a comprehensive dataset from the UNICEF repository spanning over five decades. Through meticulous data preprocessing, we structured the dataset for subsequent analysis. We used lambda functions and pivot tables for this purpose. Exploratory data analysis was carried out on the data. This was helpful in answering questions like which are the top 10 countries that are affected by Stunting?

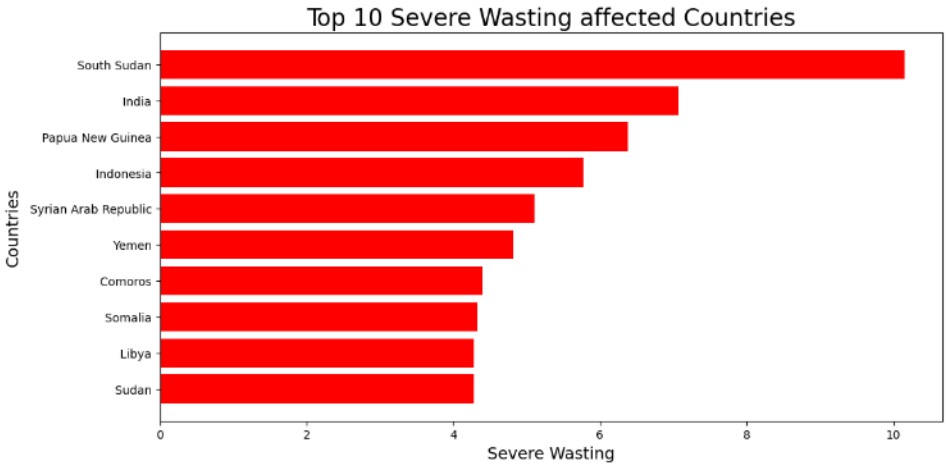

Figure 1. Top 10 Severe wasting affected countries

Feature engineering, model selection, and performance evaluation form integral components of our approach. The data had multicollinearity problem. It was solved using Principal Component Analysis. Machine learning models, including ElasticNet, XGBoost, Linear Regression, and Gradient Boosting, are employed. Concurrently, deep learning architectures such as Convolutional Neural Networks (CNN) and Recurrent Neural Networks (RNN) are developed.

Results and Implications:

With the help of the time series forecasting model we were able to look into the future trends of the various burdens of Malnutrition. We saw the data for next five years.

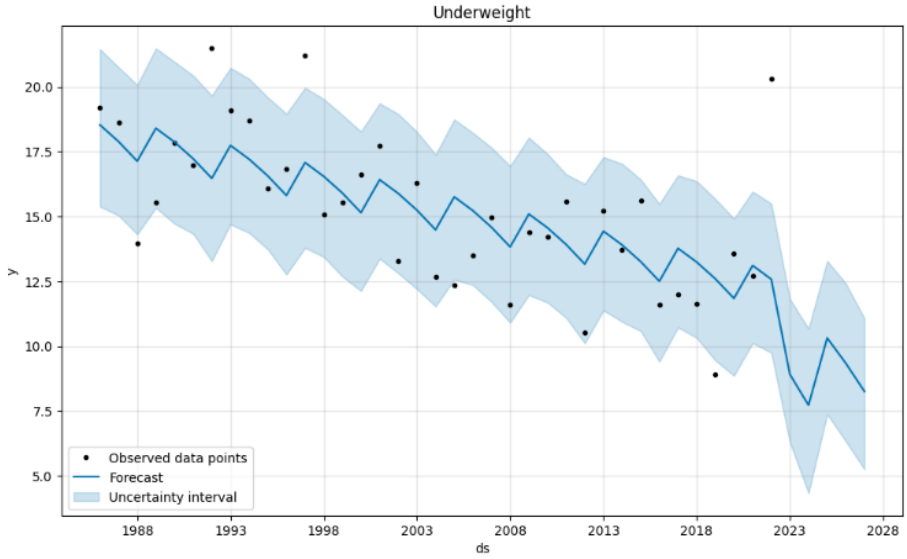

Figure 2. Global Annual Underweight forecast

The research underscores the efficacy of AI models in predicting malnutrition indicators. Model performance is evaluated using Mean Squared Error (MSE), revealing ElasticNet as the top performer, followed by CNN and Gradient Boosting. Time series forecasting sheds light on potential trends, aiding in proactive policy formulation and intervention strategies

Interactive dashboard for visualizing Malnutrition data was developed. This dashboard was developed in python using plotly and dash. Governments, healthcare professionals, and communities can use this dashboard to understand the trends and combat malnutrition

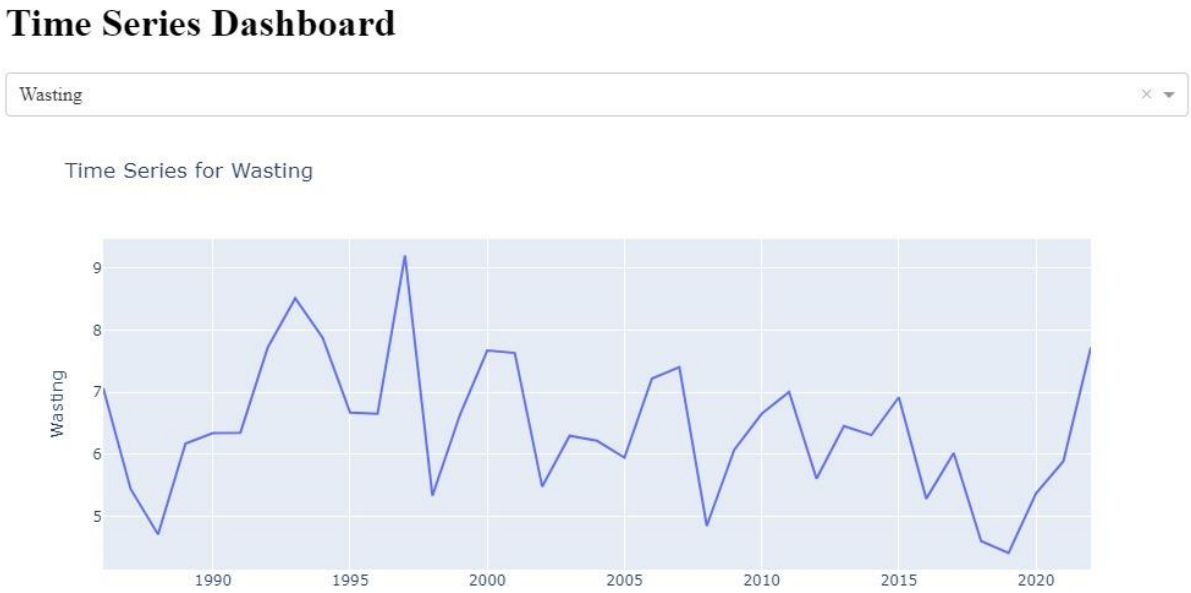

Figure 3. Time series Dashboard

Conclusion:

Our study showcases the transformative potential of AI in addressing the intricate challenge of child malnutrition. By integrating machine learning and deep learning, we enhance predictive accuracy and illuminate the nuanced interplay between diet and malnutrition. These insights are instrumental in devising evidence-based strategies to combat malnutrition's adverse impact on global child health.

Our machine learning and deep learning models have performed better compared to the work done by the Seaborn team in the previous cohort. Also, we have carried out extensive diet analysis by considering a wider range of diet related features. Also, we have predicted indicators of malnutrition that are related to micronutrient deficiencies. With interactive dashboards, the work has become more user friendly.

To combat malnutrition, interventions should focus not only on increasing access to nutritious food but also on educating individuals about the importance of a balanced diet and healthy lifestyle choices. Governments, healthcare professionals, and communities can use these dashboards to better understand the situation and educate people.

References:

[1] Team Seaborn, "Machine Learning for Malnutrition Risk Prediction," HDSC 2023 Winter Cohort.

[2] Data Warehouse - UNICEF DATA