# Machine Learning to Predict Undernutrition in Ghanaian Children under Five Years

Eric Komla Anku, MPH, RD [1] Henry Ofori Duah, MPH, RN [2]

[1]Cape Coast Teaching Hospital, Cape Coast, Ghana [2]University of Cincinnati College of Nursing, Ohio, United States of America

## INTRODUCTION

Undernutrition among children under the age of five is a major public health concern, especially in developing countries. This study aimed to use machine learning (ML) algorithms to predict undernutrition.

## METHODS

Secondary data analysis of the 2014 Ghana Demographic and Health Survey was performed using R, version 4.2.2. The main outcomes of interest were undernutrition (stunting: height-for-age (HAZ) < -2 SD; wasting: weight-for-height (WHZ) < -2 SD; and underweight: weight-for-age (WAZ) < -2 SD). Six ML algorithms were trained and tested: linear discriminant analysis (LDA), logistic model, support vector machine (SVM), random forest (RF), least absolute shrinkage and selection operator (LASSO), and ridge regression. Training dataset was oversampled to deal with class imbalance. The ML models were evaluated using the accuracy, confusion matrix, and area under the curve (AUC) receiver operating characteristics (ROC).

## CONCLUSION

The RF and SVM models were relatively better classifiers for predicting wasting, stunting and underweight. The findings showed that different ML algorithms could be useful for predicting undernutrition and identifying important predictors for targeted interventions.

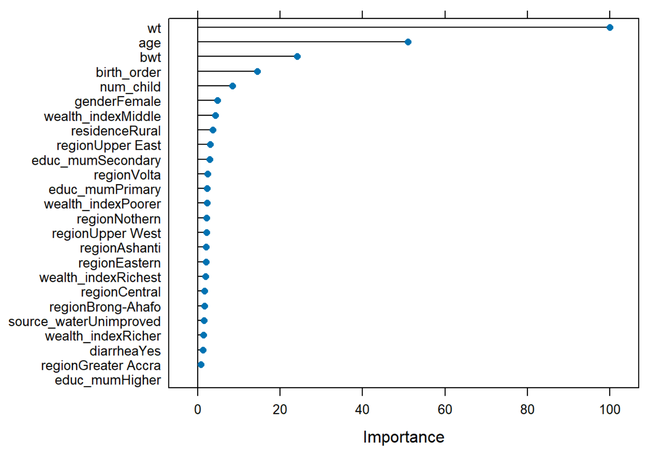


Figure 1. Important variables from the random forest model for wasting

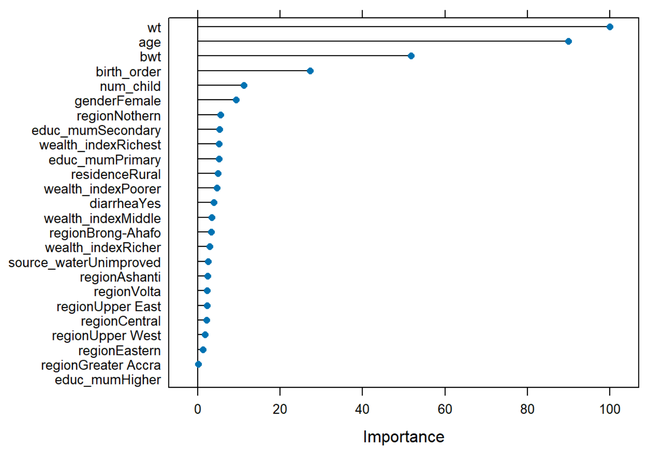


Figure 2. Important variables from the random forest model for stunting

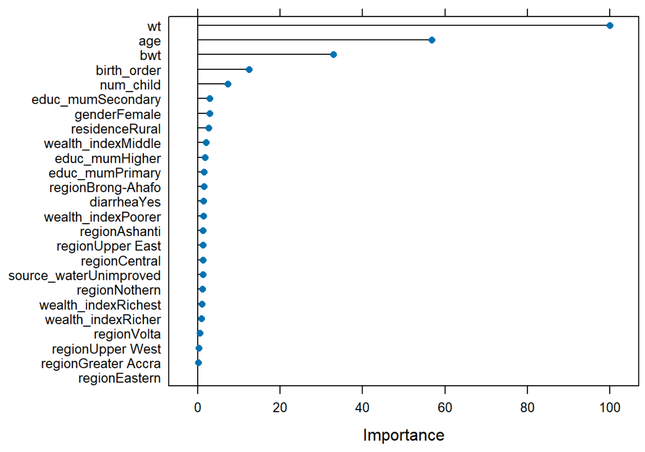


Figure 3. Important variables from the random forest model for underweight

## References

[1] United Nations Children's Fund (UNICEF). Malnutrition [Internet]. 2022 [cited 2022 Dec 24]. Available from: https://data.unicef.org/topic/nutrition/malnutrition/

[2] WHO. Malnutrition [Internet]. 2021 [cited 2023 Jan 31]. Available from: https://www.who.int/news-room/fact-sheets/detail/malnutrition

## RESULTS

In total, 1557 children were included in the final analysis. The average age of the children was 26 months, and the majority were males. The weighted prevalence rates of stunting, wasting, and underweight were 14%, 5%, and 10%, respectively. The accuracies of all the ML models for wasting were (LDA: 77%; Logistic: 83%; SVM: 100%; RF: 100%; LASSO: 82%; Ridge: 78%), stunting (LDA: 76%; Logistic: 76%; SVM: 99%; RF: 100%; LASSO: 75%; Ridge: 76%), and for underweight were (LDA: 84%; Logistic: 91%; SVM: 100%; RF: 100%; LASSO: 94%; Ridge: 82%), respectively. The AUC values of the wasting models were (LDA: 82%; Logistic: 82%; SVM: 100%; RF: 100%; LASSO: 80%; Ridge: 76%), for stunting were (LDA: 75%; Logistic: 76%; SVM: 99%; RF: 100%; LASSO: 77%; Ridge: 77%), and for underweight were (LDA: 91%; Logistic: 95%; SVM: 100%; RF: 100%; LASSO: 96%; Ridge: 86%).

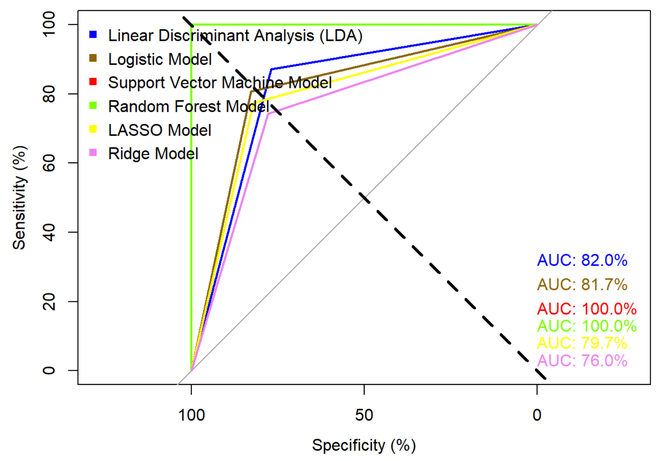


Figure 5. Receiver Operator Characteristics on the ML models for wasting test data

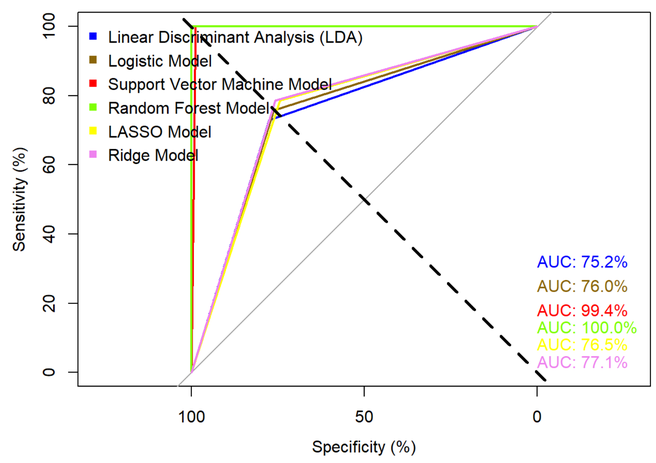


Figure 6. Receiver Operator Characteristics on the ML models for stunting on test data

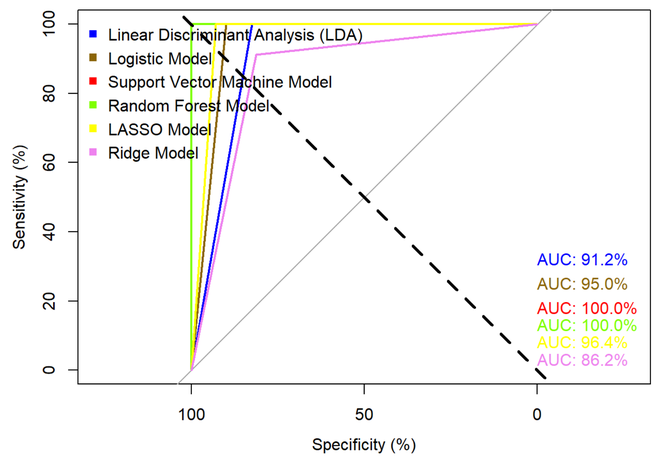


Figure 7. Receiver Operator Characteristics on the ML models for underweight on the test data

Table 1. Accuracy of Predictive algorithms for child undernutrition indicators on the test data

| | Linear Discriminant Analysis | Logistic Model | Support Vector Machine | Random Forest | LASSO | Ridge |
|---|---|---|---|---|---|---|
| **Wasting** | | | | | | |
| Accuracy | 77% | 83% | 100% | 100% | 82% | 78% |
| Sensitivity | 87% | 81% | 100% | 100% | 77% | 74% |
| Specificity | 77% | 83% | 100% | 100% | 82% | 78% |
| | | | | | | |
| **Stunting** | | | | | | |
| Accuracy | 76% | 76% | 99% | 100% | 75% | 76% |
| Sensitivity | 73% | 76% | 100% | 100% | 79% | 79% |
| Specificity | 77% | 76% | 99% | 100% | 74% | 76% |
| | | | | | | |
| **Underweight** | | | | | | |
| Accuracy | 84% | 91% | 100% | 100% | 100% | 100% |
| Sensitivity | 100% | 100% | 100% | 100% | 100% | 91% |
| Specificity | 82% | 90% | 100% | 100% | 93% | 81% |



ankueric1@gmail.com