Rating immunity-boosting capabilities of foods

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Springboard

Problem Statement

The immune system is the first line of defense against disease causing pathogens. How can one improve the strength of the immune system through dietary changes? Which food products support the strength of the immune system?

Stakeholders

- The General Public
- Healthcare Providers
- Dieticians
- Medical Researchers
- Food Manufacturers
- Food Retailers
- Healthcare and Food Regulatory Agencies

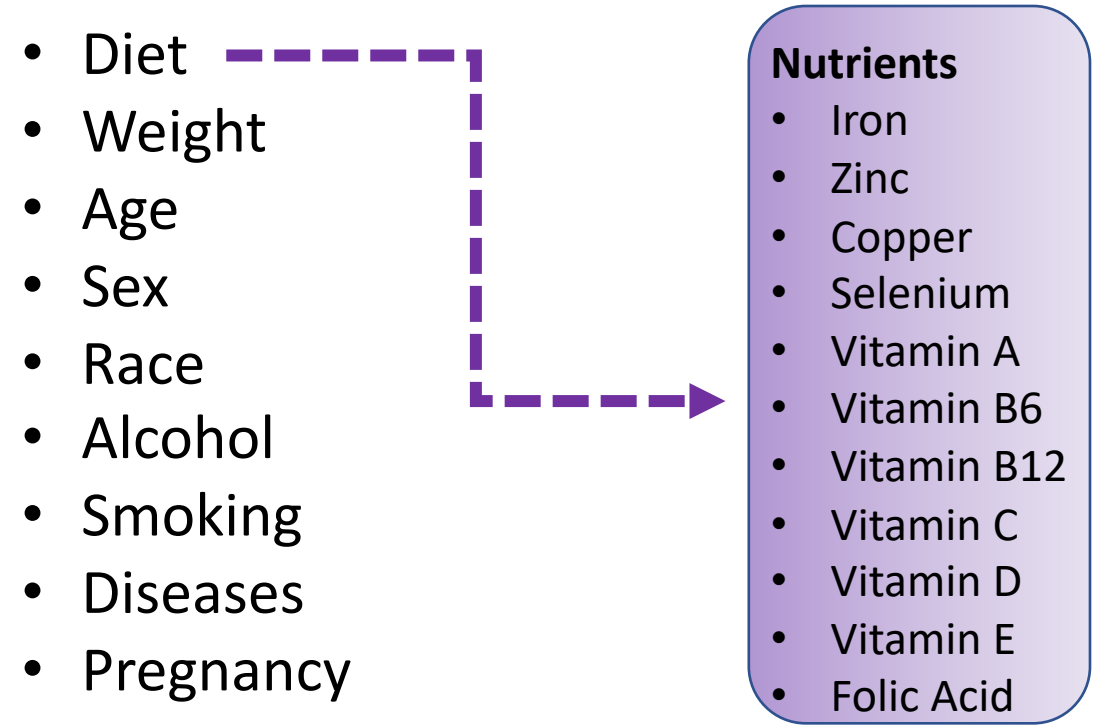
Data Sources

- National Health and Immunity Survey
  - Used to determine important micronutrients contributing to immune health

- Food Nutrition Dataset
  - Used to score foods by immune boosting capability

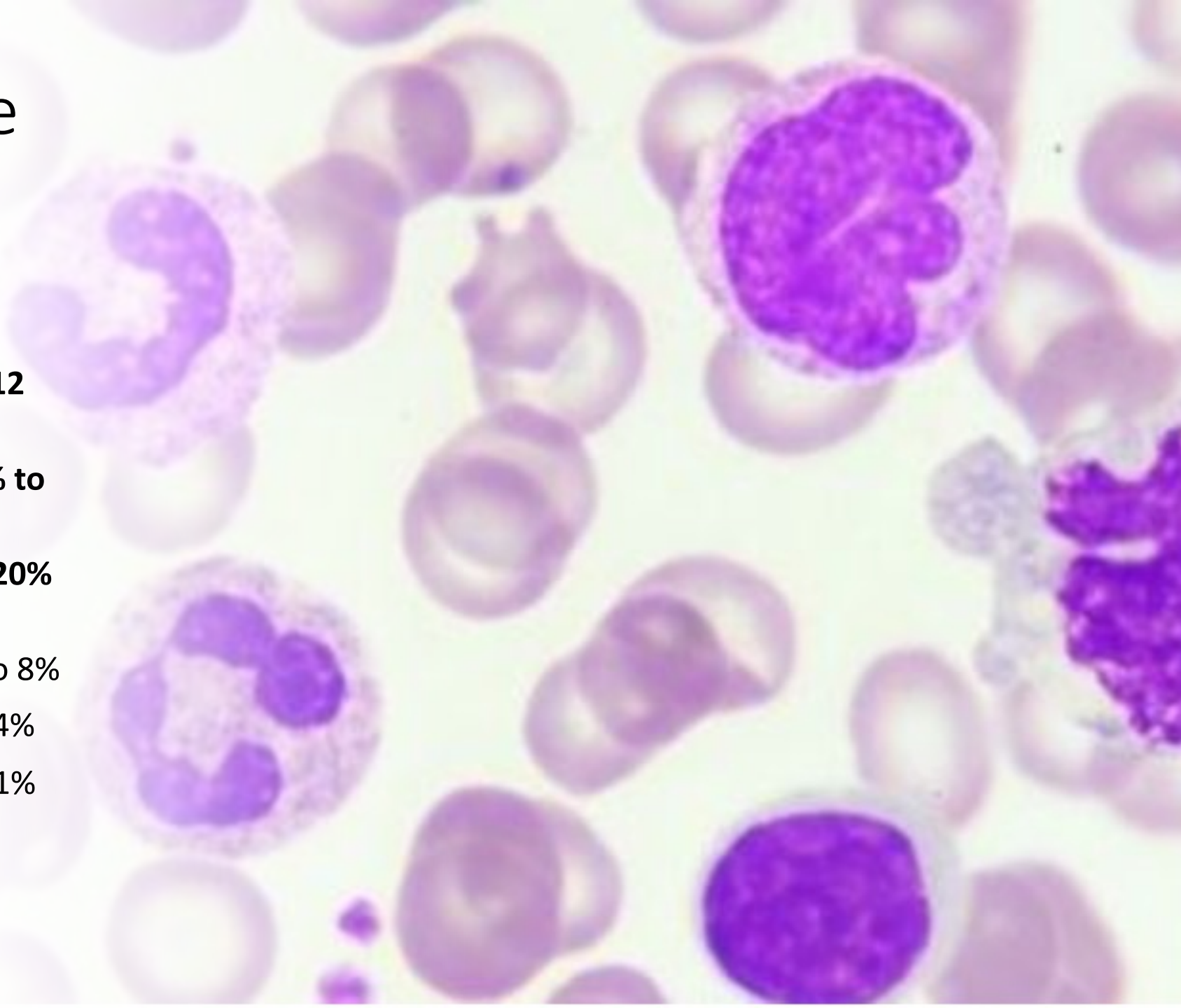
What factors affect the strength of the immune system?

- Diet
- Weight
- Age
- Sex
- Race
- Alcohol
- Smoking
- Diseases
- Pregnancy

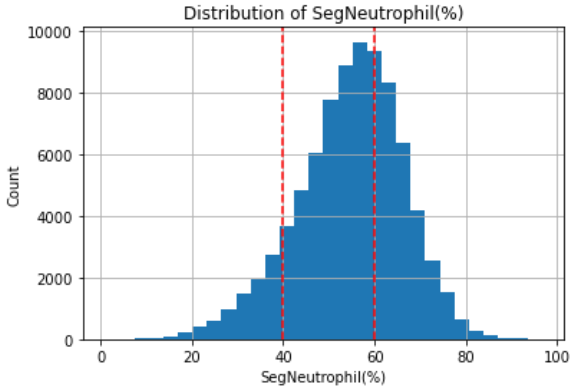


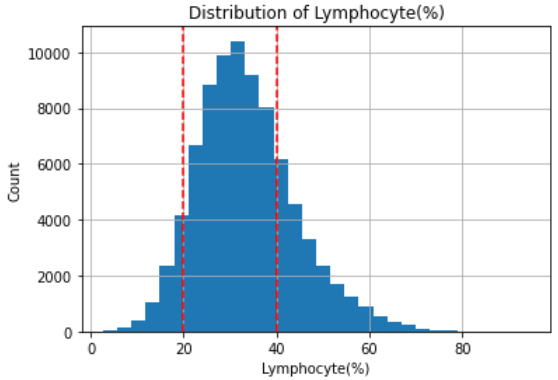
How to measure immune system strength

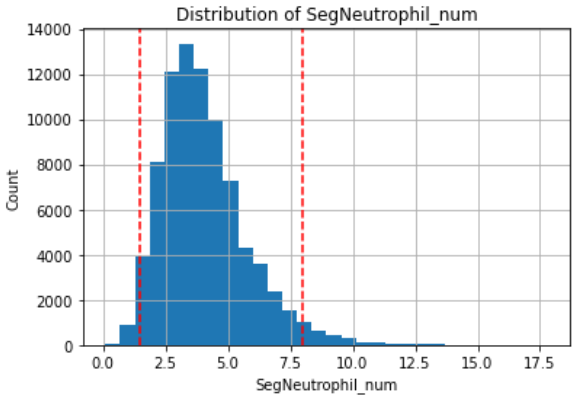
- **Total white blood cells 4.5 to 12 ug/L**
- **Neutrophils: 1.5 to 8 ug/L 40% to 60%**
- **Lymphocytes: 1.4 to 5.7 ug/L 20% to 40%**
- Monocytes: 0.3 to 1 ug/L 2% to 8%
- Eosinophils: 0 to 1 ug/L 1% to 4%
- Basophils: 0 to 1 ug/L 0.5% to 1%

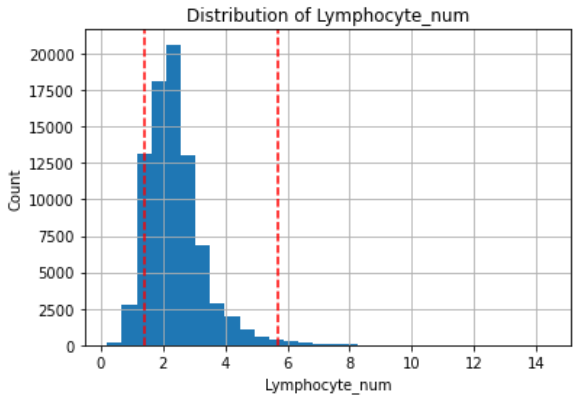


Labeling the data by immunity strength



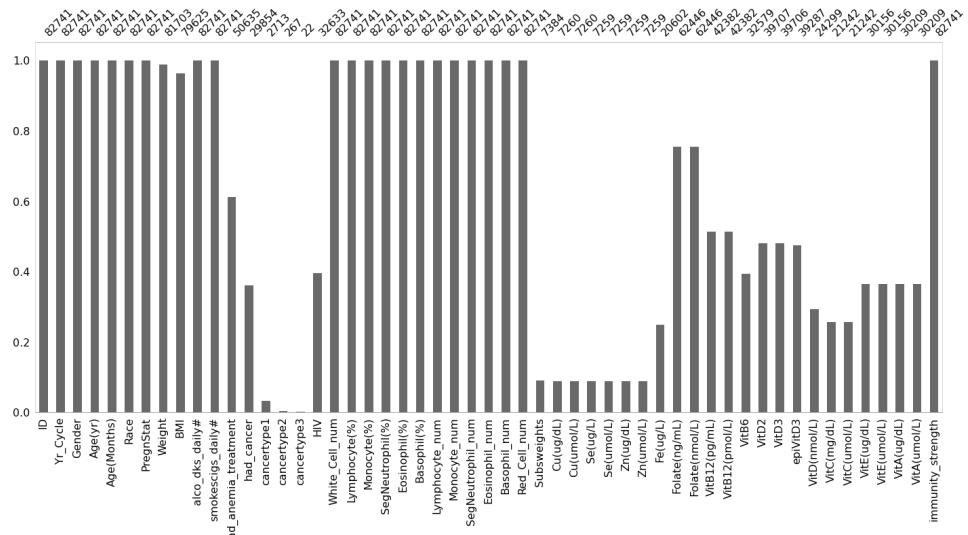


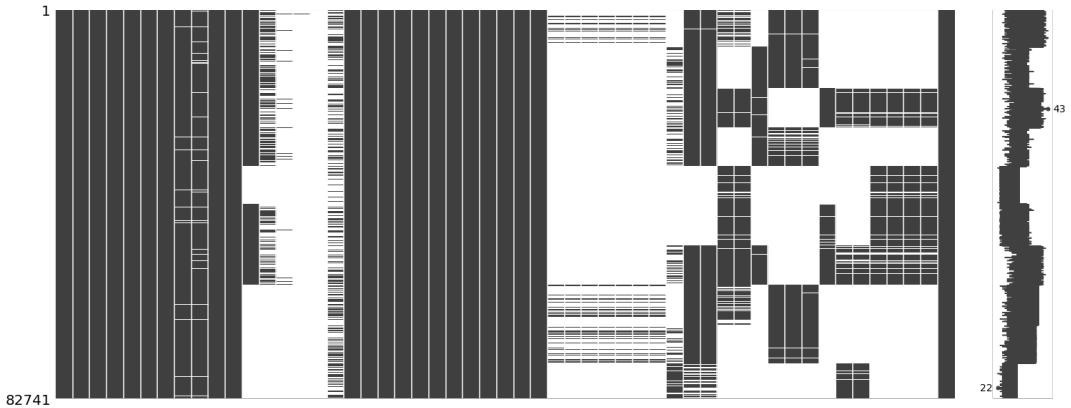




- Cutoffs for total white blood cell count, neutrophils and lymphocytes to label the survey participant's immune system strength as “High” or “Low”
- 62% “Low” and 38% “High”

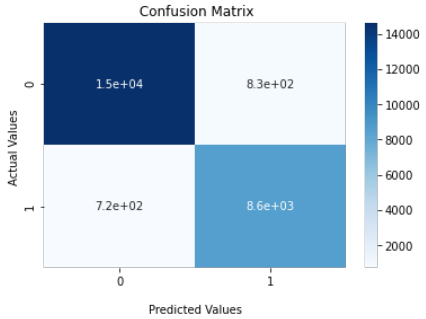
Missing data in the NHANES data set

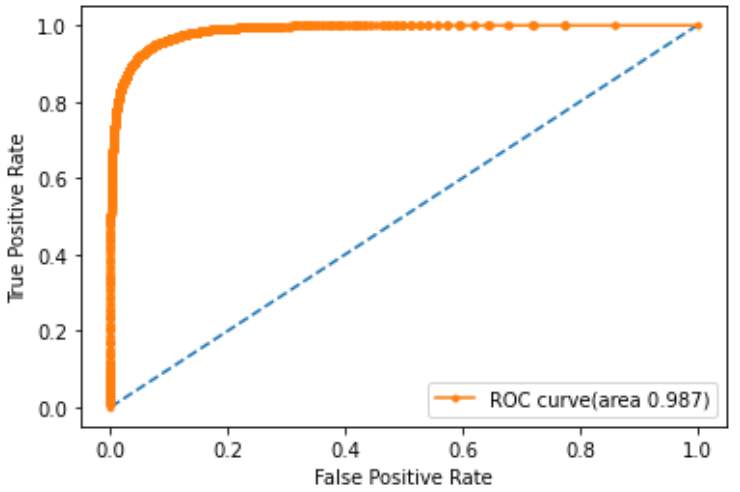




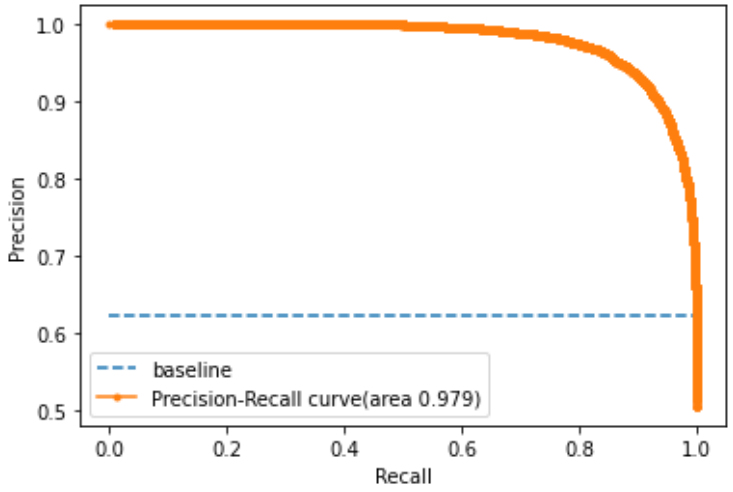
- There were many missing values in most of the columns
- Missing values were imputed using Datawig SimpleImputer

Random Forest Best Model Metrics

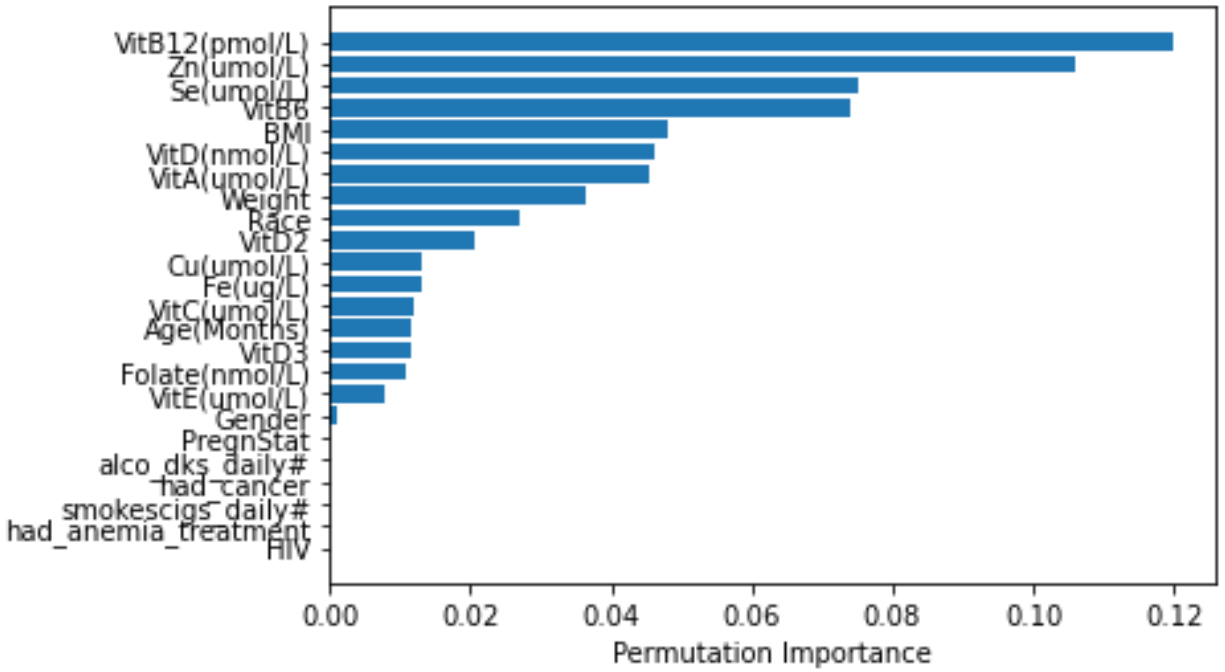




Accuracy: 0.94
Precision score: 0.95



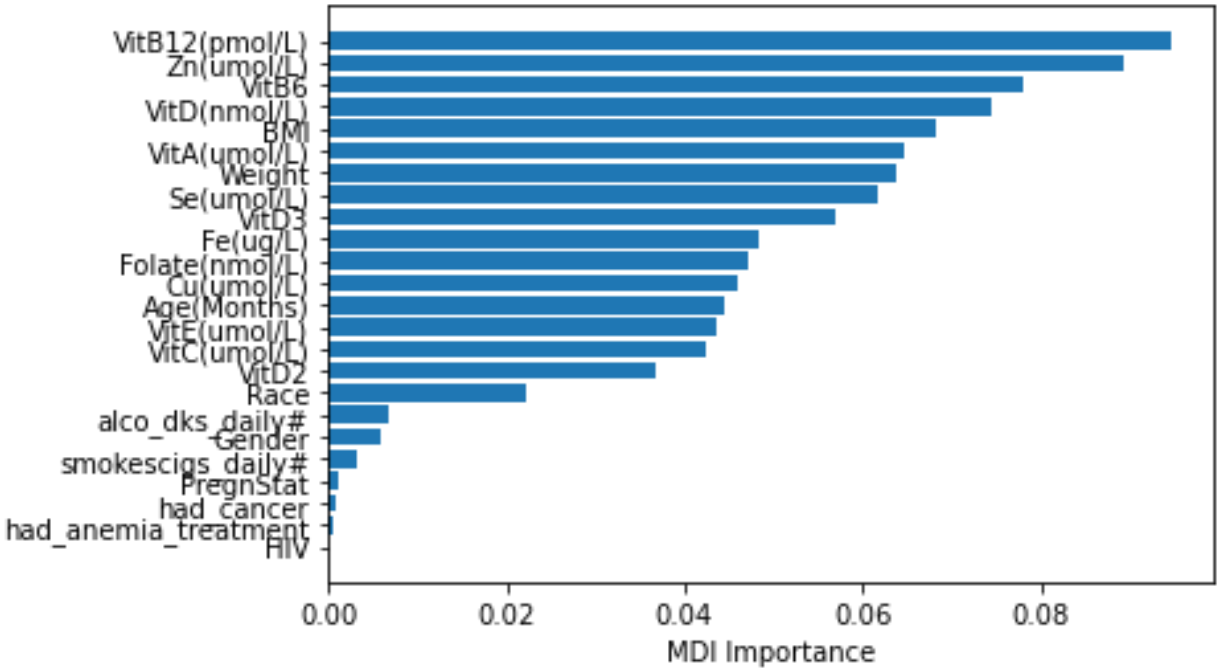
Permutation Feature Importance



Most Important Nutrients

- Vitamin B12
- Zinc
- Selenium
- Vitamin B6

Random Forest MDI Feature Importance



- Vitamin B12, Zinc rank the highest

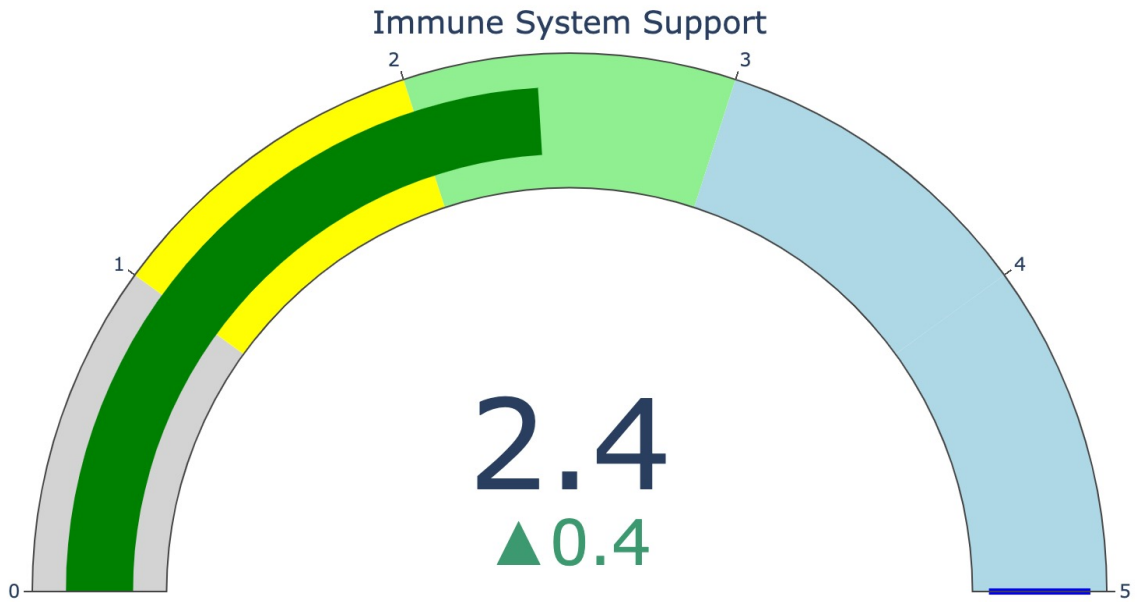
Scoring foods by content of the top nutrients

- A scoring function was used to rate food according to their Vitamin B12, Zinc, Selenium and Vitamin B6 content

NDB_No	Shrt_Desc	Zinc_(mg)	Selenium_(¾g)	Vit_B6_(mg)	Vit_B12_(¾g)	GmWt_1	GmWt_Desc1	GmWt_2	GmWt_Desc2	Immune_boost_Score
44258	PUDDINGS,CHOC FLAVOR,LO CAL,REG,DRY MIX	1.49	5.1	0.027	0.00	9.9	1 serving	40.0	1 package	0.0
44259	PUDDINGS,ALL FLAVORS XCPT CHOC,LO CAL,REG,DRY MIX	0.19	0.9	0.000	0.00	113.0	1 serving	260.0	1 cup	0.0
44260	PUDDINGS,ALL FLAVORS XCPT CHOC,LO CAL,INST,DRY...	0.10	0.8	0.005	0.05	8.0	1 serving	32.0	1 package, 4 servings	0.0
48052	VITAL WHEAT GLUTEN	0.85	39.7	0.000	0.00	NaN	NaN	NaN	NaN	1.0
80200	FROG LEGS,RAW	1.00	14.1	0.120	0.40	45.0	1 leg	NaN	NaN	0.0
83110	MACKEREL,SALTED	1.10	73.4	0.410	12.00	80.0	1 piece, (5-1/2" x 1-1/2" x 1/2")	17.0	1 cubic inch, boneless	3.6
90240	SCALLOP, (BAY&SEA),CKD,STMD	1.55	21.7	0.112	2.15	85.0	3 oz	NaN	NaN	1.6
90480	SYRUP,CANE	0.19	0.7	0.000	0.00	21.0	1 serving	NaN	NaN	0.0
90560	SNAIL,RAW	1.00	27.4	0.130	0.50	85.0	3 oz	NaN	NaN	1.0
93600	TURTLE,GREEN,RAW	1.00	16.8	0.120	1.00	85.0	3 oz	NaN	NaN	0.0

Immune System-boosting Gauge

Simple visualization of food scores



Why not take vitamin supplements?

- Medical condition
- Adverse reaction to supplements
- Accessibility
- Affordability

Conclusion

- The dataset obtained from NHANES was used to identify the most immune-boosting nutrients
- The data was labeled using white blood cell cutoffs
- Random Forest Classification was the best model
- Permutation feature importance was used to identify micronutrients that contribute most to immune health
- The 4 most important nutrients, Vitamin B12, Zinc, Selenium and Vitamin B6 were used to score the food in the nutritional dataset
- The scores can be visualized using a scoring gauge