University of Milano-Bicocca
Master's Degree in Data Science
Big Data in Biotechnology & Biosciences
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A LINK BETWEEN MIGRAINE, GASTROINTESTINAL DISORDERS AND GUT MICROBIOTA: MICROBIOTA-GUT-BRAIN CONNECTION

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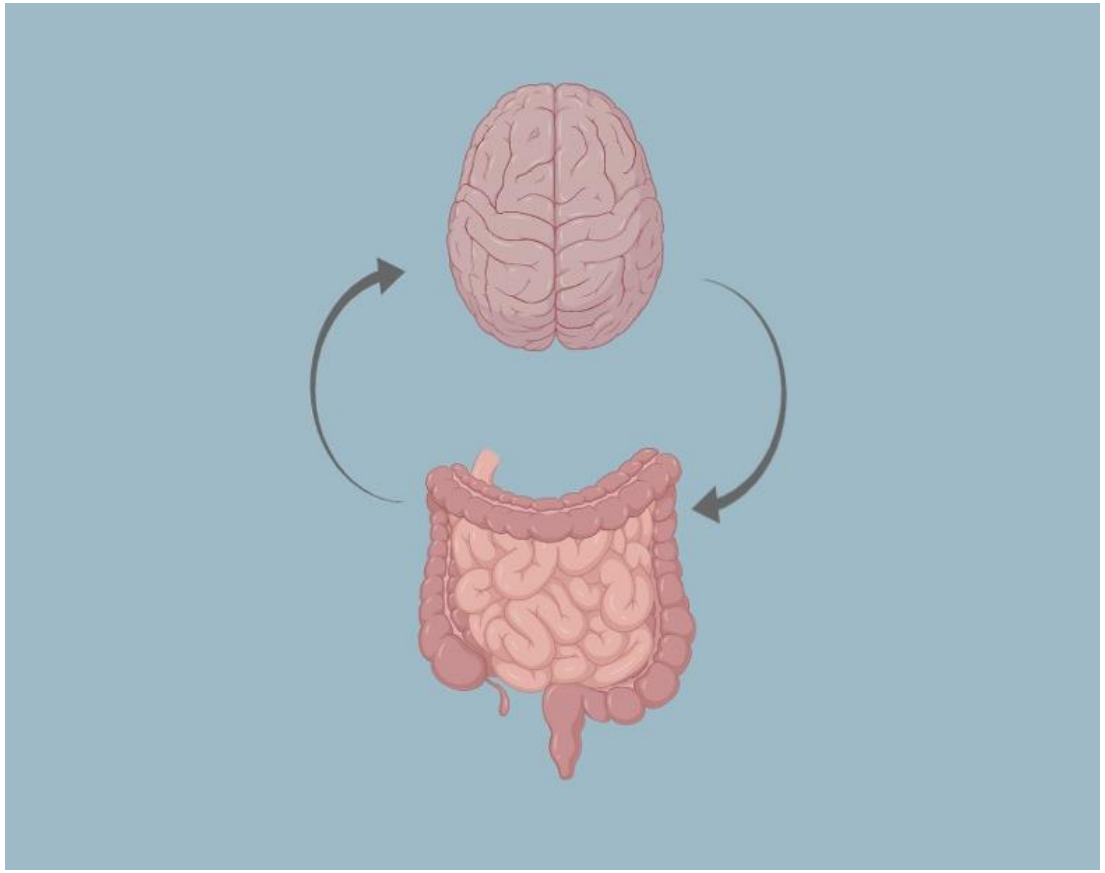
The Gut-Brain Axis, Gut Microbiota and Brain Pathology

- **Gut-brain axis (GBA)**: bidirectional **cross-talk** between the **gastrointestinal (GI) system** and the **central nervous system (CNS)**
- Various **neurological disorders** (such as **migraine**) appear to be directly and indirectly associated with some **gastrointestinal (GI) disorders**
  - e.g. Irritable bowel syndrome (**IBS**)
- **Migraine** → cause of disability among the adult population
- Importance of **gut microbiota profile** in **influencing GBA cross-talk** and contributing to the **pathogenesis** of migraine
- Gut Microbiota-improving methods (probiotics, healthy diets, …) → **microbiome-based therapy** for migraine



Source

The American Gut Project: metadata analysis

- Research **objectives**
  - study the characteristics of **subjects** suffering from **migraine**
  - reveal any **relationships** with the presence of **gastrointestinal diseases**
  - reveal any **relationships** with the **supplementation of probiotic** sources in the diet
    - fermented foods
    - probiotics supplements
  - reveal any **relationships** and with the use of **antibiotics**

AMERICAN GUT PROJECT

Relevant Features Selection

- **Target** Variable → "migraine"
  - "I do not have this condition"
  - "Diagnosed by a medical professional"
  - "Self-diagnosed"
  - "Diagnosed by an alternative medicine practitioner"

- **Sample** and **Subject** Descriptors:
  - sample_name, anonymized_name
  - **age**_corrected, age_cat
  - race, sex, country, level_of_education
  - scientific_name, host_common_name, env_package, dna_extracted, collection_date
  - bmi, bmi_cat

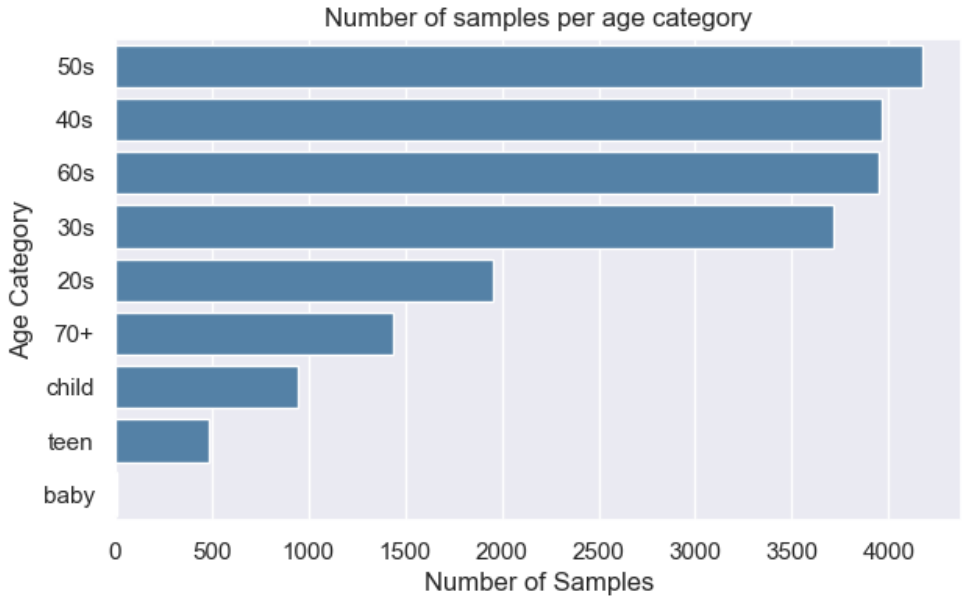
- **Gastrointestinal disorders:**
  - Inflammatory bowel disease (IBD): ibd, ibd_diagnosis, ibd_diagnosis_refined
  - Irritable bowel syndrome (IBS): ibs
  - Gluten sensitivity: gluten
- Supplementation of **Probiotics:**
  - probiotic_frequency
  - fermented_frequency, fermented_increased
- **Antibiotics**
  - antibiotic_history, subset_antibiotic_history

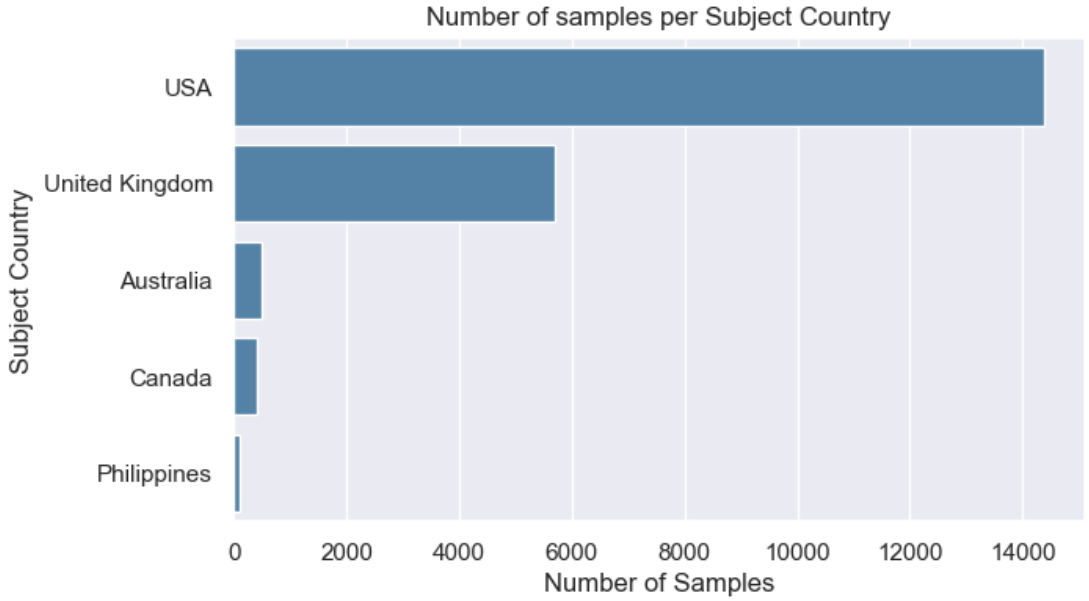
Subsampling, Data Cleaning and Data Normalization

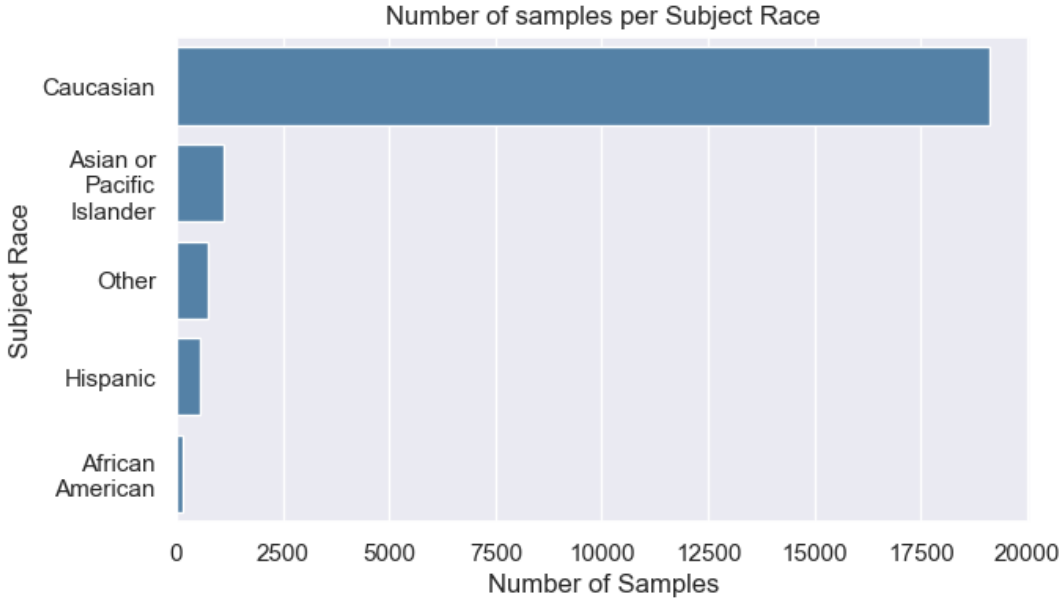
1. Selection of instances related to **human gut metagenome** samples **only**
2. Checking and **removing** any **duplicates/NaN instances** from the **ID variables** `'sample_name'` and '`anonymised_name`'.
    - Cardinality → from 29960 samples/instances to 22281 instances
3. Resolving **inconsistencies** in **null values**
    - `'Not provided','Unspecified','not collected','LabControl test','unspecified'` → `NaN`
4. Resolving **inconsistencies** in **boolean features**
    - `'True', 'true', 'TRUE', 'Yes'` → True
5. Resolving **inconsistencies** in other features and **boolean feature crafting**
6. Features **types correction**

Subjects Descriptors

- Most of the subjects are **Caucasian**, between **30 and 60 years old** and come from the **United States** or the **United Kingdom**

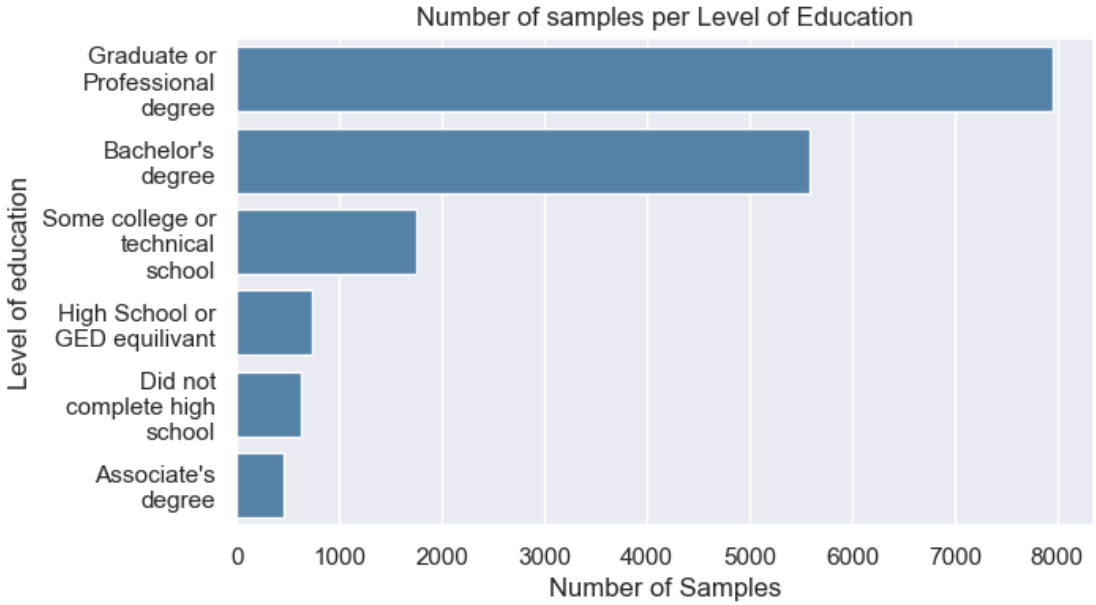


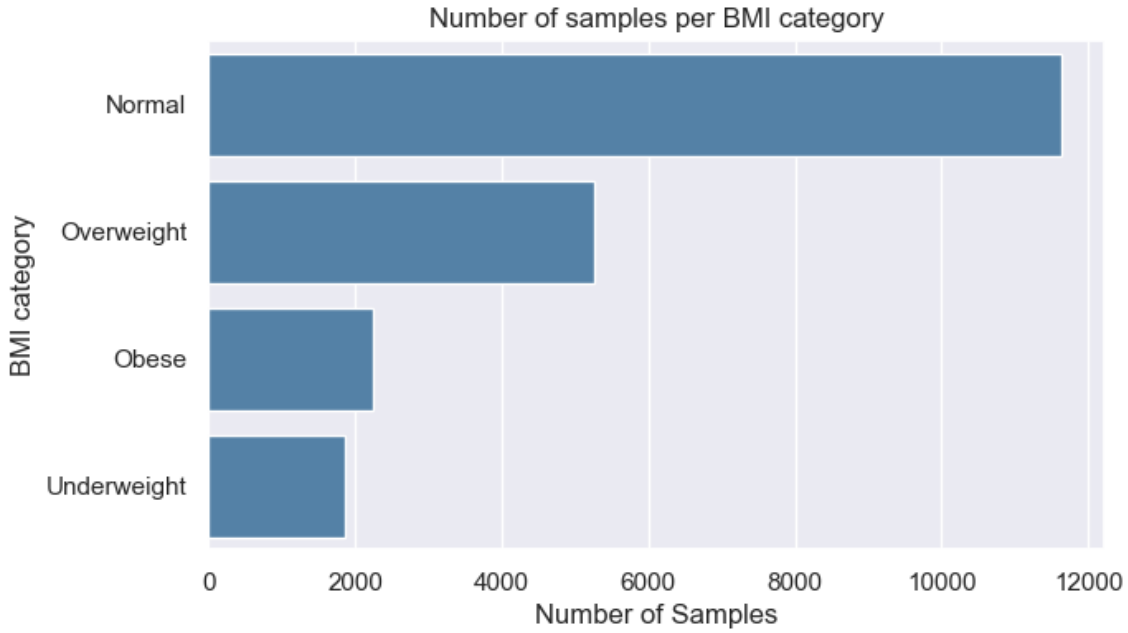




Subjects Descriptors

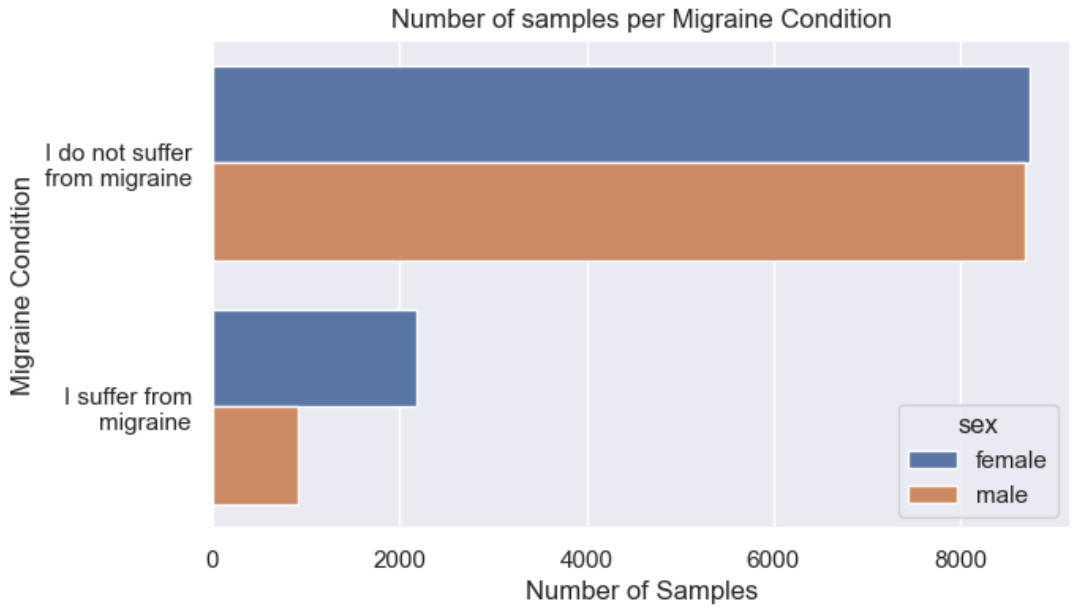
- Most of the subjects have a **high level of education**
- A large proportion of subjects are **normal weight** or **overweight**

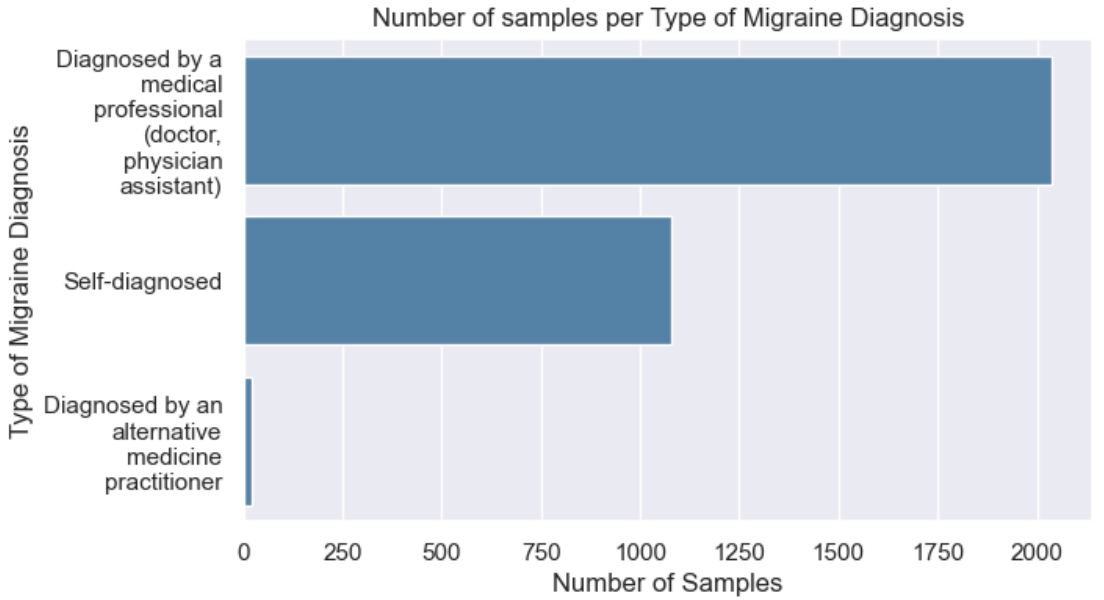




Target Variable: migraine

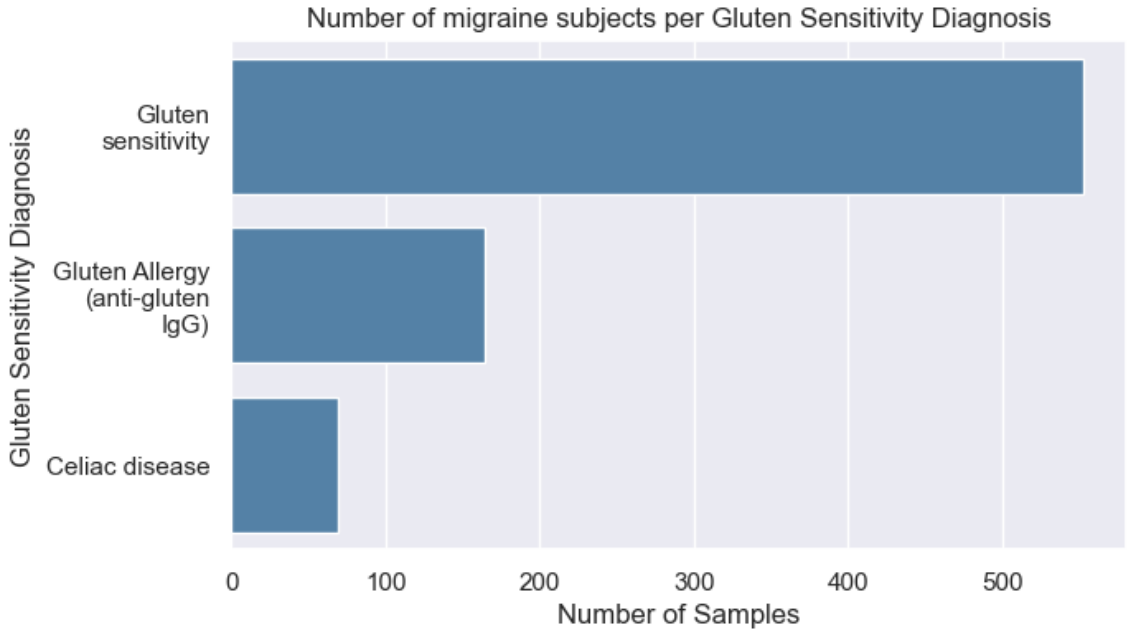
- 17815 subjects claim not to suffer from migraine
- **3138 subjects** report **suffering from migraine**
  - **2038 diagnosed** by a **medical professional**
  - **1078 self-diagnosed**
  - **22** diagnosed by an **alternative medicine** practitioner
- **70.6%** of **migraine subjects** are **women**

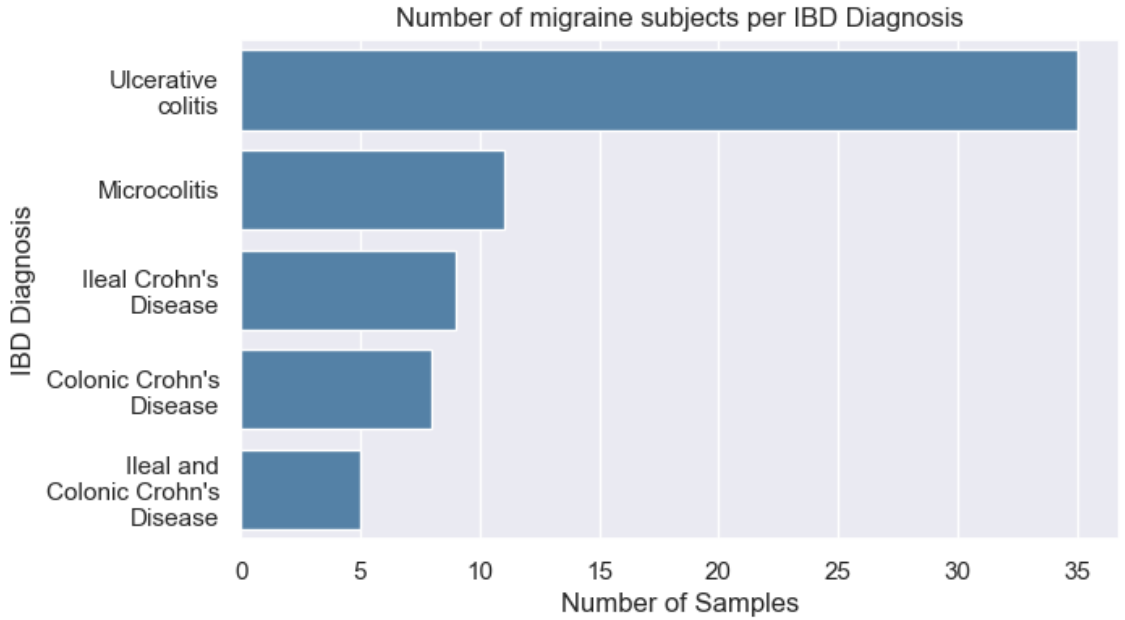




Migraine and GI diseases

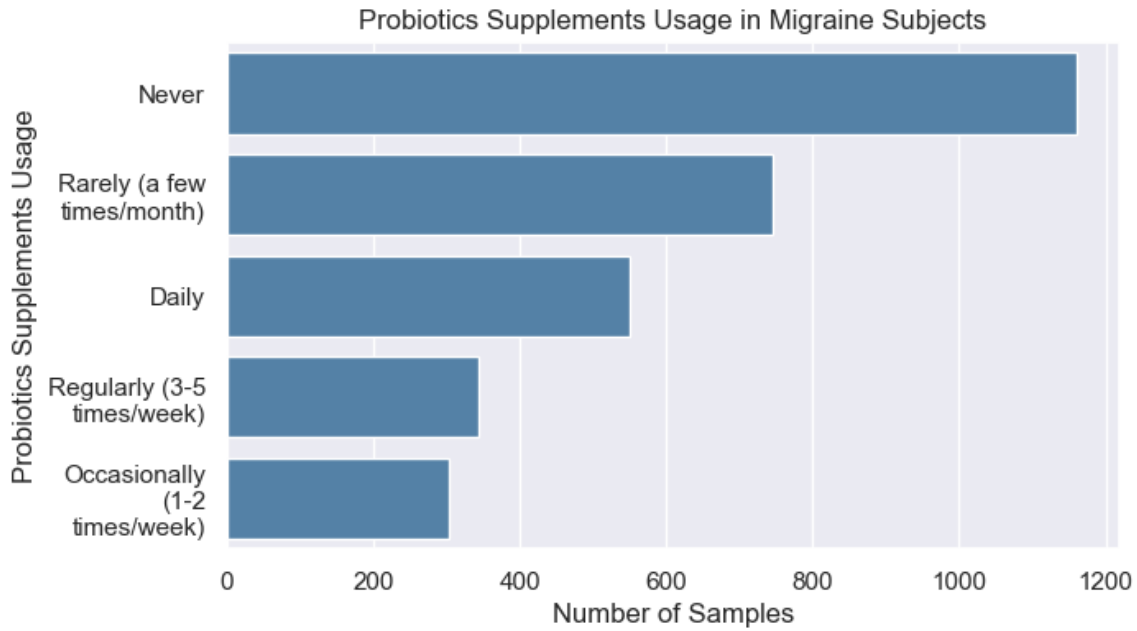
- Of the **3138** subjects who report **suffering from migraine**
  - **188** also suffer from **IBD**
    - **Ulcerative colitis** is the most prevalent
  - **1015** also suffer from **IBS**
  - **786** have some form of **gluten sensitivity**
    - **generic sensitivity** seems to prevail over gluten allergy and coeliac disease

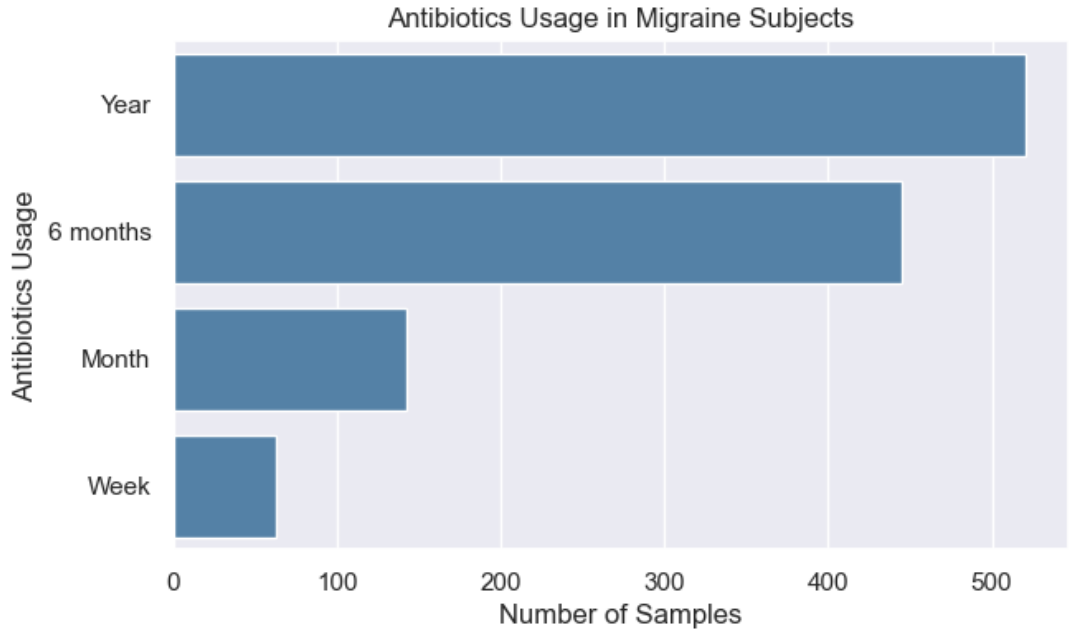




Probiotics and Antibiotics

- Of the **3138** subjects who report **suffering from migraine**
  - **1942 subjects** report using **probiotic supplements**, although **746** of them **rarely**
  - **61 subjects** report incorporating **fermented foods** into their diet, **18** report **not consuming them**
  - **1171 subjects** report having taken **antibiotics during the year prior** to sampling





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