**Client 24-148 IM Agenda**

**3/5/25 11:30 AM**

**Goal: PhD Dissertation**

**Phase: Analysis (All Data Collected)**

Background:

* The client is a PhD student in Nutrition Sciences who has used the consulting service before in a previous semester.
* The main goal of this project is to analyze the NIH ABCD (Adolescent Brain Cognitive Development) to accomplish the following 4 tasks:

1. Investigate the relationship between iron levels and the volumes of the left and right hippocampus in adolescents.
2. Analyze how hippocampal atrophy is associated with adiposity, focusing on whether structural brain changes contribute to increased BMI and waist circumference.
   1. Hippocampal atrophy: Shrinkage of the hippocampus
   2. Adiposity: Having a lot of body fat.
3. Examine the relationship between iron status and adiposity and determine if hippocampal volume mediates the connection between iron status and both BMI and waist circumference.
4. Assessing the long-term effects of iron deficiency-induced hippocampal atrophy on adiposity by tracking changes over time to understand how early hippocampal alterations influence later anthropometric measures

* With respect to their dataset, it aims to characterize psychological and neurobiological development from pre-adolescence to young adulthood.
  + A baseline cohort of 11,500 nine and ten-year-old children (and their parents/guardians) were recruited and will be followed for ten years with annual lab-based assessments including biennial Magnetic Resonance Imaging (MRI).
  + The dataset has several variables, but client is focusing on iron biomarkers, hippocampal variables and variables/covariates associated with weight (BMI/waist circumference)

Research question: (From the grant document)

* Does iron deficiency leads to hippocampal alterations, which in turn mediate an increase in adiposity?

Analysis techniques:

AIM 1:

* *Statistical Analysis*
  + Conduct multiple regression analyses examining associations between iron status and hippocampal volumes
  + Control for relevant covariates (e.g. age, sex, socioeconomic status, pubertal status, etc.)
  + Test for potential non-linear relationships using generalized additive models, if needed
  + Conduct sensitivity test for outliers

AIM 2:

* *Data Analysis*
  + Implement linear mixed-effects models to examine relationships
  + Investigate potential sex-specific effects through stratified analyses
  + Adjust for covariates like total intracranial volume, physical activity, socioeconomic factors, etc.
  + Test interaction effects

AIM 3:

* *Statistical Analysis*
  + Use mediation analysis to test hippocampal volume as a mediator between iron status and adiposity
  + Apply bootstrapping for confidence intervals
  + Assess model fit using standard indices and test for moderated mediation as necessary.

AIM 4:

* *Analysis Strategy*
  + Begin with mixed-effects models to establish baseline temporal relationships
  + Use linear regression to examine predictive associations between iron status, hippocampal volume, and BMI.
  + Follow with decision trees to identify thresholds of iron status and hippocampal volume that correlate with BMI changes over time.
  + Apply K-Nearest Neighbors (KNN) to assess pattern similarity and classify BMI outcomes based on historical data.

Statistical Issues:

1. Client wants to validate if the above approaches are statistically sound for the analysis.
2. They are curious to see if using supervised learning methods would be useful for the predictive analysis in aim 3 and aim 4.

Questions about this project:

1. Did she split the dataset into test-train-validate sub datasets already?
2. Is logistic regression appropriate for the classification / statistical testing for the aims?
3. She mentioned that the dataset needs access from the NIH to view, is she allowed to share it with the SCS for analysis?