
BIOS 507 PROJECT DESCRIPTION

Due 5/2/2025 by Noon

1 Background and Aims

During pregnancy, it is important to ensure that women receive adequate nutrition to support fetal growth and development. Micronutrients such as iron, folate, and vitamin B12 are particularly important during this time, as deficiencies can contribute to anemia and other adverse pregnancy outcomes. However, inflammation can complicate the assessment of micronutrient status, as it can lead to alterations in blood biomarkers that are used to assess nutritional status.

To account for the effects of inflammation on micronutrient status, several approaches have been proposed, such as the use of correction factors or adjustment equations. These methods aim to estimate a woman's "true" micronutrient status by accounting for the effects of inflammation, allowing for more accurate assessment of micronutrient deficiencies.

Anemia, a common condition in pregnancy, can be caused by a variety of factors, including micronutrient deficiencies, inflammation, and blood loss. Micronutrient deficiencies, particularly of iron and folate, are known to contribute to anemia. Inflammation can also contribute to anemia by interfering with the production of red blood cells and altering the balance of iron metabolism. Thus, it is important to consider both micronutrient status and inflammation when assessing and addressing anemia in pregnant women.

In this study, the inflammatory biomarker of interest is C-reactive protein (CRP), which should be treated as a predictor variable. The micronutrients of interest are serum ferritin (an iron-storage protein), iron, serum folate, and vitamin B12. These are the response variables for Aim 1. Anemia (the response variable for Aim 2) among women is defined as hemoglobin < 12 g/dL.

Research Aims

1. Investigate the associations between CRP and micronutrients in pregnant women and examine if maternal age and/or gestational age (or pregnancy trimester) modifies these

relationships. If any effect modification (interaction) is present, interpret and report (or visualize) subgroup findings. Please investigate one micronutrient at a time.

2. Examine and characterize the contributions of CRP and micronutrients to anemia. Consider including demographic and clinical covariates (e.g., maternal age, BMI, trimester or gestational age) and determine if they contribute to this association and if they modify any of these associations.
3. Finally, develop a prediction model for anemia in pregnant women and report the performance, considering all the variables available in the data set.

The data were derived from the National Health and Nutrition Examination Survey (NHANES), which is a program of studies designed to assess the health and nutritional status of adults and children in the United States and the data are publicly available (cdc.gov/nchs/nhanes). In general, when using the NHANES data, analysis accounting for complex survey design (e.g., cluster, sampling weight) needs to be implemented following the NHANES guidelines. However, since this was not covered in our course, you do not need to use any survey-specific analysis.

The study data set is `pregnancy.csv`. The variables in the study data set are listed in the table below:

| Variable | Label |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------|
| subjid | Subject's unique ID |
| crp | C-reactive protein (mg/L) |
| hb | Hemoglobin (g/L) – this is used to evaluate anemia status. |
| sf | Serum ferritin (µg/L) |
| sfo | Serum folate (nmol/L) |
| si | Serum iron (µmol) |
| vitb12 | Serum vitamin B12 (pmol/L) |
| age_yr | Maternal age (years) |
| ht | Height (cm) |
| wt | Weight at examination (kg) |
| mstatus | Marital status: 0=Not married, living w/partner, 1=Married, 2=Widowed, 3=Divorced, 4=Separated, 5=Never married, blank=Don't know |
| trimester | Pregnancy trimester: 1=1st trimester=(0, 12] weeks; 2=2nd trimester=[13, 28] weeks; 3=3rd trimester=[29, 40] weeks; 4=overdue=[41,) weeks |
| gagewks | Gestational age (weeks) |
| tpreg | Number of previous pregnancies |

2 Report Requirements

The report should be aimed at a general public health professional audience that is familiar with research language. The report must include the following sections:

- Introduction (10% of grade) - provide a brief background and state the study objectives
- Methods (40% of grade) - describe the study design, study subjects, analysis methods (including methods used for exploratory, approaches to handle missing data, functional forms of quantitative variables, regression models, model selection, and model

diagnostics), software tools, etc. The purpose of documenting statistical methods is to enable others to replicate your exact analysis results.

- Results (40% of grade) - descriptive statistics (e.g., number of observations), main results of your analyses summarized in tables or figures (visualization is strongly encouraged!) that address the research objectives, appropriate interpretations of model estimates (including 95% CI and p-values in general).
- Discussion and Conclusions (10 % of grade) - a short discussion to state 1) primary findings, 2) anything you notice that is worth reporting during the analysis process, 3) limitations of your analyses and their impacts on the validity of your results, and 4) the conclusion.

2.1 Report Formatting

Please turn in a pdf and use the following guidelines:

- SIX PAGES MAXIMUM. This includes tables, figures, and reference (if applicable)
- One inch margins on each side
- Font size 11
 - Smaller font size for captions and footnotes is OK if needed.
- Single spaced at minimum (no half line spacing)
- Label all tables and figures
- Include a cover page (not counted in the 6 pages) that includes a title and the names of your team members as well as the specific contribution of each team member. This will be taken into consideration for grading. It is strongly encouraged that all teammates make a roughly even contribution.
- Submit your code (that generates the results included in the final report) in the appendix. Be sure to include comments and organize the code by sections/chunks for someone else to easily replicate the findings. No other supplementary materials are allowed.
- Save the final report as a PDF and submit via Canvas.