Anti-oxidant Anti-inflammation evaluation for subjects ingesting seaweed fulvescens extract

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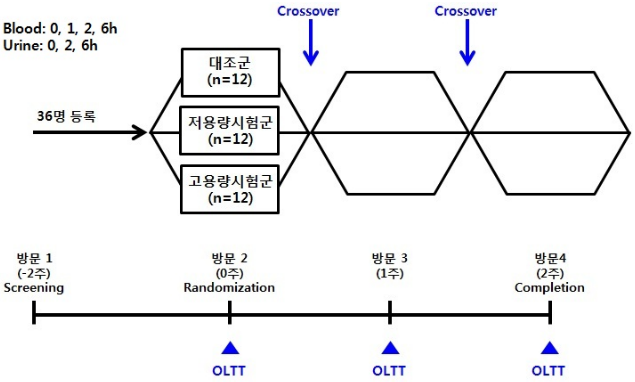
Objective

- To evaluate the effect of ingestion of seaweed fulvescens extract on postprandial oxidative stress



Data

- Sample : 36 individuals
  - Cross-over(3 groups)
- Clinical data
  - ROS(blood), MDA(urine), ox-LDL(blood)
- Proteome data(urine)
  - 38 (EGF, IL6,)

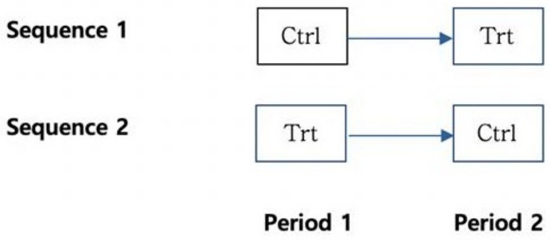
Data

- Data Layout

Sample ID	Group	Week	Hour	Proteome1	Proteome2	⋯
Sample 1	High	0	0	33.86	122.4306759	⋯
	High	0	2	20.46	144.8632612	⋯
	High	0	6	19.32	257.705067	⋯
	Low	1	0	27.49	291.6198791	⋯
	Low	1	2	22.72	213.642376	⋯
	Low	1	6	36.14	122.1773002	⋯
	Placebo	2	0	22.6	199.5918112	⋯
	Placebo	2	2	36.17	232.1971831	⋯
	Placebo	2	6	34.27	179.2464443	⋯
Sample 2	Low	0	0	30.63	192.3319045	⋯

Data

- For simplicity, assume following data structure. (2 x 2 cross-over design)



- There are treatment group and control group. And we dont consider the Hour repeated measurements, only consider Week repeated measurements.
- Assume we have just two samples.

Methods

- We can apply following two models in this data structure.
  1. Linear mixed effect model
  2. Generalized estimating equation (GEE) model

Linear mixed effect model

- Let, y_{ijk} is the observation for i^{th} sequence ($i = 1, 2$), j^{th} subject ($j = 1, 2, \ldots, n_i$), k^{th} period ($k = 1, 2$)
- The model can be defined as:

$$y_{ijk} = \beta_0 + \beta_1 X_{trt} + \beta_2 X_{Period} + \beta_{12} X_{trt} X_{Period} + S_{ij} + \varepsilon_{ijk}$$

where $S_{ij} \sim N(0, \sigma_s^2)$ and $\varepsilon_{ijk} \sim N(0, \sigma^2)$

- Two dummy variables are:

$$X_{trt} = \begin{cases} 1, & \text{subject is in Treatment;} \\ 0, & \text{Otherwise} \end{cases}$$

$$X_{Period} = \begin{cases} 1, & \text{Subject is in Period 2;} \\ 0, & \text{Otherwise.} \end{cases}$$

Linear mixed effect model

- Matrix form

$$\begin{bmatrix} y_{111} \\ y_{121} \\ y_{112} \\ y_{122} \\ y_{211} \\ y_{221} \\ y_{212} \\ y_{222} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 0 & 0 \\ 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} \beta_0 \\ \beta_1 \\ \beta_1 \\ \beta_{12} \end{bmatrix} + \begin{bmatrix} S_{11} \\ S_{12} \\ S_{11} \\ S_{12} \\ S_{21} \\ S_{22} \\ S_{21} \\ S_{22} \end{bmatrix} + \begin{bmatrix} \varepsilon_{11} \\ \varepsilon_{12} \\ \varepsilon_{11} \\ \varepsilon_{12} \\ \varepsilon_{21} \\ \varepsilon_{22} \\ \varepsilon_{21} \\ \varepsilon_{22} \end{bmatrix}$$

Generalized estimating equation (GEE) model

- Let, y_{ij} be the response from subject i at period j for $j = 1, 2, \ldots, n_i$ and $i = 1, 2, \ldots, N$.
- Response variable is binary, $y_{ij} \sim B(1, \pi_{ij})$ where $\pi_{ij} = Pr(y_{ij} = 1)$.
- y_{ij} is defined as $y_{ij} = \begin{cases} 1, & i^{th} \text{ subject at } j^{th} \text{ period is in treatment;} \\ 0, & i^{th} \text{ subject at } j^{th} \text{ period is in control.} \end{cases}$
- Vector of measurements for i^{th} subject: $\mathbf{y_i} = (y_{i1}, y_{i2}, \ldots, y_{in_i})'$.
- Vector of measurements for all subjects: $\mathbf{Y} = (\mathbf{y_1}, \mathbf{y_2}, \ldots, \mathbf{y_N})'$.
- Let, $V_i = Cov(\mathbf{y_i})$: $n_i \times n_i$ variance-covariance matrix