

Practical 3: Sensitivity analysis and DAG model

Ting Ye and Qingyuan Zhao

July 8, 2026

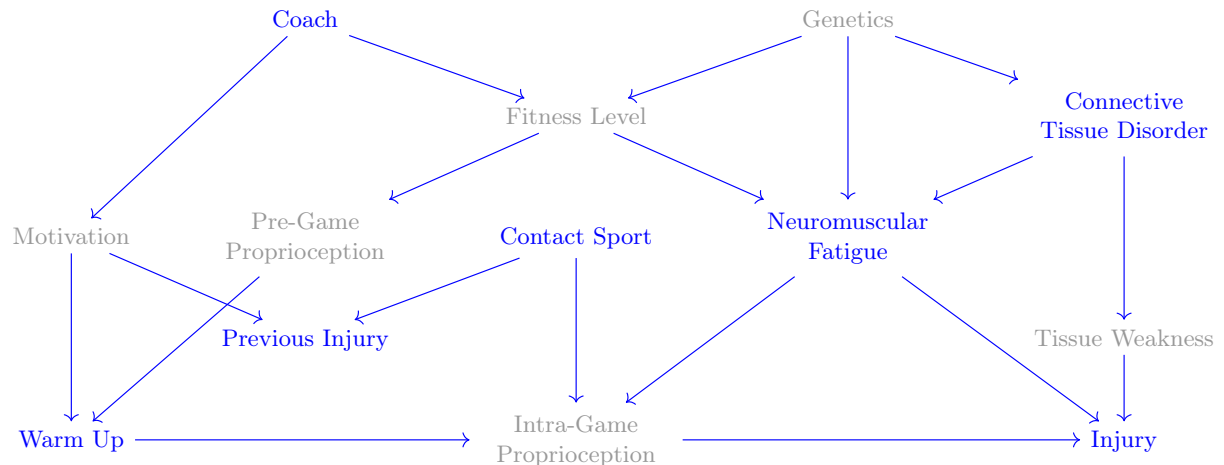
The first two questions continue from Practical 2 (Matching).

1. (Group discussion) Can you think of any potential unmeasured confounders?
2. Using one of your matchings (e.g., your pair matching) to perform a sensitivity analysis. Up to what value of Γ is there still evidence that being physically active causes you to live longer?

Below are some useful R code:

```
diff=df_treated$years.lived.since.1971.up.to.1992-  
      df_control$years.lived.since.1971.up.to.1992  
library(DOS)  
senWilcox(diff, gamma = 1, conf.int = FALSE, alpha = 0.05, alternative = "less")  
senWilcox(diff, gamma = 1.6, conf.int = FALSE, alpha = 0.05, alternative = "less")
```

3. (Group discussion) Consider the following directed acyclic graph and the corresponding causal model:



Are the following conditional independences true?

- (a) $\text{Coach} \perp\!\!\!\perp \text{Genetics}$.
 - (b) $\text{Coach} \perp\!\!\!\perp \text{Neuromuscular Fatigue} \mid \text{Fitness Level}$.
 - (c) $\text{Coach} \perp\!\!\!\perp \text{Neuromuscular Fatigue} \mid \text{Fitness Level}, \text{Genetics}$.
 - (d) $\text{Warm Up} \perp\!\!\!\perp \text{Injury} \mid \text{Intra-Game Proprioception}, \text{Neuromuscular Fatigue}, \text{Genetics}$.
4. (Group discussion) Continuing from the previous question, suppose the blue variables are observed in a dataset for sports medicine and the gray variables are not observed. We are interested in estimating the causal effect of Warm Up (A) on Injury (Y). Can you pick a set of observed covariates (let's call it X) so that there is no unmeasured confounding, that is, $A \perp\!\!\!\perp Y(a) \mid X$?