Gold standard of evidence: Randomized Controlled Trial 101

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15/10/2023

Scientific Method Review: Algorithm

1. Identify the research question
2. Identify the hypothesis
3. Identify the study design
4. Observations
5. Conclusions
6. Inferences

Scientific Method Review: Algorithm

1. **Identify the research question**

   What's the independent variable and effect dependent variable?

   Key words/phrases: cause and effect, before and after
2. Identify the hypothesis
3. Identify the study design
4. Observations
5. Conclusions
6. Inferences

Scientific Method Review: Algorithm

1. Identify the research question
2. **Identify the hypothesis**

   What does the researcher expect to find?

   Key words/phrases: if/then statements, predict, anticipate
3. Identify the study design
4. Observations
5. Conclusions
6. Inferences

Scientific Method Review: Algorithm

1. Identify the research question
2. Identify the hypothesis
3. **Identify the study design**
   - What's the group we're comparing everything to?
   - Which group is getting the treatment?
   - What things are staying the same during the experiment?
   - How many times are we doing the experiment to make sure our results are reliable?

   Key words/phrases: different, same/identical
4. Observations
5. Conclusions
6. Inferences

Scientific Method Review: Algorithm

1. Identify the research question
2. Identify the hypothesis
3. Identify the study design
4. **Observations**

   What do the researchers learn from the trials?
5. Conclusions
6. Inferences

Scientific Method Review: Algorithm

1. Identify the research question
2. Identify the hypothesis
3. Identify the study design
4. Observations
5. **Conclusions**

   Do the observations align with the hypothesis?
6. Inferences

Scientific Method Review: Algorithm

1. Identify the research question
2. Identify the hypothesis
3. Identify the study design
4. Observations
5. Conclusions
6. **Inferences**

   How do the researchers apply their knowledge to make sense of what they observe?

What is the effect of **exercising** on **health**?

Independent variable:

Dependent variable:

What is the effect of **exercising** on **health**?

Independent variable: whether someone exercises or not

Dependent variable:

What is the effect of **exercising** on **health**?

Independent variable: whether someone exercises or not

How much time per week does someone spend exercising?

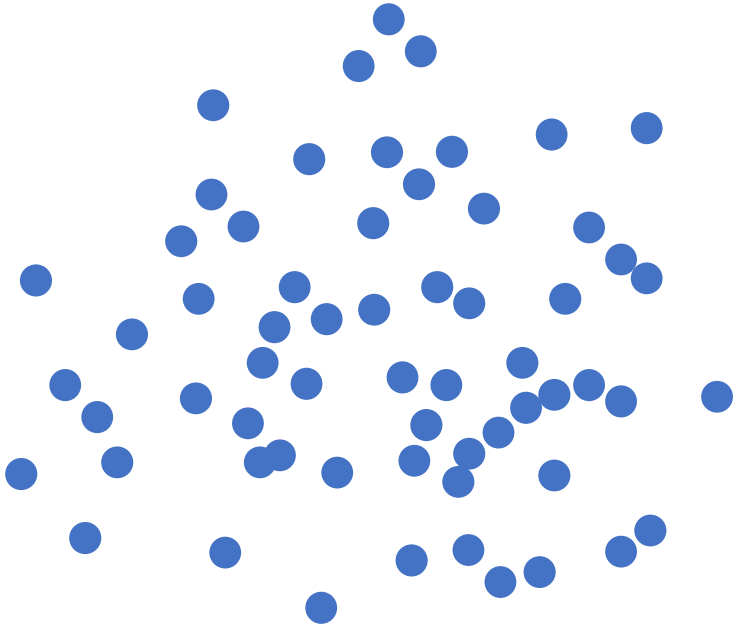
Dependent variable: cholesterol levels

Blood pressure? Resting heart rate? Mobility?

Many ways to define
the **independent** and **dependent**
variables!

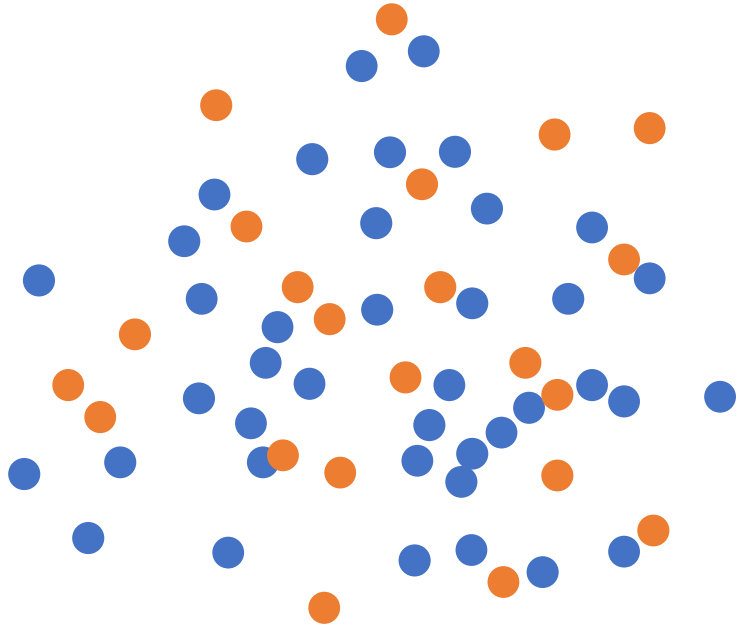
What is the effect of **exercising** on **health**?

Recruit participants



What is the effect of **exercising** on **health**?

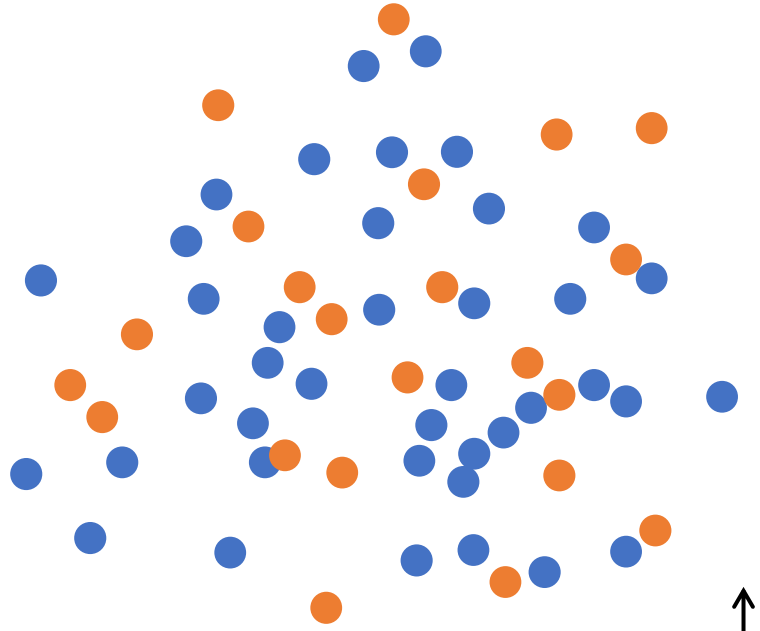
Ask about their exercise habits



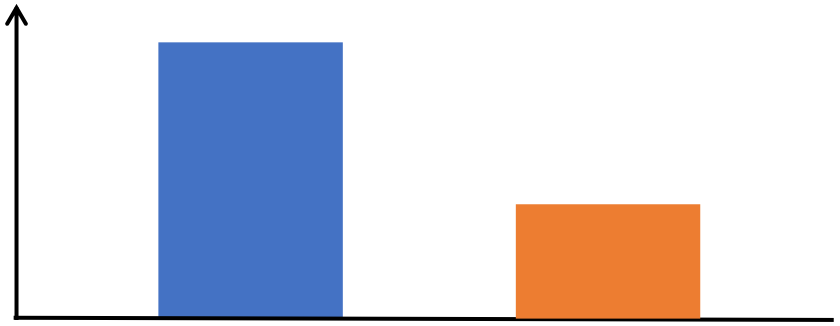
Person does not exercise

Person exercises

What is the effect of **exercising** on **health**?



Cholesterol levels

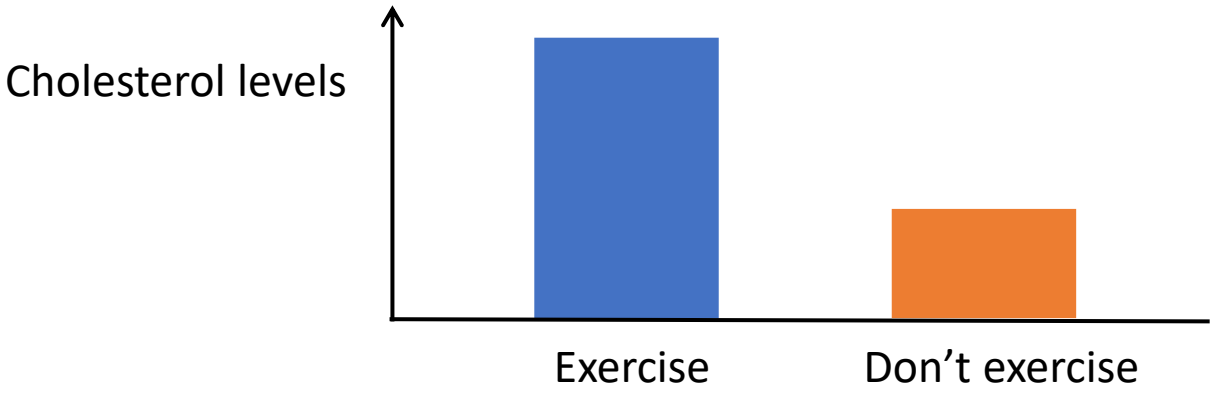


Person does not exercise

Person exercises

Exercising raises cholesterol levels???

Bias: systematic error in sampling or testing



Exercising raises cholesterol levels???

A potential bias

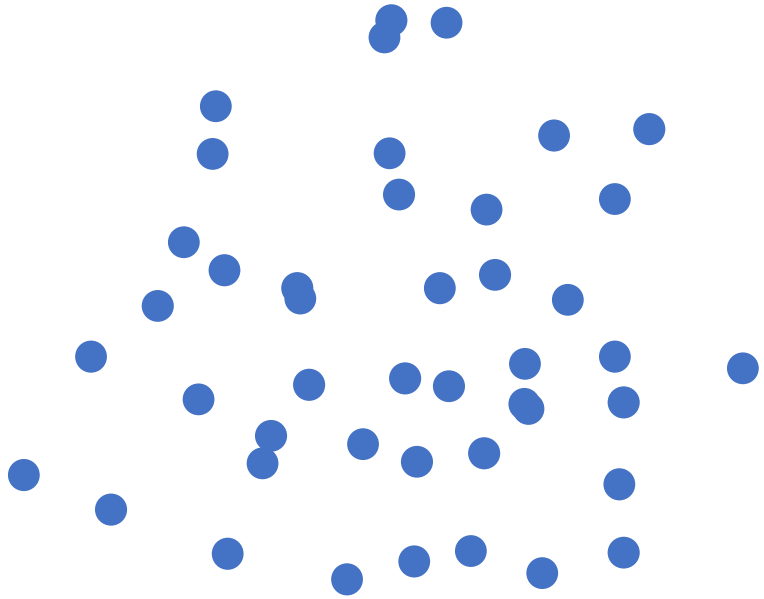
Unhealthy individuals may be more motivated to exercise

Solution: Fair Experiment

- How would you design a fair experiment?
- **Treatment**:
- **Control**:

Why might we want to provide the control group with light stretching exercises?

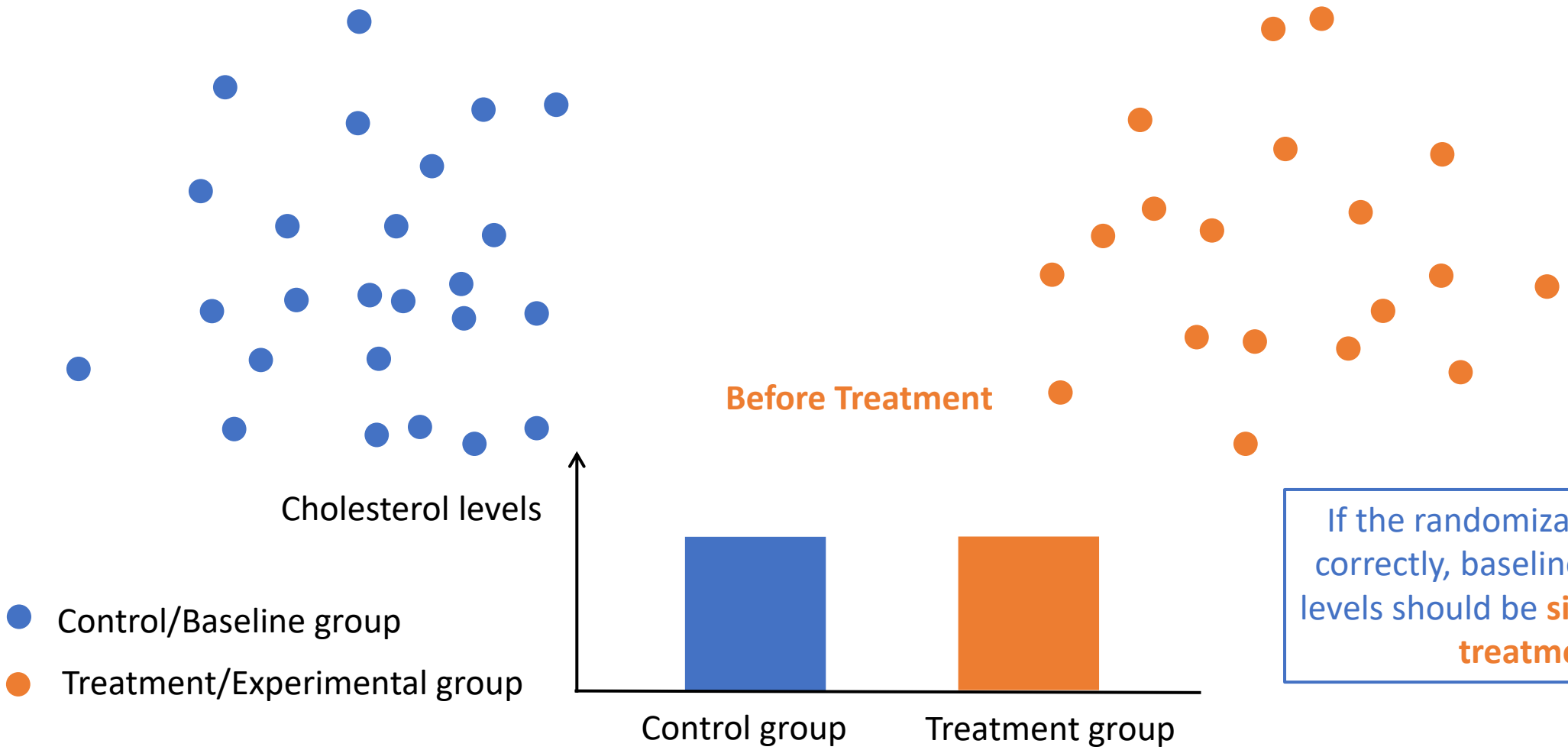
Randomized Controlled Trial



Randomized Controlled Trial

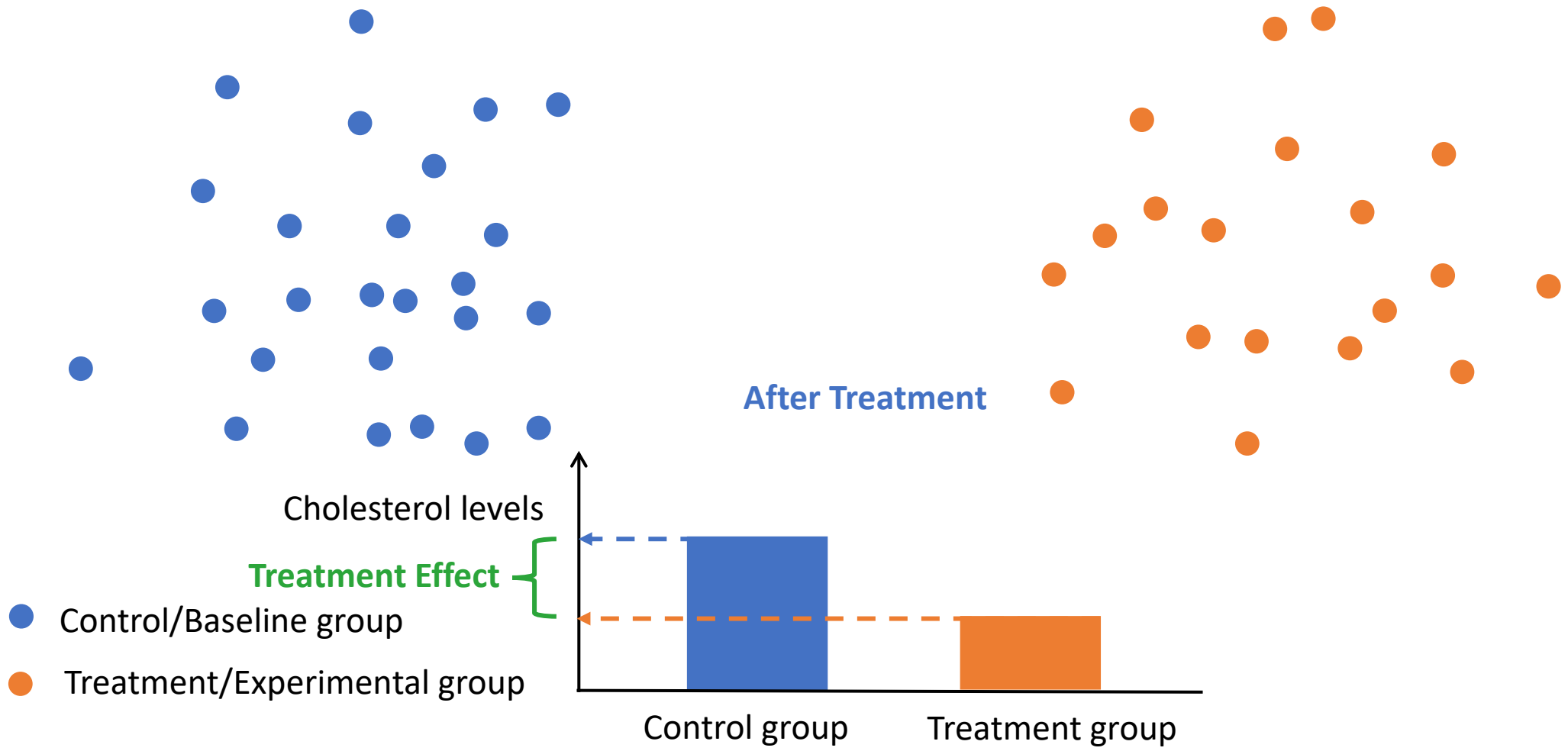
Random assignment!

Before Treatment: No observed differences



If the randomization is done correctly, baseline cholesterol levels should be **similar prior to treatment**

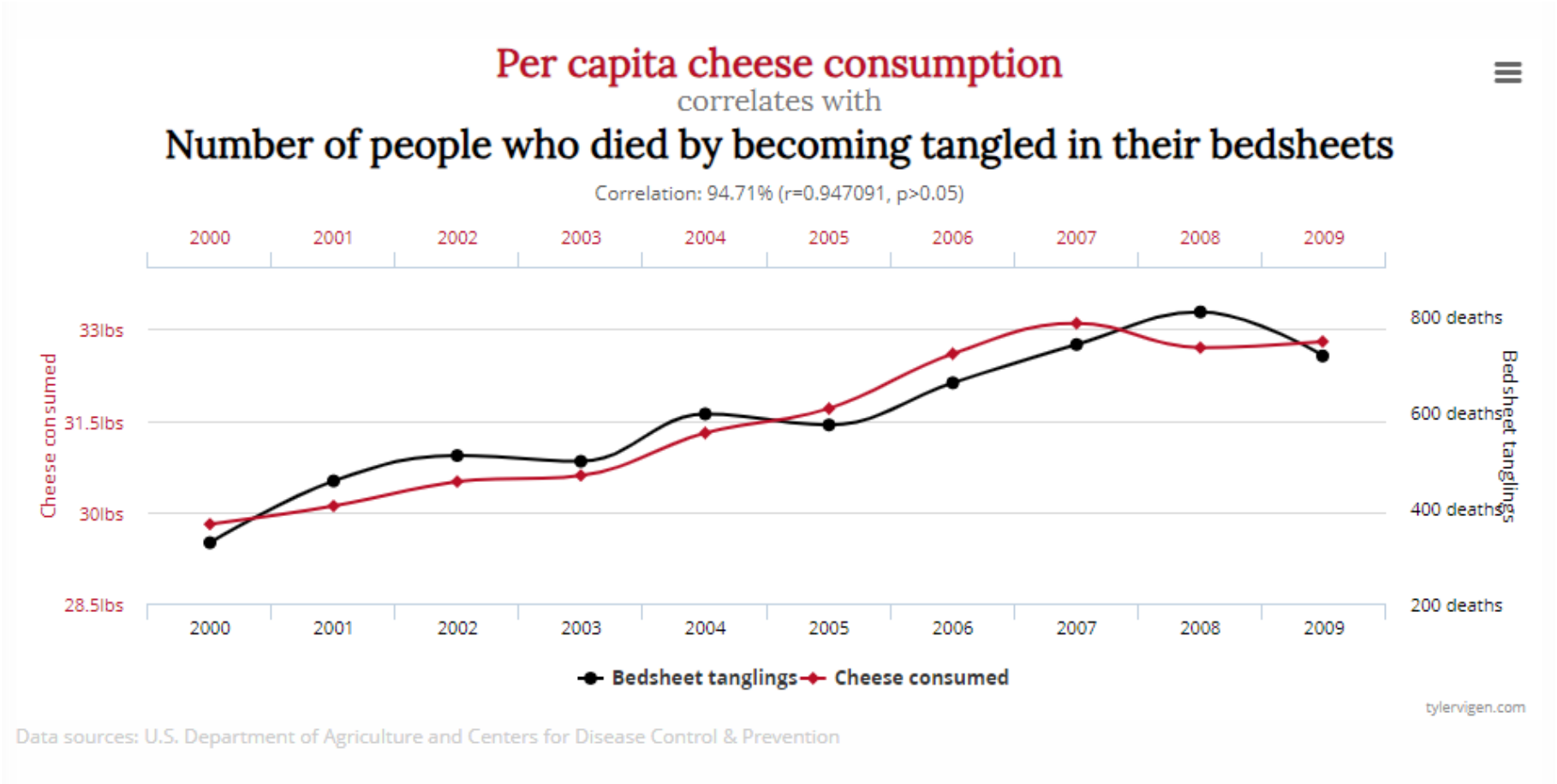
After Treatment: Effect of Daily Exercise



Takeaways

- Bias could produce misleading and counterintuitive findings
- Randomization at the start of the study ensures group comparability, allowing for a fair comparison
- Defining the independent and dependent variables are at the heart of study design
- Many considerations (e.g., ethical concerns, cognitive biases, and others) come into play when determining what the treatment and control groups receive

Spurious correlation



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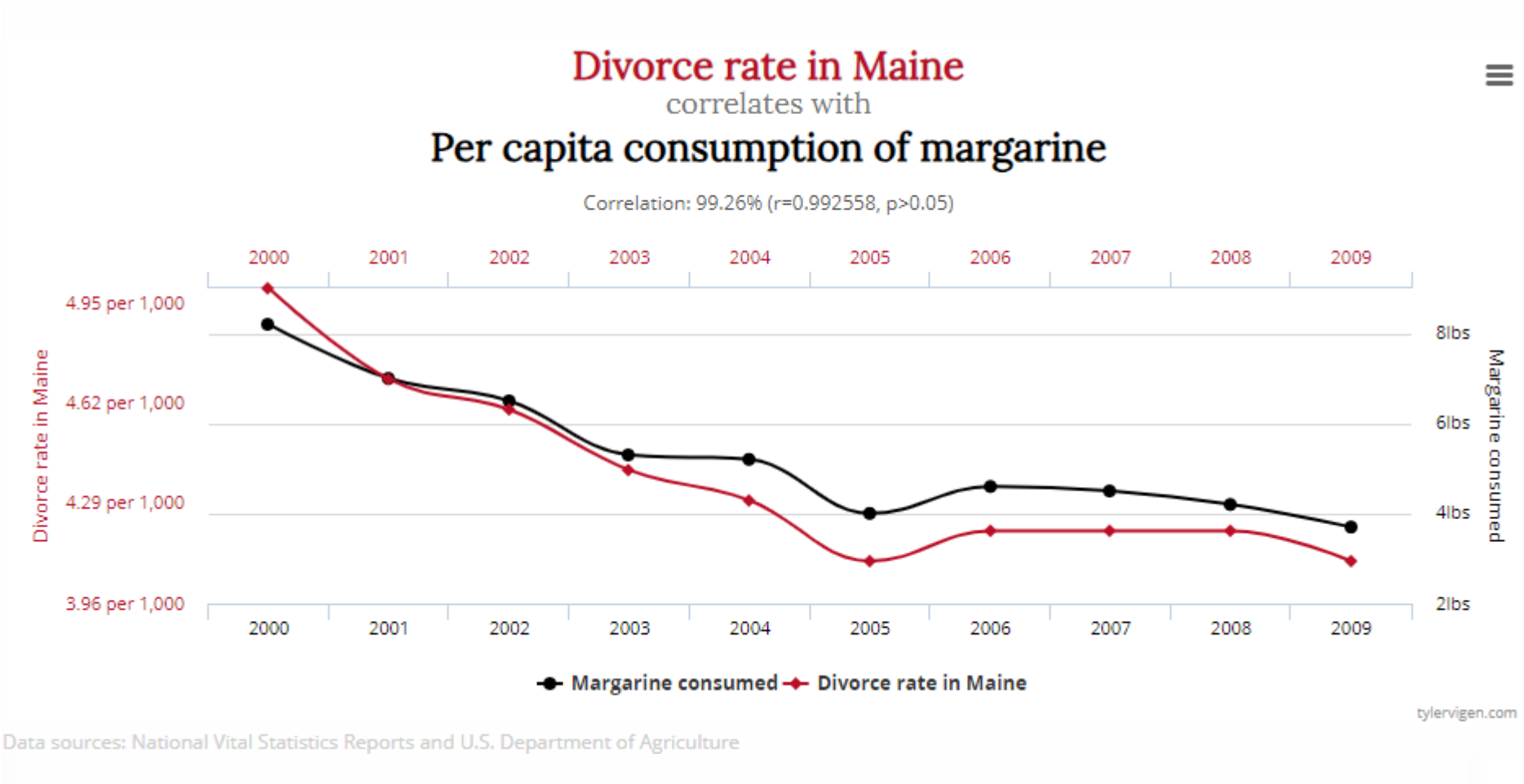
Spurious correlation



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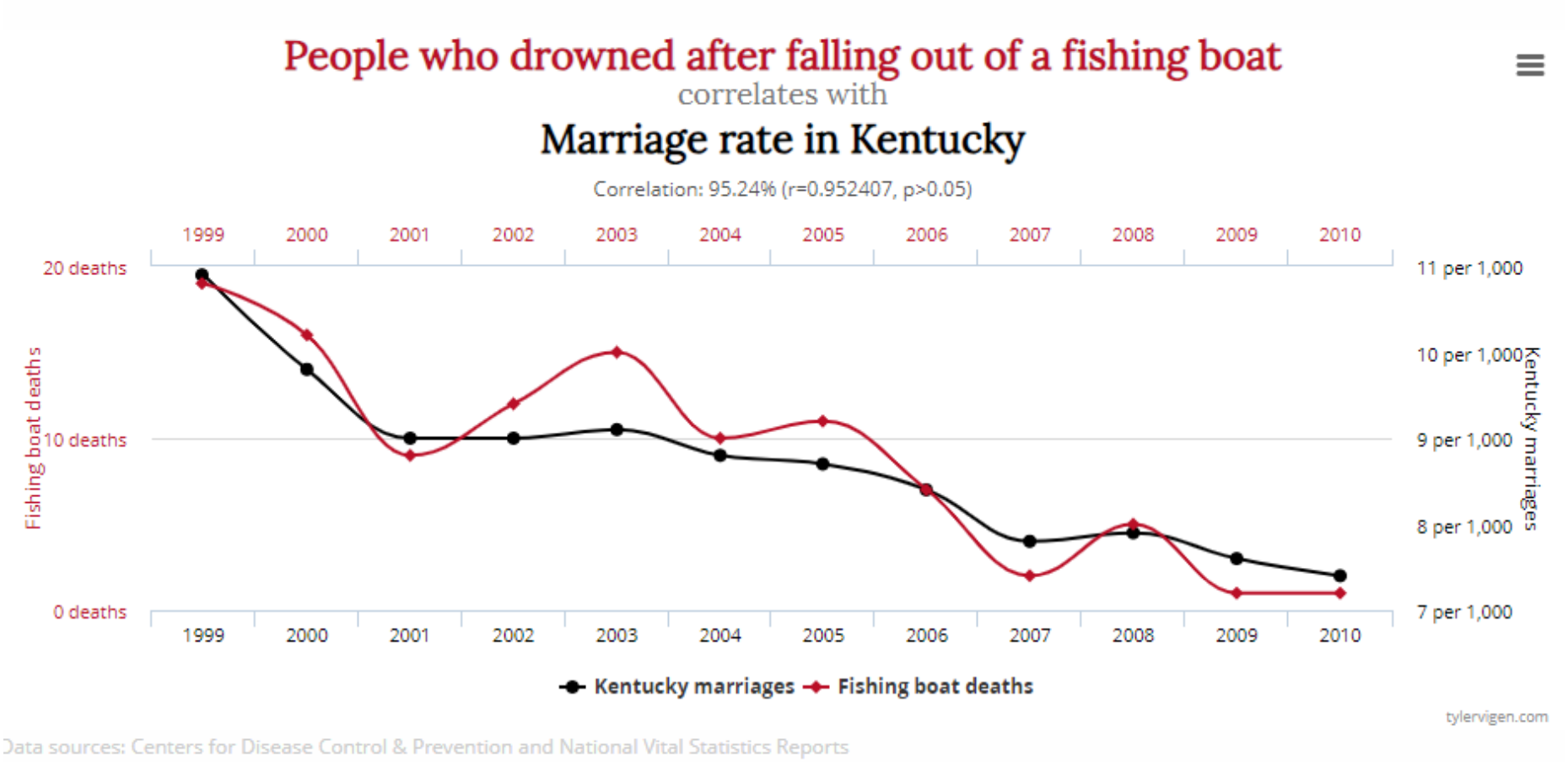

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