

MATH1401

Fall 2021

Lecture 2

Cause and Effect

Announcements

Text Book – Chp 2 and Keywords

- **Individuals**
 - **Treatment**
 - **Outcome**
 - **Observational study**
 - **Association**
 - **Causality**
 - **Comparison**
 - **Treatment group**
 - **Control group**
 - **Confounding variable**
-

A Link

Coffee

Three coffees a day linked to a range of health benefits

Research based on 200 previous studies worldwide says frequent drinkers less likely to get diabetes, heart disease, dementia and some cancers



< 34

6

Staff and agencies

Wednesday 22 November
2017 19:54 EST



 The findings supported other studies showing the health benefits of drinking coffee. Photograph: Wu Hong/EPA

Guardian UK

A Stronger Link?

eating and health

Chocolate, Chocolate, It's Good For Your Heart, Study Finds

JUNE 19, 2015 5:03 AM ET



ALLISON AUBREY



npr.org (report on a study in heart.bmj.com)

Observation

- **individuals**, study subjects, participants, units
 - *European adults*
 - **treatment**
 - *chocolate consumption*
 - **outcome**
 - *heart disease*
-

The first question

Is there **any relation** between chocolate consumption and heart disease?

- **association**
 - any relation
 - link
-

An answer

Some data:

“Among those in the top tier of chocolate consumption, 12 percent developed or died of cardiovascular disease during the study, compared to 17.4 percent of those who didn’t eat chocolate.”

- Howard LeWine of Harvard Health Blog, reported by [npr.org](https://www.npr.org)

- Does this point to an association?
-

The next question

Does chocolate consumption **lead to** a reduction in heart disease?

- **causality**

This question is often harder to answer.

“[The study] doesn’t prove a cause-and-effect relationship between chocolate and reduced risk of heart disease and stroke.”

- JoAnn Manson, chief of Preventive Medicine at Brigham and Women’s Hospital, Boston

Association

London, early 1850's



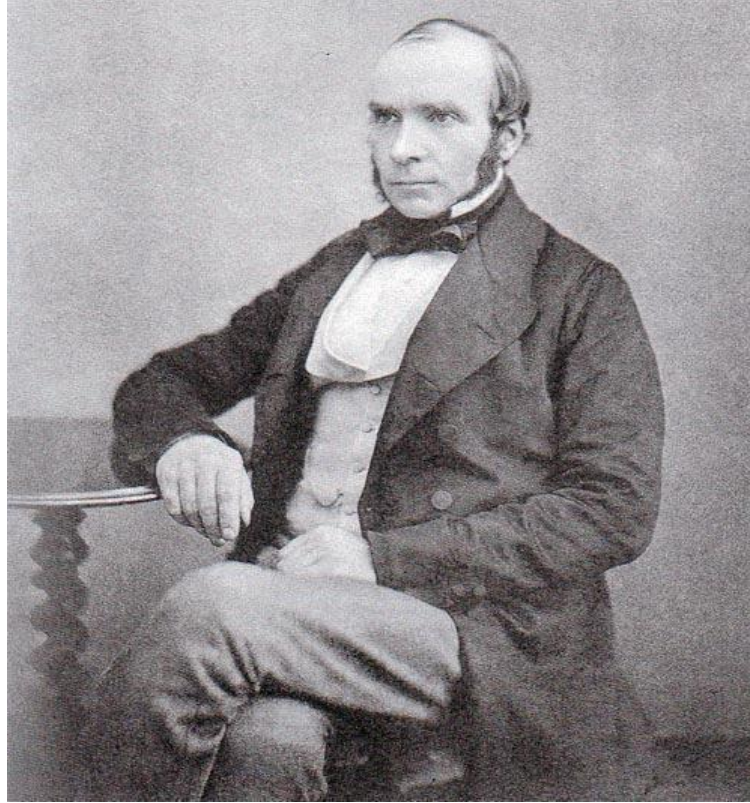
A COURT FOR KING CHOLERA.

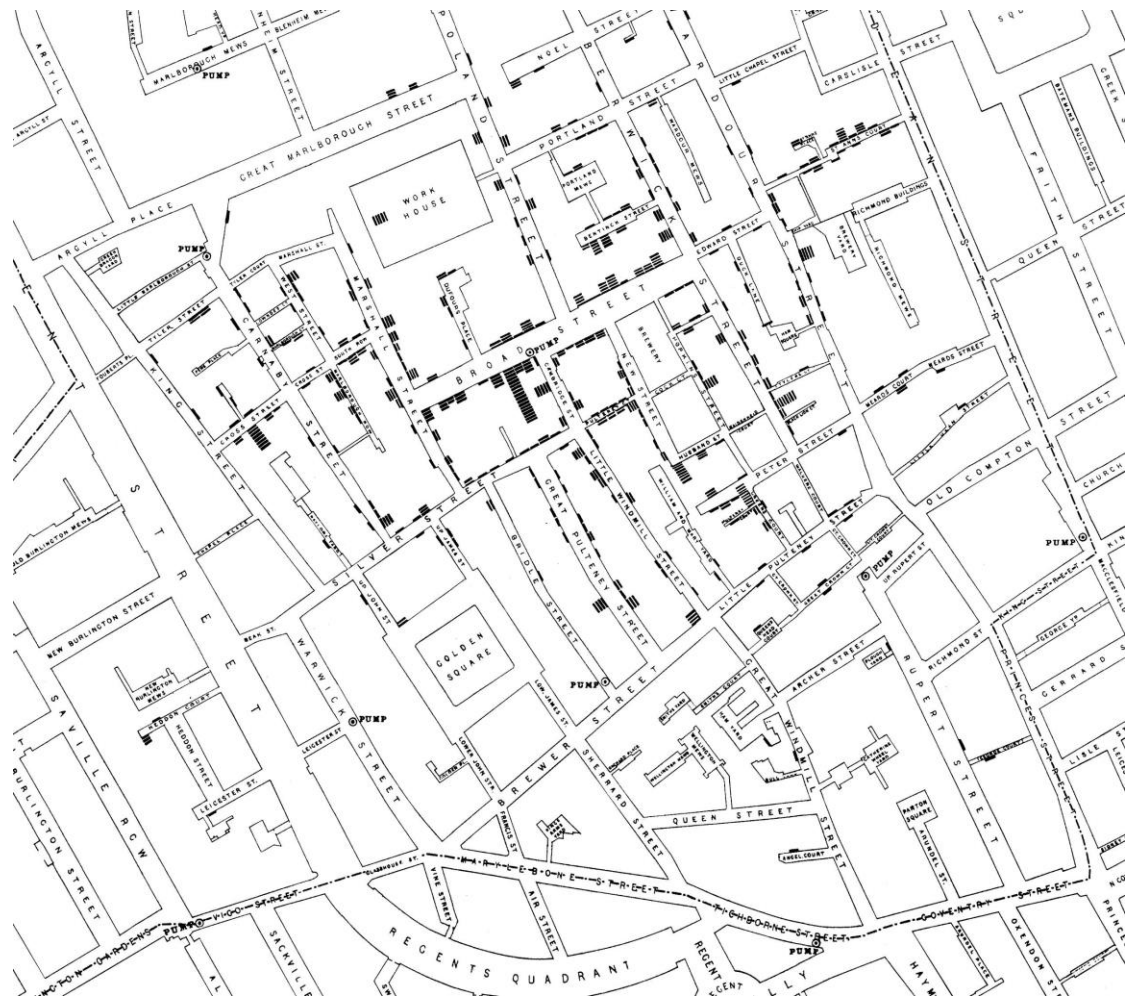
Illustration from *Punch*
(1852).

Miasmas, miasmatism, miasmatists

- **Bad smells** given off by waste and rotting matter
 - **Believed to be the main source of disease**
 - Suggested remedies:
 - “fly to clene air”
 - “a pocket full o’posies”
 - “fire off barrels of gunpowder”
 - Staunch believers:
 - Florence Nightingale (founder of modern nursing)
 - Edwin Chadwick (Commissioner of the General Board of Health)
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John Snow, 1813-1858

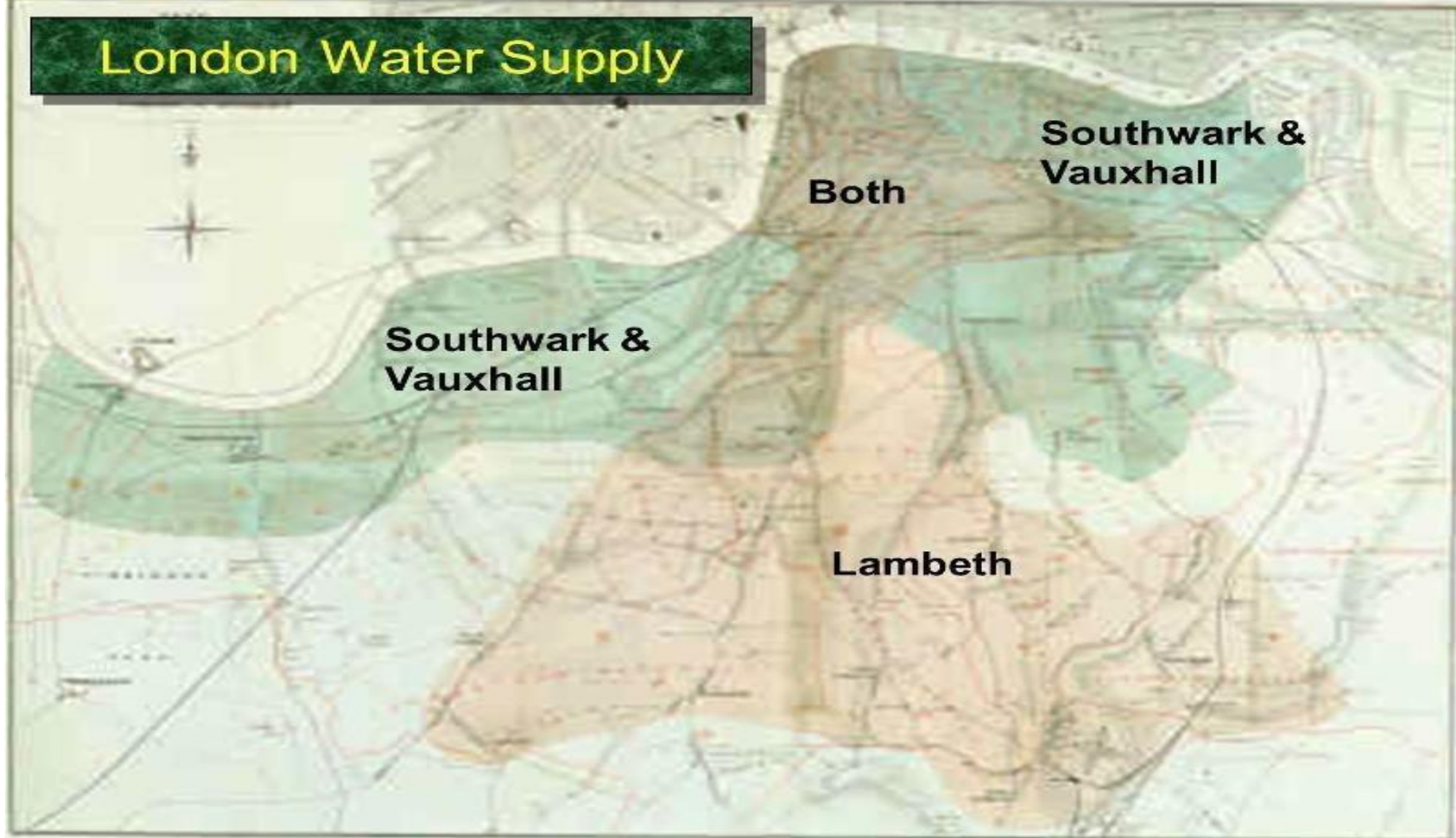






Causation

London Water Supply



Comparison

- **treatment group**
- **control group**
 - does not receive the treatment

Snow's table

Supply Area	Number of houses	Cholera deaths	Deaths per 10,000 houses
S&V	40,046	1,263	315
Lambeth	26,107	98	37
Rest of London	256,423	1,422	59

Key to establishing causality

If the treatment and control groups are *similar apart from the treatment*, then differences between the outcomes in the two groups can be ascribed to the treatment.

Confounding

Trouble

If the treatment and control groups have **systematic differences other than the treatment**, then it might be difficult to identify causality.

Such differences are often present in **observational studies**.

When they lead researchers astray, they are called **confounding factors**.

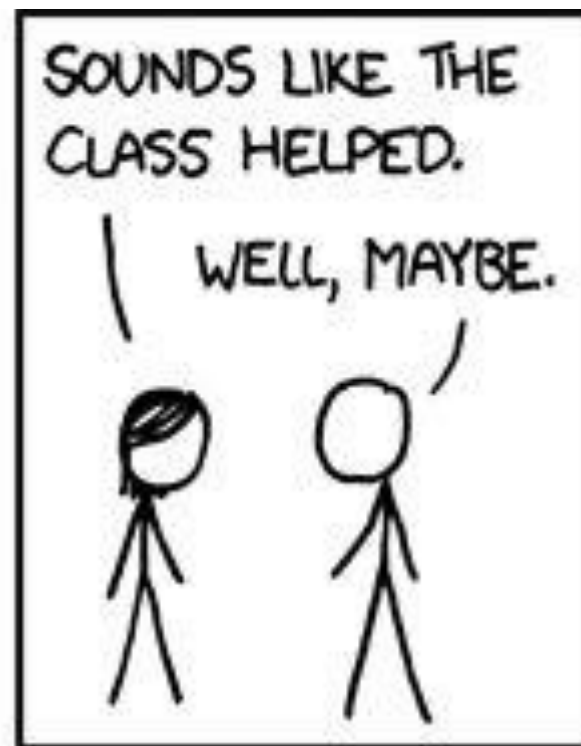
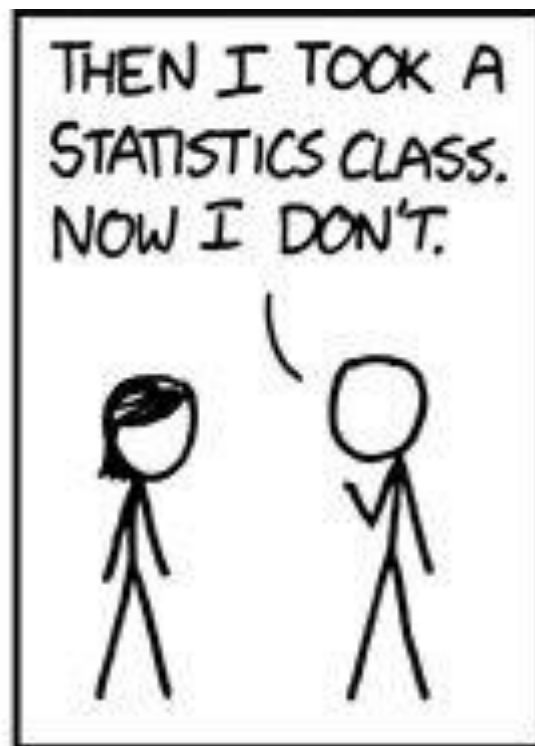
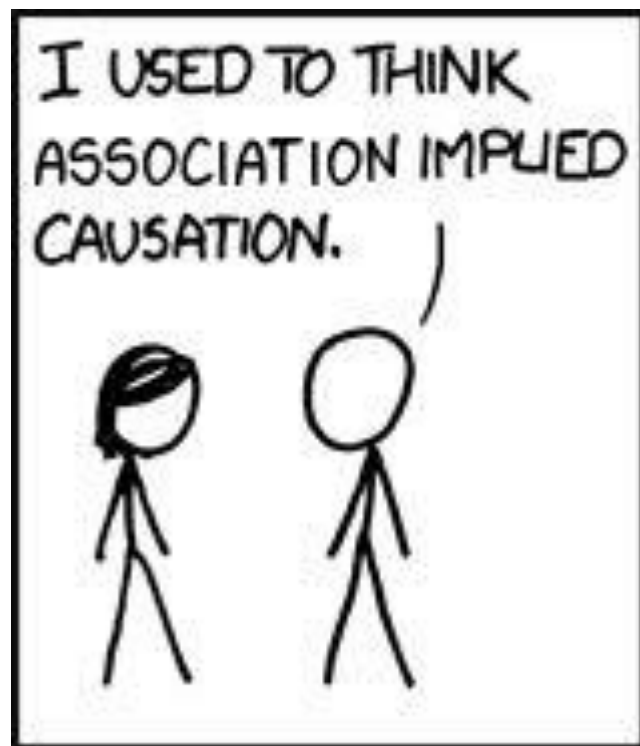
Randomize!

- If you assign individuals to treatment and control **at random**, then the two groups are likely to be similar apart from the treatment.
 - You can account – mathematically – for variability in the assignment.
 - **Randomized Controlled Experiment**
-

Careful ...

Regardless of what the dictionary says,
in probability theory

Random \neq Haphazard



Credit: xkcd