Causality in Epidemiology

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Proof is the End Game

• How do we know when we have it?
  – Type I or Type II error
  – Biologic mechanism
  – No alternative hypotheses
  – Bradford Hill Criteria
• “[L]ung cancer is correlated with both smoking and with stained teeth, but if we wish to avoid lung cancer, it will pay to quit smoking but not to whiten our teeth.” (Page 4)


Nonetheless, we pursue causation.

Bradford Hill Criteria Are the Currency of Epidemiology

• Presumes (perhaps):
  – A new positive result
  – Multiple reports
  – Conflicting results
  – Ideal measure or measurement is not available
  – Resources to conduct one more study are not available...
Sir Austin Bradford Hill

• “I have no wish, nor the skill, to embark upon a philosophical discussion of the meaning of “causation”. ... But with the aims of occupational, and almost synonymously preventive, medicine in mind, the decisive question is whether the frequency of the undesirable event B will be influenced by a change in the environmental feature A”.


Bradford Hill Criteria

1. Strength
2. Consistency
3. Specificity
4. Temporality
5. Biologic gradient
6. Plausibility
7. Coherence
8. Experiment
9. Analogy

Hill listed the criteria in priority order.
Does Alcohol Have a Role in Causing Cancer?

National Cancer Institute

- Drinking alcohol can increase your risk of cancer of the mouth, throat, esophagus, larynx (voice box), liver, and breast. The more you drink, the higher your risk. The risk of cancer is much higher for those who drink alcohol and also use tobacco.
- Doctors advise people who drink to do so in moderate amounts. The federal government’s Dietary Guidelines for Americans defines moderate alcohol drinking as up to one drink per day for women and up to two drinks per day for men.
- It has been suggested that certain substances in red wine, such as resveratrol, have anticancer properties. However, there is no evidence that drinking red wine reduces the risk of cancer.

Strength
Consistency
Specificity
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Centers for Disease Control and Prevention

- Drinking alcohol raises the risk of some cancers. Drinking any kind of alcohol can contribute to cancers of the mouth and throat, larynx (voice box), esophagus, colon and rectum, liver, and breast (in women). The less alcohol you drink, the lower the risk of cancer. Drinking alcohol can increase your risk of cancer of the mouth, throat, esophagus, larynx (voice box), liver, and breast. The more you drink, the higher your risk. The risk of cancer is much higher for those who drink alcohol and also use tobacco.
- When you drink alcohol, your body breaks it down into a chemical called acetaldehyde. Acetaldehyde damages your DNA and prevents your body from repairing the damage. When DNA is damaged, a cell can begin growing out of control and create a cancer tumor.

Hill’s Advice

- Don’t ignore prior evidence
- Don’t rely solely on statistics
- Notice differences in the study characteristics (time period, population studied, retrospective/prospective) (Table 2)
- Is removal of the suspect exposure associated with lessening or removal of the disease?
- Is there enough evidence for an intervention that would be satisfactory?
- Strong evidence is not always needed
Boniface, Scannell, and Marlow

- Systematic review (PRISMA Guidelines)
- Reviewed evidence base for minimum unit pricing (MUP) of alcohol
- 33 studies Cochrane Handbook for assessing public health studies
- Table 2: study type, author, year, country, study design, intervention, outcome, peer-reviewed, conflict of interest included?, quality rating, Bradford Hill criteria met
- Nine Bradford Hill criteria

Boniface, Scannell, and Marlow (Continued)

- What are the advantages of conducting a systematic review?
  - Completeness
  - Specific intervention
  - Statistics
- What did examination of Bradford Hill Criteria add?
- Do Bradford Hill criteria work well for environmental health questions?
Thanks!
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Key Points

Be able to distinguish the following criteria using an example similar to the one given in this lecture on alcohol:

1. Strength
2. Consistency
3. Specificity
4. Temporality
5. Biologic gradient
6. Plausibility