Lecture One

- **Effect Modification**
- Confounding
- Internal/External validity
- Effect modification vs. interaction

Lecture Two

- **Causality** (counterfactual outcomes)
- Exchangeability
- Conditioning
- DAG's

Lecture Three

- Planning an **RCT**
- RCT tools
- Intention to treat
- Loss to follow-up in RCTs
- PICOST
- Analysis process
- Explanatory vs. Pragmatic trials
- Multi-arm RCTs
- Crossover trials
- Trial Phases
- Non-inferiority/Equivalence trials

Lecture Four

- **Cluster RCT's**
- Intraclass correlation
- Design effect
- Sample size for cluster RCT's
- Matching
- Stratified randomization
- Cluster vs. individual randomization

Lecture Five

- **Cohort Studies**
- Selection/Information/Confounding Bias
- Conditioning for Confounding

Lecture Six

- **Case-control studies**
- Nested case-control studies
- Density/Cumulative sampling
- **Case-cohort** studies
- Matching in case-control studies
- **Case-crossover** studies
- Sample size for case-controls studies

Lecture Seven

- **Ecological studies**
- Types of measures
- Types of inferences
- Types of designs
- Levels of analysis
- Ecological fallacy
- Strengths/Limitations

Lecture Eight

- Survey design
- Reliability / Validity
- Writing good questions
- Evaluation
- Ethical issues

Lecture One

What is Effect Modification?

It is when the effect of a particular exposure depends on the value of a third variable, or is modified by a third variable.
We **evaluate it** by seeing if the measure of association varies across strata of the third variable.
Also known as **interaction** or **heterogeneity of effect**.

Effect Modification vs. Confounding

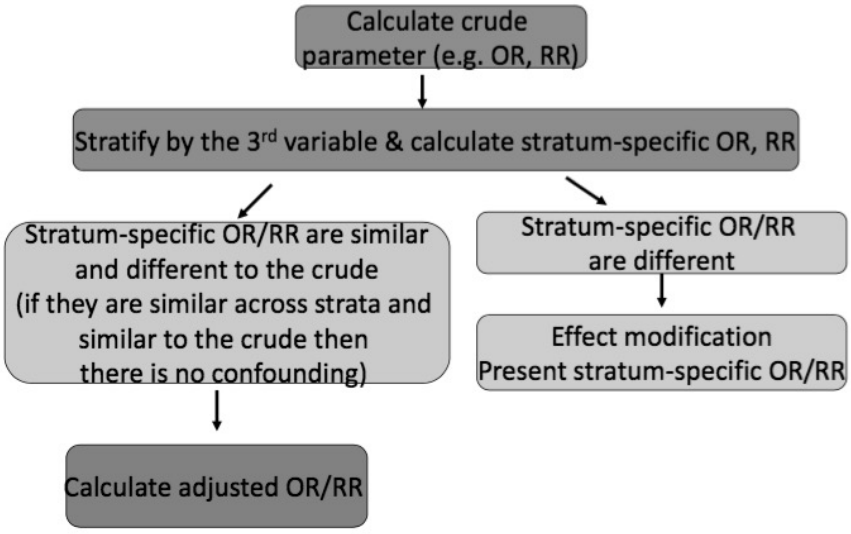
Confounding:

- When there is a biased measure of association due to a third variable that is a **common cause** of both exposure and outcome
- Creates noise, and therefore should be eliminated (controlled/adjusted for)

Effect modification

- When the measure of association varies according to the value of a third variable
- This third variable is not necessarily a confounder
- Source of useful information that we want to describe/study further
- We do this by comparing stratum specific estimates and checking for statistical interaction

How to identify which is present?



How do we identify if estimators are "different"?

1. Visual comparison of OR's across strata
    - Often just a matter of informed opinion
    - There is always a little variation across strata

- Is the difference meaningful or just random/due to chance?

2. **Test of Homogeneity/Heterogeneity**
   a) Mantel-Haenszel test
   b) Fit an interaction term in the regression model

Why is effect modification important?

- Better understanding of causation
- Identification of "high-risk groups"
- Hence we can target interventions at specific subgroups

Internal Validity

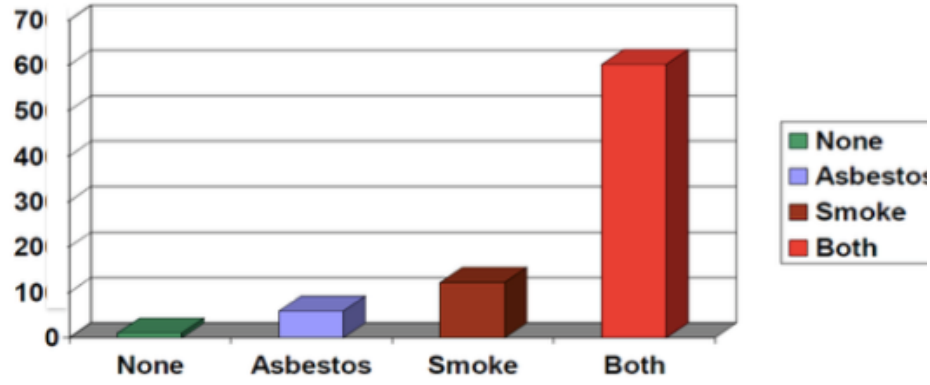
- Can we apply the results to the study population?
- How valid is the estimated result?
- How valid are the measurements themselves? (eg. IQ)
- Are the results free from
  - Selection bias
  - Information bias
  - Confounding?

External Validity (generalizability/transportability)

- Is there **effect modification** present that we haven't investigated?
- Can we apply the results to everyone beyond the study population?
- To whom to the results apply? Everybody? Only study participants?
- Things to think about:
  - Are men and women the same?
  - Does the effect depend on ethnicity?
  - Is a resource-intensive intervention likely to succeed in a low resource setting?

Observed risk ≠ Expected risk

The effect is not just a matter of addition of effects, we can see that the exposure and third variable are interacting to create an exaggerated effect that is **greater than the sum of both individual effects.**



Death rates from Lung cancer (per 100,000)