

# STUDY DESIGNS

## BIOS 662

Michael G. Hudgens, Ph.D.

[mhudgens@bios.unc.edu](mailto:mhudgens@bios.unc.edu)

<http://www.bios.unc.edu/~mhudgens>

2008-08-18 12:50

# Types of Studies

- Def 2.1. An *observational study* collects data from an existing situation. The data collection does not intentionally interfere with the running of the system.  
→ beware *Hawthorne effect*.
- Def 2.2. An *experiment* is a study in which an investigator deliberately sets one or more factors to a specified level.  
→ leads to stronger scientific/causal inference

# Types of Biomedical Studies

- Observational studies:
  - Cross Sectional
  - Cohort (prospective)
  - Case Control
- Experimental Studies:
  - Clinical Trials
  - Laboratory

# Cross Sectional Studies

- Def 2.16: A *cross sectional study* collects data on study units at only one point in time.
- Purposes:
  1. To describe the population at one point in time; measure prevalence  
Examples: U.S. Census, National Health and Nutrition Examination Surveys (NHANES)
  2. To examine associations  
Examples: menopause status and blood cholesterol level, hyperactivity and blood lead levels

# Longitudinal Studies (Panel Studies; Repeated Measures)

- Def 2.16: A *longitudinal study* collects information on study units on at least two occasions.
- Purposes:
  1. To measure change  
Examples: change in height for each year of age; change in viral load in HIV+ individuals
  2. To develop predictions  
Example: given blood pressure at age 10, what would we expect blood pressure to be at age 15?
  3. To examine the association between the changes in 2 or more variables  
Example: is change in viral load associated with change in CD4+ T-cell count?

# Cohort Studies

- Def 2.10: A *cohort study* or *prospective study* is one in which a cohort of people is identified at beginning of study and followed to observe specified endpoints (e.g., occurrence of disease).
- Purposes:
  1. Estimate incidence of disease; relate baseline measures to the occurrence of disease  
Example: Framingham Heart Study

## Question:

- Are cohort and longitudinal studies mutually exclusive?
- If not, how do the two relate?

## Case-Control Studies

- Def 2.13: A *case-control study* selects all cases, usually of a (rare) disease, that meet fixed criteria.

A disease-free group, called *controls*, that serve as a comparison for the cases is also selected.

The cases and controls are compared with respect to various characteristics (exposures, risk factors)

- Example 2: Investigators interested in association between thromboembolic disease and oral contraceptive (OC) use
  - Cases: women aged 16-40 who had been discharged from one of 19 hospitals for deep vein thrombosis, ...
  - Controls: women suffering acute medical conditions (other than thromboembosis) or elective surgery
  - All participants asked about OC history (50% cases, 14% controls)



# Case-Control Studies

- Def 2.14: In a *matched case-control study*, controls are selected to match characteristics of individual cases.

The cases and controls(s) are associated with each other.

There may be more than one control for each case.

- Example 2: two controls per case; matched on age, date of hospital admission, parity

# Experimental Studies

- Definition: Interventions are applied by investigator
- Purpose: to compare outcomes between two or more interventions
- Example: Compared to placebo, does a candidate vaccine result in a lower incidence of HIV in high risk individuals?
- Usually interventions are assigned using *randomization*: a random but known process by which participants are assigned to different treatments or interventions  
E.g., each participant is equally likely to be assigned drug or placebo

# Randomization

- Attributed to R. A. Fisher
- “One of the greatest intellectual advances of the 20th century”
- Advantages:
  - Removes potential bias in allocating participants to different intervention groups
  - Tends to produce comparable groups on average
  - Provides a basis for statistical tests
- Disadvantages:
  - Ethical?

# Crossover Experiment

- Def 2.6: In a *crossover experiment* the sample experimental unit receives more than one treatment during non-overlapping time periods.
- Advantage: each experimental unit serves as its own control, eliminating subject-to-subject variability
- Disadvantage: possible carryover effects of treatment, calendar time effects

# Blinding

- Def 2.19: A study is *single blind* if subjects being treated are unaware of which treatment (including any control) they are receiving
- A study is *double blind* if it is single blind and the people who are evaluating the outcome variable are also unaware of which treatment the subjects are receiving
- *Triple blind*: double blind **plus** statistician/monitoring committee is unaware of treatment assignments (Friedman et al. 1998)

# Blinding

- Aka masking
- Sometimes impossible/infeasible: nutrition, circumcision
- Unblinded studies (aka “open label”):
  - Disadvantage: potential for bias (systematic error)
  - Advantages: reflects clinical practice, simpler

# Endpoints

- Def 2.9: An *endpoint* is a clearly defined outcome or event associated with an experimental or study unit
- Important considerations in choosing an endpoint:
  - Relevance
  - Reliability
  - Rate
- Hierarchy: primary, secondary, tertiary, etc

# Inferences from a Study

- What was the design?
- Guard against bias:
  - Comparability
  - Representative of target population
- Source of, control for, and quantify uncertainty/variation



# BIOS 668

668 DESIGN OF PUBLIC HEALTH STUDIES (3). Prerequisites, BIOS 545, 550, or equivalents. Statistical concepts in basic public health study designs: cross-sectional, case-control, prospective, and experimental (including clinical trials). Validity, measurement of response, sample size determination, matching and random allocation methods. Spring. Lavange, Catellier, Couper.

# Homework 1

1. Read Chs 1 and 2 BFHL.
2. Problem 2.1 page 23 BFHL.
3. Due Monday, August 25

General guidelines for HWs:

- Should be neat; typed preferable.
- Use complete sentences w/ correct spelling and grammar.
- Show all work; do not just provide answer.
- Do not show undigested computer output.