Learning Objectives

- Understand the concepts of confounding and bias
- Understand how confounding and bias can be controlled
Bias and Confounding

• Key difference between bias and confounding

  – Bias is a systematic characteristic introduced by the investigator
  – Confounding is a relationship of some characteristic that is associated with the exposure and independently a risk factor for disease and is not on the causal pathway
Types of Bias

- Two broad categories of bias
  - Selection Bias
  - Observation (information) bias

- Under each general term specific types of bias occur
Selection Bias

• Can result from the way that individuals are selected for the study
  – Differential surveillance, diagnosis or referral
    • Classic example is thromboembolism and oral contraceptive use
• Refusal or non-response among either study group
  – If rates of response are related to exposure status
Observation or Information Bias

• Systematic differences in the way data on exposure or outcome are obtained from the various study groups
  – Inaccurate or Incomplete
    • If it affects the groups to different degrees

• Recall Bias

• Interviewer Bias

• Lost to follow up

• Misclassification
Control of Bias

• Choice of Study Population
  – Using hospital controls in case-control studies
    • Decreases likelihood of non-response, selection, and recall bias
  • Use well defined population relative to some defined characteristic (occupation, area of residence, alumni, etc) that gains access to centralized data
    – Decreases the likelihood of loss to follow up
Control of Bias

• Methods of data collection
  – Use specific instruments, such as validated questionnaires, standard physical exam forms, data extracted from a record
  – Administer the instruments by study personnel only
  – Example: if you are studying hypertension, collect data from several blood pressure readings given by a trained study person rather than asking a participant about hypertensive history
  – Try to maintain blindness
Bias – One Final Thought

• All analytical studies are susceptible to bias, but each study may be more susceptible to a particular bias
  – Case – control
    • Disease status may influence determination of exposure status- recall bias
    • Exposure status may influence identification of disease and non-disease participants- selection bias
  – Cohort studies
    • Loss of follow-up, (retrospектив) selection bias
CONFOUNDING FACTORS

• Confounders are related to both the outcome of interest and exposure not on the causal pathway.
Confounders

• Confounding can be either positive or negative in terms of the confounders effect on the outcome of interest.
• Positive confounding results in an over-estimation of the association between exposure and outcome
• Negative confounding results in an under-estimation of the association between exposure and outcome
Controlling Confounding in the Design

• Randomization of the study participants is the preferred method in interventional studies
  – This will distribute a potential confounder (either known or unknown) evenly over the treatment groups, but the sample size must be sufficiently large

• Restriction can be used if the potential confounder does not vary across either the exposure or disease
  – If sex and race are confounders then restrict the participants to nonwhite men or white women
Controlling Confounding in the Design

• Matching
  – If matching is used, then this must be considered in both the design phase and the analysis phase of the study
  – An example of matching would be:
    • Lets say age, sex and smoking are potential confounders for AMI, a 65 year old woman who is an MI patient would be matched with a 65 year old women with the same smoking history who never had an MI
  – Matching is used primarily in case-control studies and in the analysis phase you must stratify the analysis based upon the matching factors
Controlling Confounding in the Analysis

• Stratified analysis can be used in any study, however, must be used in a matched case-control study
  – Rule to live by = if you stratify the design, then stratify the analysis

• Multivariate analysis
  – If there are several potential confounders, stratification will not be adequate
  – Multivariate analysis are commonly used and in general multiple regression analysis is the most common.
Questions???