Epidemiologic Study Design: Cross-Sectional Studies

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Objectives

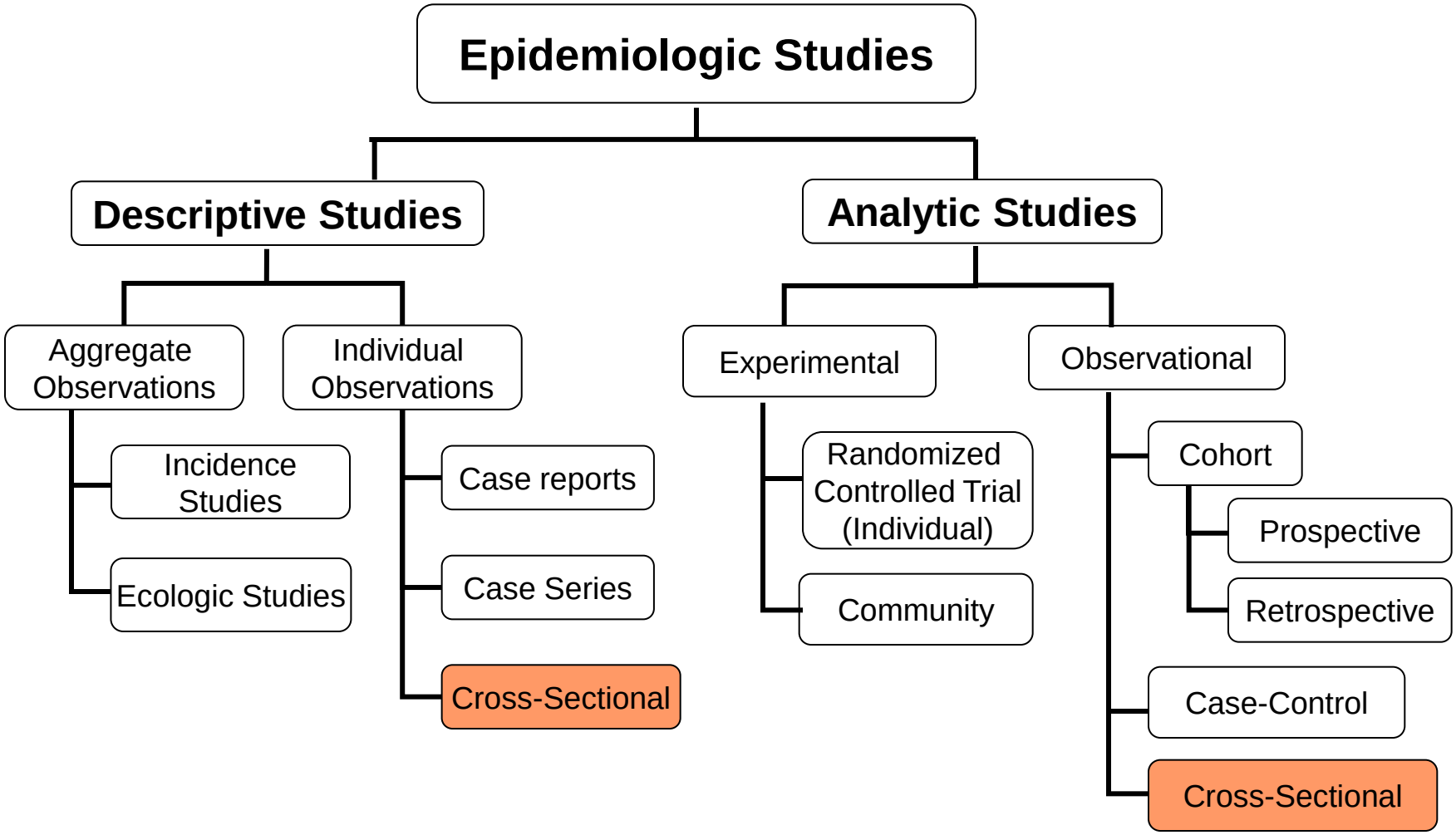
- Describe the features of a cross-sectional study
- Develop exposure and outcome definitions
- Describe uses and limitations of cross-sectional studies

Epidemiologic Investigative Process

1. Generate specific hypotheses
2. Design analytic study
3. Collect data
4. Conduct descriptive analyses
5. Calculate measures of association and **test hypotheses**
6. Make conclusions and report results

Analytic
Cross-Sectional Studies

Taxonomy of Epidemiologic Studies:
Descriptive vs. Analytic Studies

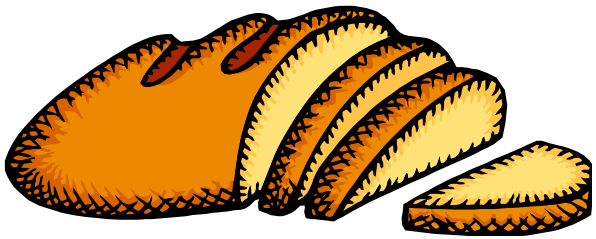


Review: Descriptive and Analytic Cross-Sectional Studies

- **Descriptive** cross-sectional studies: Examine the ***prevalence*** of disease (or exposure) in a defined population at one point in time
- **Analytic** cross-sectional studies: Examine the ***relationship*** between exposure and disease in a defined population at one point in time

Cross-Sectional Study Design

- A “slice” in time (**snapshot**) , e.g. no follow-up period
- Investigator selects sample from population
- Study population selected based on a characteristic (such as age, location) that is NOT an exposure or an outcome!
- Exposures and outcomes measured at one time



Elements of Study Design

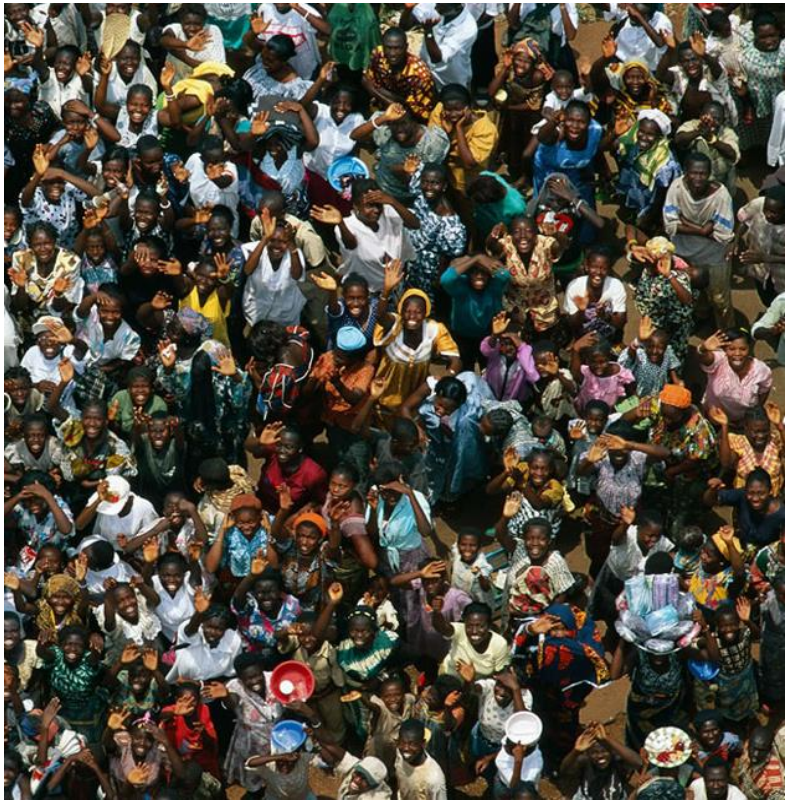
Important Elements of Study Design

- Defining the study population
- Defining outcomes
- Defining exposures

Defining the Study Population

Who do you want to apply your results to?

- General population
- Sex
- Age
- Race
- Geographic location
- Occupation



http://www.mymodernmet.com/profiles/blogs/hidef-photos-earth-from-above?context=tag-earth

Exposures and Outcomes

- **Exposure**: What you *do*
- **Outcome**: What *happens* to you
- Almost anything can be an exposure, and almost anything can be an outcome!
  - Secondhand smoke → Lung disease
  - Drought → Malnutrition
  - Malnutrition → Cognitive delays
  - Drunk driving → Road traffic accidents
  - Road traffic accidents → Premature deaths

Defining Exposures

Factors to consider when defining exposures:

- **Frequency**, e.g. alcohol consumption per week
- **Duration**, e.g. annual exposure to pesticides
- **Dose**, e.g. mild, moderate, or severe violence
- Exposures that **change over time**, e.g. exercise, pregnancy, depression

Defining Outcomes

Components of a case definition:

- **Person** (who has the outcome?)
- **Place** (where is the study being conducted?)
- **Time** (what is the study time frame?)
- **Clinical criteria**
  - Symptoms
  - Laboratory tests
  - Diagnosis codes

Sources of Data for Cross-Sectional Studies

Data sources	Examples
Medical records	Care and treatment form (“CTC 2”) for HIV-positive patients
Surveys/questionnaires	National Demographic and Health Survey
Physical measurements	Child nutrition study – height and weight
Laboratory tests	Cholesterol, pregnancy, HIV viral load (‘bio-behavioral surveys’)

Sources of Information

Can you think of some possible sources of information on exposure or disease?

- Questionnaires
- Medical records
- Laboratory reports
- Prescription records
- Birth certificates
- Death certificates
- Disease registries
- Employee records

Analyzing Cross-Sectional Studies

- Measures of exposure (or outcome) frequency:
  - *e.g. Prevalence of drinking alcohol in youth ages 13-15 in Dar es Salaam is 5.1% (**exposure**)*
  - *e.g. Prevalence of unprotected sex in youth ages 13-15 in Dar es Salaam is 4.5% (**outcome**)*

- Measures of association:
  - *e.g. Relationship between youth drinking and unprotected sex*
  - **Prevalence ratio**
  - **Prevalence odds ratio**

Advantages of Cross-Sectional Studies

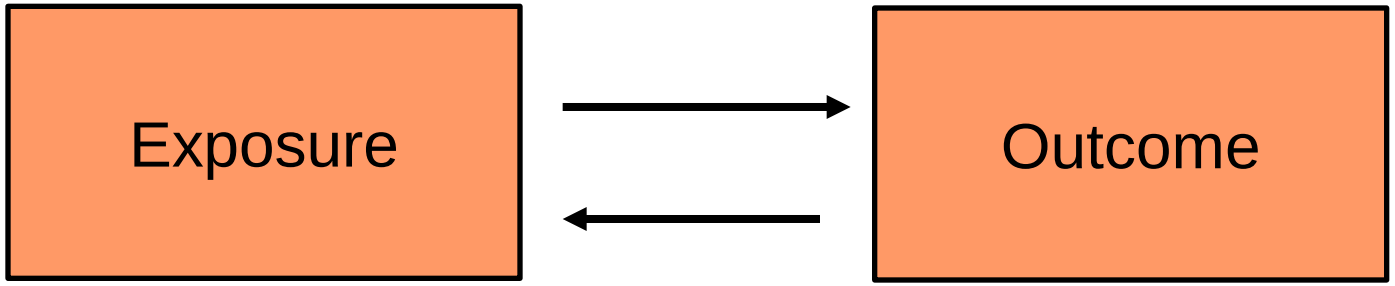
- Inexpensive – One-time household survey
- Simple – Data collection and analysis
- Generalizable results (if sampled correctly)
- Can examine multiple exposures and outcomes without restrictions on either

Cross-Sectional Studies: Disadvantages (1 of 3)

- Can**not** establish **causality** (don't know if 'exposure' preceded 'outcome' or vice versa)
  - In above example, we do not know if alcohol use lead to more unprotected sex, or if unprotected sex encourages alcohol use
- Difficult to detect **acute outcomes**
  - Not ideal if we want to know about heavy alcohol use and likelihood of RTA

Cross-Sectional Studies: Disadvantages (2 of 3)

- **Reverse causality** must be considered
  - Exposures and outcomes that change over time may have complex relationships
    - Childhood physical activity and overweight
    - Alcohol use and job stability
    - Other examples?



Cross-Sectional Studies: Disadvantages (3 of 3)

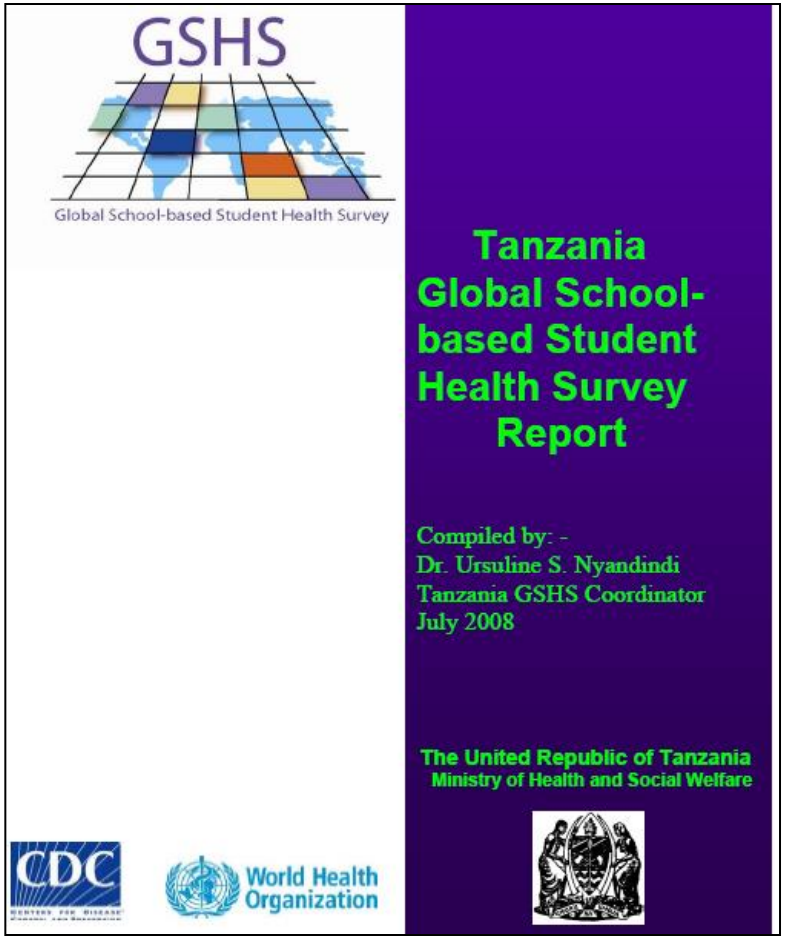
- **Bias** introduced when *exposure affects duration of illness*
  - i.e.: liver inflammation can have many causes
  - Chronic alcohol use (exposure) results in longer-term liver inflammation (outcome), compared with other exposures
  - this increases its apparent association with liver inflammation a cross-sectional study
- Can**not** calculate **incidence**
  - Slice in time means no follow-up measures

Uses of Cross-sectional Studies

- Study **exposures associated with chronic illnesses** (or at least not short-lived illnesses)
- Evaluate effects of **long-lasting exposures**
- Evaluate **exposures that are not affected by outcomes** (i.e., not subject to reverse causation)
- May serve as **baseline** for a cohort study
  - Baseline and 12-month survey in a population
- Can conduct **repeated cross-sectional studies** to measure **change in a population**
  - Time trends in TB prevalence

Example: School Health Survey, Tanzania

- In 2008, 2,176 questionnaires given in 25 randomly selected schools in Dar es Salaam
- Participants were students ages 13-15 years
- Questions on diet, smoking, alcohol use, sexual behavior, exercise, violence



Tanzania GSHS 2008

Example: Cross-Sectional Study

Research question: What **factors** are associated with **occupational injuries** among **children working in the streets** in major African cities?

- **Study population**: **584 children aged 5-17 working on the streets** of Lagos, Nigeria; Dar es Salaam, Tanzania; Johannesburg, South Africa, April-June 2014
- **Data source**: **Questionnaire** (interview)
- **Outcomes**: Specific types of **injuries** sustained while working on the streets
- **Exposures**: **Sociodemographic characteristics**, **occupational characteristics**

Example: Cross-Sectional Study

What are the **characteristics** of this study that make it a cross-sectional study?

- Study population **selected independently of exposures or outcomes**
- Exposures and outcomes evaluated **at a single point in time** (i.e., no follow-up of subjects)
- **Multiple exposures** and **outcomes** examined

Example: Cross-Sectional Study

Study results:

- **40%** of the children reported an **injury** sustained while working in the streets
- Children **working the highest number of hours** and children who **performed on the streets** had the **highest risk of injury**
- **Boys** (vs girls), **children>10 years** (vs those ≤10), and **children in Lagos** (vs other cities) were more likely to experience moderate-to-severe injuries

Quiz: Cross-Sectional Studies

1. How is the study population defined in a cross-sectional study?
2. True or False: You cannot calculate incidence from a cross-sectional study.
3. What measures of association are used to analyze cross-sectional studies?
4. True or False: You can study one exposure and multiple outcomes in a cross-sectional study.

Summary

- Cross-sectional studies are **simple** and **inexpensive**
  - Can examine multiple exposures and outcomes in the same population
- Cross-sectional studies can**not** be used to infer **temporal relationships** between exposures and outcomes
- Choosing an appropriate study design takes careful consideration of the strengths and limitations of each type of design
- Proper selection of study population and careful definition of exposures and outcomes is essential

References

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