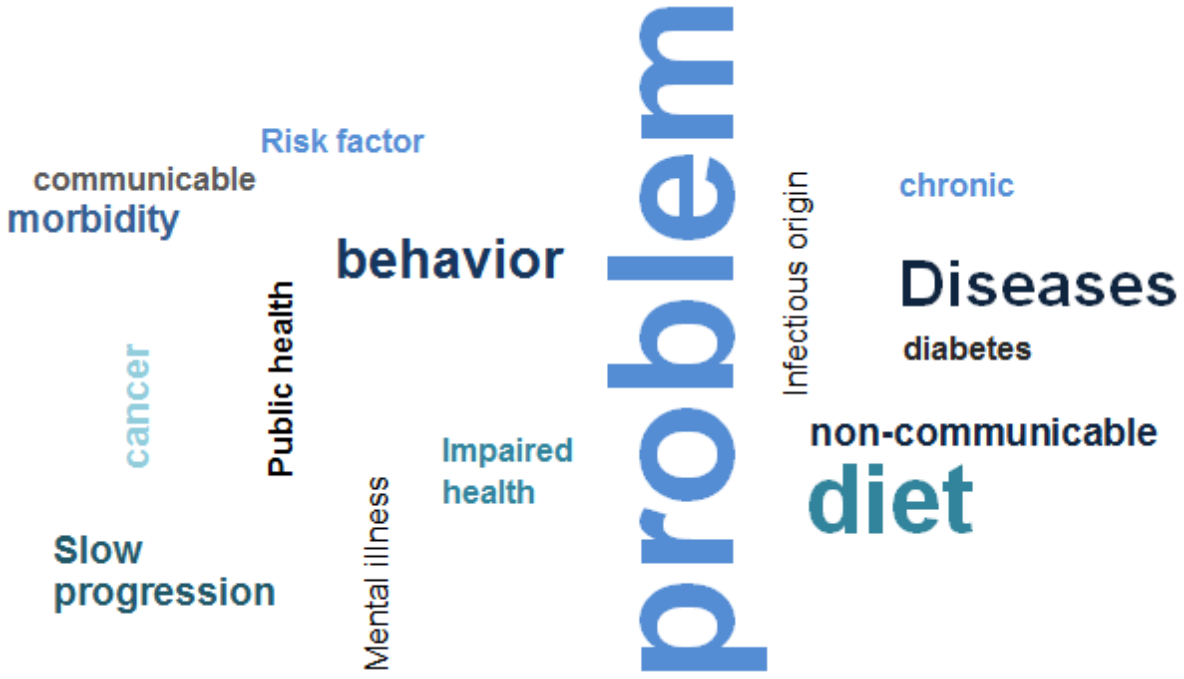
PARTICIPANT GUIDE



Descriptive and Analytic Studies

Created: 2013

Descriptive and Analytic Studies. Atlanta, GA: Centers for Disease Control and Prevention (CDC), 2013.

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Descriptive and Analytic Studies

LEARNING OBJECTIVES

At the end of the training, participants will be able to:

- Identify the following for an NCD problem:
  - Type of study to conduct
  - Sampling methods to use
  - Measure of association to calculate for a particular study
- Interpret the results of descriptive and analytic studies.

ESTIMATED COMPLETION TIME

- 5 hours, 30 minutes (4 hours for interactive lecture; 1 hour, 30 minutes for Skill Assessment).

REFERENCES AND RESOURCES

- Aschengrau A, Seage GR. Essentials of Epidemiology in Public Health, 2nd edition. Sudbury, Massachusetts: Jones and Bartlett Publishers; 2008.
- Aschengrau A, Seage GR. Essentials of Epidemiology in Public Health, 2nd edition. Case-control Studies PowerPoint™ Slides: http://publichealth.jbpub.com/aschengrau/ppts/case-control%20studies.ppt accessed on February 22, 2011
- Gordis, L. Epidemiology, 2nd edition. Philadelphia, PA: W.B. Saunders Company; 2000.
- Herold JM and Peavy JV. Surveys and Sampling. Field Epidemiology, 2nd ed. Ed. Gregg M. New York: Oxford University Press, 2002.
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- Remington RP, Brownson RC, Wegner MV, ed. Chronic Disease Epidemiology and Control. 3rd ed. Washington DC: American Public Health Association; 2010
- Rothman K.J., Greenland S. Modern Epidemiology, Second edition, Philadelphia, PA, 1998.
- Stehr-Green, J and Stehr-Green P, Survey Design Part 1: Sampling. North Carolina Center for Public Health Preparedness Training Website. Accessed on January 31, 2011 at http://cphp.sph.unc.edu/training/HEP_SDP1/certificate.php
- Stöckl H, Watts C, Kilonzo Mbwambo JK. Physical violence by a partner during pregnancy in Tanzania: prevalence and risk factors. Reprod Health Matters. 2010 Nov;18(36):171-80.

- Stern, F, Halpern, W, Hornung, R, Ringenburg, V and McCammon, C. Heart Disease Mortality Among Bridge and Tunnel Officers Exposed to Carbon Monoxide. American Journal of Epidemiology. 1988;128:1276-1288.
- Unwin N, James P, McLarty D, Machybia H, Nkulila P, Tamin B, Nguluma M, McNally R. Rural to urban migration and changes in cardiovascular risk factors in Tanzania: a prospective cohort study. BMC Public Health. 2010 May 24;10:272.

MODULE CONTENT

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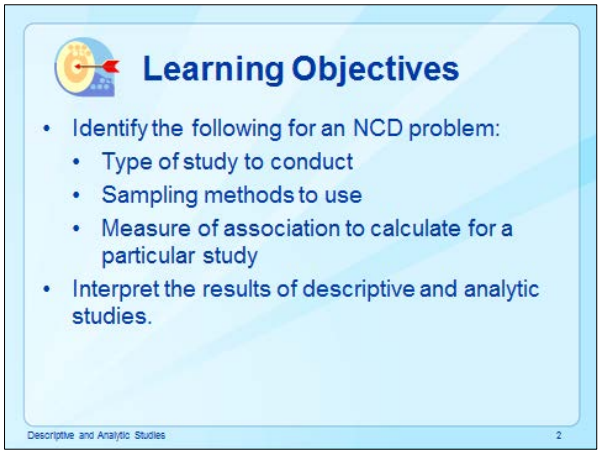

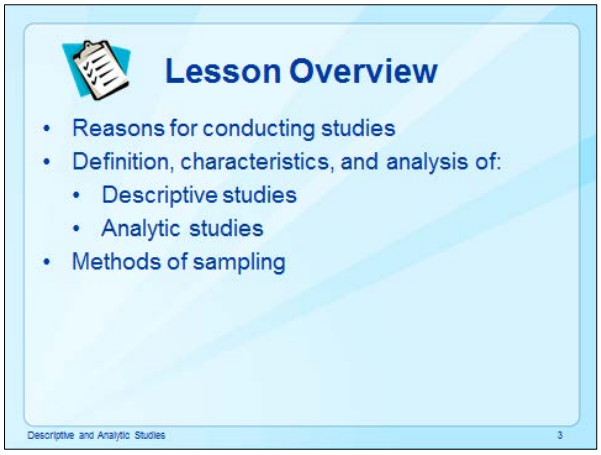

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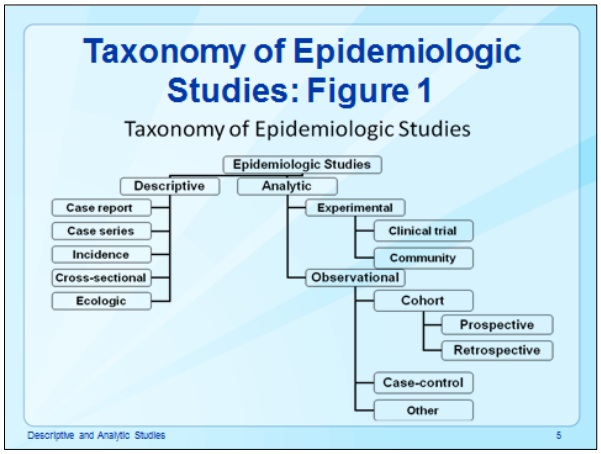
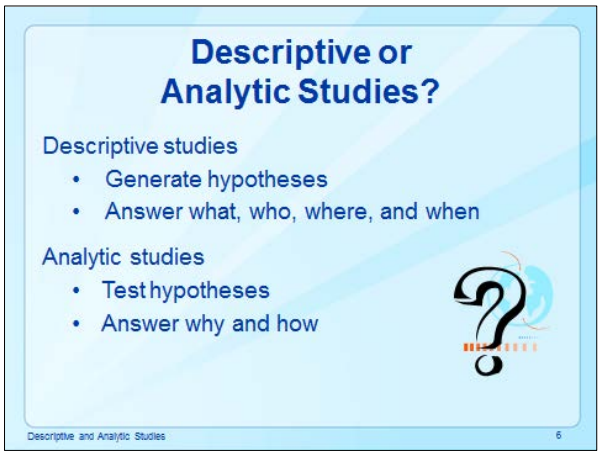

Taxonomy of Epidemiologic Studies: Figure 1
Taxonomy of Epidemiologic Studies
Epidemiologic Studies
Descriptive
Analytic
Case report
Case series
Incidence
Cross-sectional
Ecologic
Experimental
Clinical trial
Community
Observational
Cohort
Prospective
Retrospective
Case-control
Other
Descriptive and Analytic Studies
5


Descriptive or Analytic Studies?
Descriptive studies
• Generate hypotheses
• Answer what, who, where, and when
Analytic studies
• Test hypotheses
• Answer why and how
Descriptive and Analytic Studies
6

DEFINITION AND CHARACTERISTICS OF DESCRIPTIVE STUDIES
Descriptive and Analytic Studies
7

Slide	Notes

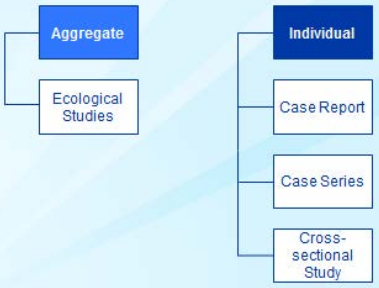
Descriptive Studies

Characterize who, where, or when in relation to what (outcome)

- **Person**: characteristics (age, sex, occupation) of the individuals affected by the outcome
- **Place:** geography (residence, work, hospital) of the affected individuals
- **Time**: when events (diagnosis, reporting; testing) occurred

Descriptive and Analytic Studies 8

Types of Descriptive Studies



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Cross-Sectional Study as a Descriptive Study

Purpose: To learn about the characteristics of a population at one point in time (like a photo "snap shot")

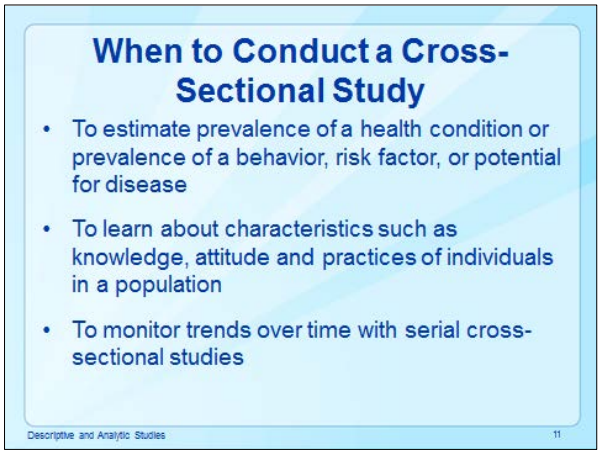
Design: No comparison group

Population: All members of a small, defined group or a sample from a large group

Results: Produces estimates of the prevalence of the population characteristic of interest

Descriptive and Analytic Studies 10

Slide	Notes


When to Conduct a Cross-Sectional Study
• To estimate prevalence of a health condition or prevalence of a behavior, risk factor, or potential for disease
• To learn about characteristics such as knowledge, attitude and practices of individuals in a population
• To monitor trends over time with serial cross-sectional studies
Descriptive and Analytic Studies
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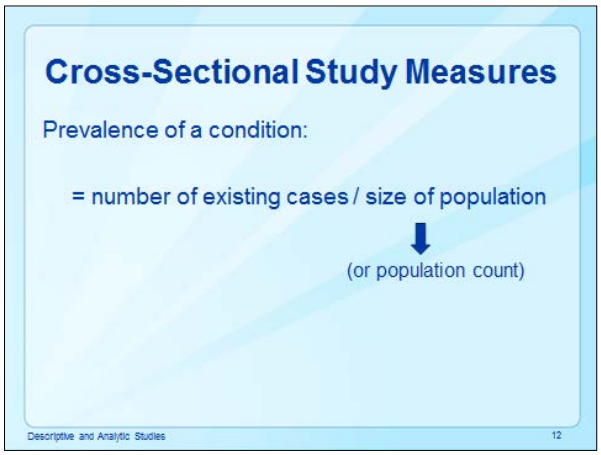
Cross-Sectional Study Measures
Prevalence of a condition:
= number of existing cases / size of population
(or population count)
Descriptive and Analytic Studies
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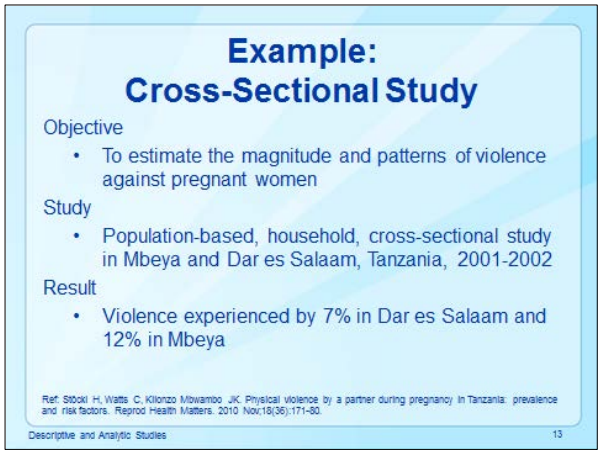
Example: Cross-Sectional Study
Objective
• To estimate the magnitude and patterns of violence against pregnant women
Study
• Population-based, household, cross-sectional study in Mbeya and Dar es Salaam, Tanzania, 2001-2002
Result
• Violence experienced by 7% in Dar es Salaam and 12% in Mbeya
Ref: Stöckl H, Watts C, Kilonzo Mbwambo JK. Physical violence by a partner during pregnancy in Tanzania: prevalence and risk factors. Reprod Health Matters. 2010 Nov;18(36):171-80.
Descriptive and Analytic Studies
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Slide	Notes

Studies to Track Trends in Newly Recognized Cases

Incidence study

- Newly reported or registered disease cases compared over time, place, or person
- Population estimates or other population group totals used as denominators

Ecological study

- Rates are linked to the level of exposure to some agent for the group as a whole

Example: Incidence Study

Objective

- To estimate the incidence and prevalence of diabetes in young persons in the United States

Study

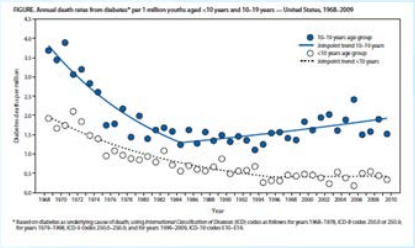
- Annual diabetes death rates among youth aged ≤19 calculated from National Vital Statistics System data from 1968-2009

Result

- Trends for diabetes death rates varied by age group

Saydah, S, Imperatore, G., Geiss, L., & Gregg, E. (2012). Diabetes death rates among youths aged ≤19 years—United States, 1968-2009. *MMWR*, 61(43), 869-871

Example Incidence Study (continued)



Saydah, S, Imperatore, G., Geiss, L., & Gregg, E. (2012). Diabetes death rates among youths aged ≤19 years—United States, 1968-2009. *MMWR*, 61(43), 869-871.

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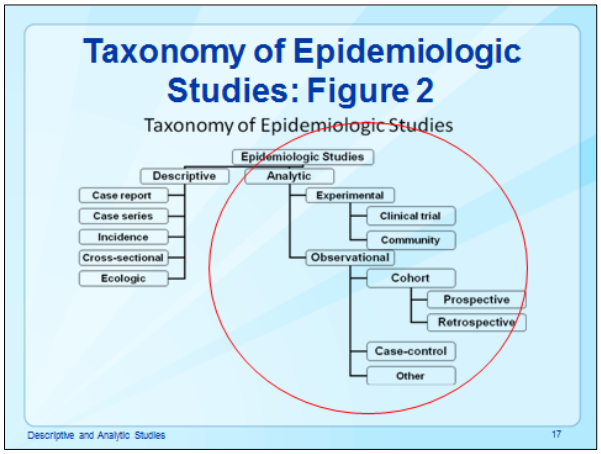
Taxonomy of Epidemiologic Studies: Figure 2
Taxonomy of Epidemiologic Studies
Epidemiologic Studies
Descriptive
Analytic
Case report
Case series
Incidence
Cross-sectional
Ecologic
Experimental
Clinical trial
Community
Observational
Cohort
Prospective
Retrospective
Case-control
Other
Descriptive and Analytic Studies
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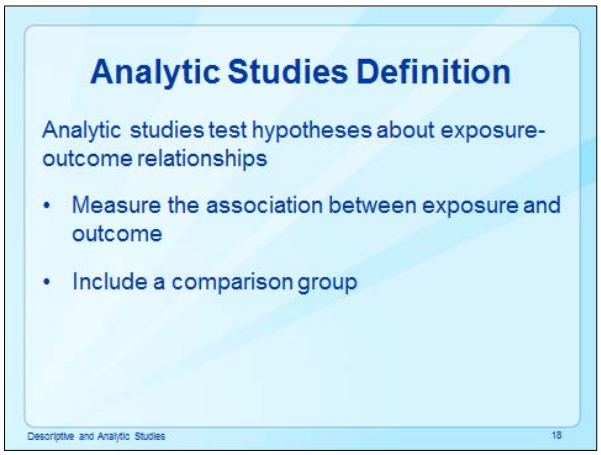
Analytic Studies Definition
Analytic studies test hypotheses about exposure-outcome relationships
• Measure the association between exposure and outcome
• Include a comparison group
Descriptive and Analytic Studies
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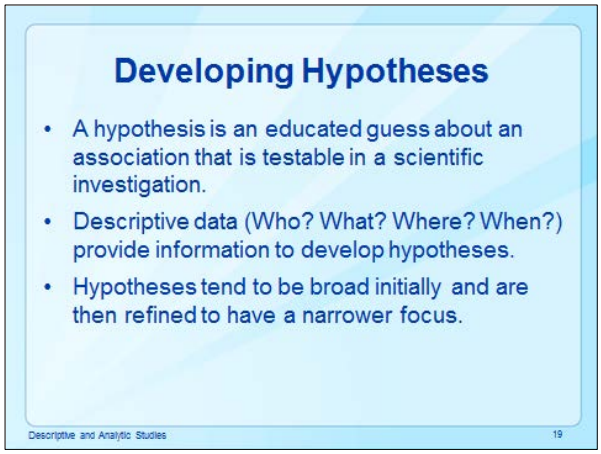
Developing Hypotheses
• A hypothesis is an educated guess about an association that is testable in a scientific investigation.
• Descriptive data (Who? What? Where? When?) provide information to develop hypotheses.
• Hypotheses tend to be broad initially and are then refined to have a narrower focus.
Descriptive and Analytic Studies
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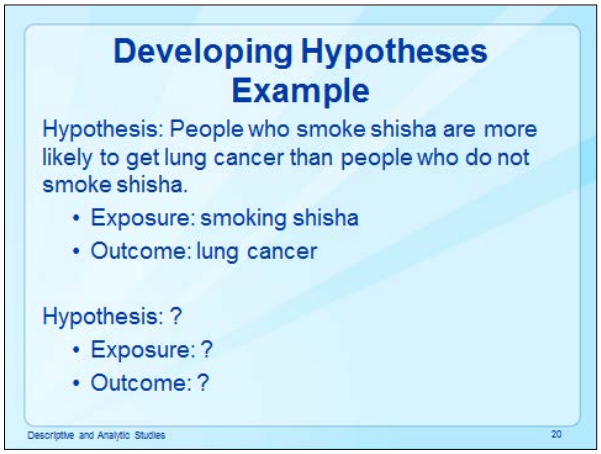
Developing Hypotheses Example
Hypothesis: People who smoke shisha are more likely to get lung cancer than people who do not smoke shisha.
• Exposure: smoking shisha
• Outcome: lung cancer
Hypothesis: ?
• Exposure: ?
• Outcome: ?
Descriptive and Analytic Studies
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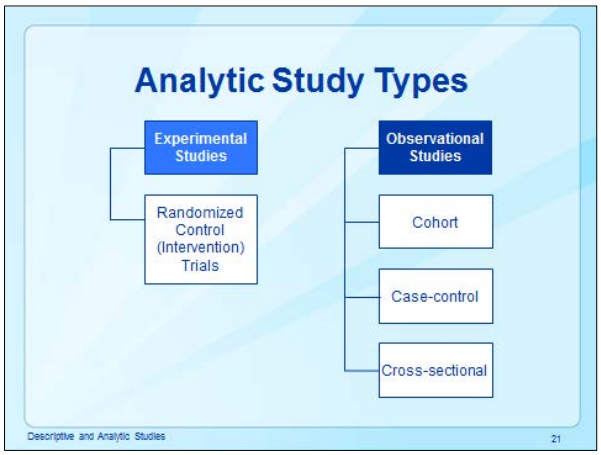
Analytic Study Types
Experimental Studies
Randomized Control (Intervention) Trials
Observational Studies
Cohort
Case-control
Cross-sectional
Descriptive and Analytic Studies
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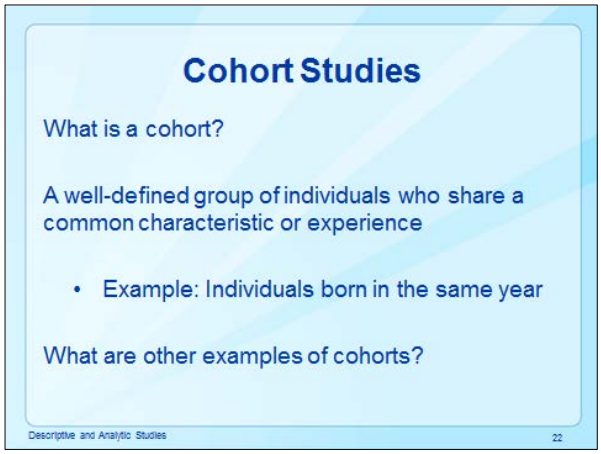
Cohort Studies
What is a cohort?
A well-defined group of individuals who share a common characteristic or experience
• Example: Individuals born in the same year
What are other examples of cohorts?
Descriptive and Analytic Studies
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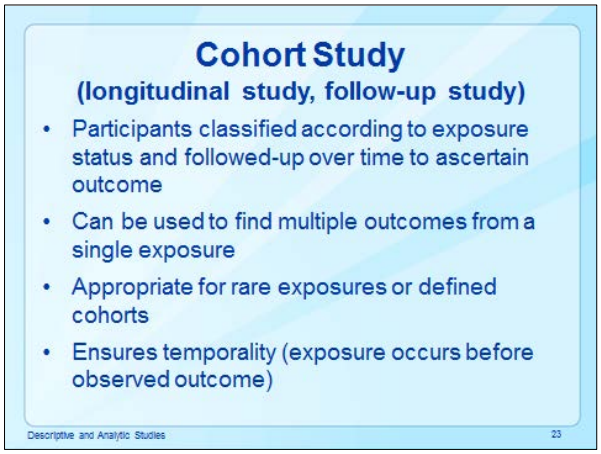
Slide	Notes


Cohort Study
(longitudinal study, follow-up study)
• Participants classified according to exposure status and followed-up over time to ascertain outcome
• Can be used to find multiple outcomes from a single exposure
• Appropriate for rare exposures or defined cohorts
• Ensures temporality (exposure occurs before observed outcome)
Descriptive and Analytic Studies
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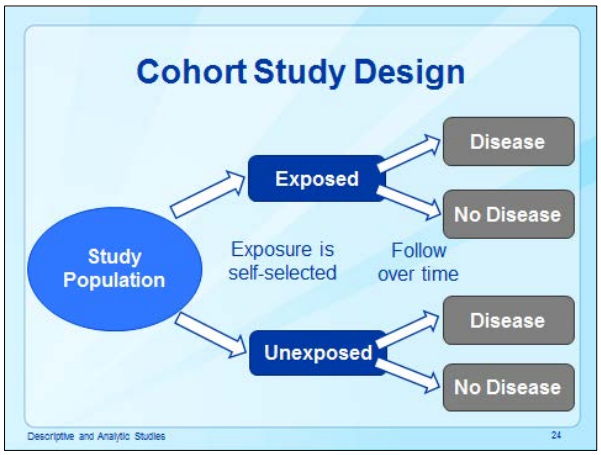
Cohort Study Design
Study Population
Exposure is self-selected
Exposed
Unexposed
Follow over time
Disease
No Disease
Disease
No Disease
Descriptive and Analytic Studies
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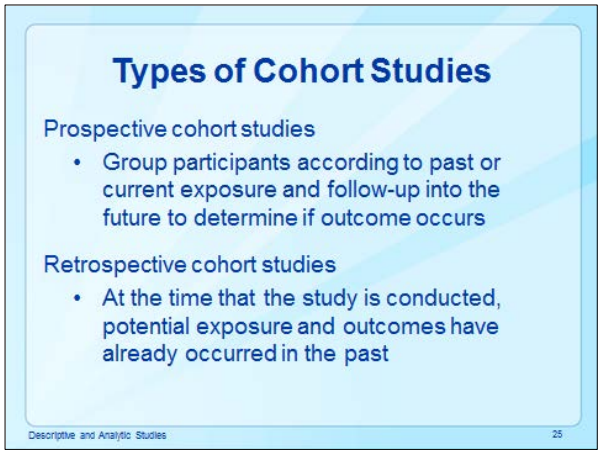
Types of Cohort Studies
Prospective cohort studies
• Group participants according to past or current exposure and follow-up into the future to determine if outcome occurs
Retrospective cohort studies
• At the time that the study is conducted, potential exposure and outcomes have already occurred in the past
Descriptive and Analytic Studies
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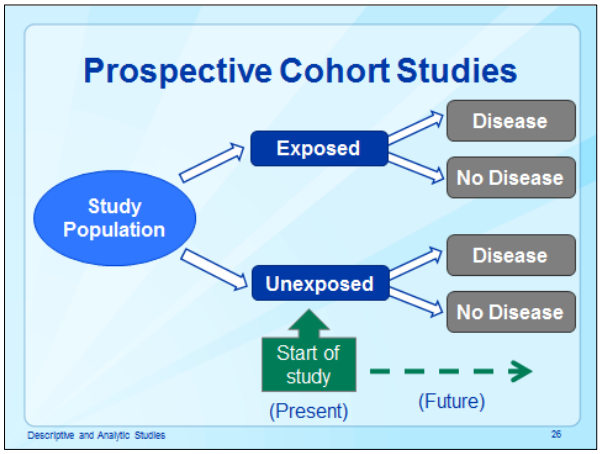
Slide	Notes


Prospective Cohort Studies
Study Population
Exposed
Unexposed
Disease
No Disease
Disease
No Disease
Start of study
(Present)
(Future)
Descriptive and Analytic Studies
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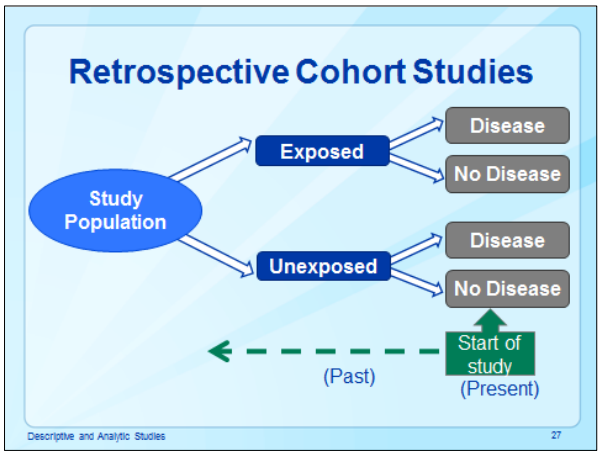
Retrospective Cohort Studies
Study Population
Exposed
Unexposed
Disease
No Disease
Disease
No Disease
Start of study
(Past)
(Present)
Descriptive and Analytic Studies
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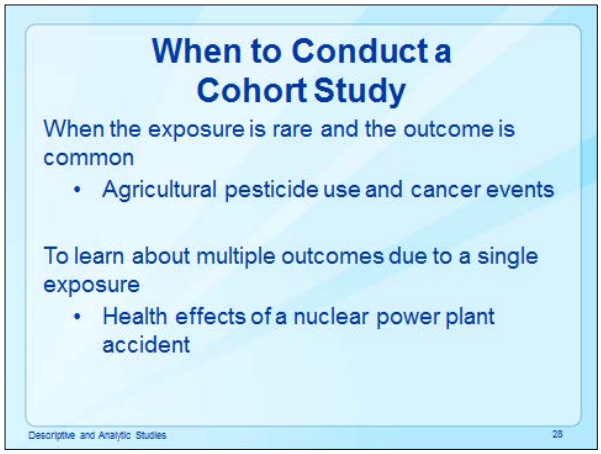
When to Conduct a Cohort Study
When the exposure is rare and the outcome is common
• Agricultural pesticide use and cancer events
To learn about multiple outcomes due to a single exposure
• Health effects of a nuclear power plant accident
Descriptive and Analytic Studies
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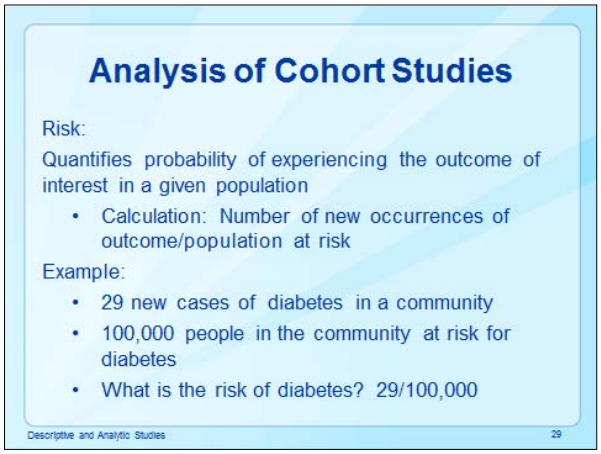
Slide	Notes


Analysis of Cohort Studies
Risk:
Quantifies probability of experiencing the outcome of interest in a given population
• Calculation: Number of new occurrences of outcome/population at risk
Example:
• 29 new cases of diabetes in a community
• 100,000 people in the community at risk for diabetes
• What is the risk of diabetes? 29/100,000
Descriptive and Analytic Studies
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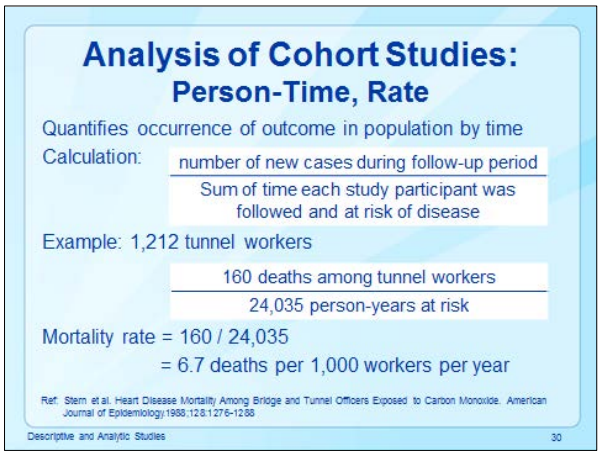
Analysis of Cohort Studies:
Person-Time, Rate
Quantifies occurrence of outcome in population by time
Calculation:
number of new cases during follow-up period
Sum of time each study participant was followed and at risk of disease
Example: 1,212 tunnel workers
160 deaths among tunnel workers
24,035 person-years at risk
Mortality rate = 160 / 24,035
= 6.7 deaths per 1,000 workers per year
Ref: Stern et al. Heart Disease Mortality Among Bridge and Tunnel Officers Exposed to Carbon Monoxide. American Journal of Epidemiology1988;128:1276-1288
Descriptive and Analytic Studies
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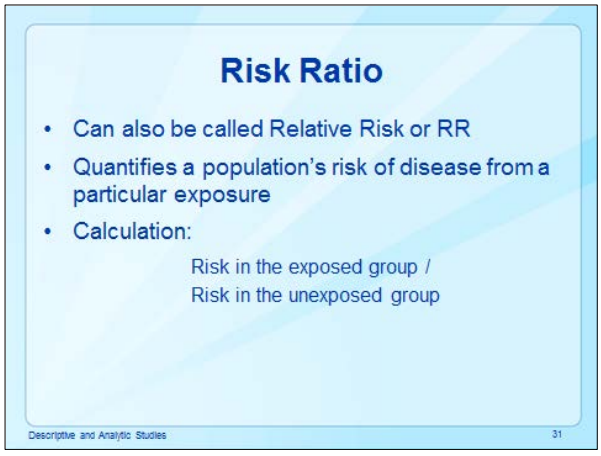
Risk Ratio
• Can also be called Relative Risk or RR
• Quantifies a population's risk of disease from a particular exposure
• Calculation:
Risk in the exposed group /
Risk in the unexposed group
Descriptive and Analytic Studies
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Rate Ratio

Compares the rates of disease in two groups that differ by demographic characteristics or exposure history

Calculation:

$$\frac{\text{Rate for group of primary interest}}{\text{Rate for comparison group}}$$

Descriptive and Analytic Studies 32

RR Strength Scales

RR	Strength	RR
0.71 – 0.99	Weak	1.01 – 1.50
0.41 – 0.70	Moderate	1.51 – 3.00
0.00 – 0.40	Very strong	>3.00

Oleckno WA. Essential epidemiology: principles and applications. Prospect Heights, IL 2002;108.

Descriptive and Analytic Studies 32

Example: Risk Ratio

Question: What is the relationship between being obese and getting type 2 diabetes?

$$\frac{\text{Risk in the exposed group (obese)}}{\text{Risk in the unexposed group (non-obese)}} = \frac{.00076}{.00013} = 5.8$$

Risk Ratio = **5.8**

Interpretation: The risk of diabetes among those who are obese is 5.8 times the risk among those who are not obese.

Descriptive and Analytic Studies 34

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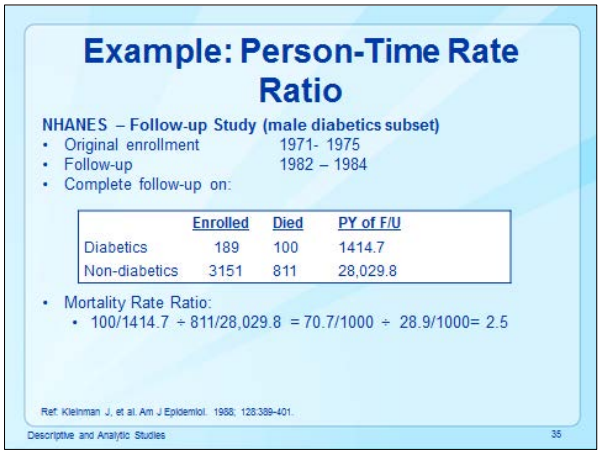
Example: Person-Time Rate Ratio
NHANES – Follow-up Study (male diabetics subset)
• Original enrollment 1971- 1975
• Follow-up 1982 – 1984
• Complete follow-up on:
Enrolled Died PY of F/U
Diabetics 189 100 1414.7
Non-diabetics 3151 811 28,029.8
• Mortality Rate Ratio:
• 100/1414.7 ÷ 811/28,029.8 = 70.7/1000 ÷ 28.9/1000= 2.5
Ref: Kleinman J, et al. Am J Epidemiol. 1988; 128:389-401.
Descriptive and Analytic Studies
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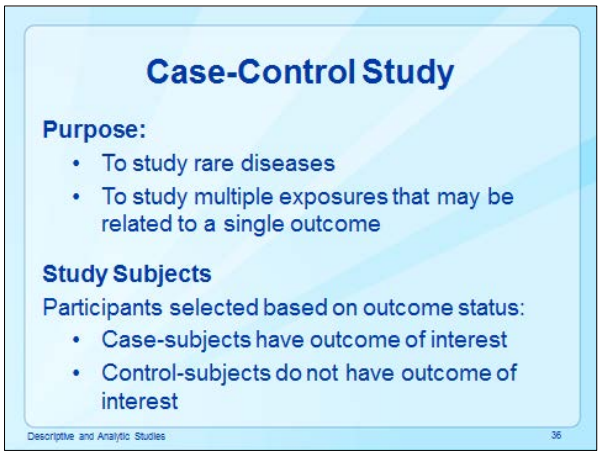
Case-Control Study
Purpose:
• To study rare diseases
• To study multiple exposures that may be related to a single outcome
Study Subjects
Participants selected based on outcome status:
• Case-subjects have outcome of interest
• Control-subjects do not have outcome of interest
Descriptive and Analytic Studies
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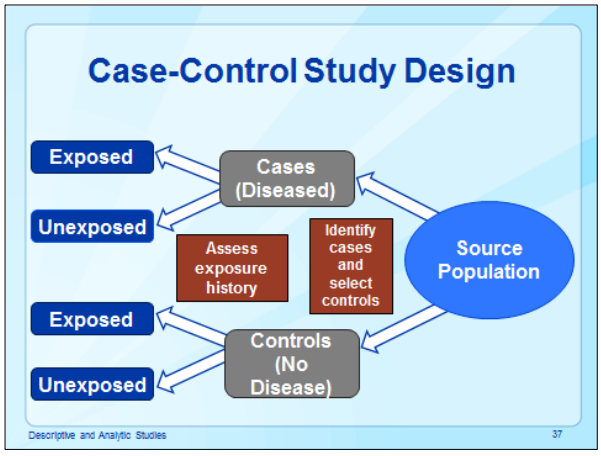
Case-Control Study Design
Exposed
Unexposed
Exposed
Unexposed
Cases (Diseased)
Controls (No Disease)
Assess exposure history
Identify cases and select controls
Source Population
Descriptive and Analytic Studies
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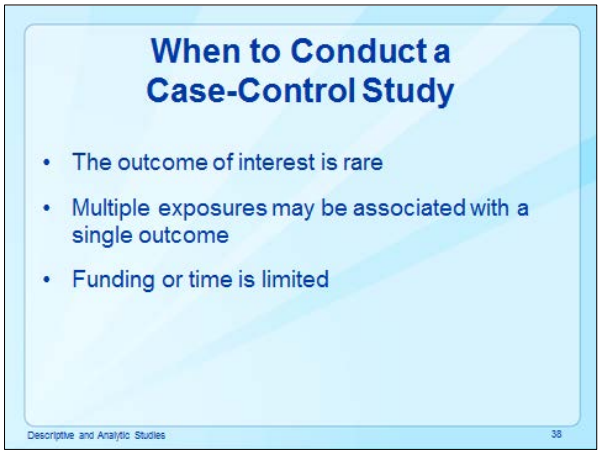
When to Conduct a Case-Control Study
• The outcome of interest is rare
• Multiple exposures may be associated with a single outcome
• Funding or time is limited
Descriptive and Analytic Studies
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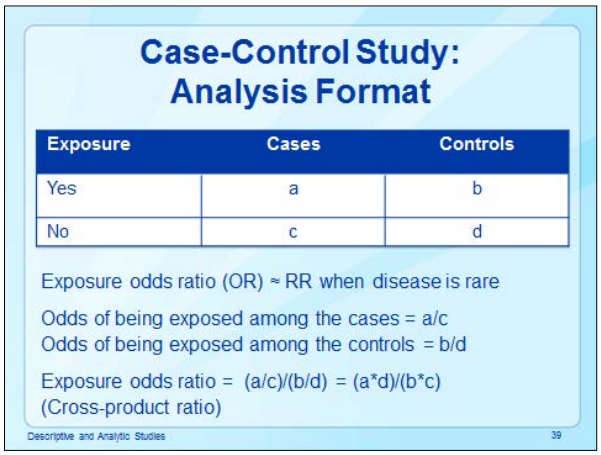
Case-Control Study: Analysis Format
Exposure | Cases | Controls
Yes | a | b
No | c | d
Exposure odds ratio (OR) ≈ RR when disease is rare
Odds of being exposed among the cases = a/c
Odds of being exposed among the controls = b/d
Exposure odds ratio = (a/c)/(b/d) = (a*d)/(b*c)
(Cross-product ratio)
Descriptive and Analytic Studies
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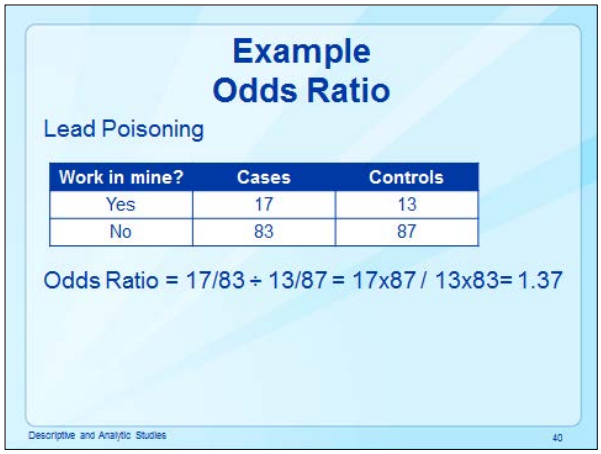
Example Odds Ratio
Lead Poisoning
Work in mine? | Cases | Controls
Yes | 17 | 13
No | 83 | 87
Odds Ratio = 17/83 ÷ 13/87 = 17x87 / 13x83= 1.37
Descriptive and Analytic Studies
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Slide	Notes

Prevalence Ratio and Prevalence Odds Ratio

- Chronic disease – date of onset is unknown
- Measure prevalence rather than incidence

RR ⟶ PR (prevalence ratio)
OR ⟶ POR (prevalence odds ratio)

Descriptive and Analytic Studies 41

Prevalence Ratio

- Usually from a cross-sectional study
- Similar to risk ratio from cohort study

Exposure	With disease	Without disease	Total
Exposed	a	b	a+b
Unexposed	c	d	c+d
Total	a+c	b+d	

- PR= Prevalence of disease in exposed group/ Prevalence of disease in unexposed group

  OR
- PR= a/(a+b) / c/(c+d)

Descriptive and Analytic Studies 42

Prevalence Odds Ratio

- Usually from a cross-sectional study
- Similar to odds ratio from case control study
- Calculated same way as odds ratio:

$$POR = \frac{a*d}{c*b}$$

	With disease	Without disease	
Exposed	a	b	a+b
Unexposed	c	d	c+d
	a+c	b+d	

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Slide	Notes

Example: Prevalence Ratio and Prevalence Odds Ratio

Prevalence of Breast Cysts

Lifetime use of oral contraceptives	Yes Cyst	No Cyst	Total
Ever Used	124	3123	3247
Never Used	77	2557	2644
Total	201	5690	5891

Prevalence of breast cysts among ever users = 124/3247 = .038

Prevalence of breast cysts among never-users = 77/2644 = .029

Prevalence ratio = .038/.029 = 1.3

Prevalence odds ratio = $\frac{124 * 2557}{3123 * 77}$

= 1.3

Descriptive and Analytic Studies 44

Practice Exercise #1

Background:

- NCDs such as type 2 diabetes are poorly understood and under-prioritized in many low-to-middle income countries.
- You want to determine the risk of type 2 diabetes associated with cardiovascular risk factors such as obesity and abdominal fat mass in your country.

Questions:

1. What type of study would you conduct and why?
2. What is the measure of association to calculate for this study?

Descriptive and Analytic Studies 45

Practice Exercise #2

Background:

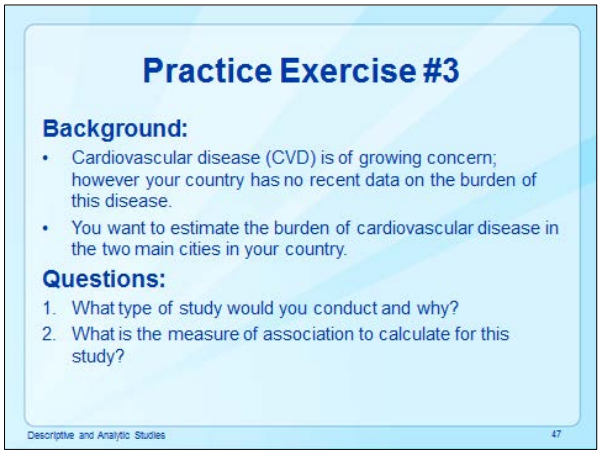
- The prevalence of prostate cancer has increased in your country over the last 5 years.
- You want to examine the association between calcium intake and prostate cancer risk.
- You have limited time and funding to conduct this study.

Questions:

1. What type of study would you conduct and why?
2. What is the measure of association to calculate for this study?

Descriptive and Analytic Studies 46

Slide	Notes


Practice Exercise #3
Background:
• Cardiovascular disease (CVD) is of growing concern; however your country has no recent data on the burden of this disease.
• You want to estimate the burden of cardiovascular disease in the two main cities in your country.
Questions:
1. What type of study would you conduct and why?
2. What is the measure of association to calculate for this study?
Descriptive and Analytic Studies
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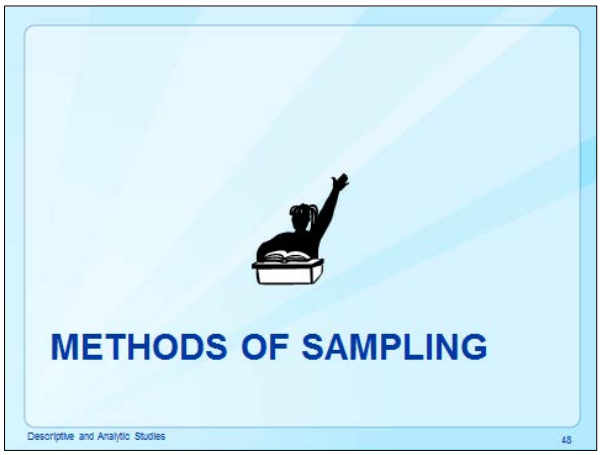
METHODS OF SAMPLING
Descriptive and Analytic Studies
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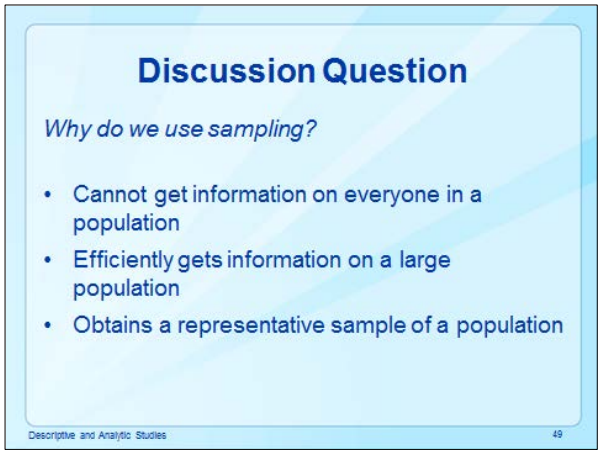
Discussion Question
Why do we use sampling?
• Cannot get information on everyone in a population
• Efficiently gets information on a large population
• Obtains a representative sample of a population
Descriptive and Analytic Studies
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Slide	Notes

Sampling Methods

Two main types of sampling methods:

- Probability sampling
- Non-probability sampling

Descriptive and Analytic Studies 50

Probability Sampling

What are types of probability-based samples?

- Simple random sampling
- Systematic random sampling
- Stratified random sampling
- Cluster sampling

Descriptive and Analytic Studies 51

Simple Random Sample

Principle

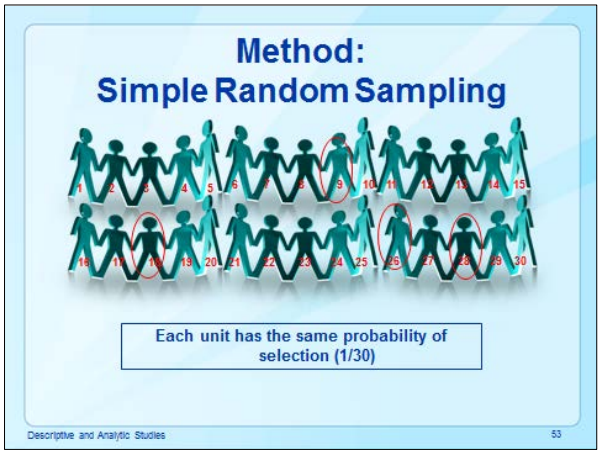
- Equal chance/probability of drawing each unit

Procedure

- List all units (persons) in a population
- Assign a number to each unit
- Randomly select units

Descriptive and Analytic Studies 52

Slide	Notes


Method:
Simple Random Sampling
Each unit has the same probability of selection (1/30)
Descriptive and Analytic Studies
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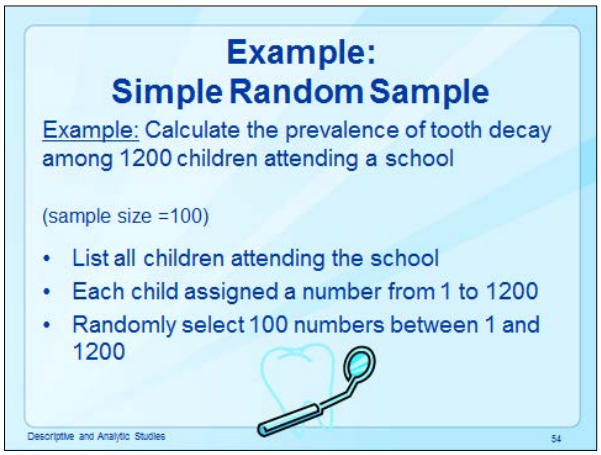
Example:
Simple Random Sample
Example: Calculate the prevalence of tooth decay among 1200 children attending a school
(sample size =100)
• List all children attending the school
• Each child assigned a number from 1 to 1200
• Randomly select 100 numbers between 1 and 1200
Descriptive and Analytic Studies
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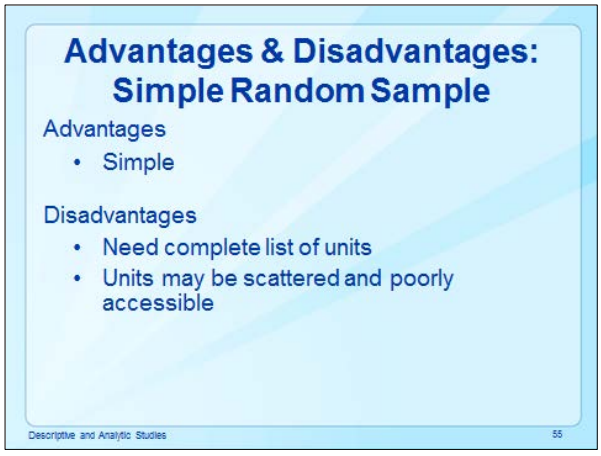
Advantages & Disadvantages:
Simple Random Sample
Advantages
• Simple
Disadvantages
• Need complete list of units
• Units may be scattered and poorly accessible
Descriptive and Analytic Studies
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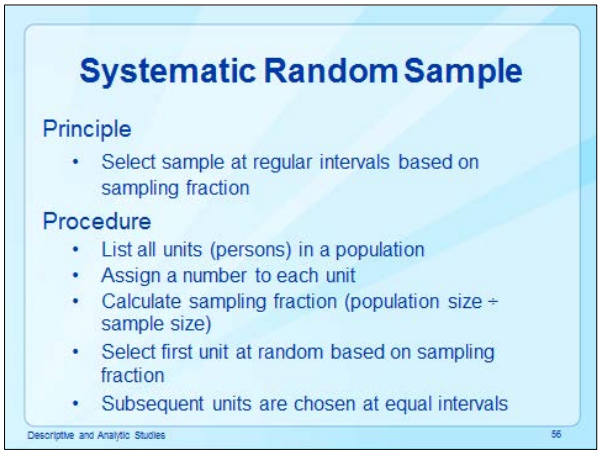
Slide	Notes


Systematic Random Sample
Principle
• Select sample at regular intervals based on sampling fraction
Procedure
• List all units (persons) in a population
• Assign a number to each unit
• Calculate sampling fraction (population size ÷ sample size)
• Select first unit at random based on sampling fraction
• Subsequent units are chosen at equal intervals
Descriptive and Analytic Studies
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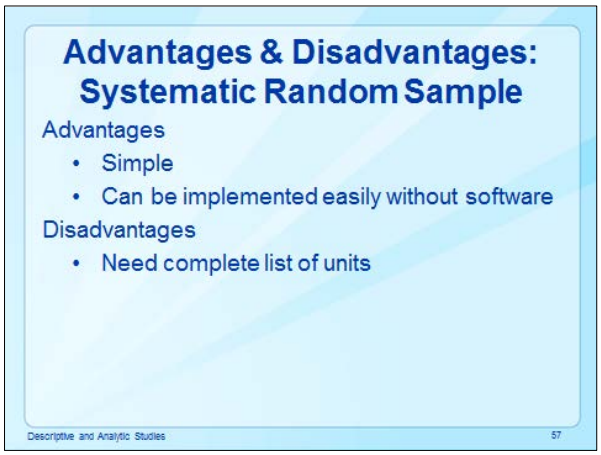
Advantages & Disadvantages: Systematic Random Sample
Advantages
• Simple
• Can be implemented easily without software
Disadvantages
• Need complete list of units
Descriptive and Analytic Studies
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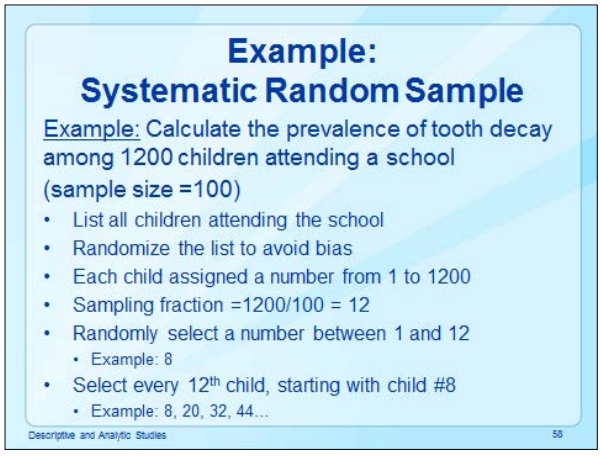
Example: Systematic Random Sample
Example: Calculate the prevalence of tooth decay among 1200 children attending a school (sample size =100)
• List all children attending the school
• Randomize the list to avoid bias
• Each child assigned a number from 1 to 1200
• Sampling fraction =1200/100 = 12
• Randomly select a number between 1 and 12
• Example: 8
• Select every 12th child, starting with child #8
• Example: 8, 20, 32, 44…
Descriptive and Analytic Studies
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Stratified Random Sample

Principle
- Select random samples from within homogeneous subgroups (strata)

Procedure
- List all units (persons) in a population
- Divide the units into groups (called strata)
- Assign a number to each unit within each stratum
- Select a random sample from each stratum
- Combine the strata samples to form the full sample

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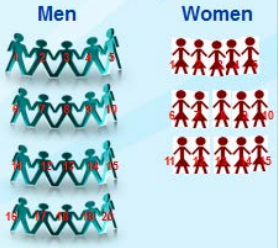
Method: Stratified Random Sample

- Sampling frame divided into groups (age, sex, socioeconomic status)
- Units in each group have the same probability of selection, but probability differs between groups



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Advantages & Disadvantages: Stratified Random Sample

Advantages
- Can get separate estimates from the whole population and from individual strata (if sample is large enough)
- Precision increased if less variability within strata than between strata

Disadvantages
- Can be difficult to identify strata

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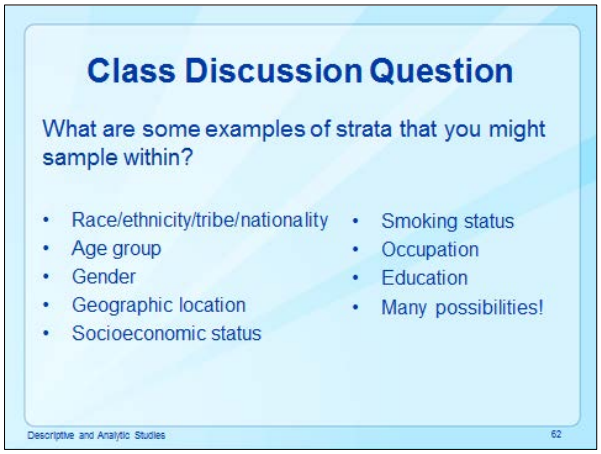
Slide	Notes


Class Discussion Question
What are some examples of strata that you might sample within?
Race/ethnicity/tribe/nationality
Age group
Gender
Geographic location
Socioeconomic status
Smoking status
Occupation
Education
Many possibilities!
Descriptive and Analytic Studies
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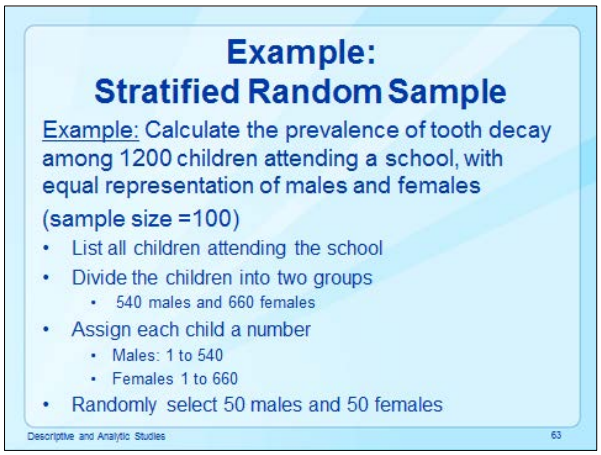
Example:
Stratified Random Sample
Example: Calculate the prevalence of tooth decay among 1200 children attending a school, with equal representation of males and females (sample size =100)
List all children attending the school
Divide the children into two groups
540 males and 660 females
Assign each child a number
Males: 1 to 540
Females 1 to 660
Randomly select 50 males and 50 females
Descriptive and Analytic Studies
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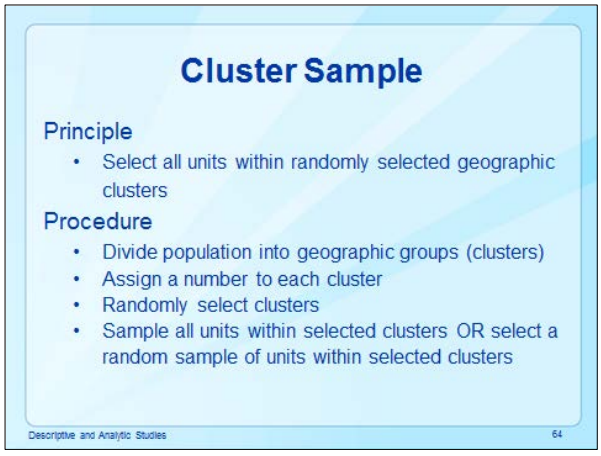
Cluster Sample
Principle
Select all units within randomly selected geographic clusters
Procedure
Divide population into geographic groups (clusters)
Assign a number to each cluster
Randomly select clusters
Sample all units within selected clusters OR select a random sample of units within selected clusters
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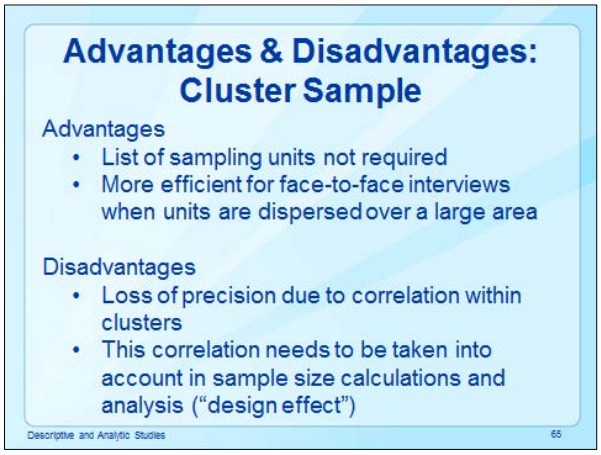
Slide	Notes


Advantages & Disadvantages: Cluster Sample
Advantages
• List of sampling units not required
• More efficient for face-to-face interviews when units are dispersed over a large area
Disadvantages
• Loss of precision due to correlation within clusters
• This correlation needs to be taken into account in sample size calculations and analysis ("design effect")
Descriptive and Analytic Studies
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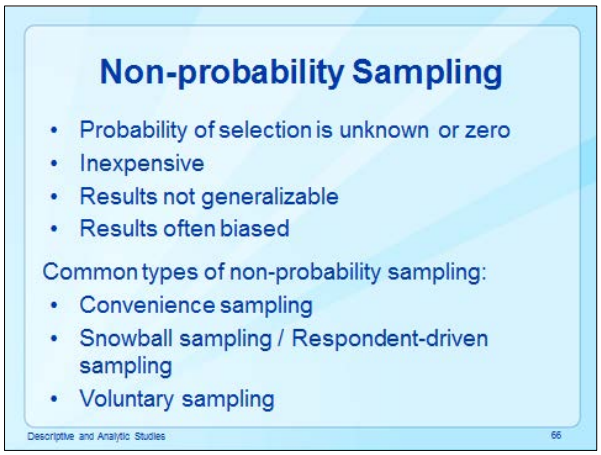
Non-probability Sampling
• Probability of selection is unknown or zero
• Inexpensive
• Results not generalizable
• Results often biased
Common types of non-probability sampling:
• Convenience sampling
• Snowball sampling / Respondent-driven sampling
• Voluntary sampling
Descriptive and Analytic Studies
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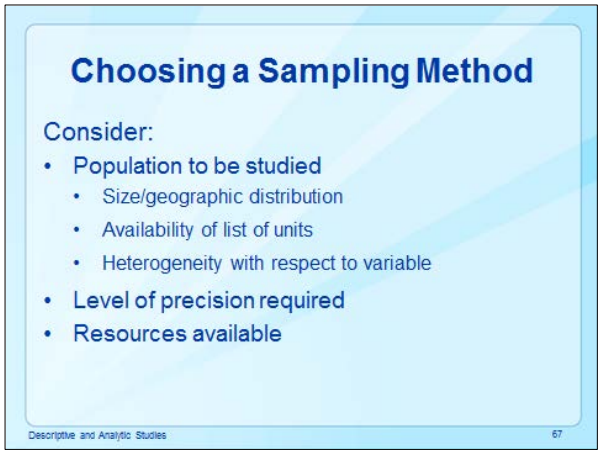
Choosing a Sampling Method
Consider:
• Population to be studied
• Size/geographic distribution
• Availability of list of units
• Heterogeneity with respect to variable
• Level of precision required
• Resources available
Descriptive and Analytic Studies
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Slide	Notes

Practice Exercise #4

Background: You will choose a sampling method for each of the following studies.

Questions:

What sampling method would you use for:

1. The cross-sectional study on CVD described in Practice Exercise #3? Why?
2. A one-time survey of citizens' attitudes toward smoking and second-hand smoke in response to proposed legislation to impose a ban on smoking in restaurants. Why?
3. Serosurvey of blood lead levels (or urinary arsenic levels) of prisoners entering the nation's largest prison (or pregnant women entering the nation's largest maternity ward) to determine average level of exposure in the population.

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SUMMARY

Descriptive and Analytic Studies 69

Descriptive vs. Analytic Epidemiology

Descriptive epidemiology:

- Who, What, When, and Where

Analytic epidemiology:

- Why and How

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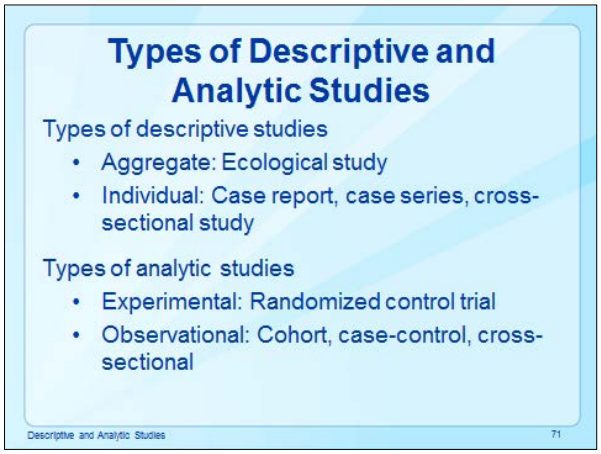
Types of Descriptive and Analytic Studies
Types of descriptive studies
• Aggregate: Ecological study
• Individual: Case report, case series, cross-sectional study
Types of analytic studies
• Experimental: Randomized control trial
• Observational: Cohort, case-control, cross-sectional
Descriptive and Analytic Studies
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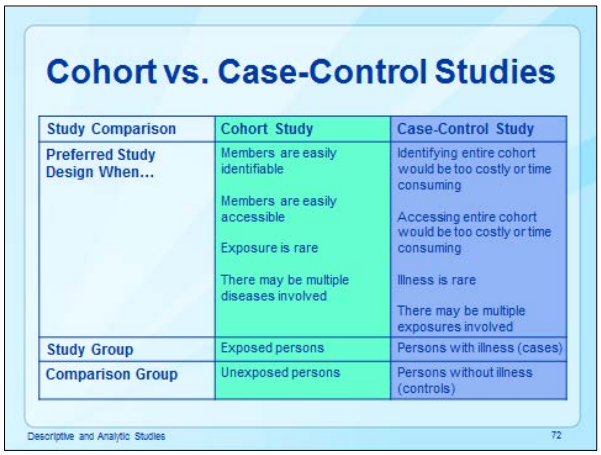
Cohort vs. Case-Control Studies
Study Comparison | Cohort Study | Case-Control Study
Preferred Study Design When... | Members are easily identifiable; Members are easily accessible; Exposure is rare; There may be multiple diseases involved | Identifying entire cohort would be too costly or time consuming; Accessing entire cohort would be too costly or time consuming; Illness is rare; There may be multiple exposures involved
Study Group | Exposed persons | Persons with illness (cases)
Comparison Group | Unexposed persons | Persons without illness (controls)
Descriptive and Analytic Studies
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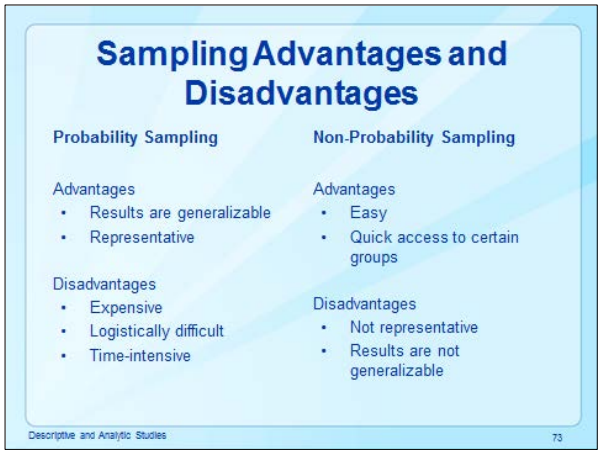
Sampling Advantages and Disadvantages
Probability Sampling
Advantages
• Results are generalizable
• Representative
Disadvantages
• Expensive
• Logistically difficult
• Time-intensive
Non-Probability Sampling
Advantages
• Easy
• Quick access to certain groups
Disadvantages
• Not representative
• Results are not generalizable
Descriptive and Analytic Studies
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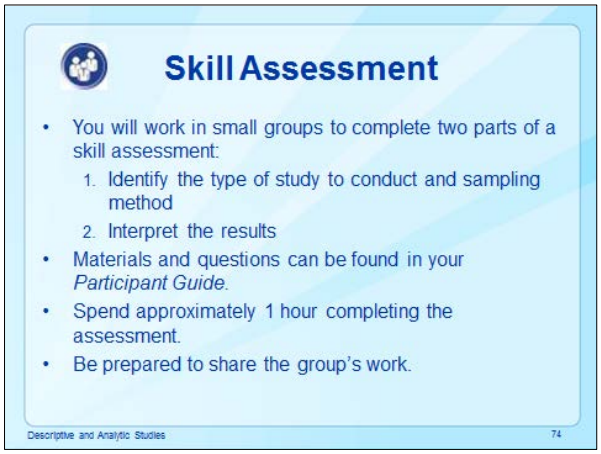
Slide	Notes


Skill Assessment
• You will work in small groups to complete two parts of a skill assessment:
1. Identify the type of study to conduct and sampling method
2. Interpret the results
• Materials and questions can be found in your *Participant Guide*.
• Spend approximately 1 hour completing the assessment.
• Be prepared to share the group's work.
Descriptive and Analytic Studies
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SKILL ASSESSMENT

Instructions:

1. You will work in small groups to complete a three-part assessment.
2. Select a member of your group to record your responses.
3. Groups will have approximately 1 hour to complete the assessment.
4. At the end of the assessment, one member from the group will share your summary with the class. (20 minutes)

Part 1. Identify study to conduct and sampling method to use (30 minutes)
Read the following three issues of public health concern and answer the questions that follow.

1. Cardiovascular disease is an increasing problem in Tanzania. The last study to examine risk factors of cardiovascular disease in Tanzania was in 1987. You want to know about the current status of risk factors for cardiovascular disease and would like to examine how the risk factors have changed since the last study in 1987.

    a. What type of study would you conduct and why?

    b. What sampling method would you use?

2. In Thailand, breast cancer incidence is increasing, but little is known about the primary risk factors for breast cancer among Thai women. Current understanding of breast cancer risk factors are from studies in high-income countries. It is unclear if identified risk factors in high-income countries are the same in Thailand. You want to learn about the risk factors for breast cancer in Thailand females.

    a. What type of study would you conduct and why?

    b. How would you use **simple random sampling** to select 860 controls?

    c. How would you use **systematic random sampling** to select 860 controls?

    d. How would you use **stratified random sampling** to select 860 controls?

3. Non-smoking women in China are disproportionally exposed to environmental tobacco smoke exposure in their homes and at work. You want to know if non-smoking Chinese women exposed to environmental tobacco smoke have increased mortality compared to non-smoking Chinese women who live and work in smoke-free

environments. You'd also like to know if environmental tobacco smoke exposure has an impact on the risk of cardiovascular and cancer deaths among Chinese women.

a. What type of study would you conduct and why?

Part 2. Interpreting the results (30 minutes)
Interpret the results for each study in 1-2 concise sentences. If applicable, explain whether the exposure was associated with an increased or decreased chance of experiencing the outcome.

1. You found that the prevalence of hypertension was 41.1% in men and 38.7% in women.

2. You found that women with older siblings had a statistically significant odds ratio of 0.3 for breast cancer.

3. You found that non-smoking women whose husbands smoked had a statistically significant risk ratio of 1.19 for mortality due to cancer.