

Study Design and Analytic Epidemiology for Outbreak Investigations

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Objectives

- Define analytic epidemiology
- Describe types of studies to investigate outbreaks
- Discuss control group selection
- Prepare 2 x 2 table
- Calculate and interpret measures of association

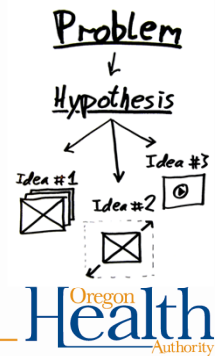


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Analytic Epidemiology

- Differs from descriptive epi (person, place, time)
- Develop then test hypothesis
- Examine **exposures** and **outcomes**
- Use **comparison group** (controls)



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Exposure and Outcome

- Exposure= potential risk factor
 - Ate specific food item
 - Worked with a chemical
 - Had a certain behavior (e.g., smoking)
- Outcome= Disease
 - Cancer
 - Diarrhea
 - Injury

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Common Types of Studies

- Cohort
- Case-Control
- Case-case
- These are **observational** studies, as compared with experimental studies

Cohort Design

- Start with defined group, classified by exposure status
 - Exposed group
 - Non-exposed group
- Assess who developed disease

Cohort Studies examples

- Nurse's Health Study- 1970's
120,000 female nurses – risk factors for cancer and cardiovascular disease
- Outbreak following a wedding reception
- Illness in a school classroom
- Outbreak after church potluck

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Why use a cohort?

- Known denominator: # at **risk** of disease
- Compare exposed and unexposed groups
- However, not always possible to define cohort

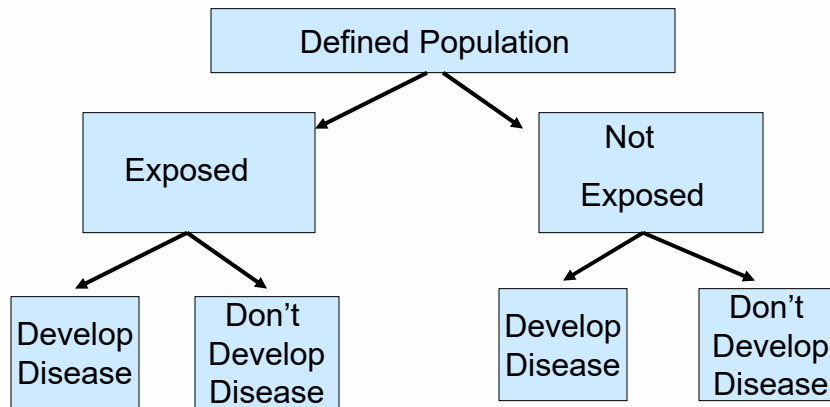


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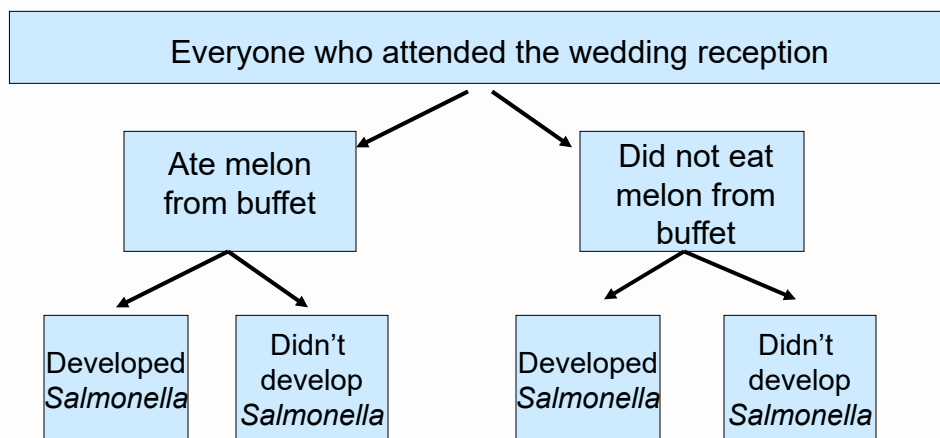
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Cohort Study



Cohort Study



Case-Control Design

- Classify people by outcome
 - Cases- have disease
 - Controls- do not have disease
- Assess past exposure

Case-control study examples

- Smoking and lung cancer, 1950s
- *Salmonella* outbreak associated with nationally distributed product
- Restaurant outbreak of norovirus



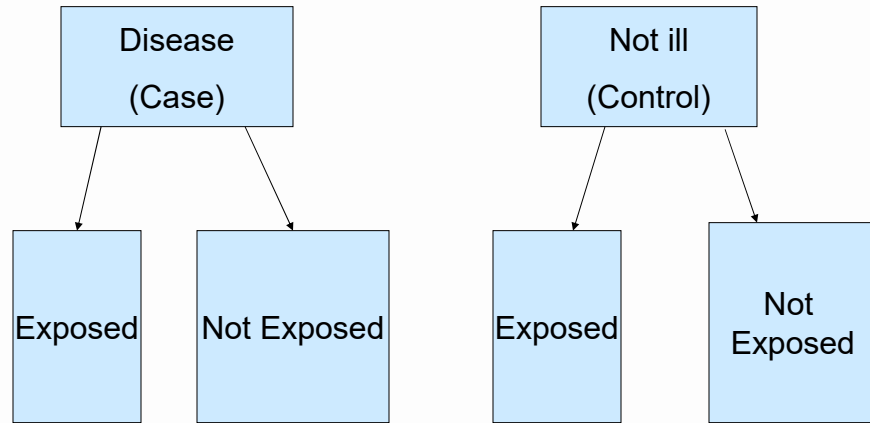
Selecting Controls

- Do not have the disease, but at risk of disease
- Must have had potential for exposure
- Should be representative of cases
- Key: **If they developed the disease, could they be identified as case?**

Potential control groups

- Others who ate at same restaurant
- Neighborhood residents
- Family members
- Friends
- Coworkers
- Random digit dialing
- Classmates
- Medical clinic patients

Case-control Study

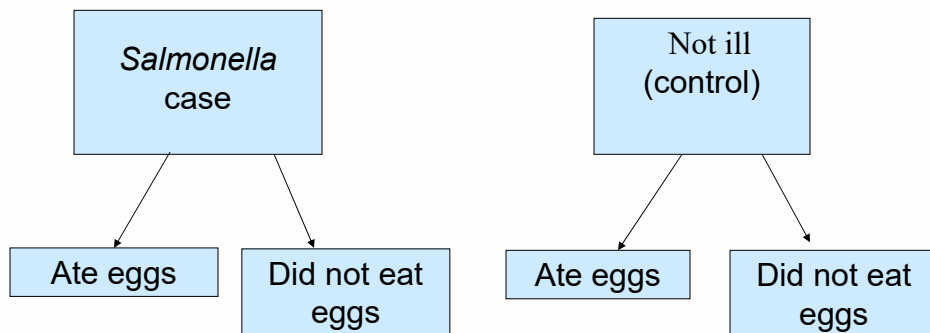


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Case-control Study Example



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Advantages & Disadvantages

	Cohort	Case-control
Advantages	Can evaluate rare exposures Can calculate risk	Quick Smaller size Cost effective Can evaluate rare disease
Disadvantages	Inefficient if incubation is long Potential expense Loss to follow up	Recall bias Selection bias

Measures of Association

- Quantifies magnitude of association between exposure and disease
 - Cohort study: relative risk (RR)
 - Case-control study: odds ratio (OR)

2 X 2 table

	Diseased	Not diseased	Row total
Exposed	a	b	a+b
Not exposed	c	d	c+d
Column total	a+c	b+d	a+b+c+d= Grand total

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Cohort Study: Relative Risk (RR)

- Risk of disease in exposed \div risk of disease in unexposed
- $RR = a/(a+b) \div c/(c+d)$

		Disease	
		Yes	No
Exposure	Yes	a	b
	No	c	d

How to interpret If $RR = 1$?

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Calculate RR for Cohort Study

- *Salmonella* Enteritidis outbreak among group of coworkers that had catered lunch with taco bar
- 40 workers ate fresh salsa; 30 developed *Salmonella* Enteritidis and 10 did not
- Another 40 workers did not eat fresh salsa; 2 developed *Salmonella* Enteritidis and 38 did not

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Relative Risk 2 X 2 table

	<i>Salmonella</i> Enteritidis	No <i>Salmonella</i> Enteritidis	Total
Salsa	a	b	a+b
No salsa	c	d	c+d

Complete with your table group.

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Relative Risk conclusion:

Those who ate salsa had higher risk (15X) of developing *Salmonella* Enteritidis than those who didn't eat salsa



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Case-Control Study: Odds Ratio (OR)

- Compare odds of exposure for cases and controls
- **Odds Ratio (OR) =**
 - $a/c \div b/d$
 - ad/bc

		Disease	
		Yes	No
Exposure	Yes	a	b
	No	c	d

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Case-Control Study: Calculate OR

- Cases: 40 restaurant patrons with *Salmonella* Enteritidis; 30 ate eggs and 10 did not
- Controls: 40 restaurant patrons without *Salmonella* Enteritidis; 2 ate eggs and 38 did not

Why might a case-control study be good option for restaurant outbreak?

Odds Ratio 2 X 2 Table

	<i>Salmonella</i> Enteritidis	No <i>Salmonella</i> Enteritidis
Eggs	a	b
No eggs	c	d
Total	a+c	b+d

Take a moment to enter numbers into 2X2 table.

Odds ratio 2X2 table results

- Odds Ratio (OR) = $(a*d)/(b*c)$

- OR=

- Conclusion:
Cases were ____ times
more likely than controls to
have eaten eggs



Complete with your table group.

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Case-case study example: Shotgun

- Compare exposures between 2 groups of cases
- Cluster of STEC 4 cases: compare exposure frequencies with background exposure frequencies in Shotgun database
- Shotgun database provides background exposure frequencies from previously interviewed cases (Salmonella and STEC)

Exposure Code	YES	%	Backgrnd	Binomial
331 CarrotsLoose	2 / 4	50	18%	0.1547
336 PepperBell	2 / 4	50	26%	0.2813
338 PepperRed	2 / 4	50	16%	0.1180
339 PepperYellow	2 / 4	50	9%	0.0456

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Is this a true association?

- P-value <0.05)

<https://tidsskriftet.no/en/2015/09/why-p-value-significant>

- Case control study example
OR=57 (95% CI, 12–280) P<0.0001
<https://www.medcalc.org/calc/index.php>



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Questions?

Stand up and stretch
break



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Exercise

- Handout: CD 303 Exercises (pages 6-8)
- Work in group to complete questions
- Complete each question before proceeding to next question
- Review questions together at end