



Controlling Bias and Confounding and Determining Causality

Bioterrorism Epidemiology Module 13

Missouri Department of Health
And Senior Services



Major Sources of Error in Conducting an Epidemiological Investigation

- Use of nonrandom samples of the study population
- Nonparticipation of members of the study group
- Observer variation



Confounding

- Factor must be associated with disease
- Factor must be associated with exposure in the study base
- Must not be an intermediate step in causal pathway
- Can be controlled in study design, analysis, or both



Confounding

- Control in study design
 - Random selection
 - Restrict to narrow range of values
 - Matching on potential confounders
- Control in analysis involves stratifying data, calculating effect estimate, then summarizing
- Can also use advanced statistical methods



Odds Ratio for Matched Pairs

$$\text{OR (matched pair)} = B/C$$

		Controls	
		Exposed	Not Exposed
Cases	Exposed	A	B
	Non-Exposed	C	D



Odds Ratio for Matched Pairs

$$\text{OR (matched pair)} = B/C$$

		Controls	
		Exposed	Not Exposed
Cases	Exposed	100	300
	Non-Exposed	100	300



Odds Ratio for Matched Pairs

$$\text{OR (matched pair)} = B/C$$

		Controls	
		Exposed	Not Exposed
Cases	Exposed	100	300
	Non-Exposed	100	300



Effect Modification

- Level of association (RR and OR) between exposure and outcome is different in different subgroups of a population
- Usually less common than confounding



Example of Effect Modification

		Diseased	Not Diseased
Attended Soccer Game	YES	40	160
	NO	12	240

		Diseased	Not Diseased
Lived within one mile of stadium	YES	32	160
	NO	20	240

Calculate the OR, 95% CI and p values for these two tables



Example of Effect Modification

		Diseased	Not Diseased	OR (CI)
Attended Soccer Game	YES	40	160	5.0 (2.5 - 9.8)
	NO	12	240	P < .001
		Diseased	Not Diseased	OR
Lived within one mile of stadium	YES	32	160	2.4 (1.3 - 4.3)
	NO	20	240	P < .004



Effect Modification

	Diseased	Not Diseased
Attended Soccer Game and lived within one mile	24	80
Attended Soccer Game and did not live within one mile	16	80
Did not attended Soccer Game and lived within one mile	8	80
Did not attended Soccer Game and did not live within one mile	4	160



Effect Modification

	Diseased	Not Diseased	OR (CI)
Attended Soccer Game and lived within one mile	24	80	12.0 (4.0 – 35.7)
Attended Soccer Game and did not live within one mile	16	80	8.0 (2.6 – 24.7)
Did not attended Soccer Game and lived within one mile	8	80	4.0 (1.2 – 13.7)
Did not attended Soccer Game and did not live within one mile	4	160	reference



Key Factors to Consider in Determining Causality

- **Temporality:** disease occurs within a biologically reasonable time frame after exposure
- **Chance:** how likely that results are due to chance
- **Consistency:** studies should demonstrate similar associations



Key Factors to Consider in Determining Causality

- **Strength:** greater estimate of risk and more precise
- **Dose Response:** increase in effect correlated with exposure
- **Biological Plausibility:** makes sense in terms of biological knowledge