

# Measures of Effect

Zuber D. Mulla

# Objectives

- 1. Calculate the following measures of association: relative risk, odds ratio, prevalence ratio, and attributable risk.**
- 2. Interpret the following measures of association: relative risk, odds ratio, prevalence ratio, and attributable risk.**

**What are measures of association  
(measures of effect)?**

# Cohort Studies

- **Relative risk**
- **Odds ratio**
- **Attributable Risk**

# Cross-Sectional Prevalence Studies

- **Prevalence ratio**
- **Prevalence odds ratio**

# Case-Control Studies (traditional)

- **Odds ratio**

# 2 x 2 Table

	<b>Ill</b>	<b>Well</b>
<b>Exposed</b>	<b>A</b>	<b>B</b>
<b>Not exposed</b>	<b>C</b>	<b>D</b>

# Relative Risk (RR)

**Incidence in the exposed**

**RR =**

---

**Incidence in the nonexposed**



# 2 x 2 Table

	<b>Ill</b>	<b>Well</b>	
<b>Exposed</b>	<b>A</b>	<b>B</b>	<b>A + B</b>
<b>Not exposed</b>	<b>C</b>	<b>D</b>	<b>C + D</b>

# Relative Risk

**Incidence in the exposed =  $A / (A + B)$**

**Incidence in the nonexposed =  $C / (C + D)$**

# Relative Risk

$$A / (A + B)$$



$$C / (C + D)$$

# Possible Values of RR



# Possible Values of RR



# Interpretation

$$RR = 1.25$$

Take 1.25 and subtract 1 (the null value). You arrive at 0.25. Multiply by 100% to arrive at 25%.

# Interpretation Version 1

$$RR = 1.25$$

**The exposed group was 25% more likely to develop the illness than the nonexposed.**

# Interpretation Version 2

$$RR = 1.25$$

**The exposed group was 1.25 times as likely to develop the illness than the nonexposed.**



# Interpretation

$$RR = 0.80$$

The exposed group had 80% of the risk of developing the illness than the nonexposed, or was 20% less likely than the nonexposed to develop the illness.

# Null Value: No Association

$$RR = 1$$

# Strong Associations

$$RR = 5.00$$

$$RR = 0.20$$

# Weak Associations

$$RR = 1.04$$

$$RR = 0.95$$

# Prevalence Ratio (PR)

$$\text{PR} = \frac{\text{Prevalence in the exposed}}{\text{Prevalence in the nonexposed}}$$

# Prevalence Ratio

$$A / (A + B)$$



$$C / (C + D)$$

# Possible Values of PR



# Odds Ratio

- **Ratio of two odds**



# What is an “odds?”

$$\text{Odds} = \frac{P}{1 - P}$$

- **Ratio of the Probability of an Event (Disease) to the Probability of a Nonevent (No disease)**

# Be careful when watching TV!

- When lay persons use the word “odds,” they usually mean “probability.”

# More on Odds

- **20% of your population are smokers**
- **Odds =  $0.2 / (1 - 0.20) = 0.2 / 0.8 = 1:4$**
- **Odds = 0.25 or Odds = 0.25:1**
- **For every smoker, there are 4 nonsmokers**

# More on Odds

- **An odds approximates a proportion when the latter is small, e.g.,  $\leq 0.05$**
- **Proportion = 0.05**
- **Odds =  $0.05 / (1 - 0.05) = 0.0526$**

**A / (A + B) is not risk in a case-control study**

	<b>Ill</b>	<b>Well</b>	
<b>Exposed</b>	<b>A</b>	<b>B</b>	<b>A + B</b>
<b>Not exposed</b>	<b>C</b>	<b>D</b>	<b>C + D</b>

# Odds Ratio (OR)

	<b>Ill</b>	<b>Well</b>
<b>Exposed</b>	<b>A</b>	<b>B</b>
<b>Not exposed</b>	<b>C</b>	<b>D</b>

$$\text{OR} = \text{AD} / \text{BC}$$

# Exposure OR

- **Odds of exposure in the cases divided by the odds of exposure in the controls**

	<b>Ill</b>	<b>Well</b>
<b>Exposed</b>	<b>A</b>	<b>B</b>
<b>Not exposed</b>	<b>C</b>	<b>D</b>
	<b>A + C</b>	<b>B + D</b>

**Probability of being exposed in the cases =**  

$$A / (A+C)$$

**Odds of exposure in cases =  $P / (1 - P)$  so....**



# Odds of Being Exposed in the Cases

$$\frac{A}{A + C}$$

$$1 - \frac{A}{A + C}$$

# Possible Values of OR



**Null Value: No Association**

**OR = 1**

# A Few Examples of Strong Associations

**OR = 5.00**

**OR = 0.20**

# A Few Examples of Weak Associations

**OR = 1.04**

**OR = 0.95**

# Cited Reference

**Szklo M, Nieto FJ. Epidemiology beyond the basics. Gaithersburg, Maryland: Aspen Publishers, Inc., 2000.**