



#### Measures of exposure effect: Lesson from Intro to Epidemiology Short course in Bristol.

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#### Measures of effect.

- Epidemiological studies investigate associations between disease and exposure
  - Fracture risk in people living with HIV.
  - Cancer risk in people with family history of cancer



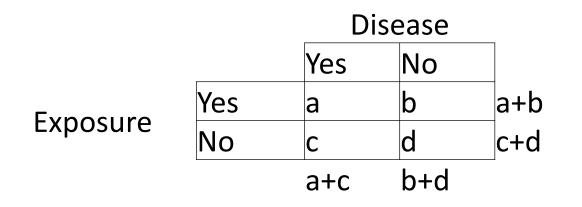
- Measures of effect quantify the relationship (association) between an exposure and disease (outcome)
- also known as a measure of association
- For randomised controlled trials we are interested in the treatment effect, but this involves similar calculations

# Relative vs Absolute measures of effect

- The measures are expressed as a **ratio** to get the **relative** measure of effect of the exposure on disease
- Alternatively, the **difference** of the two measures of occurrence gives the **absolute** measure of effect of the exposure (risk of outcome in exposed individuals from that of unexposed individuals)

- Relative Risk"
  - risk ratio (RR)
  - odds ratio (OR)
  - incidence rate ratio (IRR) or rate ratio (RR)
  - hazard ratio (HR)

#### Risk Ratio.



- Risk of disease in exposed = a / a + b
- Risk of disease in unexposed = c / c + d
- Risk Ratio = risk in exposed / risk in unexposed = (a/a+b) / (c/c+d) = a(c+d)/c(a+b)

# **Risk Ratio**

- Is HIV infection associated with low trauma fracture?
- Cross sectional study and 2500 people living with HIV.
- Risk ratio= <u>Risk in the exposed group</u> Risk in the unexposed group
- RR=0.1/0.05 = 2

|      | Fracture | No Fracture | Total | Risk of<br>fracture |
|------|----------|-------------|-------|---------------------|
| HIV+ | 250      | 2250        | 2500  | 0.1                 |
| HIV- | 375      | 7125        | 7500  | 0.05                |

### Interpreting risk ratios

#### **Result Interpretation**

1 No effect/association

Positive association/Increased risk of disease amongst those

> 1 exposed/Harmful effect

Negative association/reduced risk of disease amongst those

< 1 exposed/protective effect

#### Odds Ratio.

|          |     | Disease |     |
|----------|-----|---------|-----|
|          |     | Yes     | No  |
| Exposuro | Yes | а       | b   |
| Exposure | No  | С       | d   |
|          |     | a+c     | b+d |

- Odds of exposure in cases = a/c
- Odds of exposure in controls= b/d
- Odds Ratio = odds in cases/ odds in controls = (a/c) / (b/d) = ad/bc

#### Where to use odds ratio?

- In case control studies where the size of the population at risk is unknown so you cannot calculate risk.
- Logistic regression estimates odds ratios.

• odds ratio = <u>odds of disease in the exposed group</u> odds of disease in the unexposed group

## Disadvantages of using risks.

- Assumes entire cohort followed up for same length of time
  - Risk increases with follow-up
  - Takes no account of when outcome occurred

### Incidence Rate Ratio.

- Incidence Rate=Total new cases in a given time period/ Total person-time at risk during that period
- Contributions to total person-time at risk ...
  - Time to development of disease
  - Time until lost to follow-up (outcome unknown)
  - Time to end of study (outcome hasn't occurred)
    Person-time units must be stated, e.g "per 1000 person years"
- Incidence Rate ratio = <u>Incidence rate in the exposed group</u> Incidence rate in the unexposed group

#### Example....

|                          | Exposed | Unexposed |
|--------------------------|---------|-----------|
| Number initially at risk | 2000    | 8000      |
| Deaths during the period | 15      | 30        |
| Person-years at risk     | 3985    | 15970     |

*Risk ratio*= <u>15/2000</u> = 2 30/8000

 $odds \ ratio = \frac{15/(2000-15)}{30/(8000-30)} = 2.0076$ 

*Rate ratio* = <u>15/3985</u> = 2.0038 30/15970

#### Hazards Ratios.

- Similar to incidence rate ratios
- Outcome is time to an event or non-event
- Calculated using Cox proportional hazards model
- Assumes that the rates of disease in the two exposure groups are related by a constant multiple
- Can include other independent variables

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