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.

		Disease		
		Yes	No	
Exposure	Yes	a	b	a+b
	No	c	d	c+d
		a+c	b+d	

- 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.

$$Risk\ ratio = \frac{Risk\ in\ the\ exposed\ group}{Risk\ in\ the\ unexposed\ group}$$

- RR=0.1/0.05 = 2

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

Interpreting risk ratios

Result	Interpretation
1	No effect/association
> 1	Positive association/Increased risk of disease amongst those exposed/Harmful effect
< 1	Negative association/reduced risk of disease amongst those exposed/protective effect

Odds Ratio.

		Disease	
		Yes	No
Exposure	Yes	a	b
	No	c	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.

- $odds\ ratio = \dfrac{odds\ of\ disease\ in\ the\ exposed\ group}{odds\ of\ disease\ in\ the\ unexposed\ group}$

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"

- $$Incidence\ Rate\ ratio = \frac{Incidence\ rate\ in\ the\ exposed\ group}{Incidence\ rate\ in\ the\ unexposed\ group}$$

Example….

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

$$Risk\ ratio = \frac{15/2000}{30/8000} = 2$$

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

$$Rate\ ratio = \frac{15/3985}{30/15970} = 2.0038$$

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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