Measures of Association

- Assess the size (strength) of the relationship between exposure (potential "cause") and outcome ("disease")
  - Re: statistical tests are about the "significance" of association
    - They are not used to indicate the magnitude of the effect
    - They are about the likelihood that the size of the difference observed was due to chance given that the null hypothesis is true

- Compare:
- Disease frequency in exposed v.
  Disease frequency in non-exposed

Or:

- Odds of exposure in those with disease (cases) and those without the disease (controls)

Risk Data

	Disease/Outcome **present**	Disease/Outcome **absent**
Present (exposed) Risk Factor	a	b
Absent (not exposed)	c	d

Incidence Rate Data

3 common measures

- Risk ratio(Relative Risk)
- Incidence rate ratio
- Odds ratio
  - All a ratio of 2 estimates of Dz frequency

Risk Ratio (Relative Risk)

- Risk of Dz in exposed to risk of Dz in non-exposed
  - RR=P(D+|E+) / P(D+|E-)
    - Not for use in case-control studies b/c D+ is arbitrarily defined by the number of cases included in the study

		Disease: present	Disease: absent	
Risk Factor	present	a	b	a / (a + b) = dz w/ factor
	absent	c	d	c / (c+ d) = dz w/OUT factor

R R = (a / (a+b)) / (c / (c+d))

> 1 = increased disease due to factor, < 1 = protection due to factor, =1 ~ exposure has no effect

Or use: https://www.medcalc.org/calc/relative_risk.php

Or use: something else

Example

- Risk Factor = FPT
- Disease = Scours
- Sampled 12 calves with refractometer
- 5 calves < 5.5 g/dl
- 7 calves > 5.5 g/dl
- 4 calves had scours
- 8 calves did not scour
- 3 had FPT and scours
- **Is there a strong association between FPT and scours?**

	Disease = Scours **present**	Disease = Scours **absent**	
present Risk Factor = FPT			a / (a + b) = dz w/ factor
absent			c / (c+ d) = dz w/OUT factor

R R = (a / (a+b)) / (c / (c+d))

(3/5) / (1/7) =__; Those calves with FPT are ____times more likely to scour

OR:

Incidence Rate Data

	Disease **# of cases**	Disease **Animal time at risk**
Present (exposed) Risk Factor	a	b
Absent (not exposed)	c	d

Incidence Rate Data

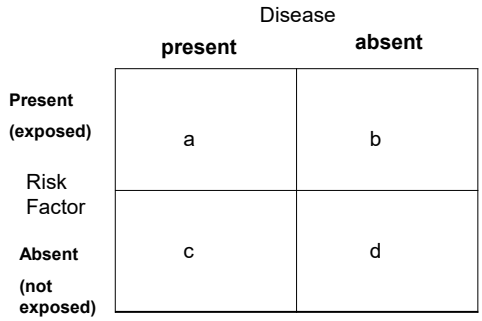
- IR = (a/b) / (c/d)
- Ranges from 0 to infinity
- 1 means no association
- >1 means increased rate of dx with exposure
- <1 means protective exposure

Incidence Rate example

	Disease **# mast cases**	Disease **Animal time at risk**
Present (no dip) Risk Factor	18	250
Absent (dip)	8	236

IR = (18/250) / (8/236)=2.12 →rate of mast 2.1 higher in cows not pre-dipped

Odds Ratio



Odds Ratio

- Odds of disease in exposed group divided by odds of disease in non-exposed group
- OR = odds (D+|E+) / odds (D+|E-)
  - = (a/b) / (c/d)
  - = (a*d) / (b*c)
- Can also be calculated as (E+|D+) / (E+|D-)
- Interpret the same as RR

Odds Ratio

- Can “switch” exposure and disease
- OR is used for Case-Control studies b/c disease frequency is “artificially” established

Relationship

- If disease occurs rarely in population (e.g. risk is ~4%) OR ~ RR
- If disease occurrence is large, OR>IR>RR for same measurement

Confidence intervals (CI)

- CI reflect the level of uncertainty (precision) in a point estimate
- Indicate the range of expected values
- Conveys more information than the point estimate and a p-value
  - Clearly shows a range of likely values for the population parameter

Confidence intervals (CI)

- Ex: for 95% CI:
  - Repeat study measurements an infinite number of times and make 95% CI for each one, 95% of these would include the TRUE parameter value
- If 95% CI includes null value (e.g. RR=1), it ***suggests*** the parameter is not statistically different from the null at a p-value of 0.05
  - It is not a hypothesis test though!