International Studer

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2. Sign in with your student email address
3. Grant location and battery optimization permissions when prompted
4. Tap ‘Check In’ at the start of each class (If the app has not checked you out after your last class, tap ‘Check Out’ and then ‘Check In’).
5. Do this any time you attend an on-campus class. This could be a lecture, lab, seminar, tutorial, etc.

Android

Apple

Revision of introduction to epidemiology

Professor David A McAllister

Aim

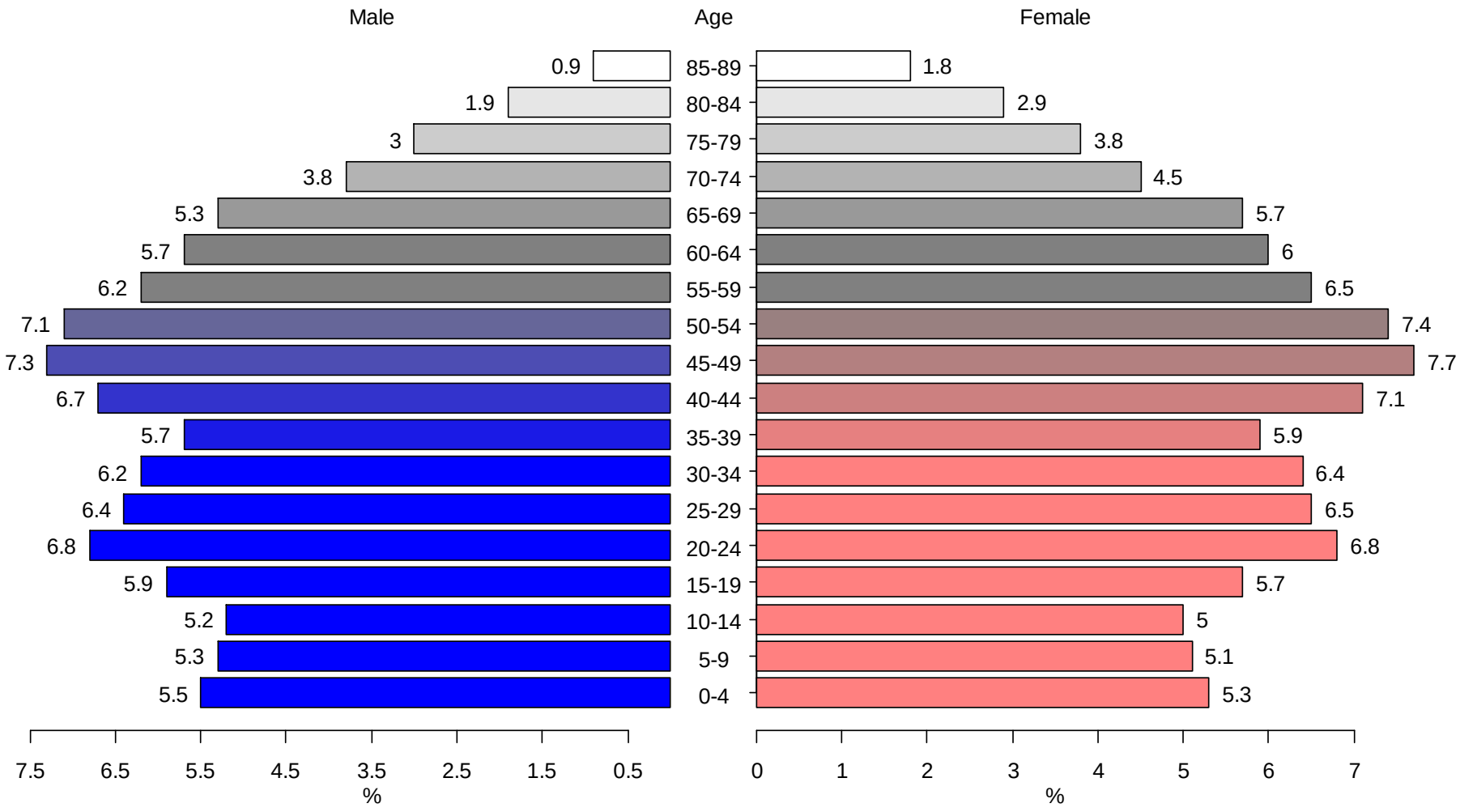
- To review the epidemiological concepts covered in previous courses

BASIC EPIDEMIOLOGICAL TERMS

Mortality rates

- Am I worried?
  - 50 people died from flu
  - 50 people in Glasgow died from flu
  - 50 people in Glasgow died from flu in past 100 years
- Meaningful statistics need
  - A denominator population
  - A time frame

Scotland’s population 2013



Other denominators

- Health board
- City
- Hospital
- Disease register
- Recruited to a study

THE DENOMINATOR MUST CORRESPOND TO THE NUMERATOR

Two sorts of time

- Person-time
  - 10 deaths per 10,000 person years
    - 10,000 people for 1 year
    - 5,000 people for 2 years
    - 2,000 people for 5 years
- n-year follow-up
  - 5-year mortality of 10 per 10,000 people
- **Without denominator population and time death rates are meaningless**

Incidence

- Number of new cases
  - person-time, eg 5 per 10,000 person years
  - n years of follow-up, 10-year cancer incidence rate is 1 per 10,000

Prevalence

- Proportion of population that has disease
  - at a specified time, eg 1% of population had COPD in 2010
  - over a specified period, eg lifetime prevalence of dementia 40%

Compare/contrast

Prevalence

- A proportion
- Useful for planning services
- Depends partly on incidence

Incidence

- A rate or a proportion
- Useful for identifying causes of diseases
- Occurs, by definition, only in people without the disease

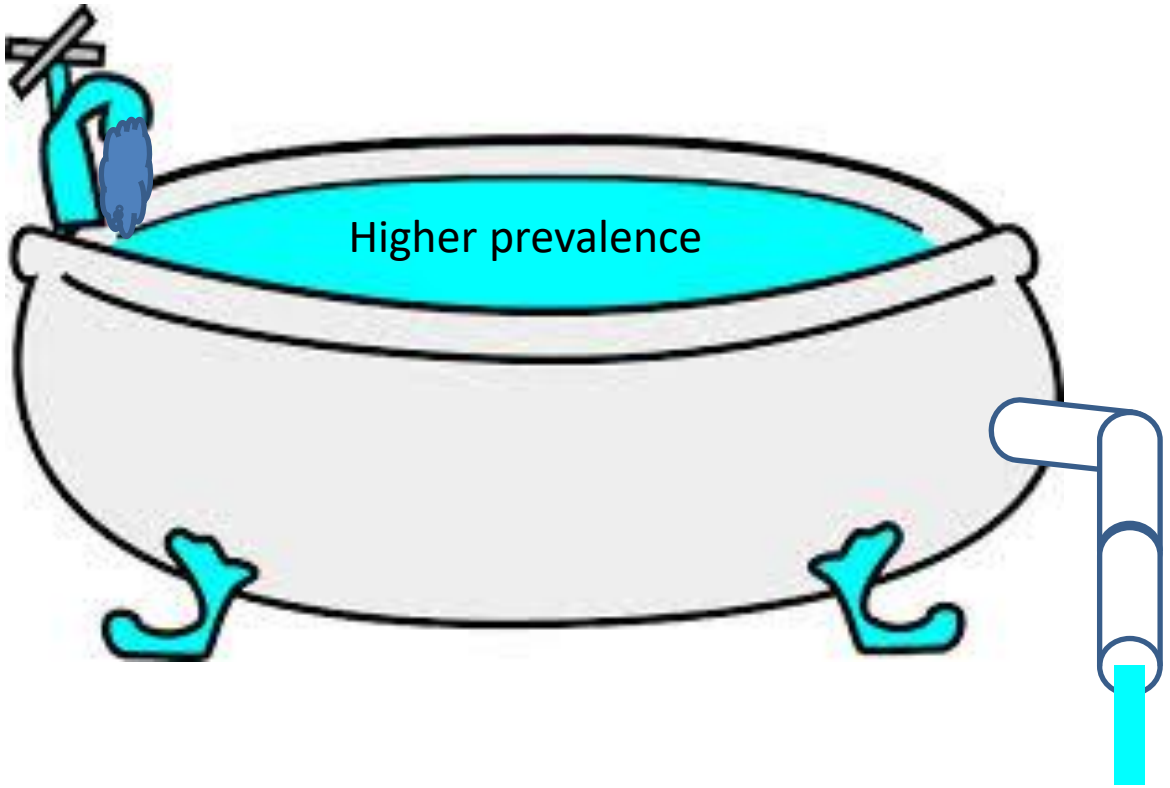
How incidence relates to prevalence

Example - heart failure

Increased myocardial infarction

↓

Increased heart failure incidence



Improved long-term management → Reduced death rate

ASSOCIATIONS BETWEEN EXPOSURES AND OUTCOMES

Outcomes

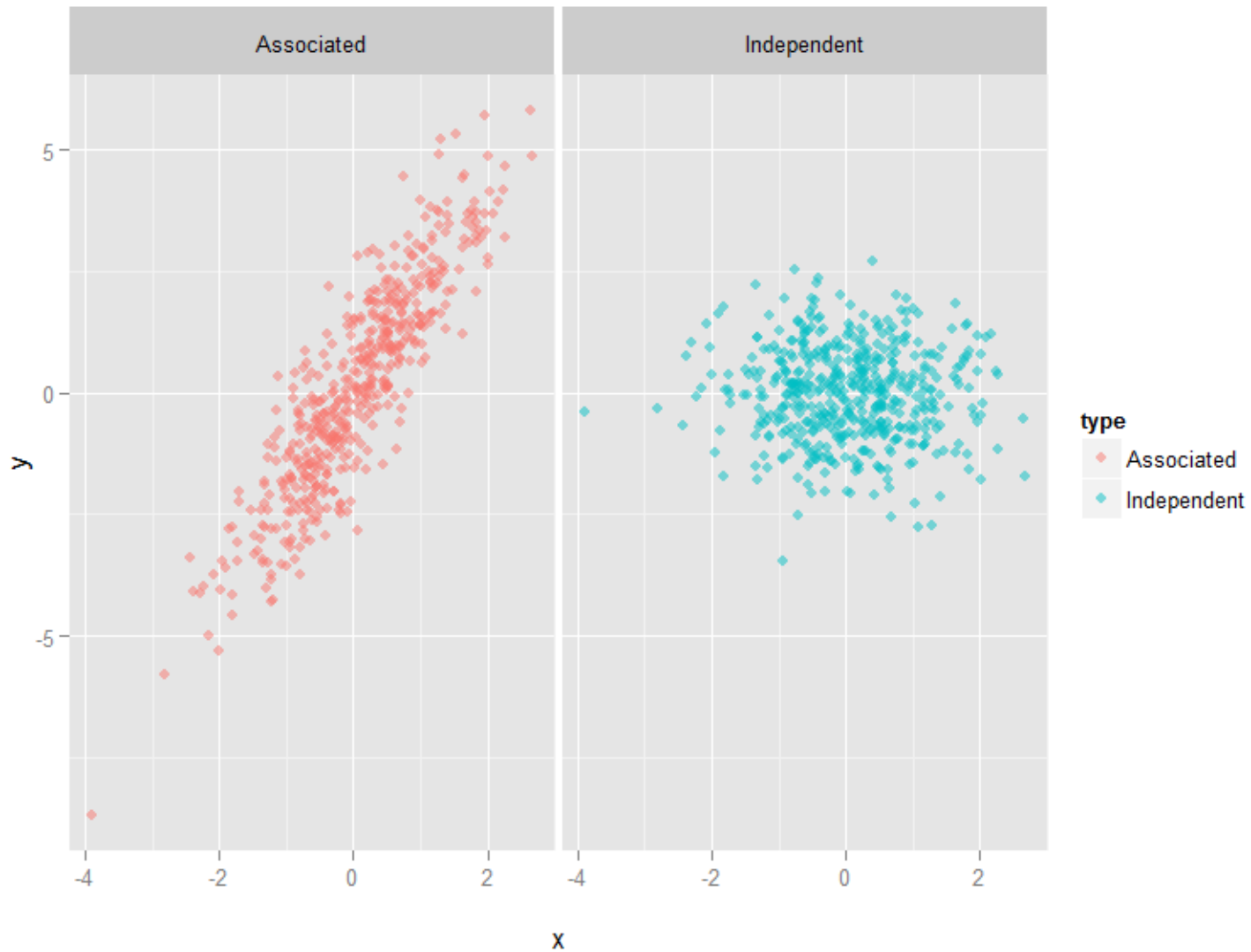
- Outcomes
  - death
  - hospitalisation
  - first diagnosis with a disease
  - recurrence, eg cancer
  - quality of life
  - surrogates – blood pressure, lung function

Exposures

- Non-modifiable
  - age, sex, genotype
- Modifiable
  - smoking, weight, diet, alcohol consumption
- Interventions – a special kind of exposure
  - drug therapy
  - surgery
  - lifestyle advice

Association

- a and b are associated when a and b are not independent
  - $P(a|b) = P(a)$
  - $P(b|a) = P(b)$
- Knowing something about a tells you nothing about b
- Knowing something about b tells you nothing about a


Associated
Independent
5
0
-5
y
-4
-2
0
2
x
type
Associated
Independent

Effect estimates

	Died	N	Proportion
Thrombolysis	100	1000	**10%**
No thrombolysis	130	1000	**13%**

$$RR = \frac{risk_{exposed}}{risk_{unexposed}}$$

$$ARR = risk_{unexposed} - risk_{exposed}$$

Measure	Result
Risk ratio (RR)	=10/13 = 0.77
Relative risk reduction (RRR)	100 x (1-0.77) = 23%
Risk difference (absolute risk reduction – ARR)	= 13-10 = 3%
Number needed to treat (NNT)	= 1/0.03 = 33

$$RRR = 100 \times (1 - RR)$$

$$NNT = \frac{1}{ARR}$$

Other commonly encountered measures

- Odds ratio – commonly used estimate of risk ratio
- Rate ratio – ratio between two mortality rates, hospitalisation rates etc
- Hazard ratio – a special kind of rate ratio

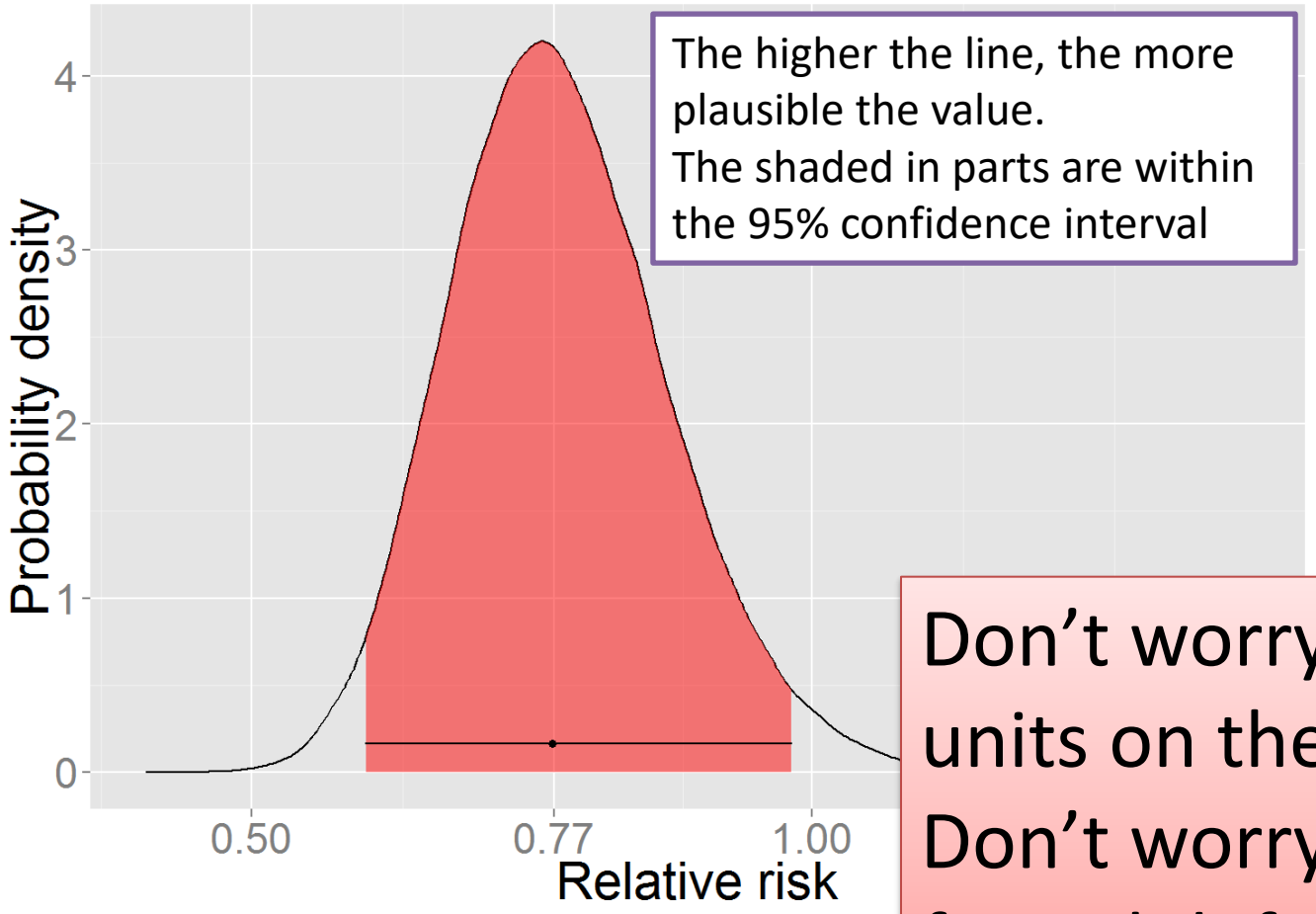
CONFIDENCE INTERVALS

Confidence intervals

- Vital to reading **ANY**! research paper
- Formal definitions are counterintuitive
- Pragmatically
  - "A confidence interval can be thought of as a range of plausible values"
  - Values near the limits are much less plausible than those in the middle

EXAMPLE – AS IN TABLE EFFECT ESTIMATES - THROMBOLYSIS

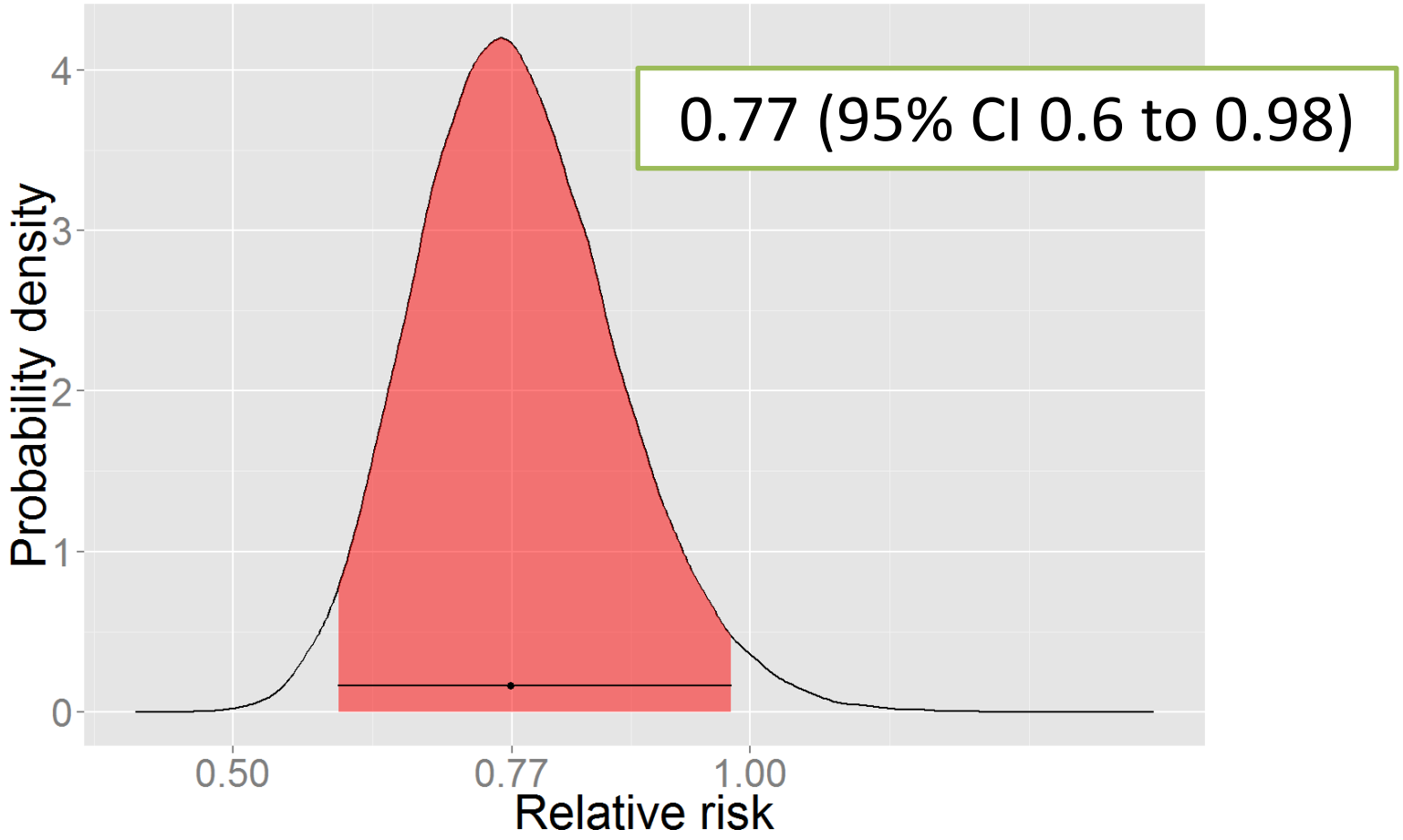
95% CI represented visually



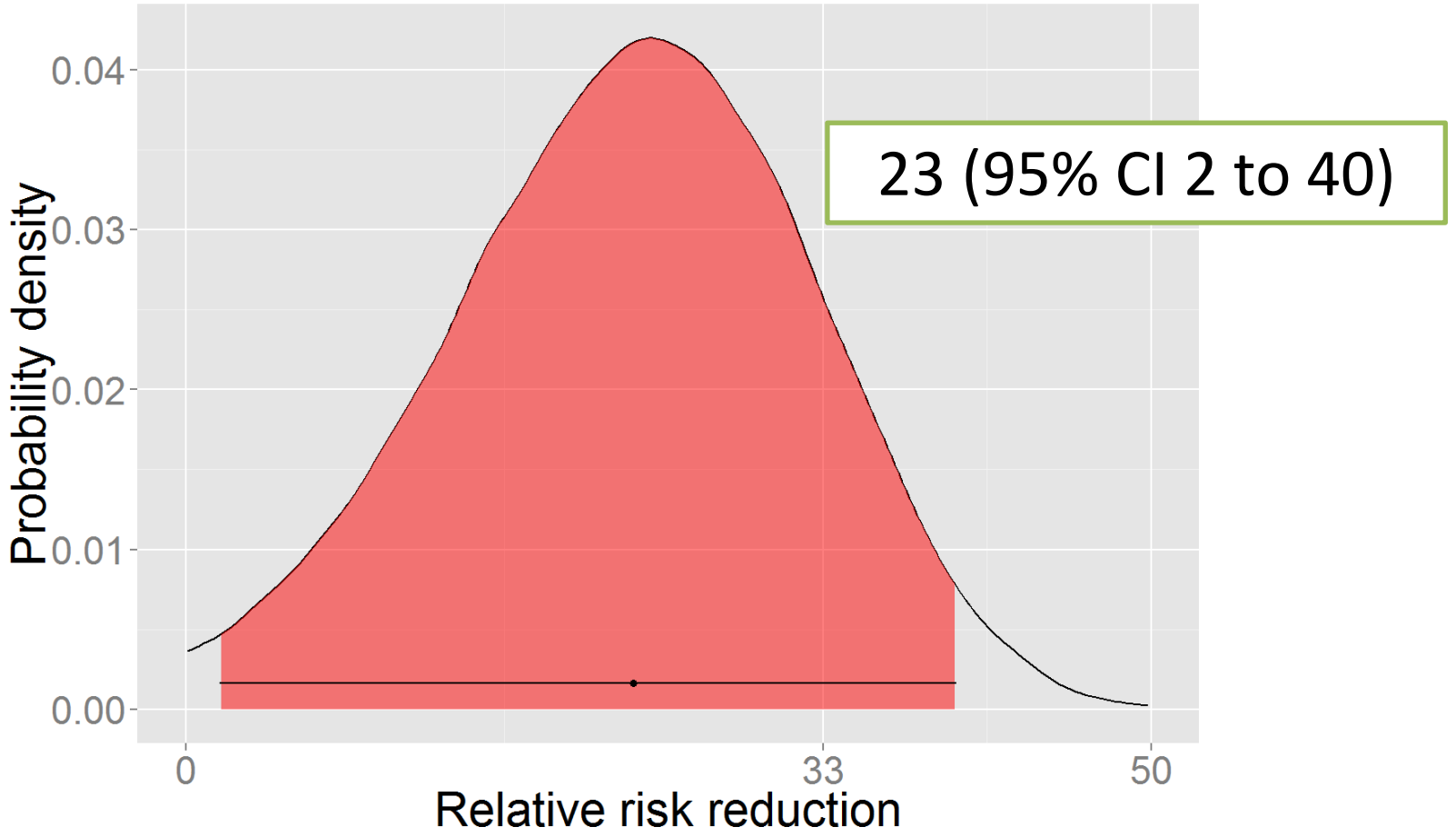
The higher the line, the more plausible the value.
The shaded in parts are within the 95% confidence interval

Don’t worry about the units on the y-axis
Don’t worry about formal definitions!!!

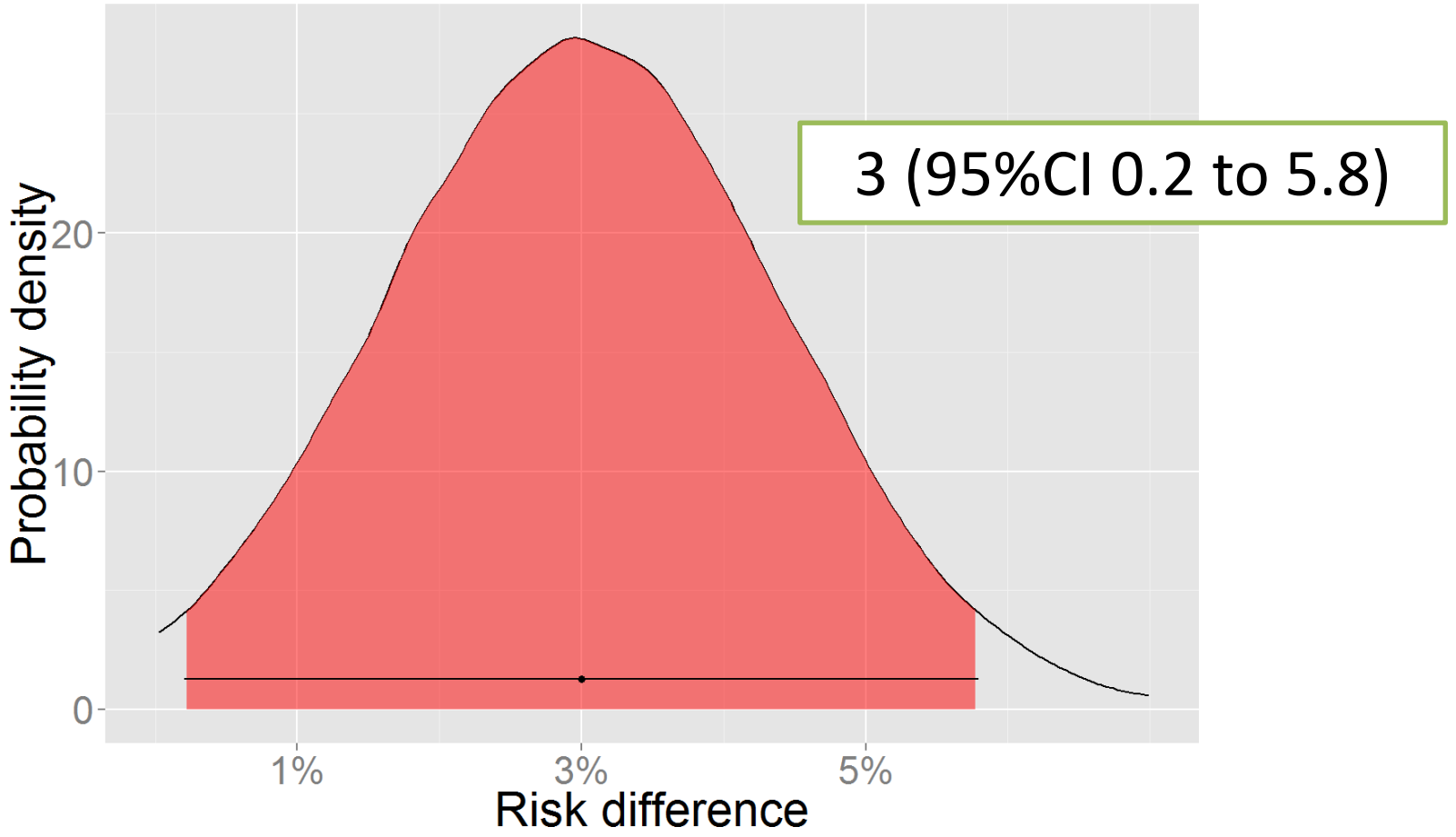
Relative risk



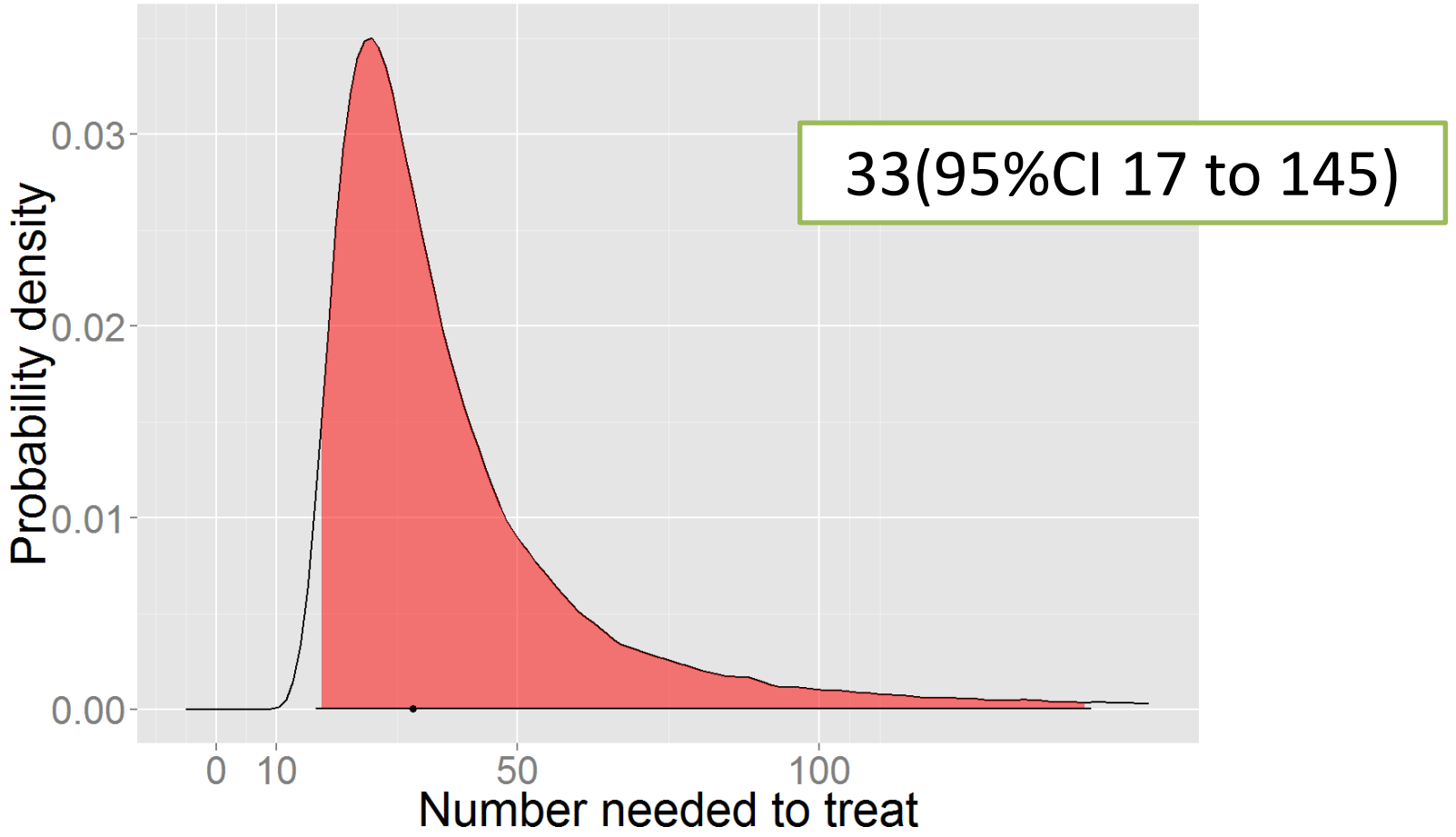
Relative risk reduction



Risk difference
(absolute risk reduction)



Number needed to treat (NNT)



Confidence intervals

- Can be presented for any statistic/effect measure
- Represents range of plausible values
- More extreme values less likely
- Very useful in appraising published research

DESCRIPTIVE EPIDEMIOLOGY

Crude mortality

State	Deaths in 2013	Population in 2013	Crude annual mortality
New York City	48,000	8,000,000	6 per 1,000
Florida	19,000	19,000,000	10 per 1000
		Rate ratio	**1.67**

WHY?

Standardised mortality ratio (SMR)

State	Deaths	Expected deaths	SMR
New York City	48,000	50,000	96
Florida	19,000	22,000	86

- Calculate expected deaths based on
  - age-sex specific mortality rates in whole of US
  - age and sex of people in NY and Florida
- Both places have lower than expected mortality
- New York has a higher SMR than Florida

CONFOUNDING

NY vs Florida was an example of confounding

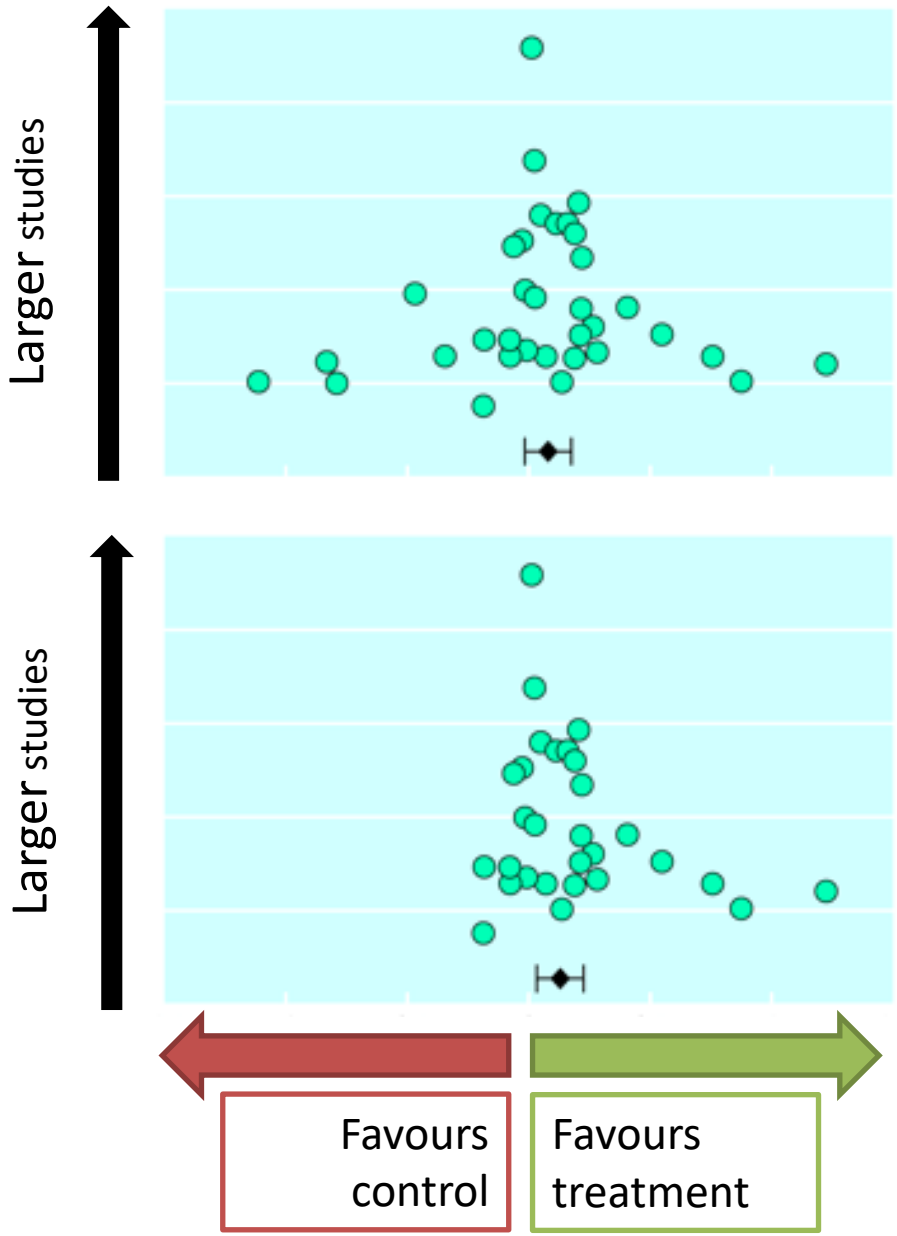
- True relationship confused by a third factor
- Can deal with confounding
  - study design
  - data analysis – eg via standardisation

Bias

- **Systematic** error in
  - what data are collected
  - how data are collected
  - how data are analysed
  - how data are interpreted
  - how data are reported
- Bias leads to wrong conclusions about
  - disease causation
  - treatment effectiveness

Bias - examples

- **Systematic** error in
  - what data are collected - novel treatments
  - how data are collected - different follow-up
  - how data are analysed - misconduct
  - how data are interpreted - highlight certain findings
  - how data are reported - publication bias
- Causes wrong conclusions about
  - disease causation
  - treatment effectiveness



All studies

Published studies

Empirical assessment of effect of publication bias on meta-analyses *BMJ* 2000;320:1574

DIFFERENT TYPES OF STUDY ARE MORE/LESS PRONE TO CONFOUNDING AND BIAS

Hierarchy of evidence

Less prone to confounding and bias

Case-control study

- Select CASES with a disease – eg lung cancer
- Select CONTROLS without that disease
- Find our what EXPOSURES the cases and controls had – eg smoking
- Compare exposures in cases and controls
- Identify if association

Cohort study

- Select people without a disease (eg heart disease)
- Classify them according to an exposure eg
  - high cholesterol
  - low cholesterol
- Follow-them, eg for 10 years
- Compare RISK of disease in exposed and unexposed

Randomised controlled trial (RCT)

- Like cohort study, except
- **ALLOCATE** PEOPLE TO INTERVENTION
  - cohort study ‘observe exposure’
  - randomised controlled trial ‘allocate intervention’
- Compare RISK of outcome in treatment and control groups

Cross-sectional study

- Sample a population
- Estimate the proportion of people with
  - different exposures (eg smoking, alcohol consumption, income)
  - different symptoms (eg breathlessness, cough)
  - different diseases (eg angina)
- Use these data
  - to describe disease burden
  - to explore associations

Hierarchy of evidence

Less prone to confounding and bias

Topics covered

- Basic epidemiological terms
- Confidence intervals
- Confounding
- Bias
- Case-control and cohort studies
- The hierarchy of evidence

Questions?