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Dichotomous outcomes

Trusted evidence.
Informed decisions.
Better health.

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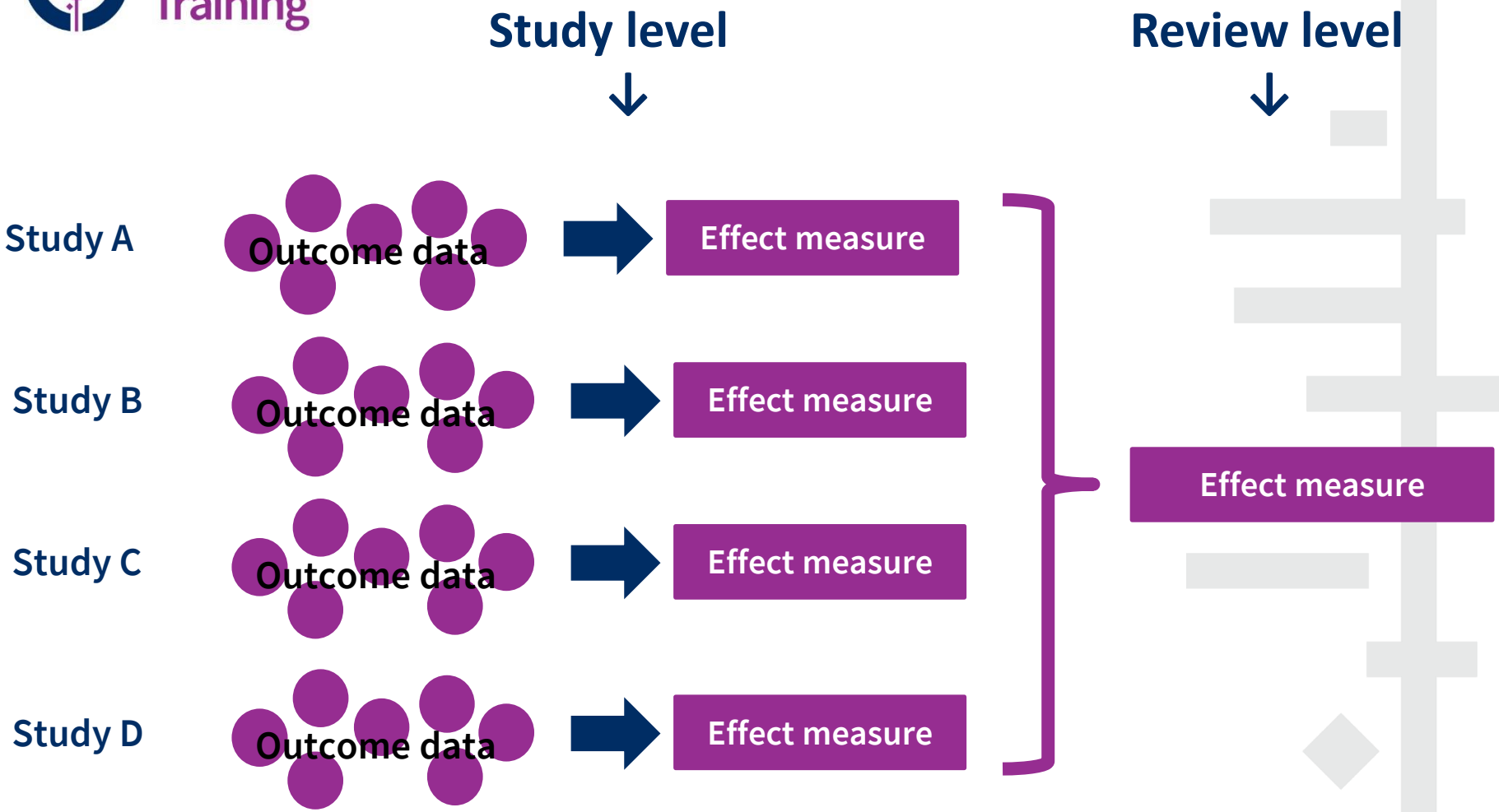
Steps of a Cochrane Review

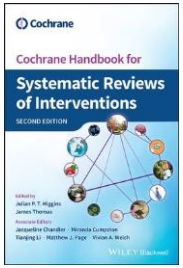
1. define the question
2. plan eligibility criteria
3. plan methods
4. search for studies
5. apply eligibility criteria
6. **collect data**
7. assess studies for risk of bias
8. **analyse and present results**
9. interpret results and draw conclusions
10. improve and update review



Source: Jo McKenzie & Miranda Cumpston

Session outline

- **expressing chance: risk and odds**
- effect measures for comparing groups
- choosing an effect measure
- collecting data for dichotomous outcomes



See Chapters 6 & 10 of the Handbook

What are dichotomous outcomes?

- when the outcome for every participant is one of two possibilities or events
  - alive or dead
  - healed or not healed
  - pregnant or not pregnant

What were the chances of that?

Risk and **odds**

- express chance in numbers
- for dichotomous outcomes, express the chance within a group of being in one of two states
- particular statistical meanings, calculated differently

Risk

- 24 people drank coffee
  6 developed a headache
- risk of a headache

  = 6 people with headache / 24 people who could have had one

  = 6/24 = ¼ = 0.25 = 25%

$$\text{risk} = \frac{\text{no. participants with event of interest}}{\text{total no. participants}}$$

Odds

- 24 people drank coffee
  6 developed a headache
- odds of a headache
  = 6 people with headache/18 without headache
  = 6/18 = 1/3 = 0.33 = 1:3 (not usually as %)

$$\text{odds} = \frac{\text{no. participants with event of interest}}{\text{no. participants without event of interest}}$$

Do risks and odds differ much?

Two examples from caffeine trials

- 5 people with ‘headache’ out of 65
- chance of having a headache

risk = 5/65 = 0.077 **odds = 5/60 = 0.083**

- 130 people ‘still awake’ out of 165
- chance of still being awake

risk = 130/165 = 0.79 **odds = 130/35 = 3.71**

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Comparing two groups

	Event	No event	Total
Intervention	a	b	**a+b**
Control	c	d	**c+d**
Total	**a+c**	**d+b**	**a+b+c+d**

Comparing two groups

	Event: Headache	**No event:** No headache	**Total**
Intervention: Caffeine	17	51	**68**
Control: Decaf	9	55	**64**
Total	**26**	**106**	**132**

Comparing two groups

- effect measures
  - risk ratio (RR) (relative risk)
  - odds ratio (OR)
  - risk difference (RD) (absolute risk reduction)
- all estimates are uncertain, and should be presented with a confidence interval

Risk ratio

- risk of event with intervention (caffeine) = **17/68**
- risk of event with control (decaf) = **9/64**

$$\text{risk ratio} = \frac{\text{intervention risk}}{\text{control risk}}$$

$$= \frac{\mathbf{17/68}}{\mathbf{9/64}} = \frac{0.25}{0.14} = 1.79$$

	Headache	No headache	Total
Intervention: Caffeine	**17**	51	**68**
Control: Decaf	**9**	55	**64**
Total	**26**	**106**	**132**

Where risk ratio = 1, there is no difference between the groups

Expressing it in words

- Risk ratio 1.79
  - the risk of having a headache with treatment was 179% of the risk in the control group
  - intervention increases the risk of events by 100*(RR-1)%
    - intervention increased the risk of headache by 79%

or for a reduction in risk:

- Risk ratio 0.79
  - the risk of having a headache with treatment was 79% of the risk in the control group
  - intervention reduces the risk of events by 100*(1-RR)%
    - intervention reduced the risk of headache by 21%

Odds ratio

- odds of event with intervention = **17/51**
- odds of event with control = **9/55**

$$\text{odds ratio} = \frac{\text{intervention odds}}{\text{control odds}}$$

$$= \frac{\mathbf{17/51}}{\mathbf{9/55}} = \frac{0.33}{0.16} = 2.06$$

	Headache	No headache	Total
Intervention: Caffeine	**17**	**51**	68
Control: Decaf	**9**	**55**	64
Total	**26**	**106**	**132**

Where odds ratio = 1, there, is no difference between the groups

Expressing it in words

- Odds ratio 2.06
  - intervention doubled the odds of headache
  - intervention increased the odds to 206% of the odds in the control group
  - intervention increased the odds of headache by 106%

or for a reduction in odds:

- Odds ratio 0.06
  - intervention reduced the odds of headache to 6% of the odds in the control group
  - intervention reduced the odds of headache by 94%

Risk difference

- risk of event with intervention = **17/68**
- risk of event with control = **9/64**

	Headache	No headache	Total
Intervention: Caffeine	**17**	51	**68**
Control: Decaf	**9**	55	**64**
Total	**26**	**106**	**132**

- risk difference = risk with intervention – risk with control

  =**17/68 – 9/64**

  = 0.25 – 0.14 = 0.11

Where risk difference = 0, there is no difference between the groups

Expressing it in words

- Risk difference 0.11
  - intervention increased the risk of headache by 11 percentage points
  - 14 out of 100 people experienced a headache in the control group. 11 more people experienced a headache with caffeine.

or for a reduction in risk:

- Risk difference -0.11
  - intervention reduced the risk of headache by 11 percentage points
  - 14 out of 100 people experienced a headache in the control group. 11 fewer people experienced a headache with caffeine.

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Now it's your turn!

	Event	No Event	Total
Intervention	2	8	10
Control	5	5	10
Total	**7**	**13**	**20**

1. calculate:
   - risk ratio for the effect of treatment on chance of event
   - odds ratio for the effect of treatment on chance of event
2. express the results in words

The answers

Risk ratio $= \frac{2/10}{5/10} = \frac{0.2}{0.5} = 0.4$

Odds ratio $= \frac{2/8}{5/5} = \frac{0.25}{1} = 0.25$

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Session outline

- expressing chance: risk and odds
- effect measures for comparing groups
- **choosing an effect measure**
- collecting data for dichotomous outcomes

Choosing an effect measure

- communication of effect
  - users must be able to understand and apply the result
- consistency of effect
  - applicable to all populations and contexts
- mathematical properties

Your Cochrane Group may have a policy

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Communication

- OR is hard to understand, often misinterpreted
- RR is easier, but relative
  - can mean a very big or very small change
- RD is easiest
  - absolute measure of actual change in risk
  - easily converted to natural frequencies or NNT

Consistency

- event rates vary from study to study within a review
- study of meta-analyses in the Cochrane Library:
  - RR and OR are less variable across different populations
  - RD is more variable, dependent on baseline risk
- readers will apply results to their own population, which may be different again

Source: Deeks JJ. Issues in the selection of a summary statistic for meta-analysis of clinical trials with binary outcomes. *Statistics in Medicine* 2002; 21:1575-1600

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Mathematical properties

- defining your event
  - good or bad, presence or absence?
  - OR and RD are stable either way, RR varies
  - think carefully and choose in advance
- unbounded values
  - OR is the only unbounded effect measure (can take any number from zero to infinity)

Summary

	OR	RR	RD
Communication	✗	✓	✓✓
Consistency	✓	✓	✗
Mathematics	✓✓	✗	✗

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Session outline

- expressing chance: risk and odds
- effect measures for comparing groups
- choosing an effect measure
- **collecting data for dichotomous outcomes**

Collecting data

- four numbers needed for effect measure and variance:

	Headache	No headache	Total
Caffeine	17	51	68
Decaf	9	55	64
Total	**26**	**106**	**132**

Try to collect the actual number measured for each outcome, at each time point

Other data formats can also be used

- percentages
  - number of events can be calculated if sample size is known
- overall effect estimate (e.g. OR, RR)
  - where results for each group is not reported separately
  - can include in meta-analysis using generic inverse variance method
  - need a measure of variance (e.g. SE, 95% CI)

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What to include in your protocol

- effect measure(s) to be used for dichotomous data

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Take home message

- risks and odds are two ways of expressing how likely an event is
- risk ratio, odds ratio and risk difference compare chance between two groups
- to enter dichotomous data you need the **number of events** and the **total number** in each group

References

- Higgins JPT, Li T, Deeks JJ (editors). **Chapter 6: Choosing effect measures and computing estimates of effect.** In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.1 (updated September 2020). Cochrane, 2020. Available from www.training.cochrane.org/handbook.
- Deeks JJ, Higgins JPT, Altman DG (editors). **Chapter 10: Analysing data and undertaking meta-analyses.** In: Higgins JPT, Thomas J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.1 (updated September 2020). Cochrane, 2020. Available from www.training.cochrane.org/handbook.

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