A brief overview of bias

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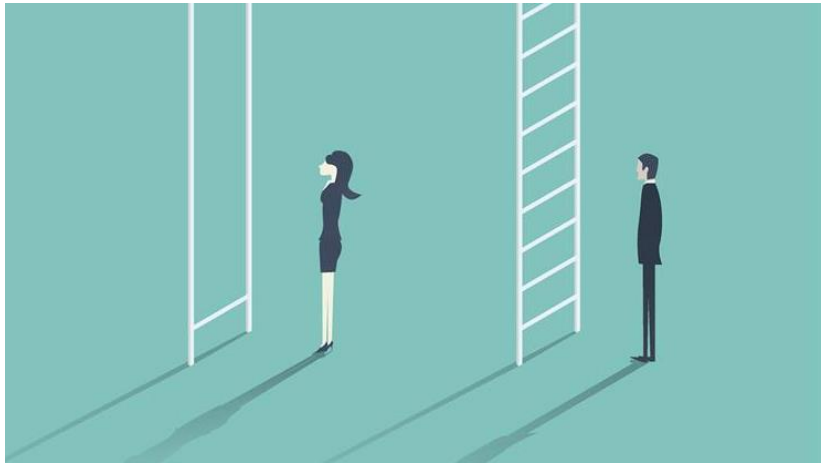
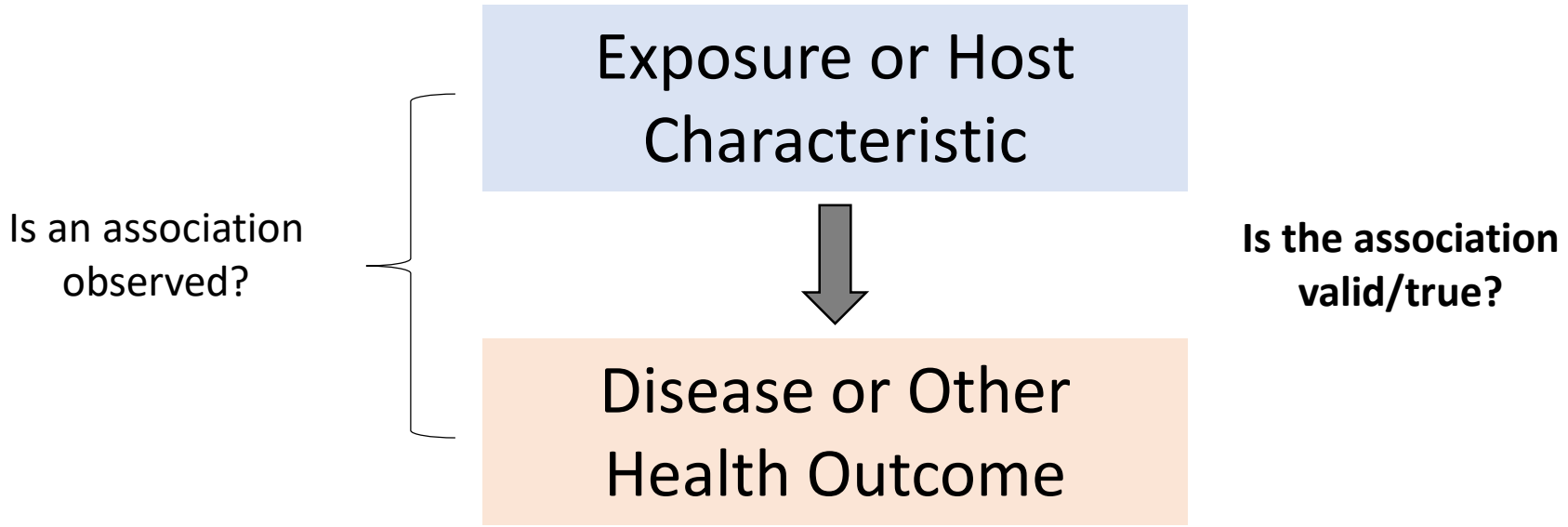
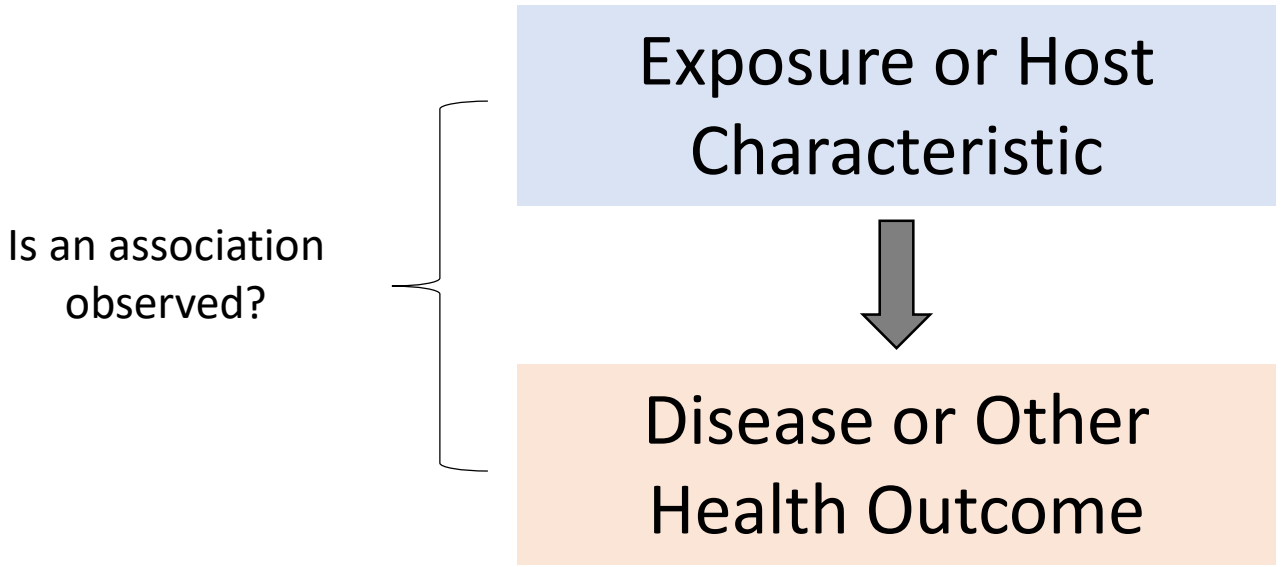
Bias in the everyday

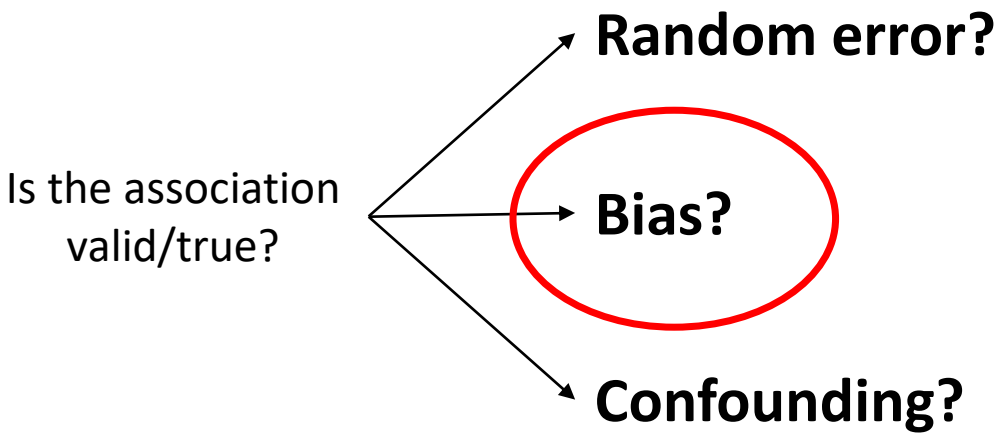


Epidemiological inference



Three sources of error





What is scientific bias?

- Bias is any trend or **deviation from the truth** in data collection, data analysis, interpretation and publication which can give rise to false conclusions.
- It does not imply prejudice or deliberate deviation, but the deviation is **systematic** and non-random.

Bias is bad news!

- Error in the design or conduct of a study
- Not much can be done about it once the study is over!
- Studies have practical and ethical constraints
  so some bias is almost inevitable.

"It's too late, Roger—they've seen us."

Bias in three parts

1) Selection bias

Concerns the people included or compared

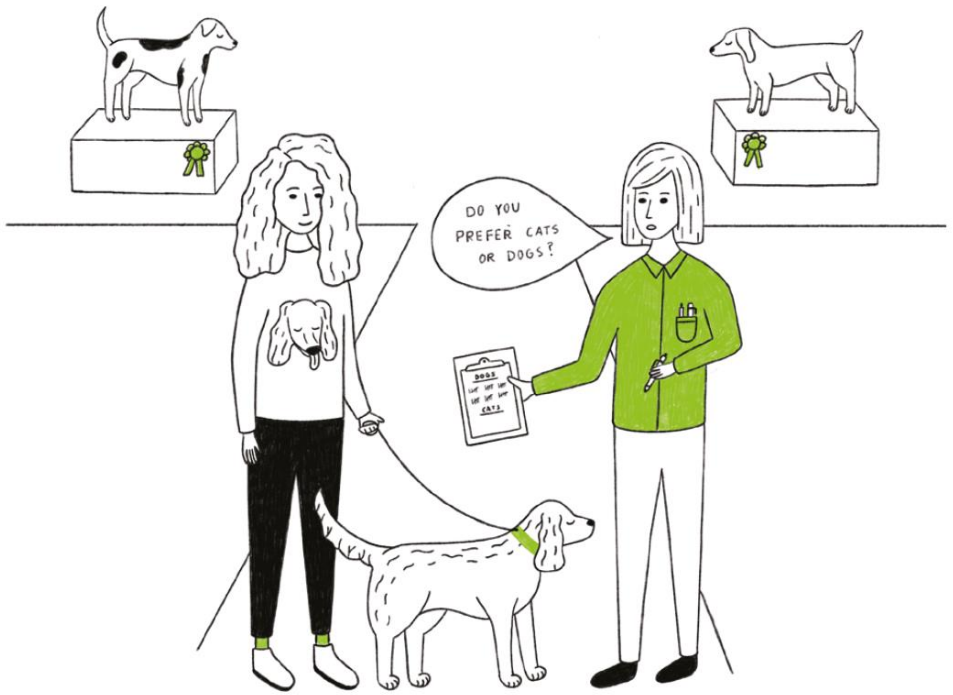
… such that selection of individuals or groups does not achieve randomisation

a. Sampling bias
b. Ascertainment bias
c. Attrition bias (loss to follow-up)

Who is selected and how are they selected?

1) Selection bias

- **Sampling bias**
- When some members of the intended population are less likely to be included than others
- Results in a non-random sample



1) Selection bias

- **Sampling bias – pneumonia and alcoholism**
- *In the community*

$$OR = \frac{D_e / H_e}{D_n / H_n}$$

$$OR = \frac{10 / 10}{90 / 90} = \frac{\mathbf{10 \times 90}}{\mathbf{90 \times 10}} = \mathbf{1.0}$$

Pneumonia

Alcoholism

	Yes	No
Yes	**10**	**10**
No	**90**	**90**
	100	**100**

1) Selection bias

- **Sampling bias – pneumonia and alcoholism**
- *In the hospital*

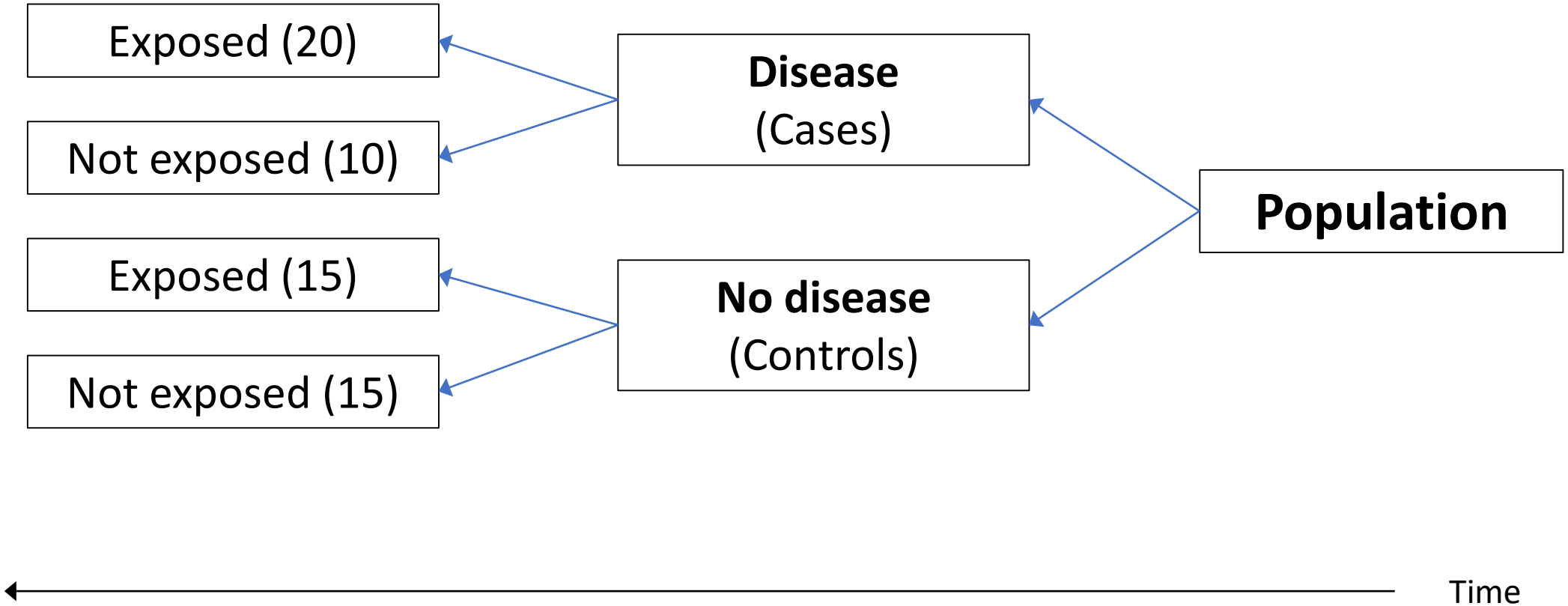
$$OR = \frac{D_e / H_e}{D_n / H_n}$$

$$OR = \frac{20 / 10}{80 / 90} = \frac{\mathbf{20 \times 90}}{\mathbf{80 \times 10}} = \mathbf{2.25}$$

Pneumonia

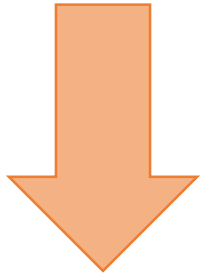
Alcoholism	Yes	No
Yes	**20**	**10**
No	**80**	**90**
	100	**100**

Sampling bias in case-control studies



Sampling bias in case-control studies

Exposures of interest influence the likelihood of an individual becoming a control



Biased assessment of exposure odds in the population from which the cases are drawn

Sampling bias in case-control studies

Examples:

- Case-control study of cancer of the oesophagus and alcohol
- Controls: Men employed in a brewery

- Case-control study of stroke and oral contraceptives
- Controls: Women who attended a family planning clinic

The major problem in case-control studies is the choice of CONTROLS

How to select **controls** in case-control studies

- Do they reflect all people without the disease?
- Typical sources for control population
  - Hospital based?
  - Population based?
  - Defined subset of population?
- Trade off between convenience and introducing error
- Key to identify potential sources of error

How to select **cases** in case-control studies

- Is the population generalisable to all patients with the disease?
- Is the severity of disease among these patients representative?
- Do cases at different levels of selection have different exposure profiles??

- E.g. epidemiology of hip fracture in Harare

1) Selection bias

- **Ascertainment bias**
- When exposed cases are more (or less) likely to be selected for the study than unexposed cases
- E.g. studies of uterine cancer in the early 1970's
  - They found a strong association with exogenous oestrogens (HRT)
  - Exogenous oestrogens cause uterine bleeding regardless of whether they cause endometrial cancer
  - Uterine bleeding result in women undergoing gynae investigations and may reveal endometrial cancers that would otherwise have gone undetected

1) Selection bias

- **Attrition bias**
- Systematic difference in withdrawals and exclusions between groups
- Loss to follow up can occur if
  - Treatment has been successful
  - Control group unhappy with lack of progress

2) Information bias

Concerns the measurements made

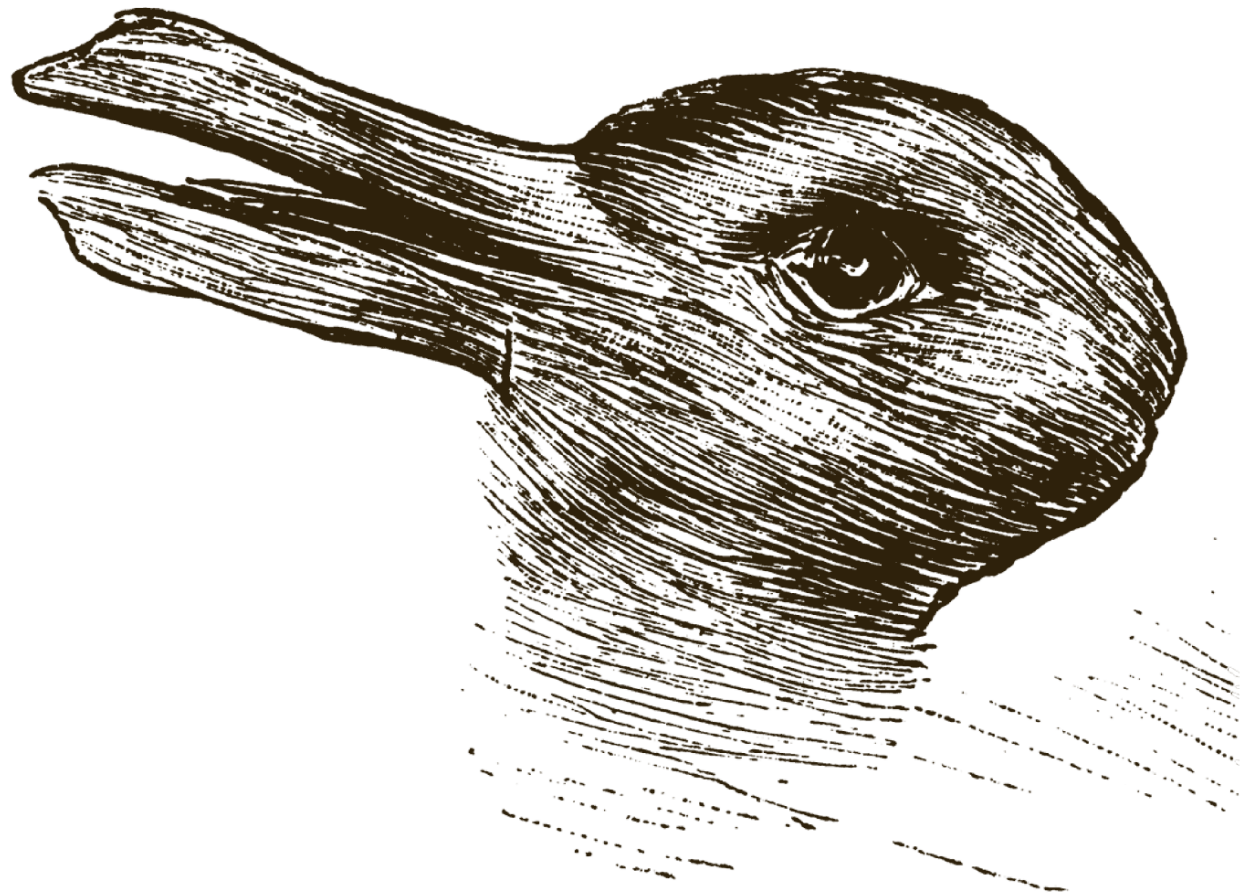
a. Misclassification
b. Recall bias
c. Observer bias
d. Performance bias

2) Information bias

- **Misclassification**
  - Can occur with anything you measure
  - Applies to exposure and/or disease outcome
    - Know the exposed group so look harder for the disease in this population
    - Know who is a case so probe for more information on exposure
  - Non-differential (random)
    - Equal misclassification
    - Bias measure of effect towards null
  - Differential (non-random)
    - Non equal misclassification of exposure/outcome
    - Bias measure of effect either way

Information bias

- **Recall bias**
  - When probability of recall is affected by disease status
  - Main form of bias in case-control
  - “Why did it happen to me?”



Information bias

- **Observer bias**
  - Tendency of humans to see what we expect/want to see
  - Can be conscious or unconscious

DUCK

RABBIT

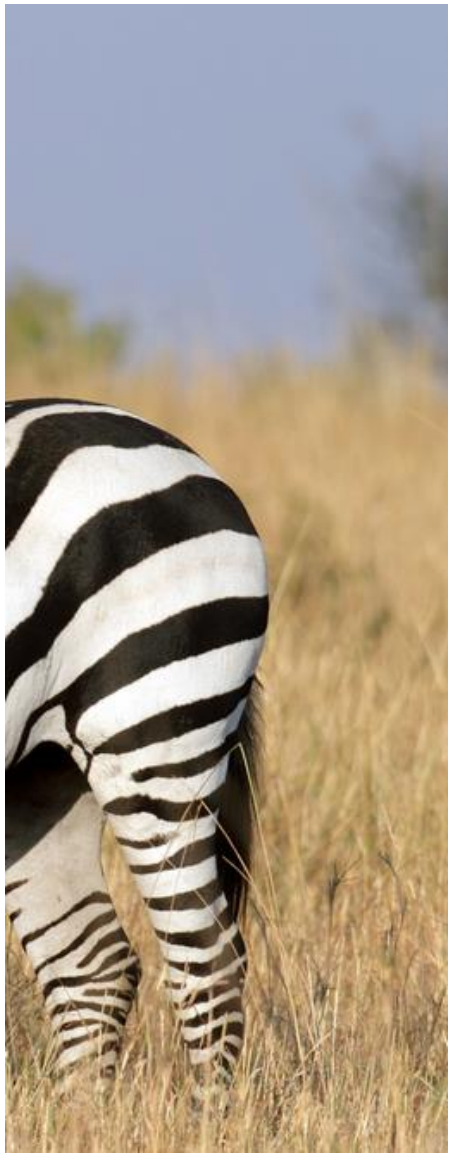
Information bias

- **Performance bias**
  - Occurs when behaviour change varies depending on group allocation
  - Can apply to participants or caregivers

3) Results bias

Concerns reporting & dissemination of results

a. Outcome reporting bias
b. Spin or selective focus
c. Publication bias
d. Citation bias



3) Results bias

- **Outcome reporting bias**
  - Statistically significant outcomes preferred
  - Subsets of data presented
  - Omission of outcomes
  - Data underreported

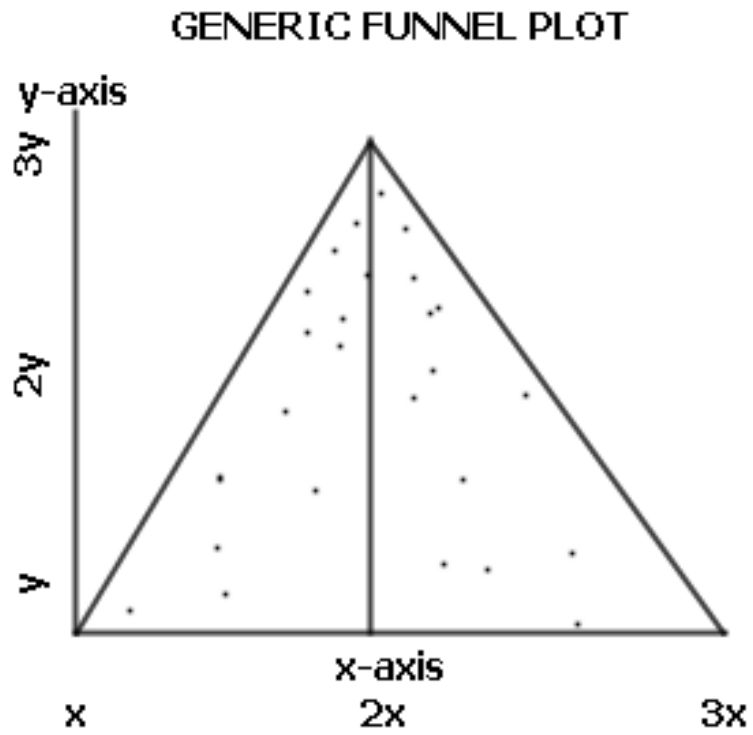
3) Results bias

- **Publication bias**
  - Mistaken emphasis on “significant” results i.e. P value < 0.05
  - Leads to overestimation of a treatment effectiveness
  - Small studies may not detect a beneficial effect

“File drawer effect”

Assessing publication bias

- Funnel plots = scatter plot of treatment effect (x-axis) versus standard error of treatment effect (y-axis)
- Funnel asymmetry points to publication bias
- Egger's test to compute statistically



3) Results bias

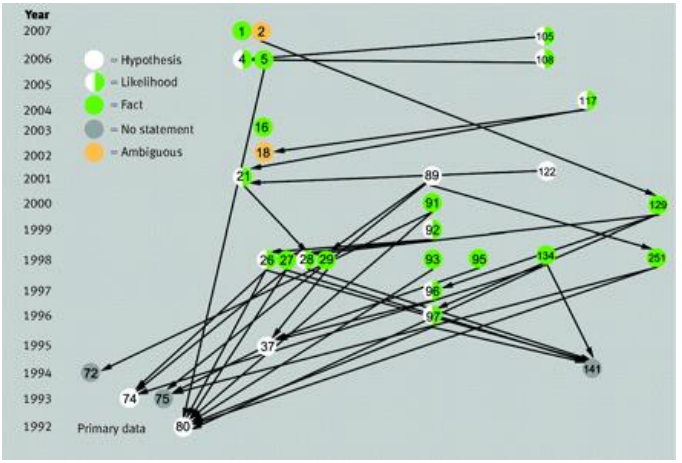
- **Spin or selective focus**
  - More commonly associated with public relations & media
  - Can make research seem more convincing than warranted
  - Examples include
    - Detracting from non-significant results
    - Inappropriate use of causal language
    - Abstract article mismatch

3) Results bias

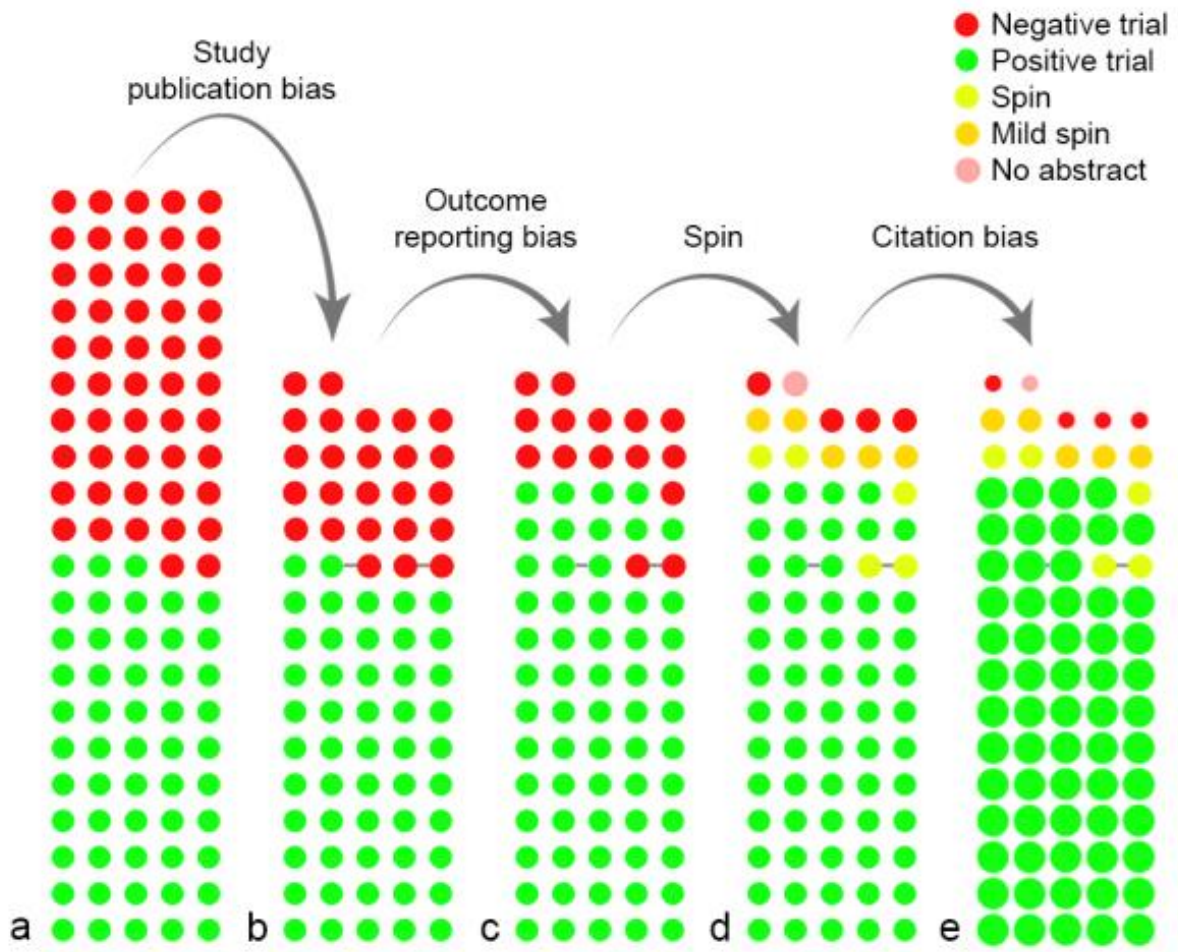
- **Citation bias**

  “The conversion of hypothesis to fact through citation alone”
  - Stephen Greenberg

  - Statistically significant results more often cited
  - Studies with non-significant results less visible

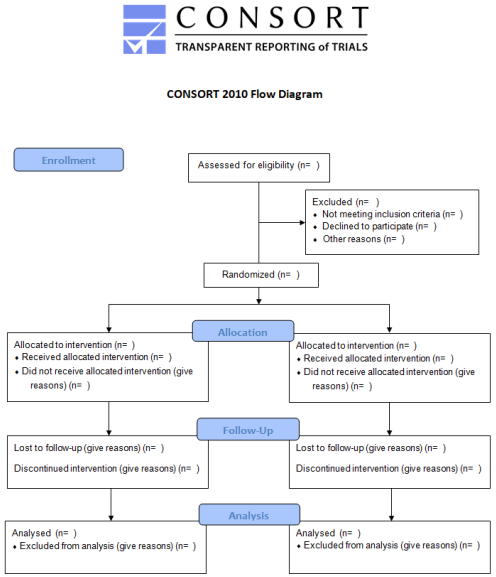


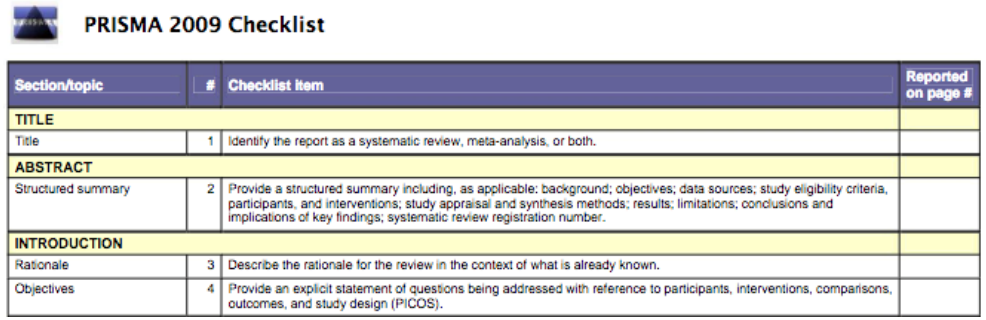
Cumulative effect of biases at the tail end



How can we mitigate bias?

- Crucially - minimise bias in the design
  - REMEMBER: it can <u>not</u> be controlled or adjusted for in the analysis
  - It can be quantified but data rarely available to do this





PRISMA 2009 Checklist

Section/topic	#	Checklist item	Reported on page #
TITLE			
Title	1	Identify the report as a systematic review, meta-analysis, or both.	
ABSTRACT			
Structured summary	2	Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number.	
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known.	
Objectives	4	Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS).	

STROBE Statement

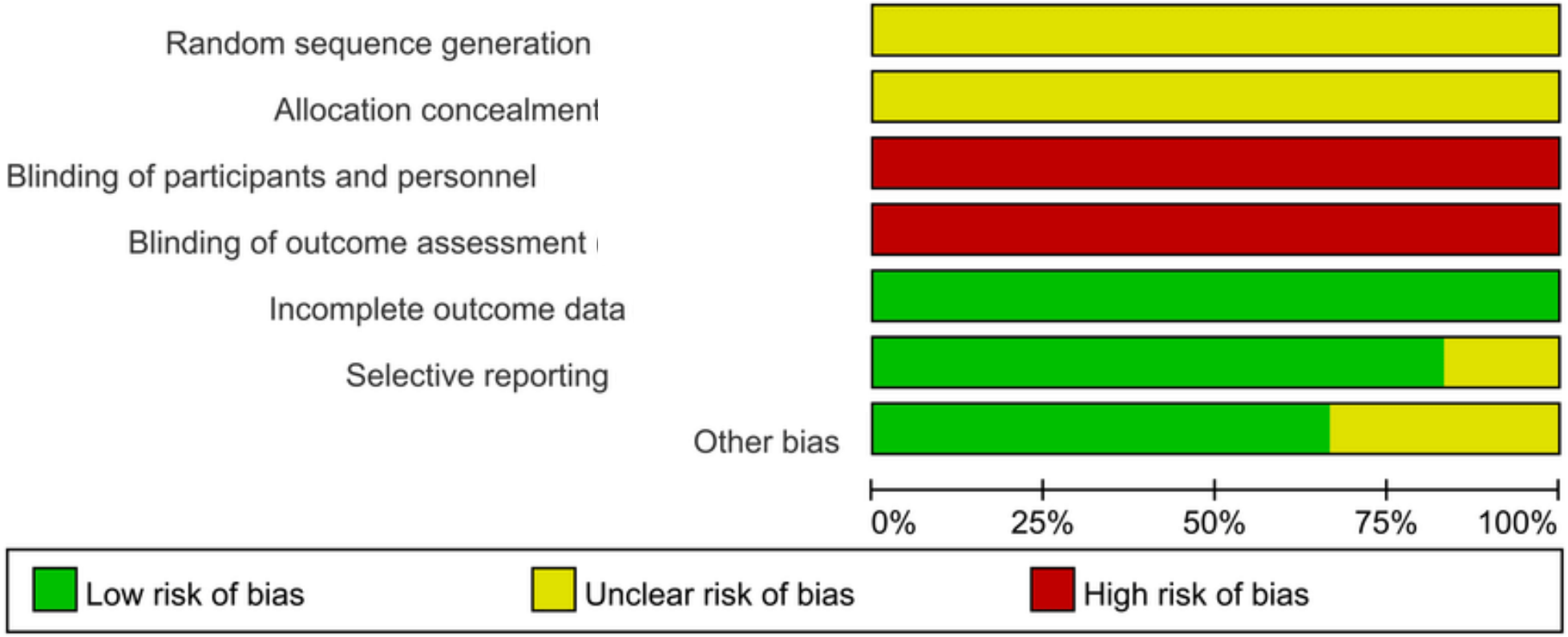
Strengthening the reporting of observational studies in epidemiology

Examples of mitigating bias in study design

• Blinding of outcome assessors	→	• Observer/detection bias
• Open reporting loss to follow up	→	• Attrition bias
• Careful randomisation	→	• Sampling bias
• Blinding of participants	→	• Performance bias
• Pre-specified trial outcomes	→	• Reporting bias
• Careful choice of control group	→	• Sampling bias
• Intention-to-treat analysis	→	• Attrition bias

Assessing bias of trials in a systematic review

- Tools to summarise risk of bias (RevMan)



Assessing bias of trials in a systematic review

• Random sequence generation	→	• Selection bias
• Allocation concealment	→	• Selection bias
• Blinding participants/personnel	→	• Performance bias
• Blinding outcome assessment	→	• Observer/detection bias
• Incomplete outcome data	→	• Attrition bias
• Selective reporting	→	• Reporting bias

Any questions?

Summary

- Research is full of bias
- Bias results in a trend or deviation away from the truth
- Understanding bias and how to detect it allows you to validate and determine quality of scientific research
- Think of bias in three zebra parts
  1) Selection bias
  2) Information bias
  3) Results bias

Thank you for listening!