

Bias and Confounding – High-Yield Summary

What is Bias?

- Bias is a systematic error that causes study results to differ from the true situation.
- Can occur at any stage of research:

design → data collection → analysis → publication.

- Leads to:
- Overestimation or underestimation of the true effect
- Fake associations

Main Types of Bias

A. Selection Bias

- Occurs when study participants do not represent the target population.
- Common in retrospective studies.

Types:

- Ascertainment bias: Non-random sample selection.
- Attrition bias: Loss to follow-up differs between groups.
- Response bias: Volunteers differ from non-participants.
- Survivorship bias: Only survivors are included → distorted results.

📌 Example: Drug appears to improve survival because only patients who survived long enough received it.

B. Information Bias

- Systematic errors in measuring exposure or outcome.

Types:

- Central tendency bias: Choosing middle option on Likert scales.
- Measurement bias: Faulty instruments (e.g., miscalibrated BP cuff).
- Misclassification bias: Incorrect classification of exposure or disease.
- Observer bias: Assessor systematically over/under-reports.
- Reporting bias: Participants under-report socially undesirable behaviors.

C. Funding Bias

- Study design, analysis, or reporting is influenced by the sponsor's interests.
- Negative results may be suppressed or interpreted favorably.

D. Publication Bias

- Studies with positive results are published more often and faster.
- Causes:
 - Journal preference for positive findings
 - File-drawer effect
 - Sponsor pressure
 - Reviewers undervaluing null results

➡ Leads to overestimation of treatment effects.

E. Confounding

What is Confounding?

- A false or distorted association between exposure and outcome due to a third variable.

Confounder characteristics:

- Associated with exposure
- Associated with outcome
- Not on the causal pathway

📌 Example:

Smoking → CHD

Alcohol consumption = confounder

Controlling Bias & Confounding

1. During Study Design

- Randomization
- Restriction
- Matching
- Blinding
- Standardization of procedures

2. During Data Collection

- Use validated tools
- Training & calibration of examiners
- Reduce recall bias (objective data)
- Blinded data collection

3. During Data Analysis

- Stratification
- Multivariable regression (logistic / linear)

Causal Pathway vs Confounding

- Causal pathway: Sequence of events leading to outcome.
- Mediator:
 - Lies on the causal pathway
 - Explains how exposure causes outcome
 - ❌ Should NOT be adjusted for
- Confounder:
 - Outside causal pathway
 - ✅ Should be adjusted for

📌 Example:

Multiple births → Preterm delivery (mediator) → Cerebral palsy

Golden Exam Rules ✨

- Bias = systematic error
- Confounding = mixing of effects
- Adjust for confounders
- Do NOT adjust for mediators
- Publication bias → overestimated effects

