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Reviewing Statistical Data

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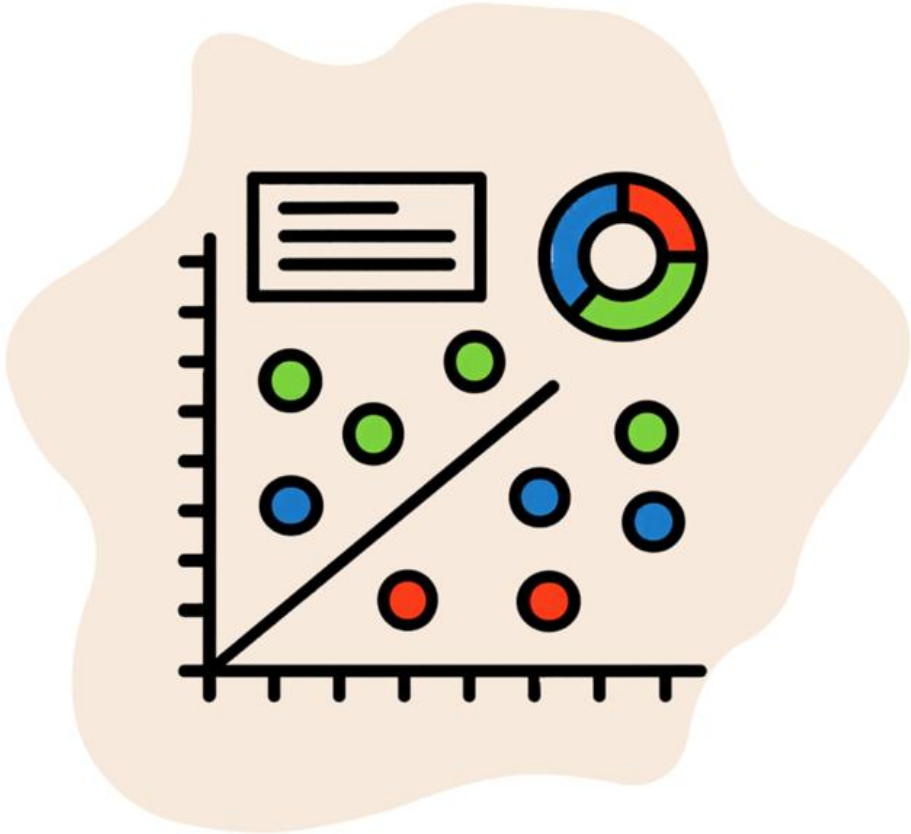


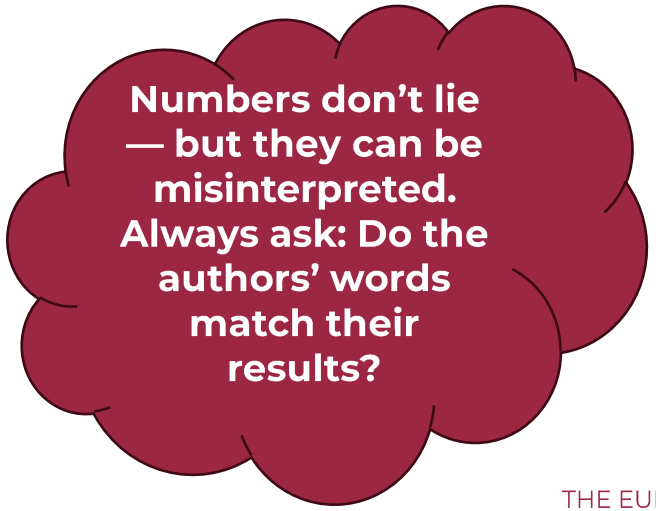
How to Review Statistical Data

- Statistical analysis is a critical component of a scientific paper. This module provides a structured approach to assess the **validity, clarity, and interpretation** of statistical data

- This will not make you a statistician — it will teach you **what signals to look for**.

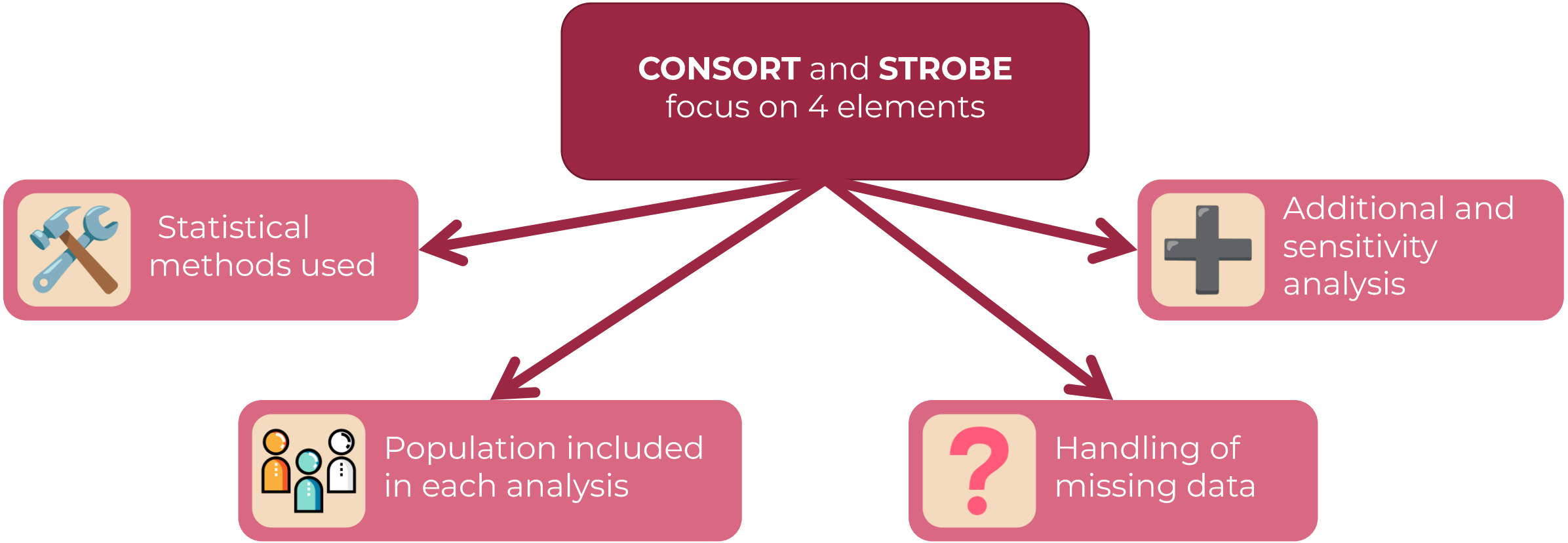
- **The overarching goal:** How to check if statistical results are ***reliable***, ***clearly presented***, *and* ***meaningful*** *for clinical decisions.*

- ***The three section to focus on:***
  - ***Section 1:*** *Statistical analysis in methods*
  - ***Section 2:*** *Results*
  - ***Section 3:*** *Discussion*



Section 1: Statistical analysis in methods

- **The Statistical Analysis** section could be intimidating for a medical reviewer, but it will become clearer with experience. If there is any doubt, always check the guidelines.



Section 1: Statistical analysis in methods

Statistical methods used = **2 Questions**

Is it well described?

- Clear enough to understand
- Description of the statistical methods used to:
  - Describe the population
  - Analyse the primary outcome
  - Analyse secondary outcomes
- If « Unusual » statistical methods (different from χ^2 or linear regression for example):
  - A brief explanation, justification, and appropriate reference should be provided.
- The statistical software (including version) should be reported.
- The significance level (alpha) should be predefined.

Is it appropriate?

- To the data type and objective (even if mistakes are rare):
  - Categorical (χ^2, logistic regression…)
  - Continuous (t-test, linear regression…)
  - Survival (log-rank, Cox regression…)
- To the data (how model assumptions were verified?):
  - Independence of observations
  - Normal distribution
- To the study design and its implication:
  - Adjustment for confounders with statistical methods (multivariable models…)
  - Are multiple testing and alpha inflation addressed? (e.g. Bonferroni, Hochberg)

Section 1: Statistical analysis in methods

Population included for each analysis

Observational study:

- How was the matching of controls in case-control study addressed?
- How was each exposition in exposed/unexposed study defined?

Cohort study:

- How was loss of follow-up addressed?

The definition of the study population depends on the **study design**

Clinical Trial:

- Per protocol or intention-to-treat?
- Check randomization process

Cross-sectional

- Analytical methods to take account of sampling strategy?

Check sample size and study power calculation:

- Effect expected clinically relevant?
- Effect size and baseline referenced from previous studies?
- Adapted to the statistical methods chosen?

Section 1: Statistical analysis in methods

Handling missing data

The minimum requirement is to **report missing data**.

How missing data were handled:

- Complete case analysis only?
- Single or multiple imputation?
- Which variables were included in the imputation model?

Why it matters: Missing data can introduce **bias** and affect the validity of results.

Additional and sensitivity analysis

- Different population:
  - Requires new definition of group
- Secondary outcome
  - Requires a new statistical methods description

⇒ Can you distinguish prespecified from post-hoc analyses?

Only exploratory/ hypothesis generating, careful with *p*-Hacking*

* *p*-Hacking: Running multiple analyses until something becomes significant

Section 2: Results

- Before interpreting results, focus on the **study population**:
  - Who was **included**? Who was **excluded** — and **why**? How many participants are analysed in each group?
- A **flowchart** is strongly recommended.

- Carefully review the **baseline characteristics table**:

  ⇒ Compare groups with each other and with the overall population

  ⇒ Identify key variables: outcome, exposure, and potential confounders

  In clinical trials: **p-values** are **not** appropriate for comparing baseline characteristics.

  ⇒ In cohort studies, always check the **follow-up duration**.

Description of Results = Coherent with Methods section

Hierarchy of analysis

1: Main result = Primary outcome
2: Exploratory results= Secondary outcome and/or sensitivity analysis

Transparency

- No new statistical methods not described in methods section should appear in the Results
- Check for missing data and if number of participants is consistent across analyses
- Post-hoc and or subgroup analyses easily traceable

Tip 1. Estimation correctly described:

- No p-value alone => Effect size and confidence interval

Tip 2. Confounding adjustment:

- Are both unadjusted and adjusted estimates reported? → Which confounders were included?
- Are confounders and potential mediators clearly distinguished? (e.g. using causal diagrams such as Directed Acyclic Graph - DAGs)
- Is the full multivariable model adequately presented?

Tip 3. Survival outcome:

- Present number of participants at each time point
- Present survival curves with number at risk at each time point

Section 3: Discussion

From numbers to meaning: are the conclusions valid?

	Key Question	Reviewer Focus	How to Check
Validity	Are conclusions consistent with results?	Effect size vs p-value, internal/external validity	• Compare reported *effect sizes* with *confidence intervals*. If CI crosses 1 (for OR/HR) or 0 (for mean difference), not significant. • No new results presented are presented in the discussion • Verify that the sample size supports the conclusions. → Small sample + strong claim = overinterpretation. • Make sure authors didn't change their primary outcome after analysis. • Make sure authors didn't spin in their conclusions regarding their results
Interpretation	Are authors overstating findings or causality?	Distinguish statistical from clinical significance	• Correlation is different from causality. Causality must be supported by robust methodological and contextual evidence — not statistical significance alone. • Check whether limitations are acknowledged (small sample, retrospective). • If the study is observational, ensure wording reflects that • Verify that non-significant findings are not presented as "the absence of effect." • Authors mitigate their conclusions on exploratory analysis

Take Home Messages and Resources

✔ Reviewer's Checklist

- ❑ **Understand the design before the data.** Wrong design = wrong statistics from the start.
- ❑ **Ask: "Is the method appropriate for the data?"** Match test ↔ variable type ↔ study aim.
- ❑ **Focus on the size and precision of the effect, not only p-values.** Confidence intervals and clinical meaning matter more than "significance."
- ❑ **Check if authors respected transparency.** Are missing data, adjustments, and post-hoc analyses clearly described?
- ❑ **Judge conclusions, not enthusiasm.** If claims exceed the data, suggest moderation in wording.

Good reviewers focus not on what was significant, but on what was done correctly.

Useful Resources

- ❑ EQUATOR Network
  https://www.equator-network.org
- ❑ CONSORT Statement – for clinical trials
  https://www.consort-statement.org
- ❑ STROBE – for observational studies
  https://www.strobe-statement.org
- ❑ JEADV Reviewer Guidelines
  https://onlinelibrary.wiley.com/journal/14683083

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