Meta-Analysis

Meta-Analysis

Traditional review articles assemble a sample of previous studies and, hopefully, by thinking deeply and broadly about them propose a new hypothesis or relationships that were not noticed before (presumably because combining studies increases number of data points and increases power)

A first rate review does more than summarize previous papers on the subject; there is commentary on the current state of thought and knowledge in a field

Traditional review articles assemble a sample of previous studies and, hopefully, by thinking deeply and broadly about them propose a new hypothesis or relationships that were not noticed before (presumably because combining studies increases number of data points and increases power)

However review articles are not quantitative and can suffer from subjective bias. Since they are not quantitative, they can't answer questions about effect size!

nullius in verba

Sometimes, review articles can simply invoke **Vote counting:** count number of published studies that reject the null hypothesis of zero effect and compare that to the number of published studies that FTR the null hypothesis

Vote counting: count number of published studies that reject the null hypothesis of zero effect and compare that to the number of published studies that FTR the null hypothesis

Limitations: magnitude of effect is downplayed and sample size differences (and therefore power differences) are not accounted for in this method.

Example in textbook: 19 of 142 studies on the effects of taking aspirin on myocardial infarction (meta-analysis by the **Antiplatelets Trialists' Collaboration**) reduced risk. However, as you can see on page 684, when meta-analysis quantitative techniques are applied to the same 142 studies, the control group had higher percentage of subsequent vascular events

Meta-analysis: ***statistical synthesis of results from a series of studies***

- Because it is quantitative, it gives us tools to be 'fair'
  - Unbiased results (and recognize others' biased results)
  - Coverage (high profile publications) can be related to sensationalism of the conclusion/effect rather than the real average effect

- Allows us to quantify effect
  - Calculate/estimate the average effect
  - Determine how variable the effect is between systems
  - Allows us to increase power by increasing sample size

Meta-analysis procedure:

1. Define question:
   - how broad (across multiple species? Just humans?)
   - How narrow (only double blind clinical trials?)
2. Review literature:
   - Exhaustive review of literature
   - Easily found studies can be different from those that are not easy to find since they are published in 'higher quality' magazines and cited more frequently by other studies, inflating their value.
   - Include poorly designed experiments? Exclude? Adopt criteria for weighting these studies?
3. Compute effect size
   - Calculate an **effect size** that can be carried across studies
   - **Effect size** measures how strong association is between two variables
   - OR, r, SMD
   - Effects of study quality

File-Drawer problem:

- Publication bias: the difference in mean effect size between published and all studies on the topic
- **File drawer problem** is the possible bias in estimates and tests caused by publication bias
- since meta analysis increases power (reduces type II error) but can also accidentally inflate type I error if data is biased, we need to determine how much bias is present
  - Easiest way to do that: **fail-safe number** = the number of (missing) studies needed to change the overall result of the meta-analysis (usually assume that all missing studies FTR H_0 of no effect)
    - If fail-safe number is **small** (approx same number of studies as those included) → results of meta-analysis not reliable
    - If fail-safe number is **large** (million) more confident in results of meta-analysis