Meta-Analyses 101

Educational Briefing

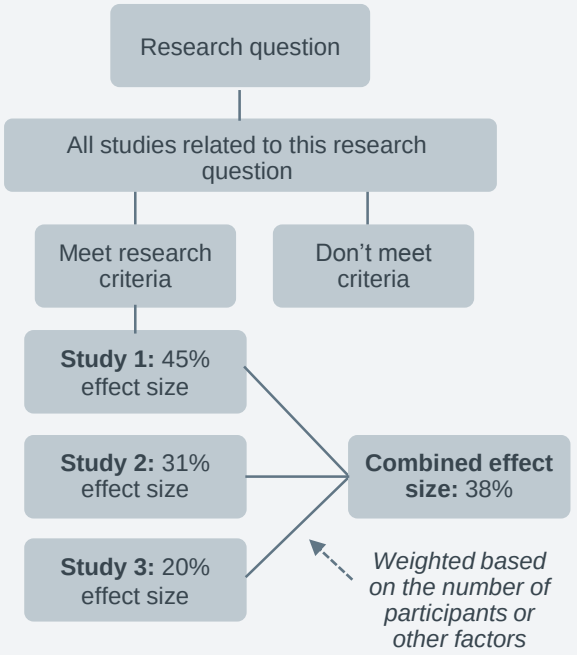
What is a meta-analysis?

- A meta-analysis is a statistical analysis that combines the data of multiple studies into a single estimate of effect size.
- The basic idea behind a meta-analysis is that aggregating the results from many individual studies leads to a more robust finding than a single study alone. Pooling these results can decrease the individual measurement error of each study and lead to a closer estimate of the truth.
- Meta-analyses are often, but not always, included as part of a **systematic review** and, like systematic reviews, allow researchers to do important overviews on a given topic area wherein they can contrast results from different studies, identify patterns, reasons for discrepancies, and other interesting relationships between results.

What steps are required to complete a meta-analysis?

1. Researchers first decide which types of studies will be included. This pre-determined research criteria may be based on the quality of the studies, the types of trials, how many/ what type of patients included, types of outcomes and the length of follow-up.
2. They then determine a strategy for finding the relevant studies (what databases will they search? Will they include unpublished studies?)
3. Next, they search for and select the studies that meet their eligibility criteria. They collect the data from these studies in a standardized way (and may complete an extra step of assessing the quality of the study on a standard scale).
4. In the most crucial step, researchers standardize the data from each study into a comparable metric. For example, this could be the difference between the intervention group and control group on a particular metric, or a standard odds ratio or relative risk measurement.
5. Finally, researchers aggregate all of these individual data measures. Usually, this is done by weighting each study result based on the its sample size, although they can also weight them based on the quality of the trial or other factors.

Basic meta-analysis process



What is an example of a meta-analysis?

- Researchers want to discover if people who wear sunscreen are less likely to develop melanoma (a type of skin cancer). To find relevant studies, they search PubMed and MEDLINE for the terms "melanoma," "skin cancer," "sunscreen," and "zinc oxide." They find 22 studies that meet their search criteria (includes a control group, at least 3 years of follow-up, more than 50 subjects) which include a total of 950 study subjects.
- All studies find that wearing sunscreen reduces the risk of melanoma. They look at the data for each study and find the reduction in relative risk for each one, then weight them based on the number of subjects (ex. the results from a study with 200 subjects is weighted twice as much as one with 100 subjects).
- Overall, they find that wearing sunscreen reduces the risk of melanoma by 48%.

How are meta-analyses different than other study types?

- Meta-analyses are often included as part of a **systematic review**. They are typically considered strong evidence, especially when performed with a large number of **randomized control trials**.
- However, they can be limited by a number of pitfalls. First, it can be hard to find similar populations in different studies, which can lead to a bias towards a particular group of participants. Second, trials are about three times more likely to be published when they are statistically significant, which means that meta-analyses that only include published studies can experience a "publication bias" where strong effects are more likely to be included than studies that did not find strong effects. Including published and non-published studies can make meta-analyses stronger.

September 2018

Source: National Institutes of Health, Publication bias in the social sciences: Unlocking the file drawer", *Science,* 2014 Advisory Board insight and analysis.