Meta-Analysis

* [**Meta-  
  Analysis**](https://himmelfarb.gwu.edu/tutorials/studydesign101/metaanalyses.cfm)
* [**Systematic  
  Review**](https://himmelfarb.gwu.edu/tutorials/studydesign101/systematicreviews.cfm)
* [**Practice  
  Guideline**](https://himmelfarb.gwu.edu/tutorials/studydesign101/practiceguidelines.cfm)
* [**Randomized  
  Controlled Trial**](https://himmelfarb.gwu.edu/tutorials/studydesign101/rcts.cfm)
* [**Cohort Study**](https://himmelfarb.gwu.edu/tutorials/studydesign101/cohorts.cfm)
* [**Case Control Study**](https://himmelfarb.gwu.edu/tutorials/studydesign101/casecontrols.cfm)
* [**Case Reports**](https://himmelfarb.gwu.edu/tutorials/studydesign101/casereports.cfm)

Definition

A subset of systematic reviews; a method for systematically combining pertinent qualitative and quantitative study data from several selected studies to develop a single conclusion that has greater statistical power. This conclusion is statistically stronger than the analysis of any single study, due to increased numbers of subjects, greater diversity among subjects, or accumulated effects and results.

Meta-analysis would be used for the following purposes:

* To establish statistical significance with studies that have conflicting results
* To develop a more correct estimate of effect magnitude
* To provide a more complex analysis of harms, safety data, and benefits
* To examine subgroups with individual numbers that are not statistically significant

If the individual studies utilized randomized controlled trials (RCT), combining several selected RCT results would be the highest-level of evidence on the evidence hierarchy, followed by systematic reviews, which analyze all available studies on a topic.

Advantages

* Greater statistical power
* Confirmatory data analysis
* Greater ability to extrapolate to general population affected
* Considered an evidence-based resource

Disadvantages

* Difficult and time consuming to identify appropriate studies
* Not all studies provide adequate data for inclusion and analysis
* Requires advanced statistical techniques
* Heterogeneity of study populations

Design pitfalls to look out for

The studies pooled for review should be similar in type (i.e. all randomized controlled trials).

*Are the studies being reviewed all the same type of study or are they a mixture of different types?*

The analysis should include published and unpublished results to avoid publication bias.

*Does the meta-analysis include any appropriate relevant studies that may have had negative outcomes?*

Fictitious Example

Do individuals who wear sunscreen have fewer cases of melanoma than those who do not wear sunscreen? A MEDLINE search was conducted using the terms melanoma, sunscreening agents, and zinc oxide, resulting in 8 randomized controlled studies, each with between 100 and 120 subjects. All of the studies showed a positive effect between wearing sunscreen and reducing the likelihood of melanoma. The subjects from all eight studies (total: 860 subjects) were pooled and statistically analyzed to determine the effect of the relationship between wearing sunscreen and melanoma. This meta-analysis showed a 50% reduction in melanoma diagnosis among sunscreen-wearers.

Real-life Examples

Goyal, A., Elminawy, M., Kerezoudis, P., Lu, V., Yolcu, Y., Alvi, M., & Bydon, M. (2019). [**Impact of obesity on outcomes following lumbar spine surgery: A systematic review and meta-analysis.**](https://pmid.us/30583093) *Clinical Neurology and Neurosurgery, 177*, 27-36. https://doi.org/10.1016/j.clineuro.2018.12.012

This meta-analysis was interested in determining whether obesity affects the outcome of spinal surgery. Some previous studies have shown higher perioperative morbidity in patients with obesity while other studies have not shown this effect. This study looked at surgical outcomes including "blood loss, operative time, length of stay, complication and reoperation rates and functional outcomes" between patients with and without obesity. A meta-analysis of 32 studies (23,415 patients) was conducted. There were no significant differences for patients undergoing minimally invasive surgery, but patients with obesity who had open surgery had experienced higher blood loss and longer operative times (not clinically meaningful) as well as higher complication and reoperation rates. Further research is needed to explore this issue in patients with morbid obesity.

Nakamura, A., van Der Waerden, J., Melchior, M., Bolze, C., El-Khoury, F., & Pryor, L. (2019). [**Physical activity during pregnancy and postpartum depression: Systematic review and meta-analysis.**](https://pmid.us/30576955) *Journal of Affective Disorders, 246*, 29-41. https://doi.org/10.1016/j.jad.2018.12.009

This meta-analysis explored whether physical activity during pregnancy prevents postpartum depression. Seventeen studies were included (93,676 women) and analysis showed a "significant reduction in postpartum depression scores in women who were physically active during their pregnancies when compared with inactive women." Possible limitations or moderators of this effect include intensity and frequency of physical activity, type of physical activity, and timepoint in pregnancy (e.g. trimester).