**A Short Primer on Power Calculations for Meta-analysis**

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**Slide 0: A Short Primer on Power Calculations for Meta-analysis**

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**Slide 1: Meta-analysis & Systematic Review**

* A common dilemma for researchers conducting a systematic review is when to include a meta-analysis
* Researchers often cite low power for meta-analytic tests as a reason for only providing a narrative summary of studies

**Slide 2: In this presentation, I will**

* Present a conceptual overview of power analysis in meta-analysis
* Provide a rationale for the importance of power analysis in meta-analysis
* Recommend how researchers should present and interpret findings when statistical power is low

**Slide 3: Power in meta-analysis**

* All statistical power analyses require a set of assumptions prior to collecting the data, or in the case of a systematic review, prior to conducting the search and eligibility screening
* To compute power, researchers need to have guesses about characteristics of a “typical” study and the number of studies that may be eligible
* Researchers could code a sample of eligible studies to inform these guesses, conduct a scoping review or evidence gap analysis, or have a deep understanding of the area for review

**Slide 4: For significance tests of the mean effect size**

* Information needed at the level of the research synthesis
  + Type I error rate for the test, i.e., α = .05 for one-tailed test
  + Effect size of practical significance
  + Number of studies eligible for the meta-analysis
  + For random effects models, the estimate of the variance component (between-studies variance)
* Information needed from the eligible studies
  + Typical within-study sample size

**Slide 5: For power of other meta-analytic tests**

* Test of homogeneity
  + At the level of the synthesis, the expected heterogeneity, i.e., amount of variance among effect sizes
* Test of categorical moderator
  + The number of studies within each group
  + The magnitude of the difference in the categorical group means
  + For random effects, the variance component (between-studies variance)
* Tests for meta-regression
  + Full covariance matrix for predictors (thus difficult to conduct)

**Slide 6: General observations about power in meta-analysis**

* Larger numbers of eligible studies -> Higher power
* Larger sample size within studies -> Higher power
* Larger effect size of interest -> Higher power
* Random effects meta-analysis generally has lower power than fixed effects meta-analysis
* Tests of moderators either using categorical models or meta-regression can have low statistical power
* Methods for computing power for meta-regression require information we do not have prior to conducting the review

**Slide 7: Prospective power analyses can help researchers understand the body of evidence**

* If we expect a lot of heterogeneity among studies because the review question is broad or the intervention is difficult to implement, then we will need a lot of studies to detect a clinically important effect size.
* Power analysis can provide information about the number of studies needed given assumptions about the body of evidence in a review

**Slide 8: Prospective power analysis can provide context if statistical tests are not significant**

* Tests of moderators are generally of low power if there are a small number of eligible studies.
* Finding that a moderator is not significantly related to effect size variation does not mean that there is no relationship, particularly in systematic reviews with few studies.
* Power analysis can help us know if we have sufficient power to detect these associations.
* With low power, we should **not** conclude that there is no relationship between the moderator and variation among effect sizes

**Slide 9: Recommendations for reporting meta-analytic results with low power**

* Report the mean effect size and its confidence interval even if you suspect low power
  + Confidence intervals provide information about the minimum and maximum likely size of the effect, the worst and best case scenarios for the effectiveness of an intervention
* Remember that the lack of statistical significance of a meta-analytic test does not mean that the effect size is zero or that the moderators are not related to effect size variation – you may need more studies to conduct this test more reliably

**Slide 10: Resources for power analysis in meta-analysis**

* How to conduct power analysis in meta-analysis:
  + Valentine, J. C., Pigott, T. D. & Rothstein, H. R. (2010). How many studies do you need? A primer on statistical power for meta-analysis. *Journal of Educational and Behavioral Statistics, 35(2),* 215-247.
  + Chapters 4 -6 in Pigott, T. D. (2012). *Advances in meta-analysis.* New York, NY: Springer
* Statistical background of power in meta-analysis
  + Hedges, L. V. & Pigott, T. D. (2001). The power of statistical tests in meta-analysis. *Psychological Methods, 6,* 203-17
  + Hedges, L. V. & Pigott, T. D. (2004). The power of statistical tests for moderators in meta-analysis. *Psychological Methods, 9,* 426-445.
  + Jackson, D. & Turner, R. (2017). Power analysis for random-effects meta-analysis. *Research Synthesis Methods, 8,* 290-302.

**Slide 11: Contact me for any questions**

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**Slide 12: Thank you!**

* We invite you to:
  + Provide your input on today’s webcast
  + Share your thoughts on future webcasts topics
* Please contact us: ktdrr@air.org
* Please complete brief evalutation form: http://www.surveygizmo.com/s3/3831773/campbellmethods

**Slide 13: Disclaimer**

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