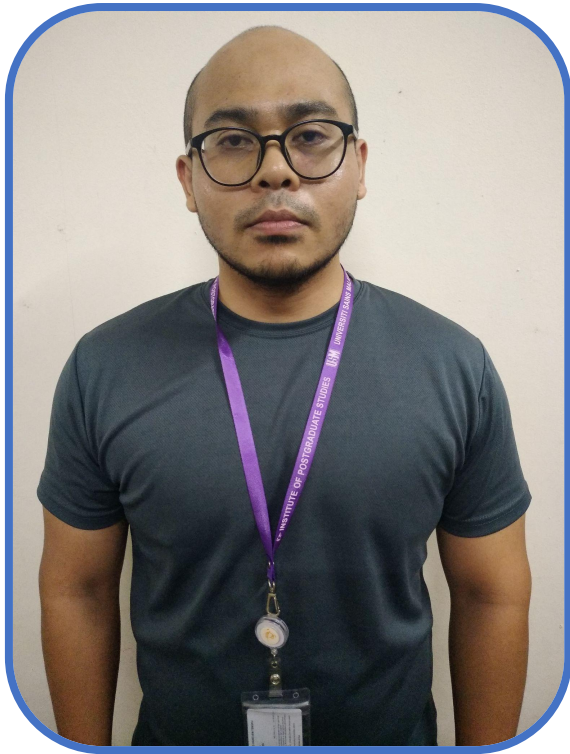


An introduction to meta-analysis in R



Tengku Muhammad Hanis Mokhtar
PhD student,
Department of Community Medicine,
USM

About me



Background:

- PhD student in Department of Community Medicine, USM
- MSc (Medical Statistics) from USM, 2019
- MBBCh from Al-Azhar University, 2015

Interest:

- Medical statistics, survival analysis, poisson regression, meta-analysis
- Machine learning application in medical sciences
- Text analysis, bibliometrics, scientometrics

Contact me:

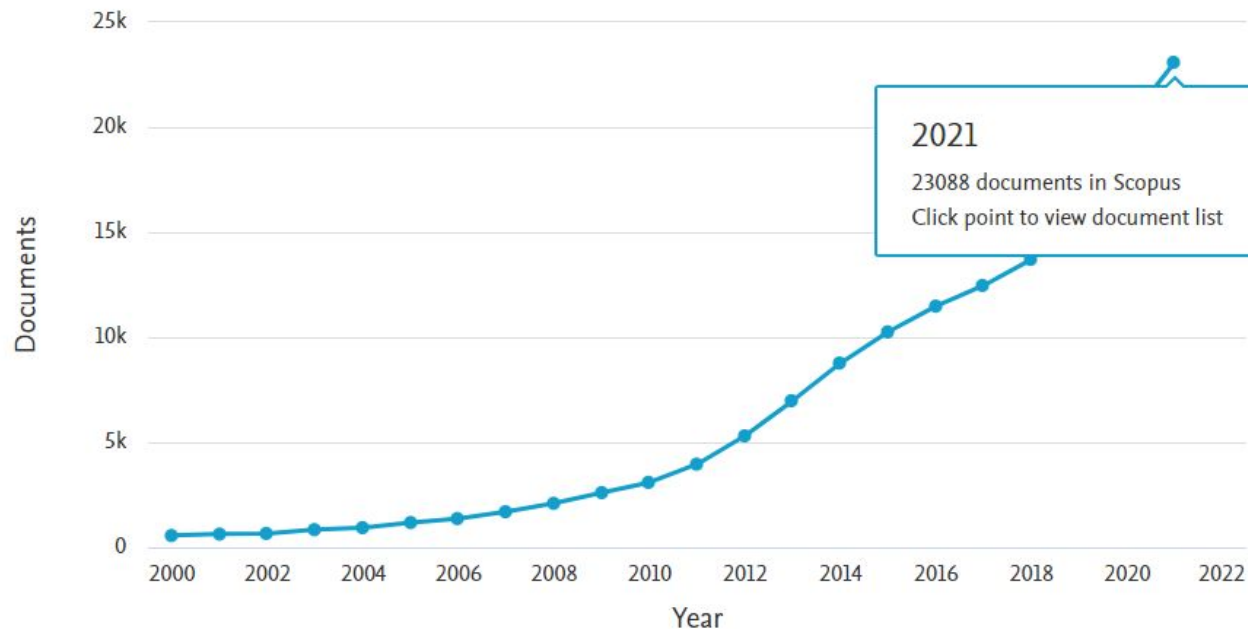
- tengkuhanismokhtar@gmail.com
- <https://tengkuhanis.netlify.app/>

Download material: <https://tny.im/eOXVV>

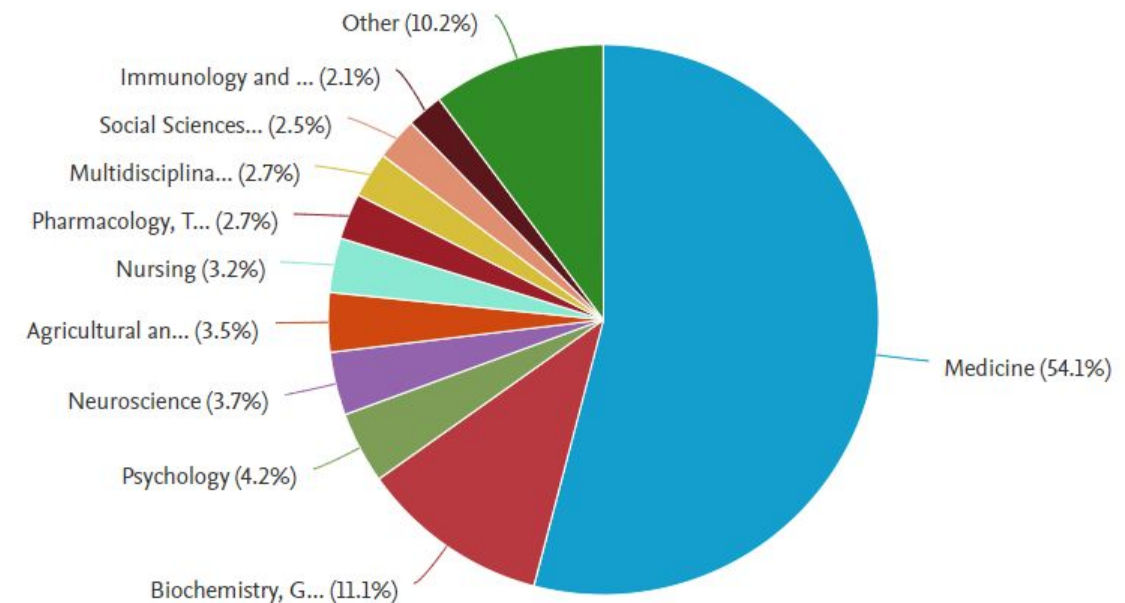
Background

- Meta-analysis:
 - Statistical methods used to combine individual results into pooled result
- From Scopus database (01-11-2021): 152, 352 documents

Documents by year



Documents by subject area



Jargons

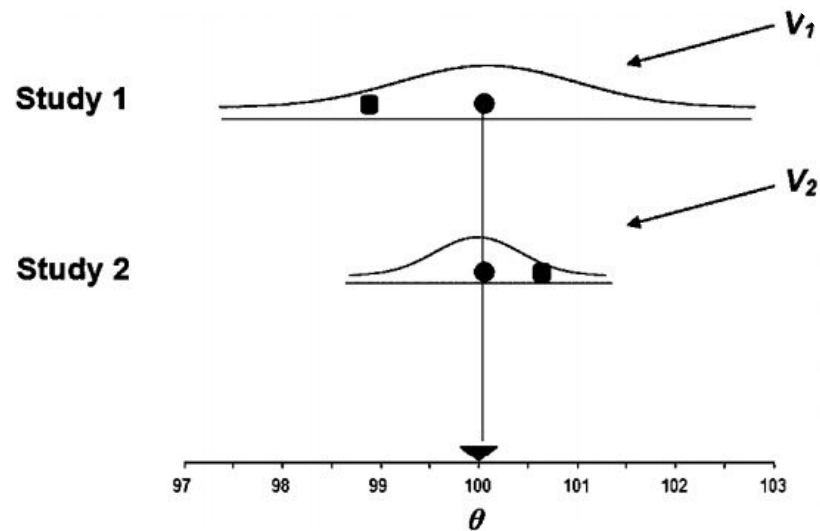
- Fixed vs random effect model
- Heterogeneity
- Publication bias
- Forest plot
- Funnel plot



Jargons (cont.)

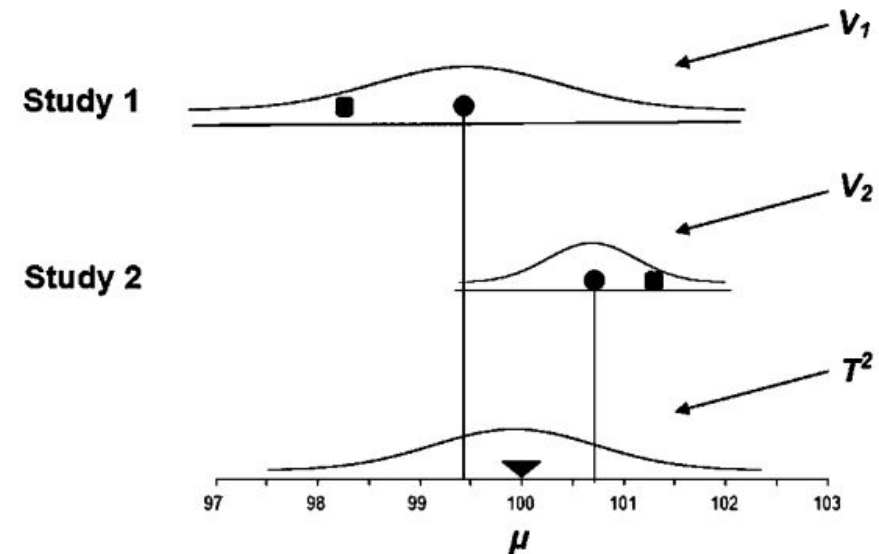
Fixed effect model:

- One true effect size
- Estimate one true effect size



Random/common effect model:

- True effects varies (ie; distribution of true effect sizes)
- Estimates mean of the distribution of true effects



(Borenstein et al., 2010)

Jargons (cont.)

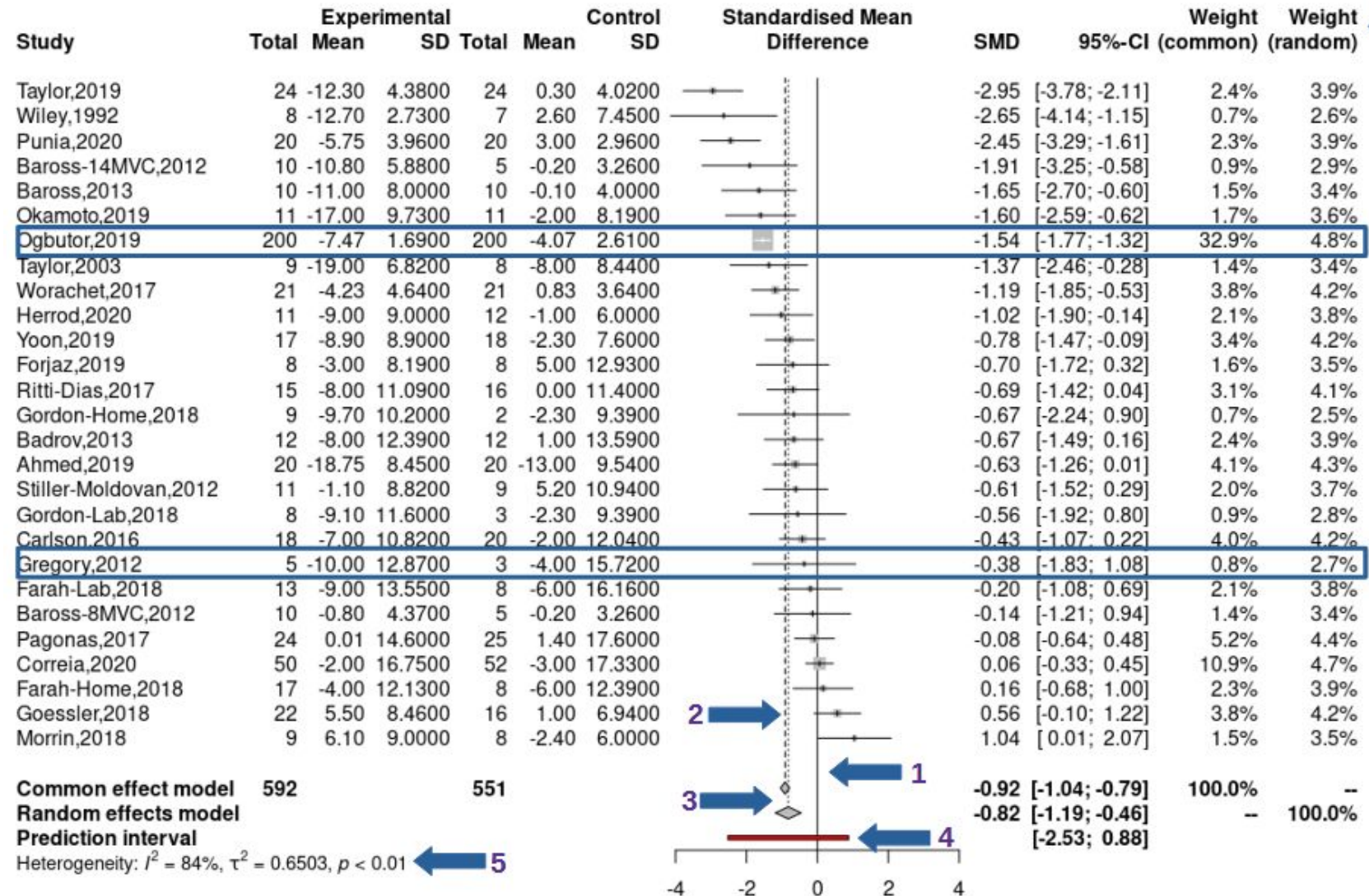
- Heterogeneity (almost always refer to between study heterogeneity):
 - Variation in study outcomes between studies (statistical heterogeneity)
 - Measurement: Q -statistics, T^2 , I^2 , H^2
 - Other types of heterogeneity refer to Rucker et al., 2008
- Publication bias:
 - Studies being published depends on the its result
 - Consequences:
 - Overestimate the effect size
 - Overlook negative effect size

Jargons (cont.)

- Certain publication bias caused by small study effect and p-hacking can be statistically adjusted (most causes usually unknown)
- Publication bias tested using:
 - Visual: Funnel plot
 - Statistical (min $k=10$):
 - ✓ Classical: Begg, Egger (default), Thompson
 - ✓ Binary outcome: Peters, Harbord (default for OR), Schwarzer, Deeks, etc
 - ✓ SMD (for Hedges' g): Pustejovsky

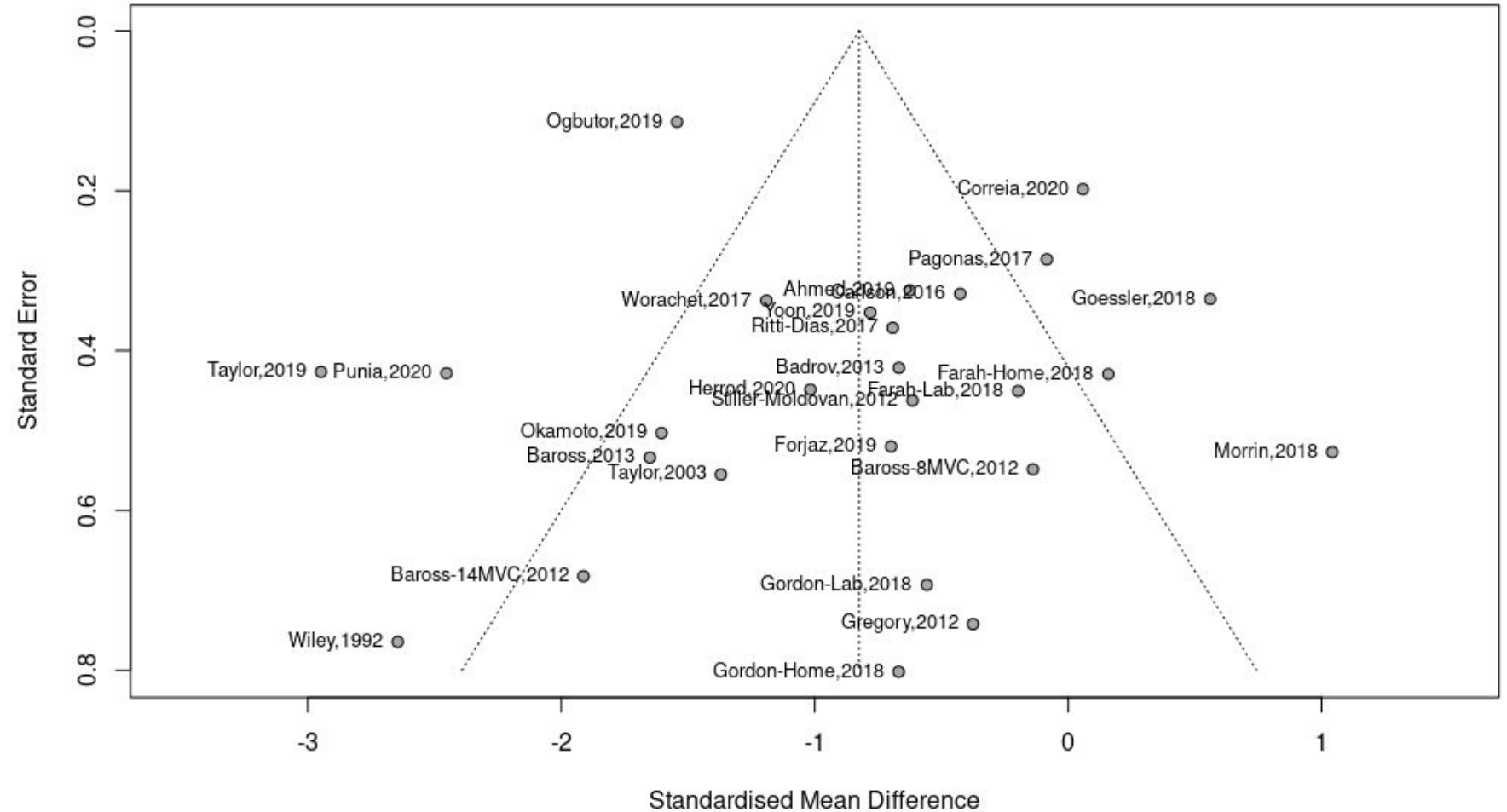
Jargons (cont.)

- Forest plot

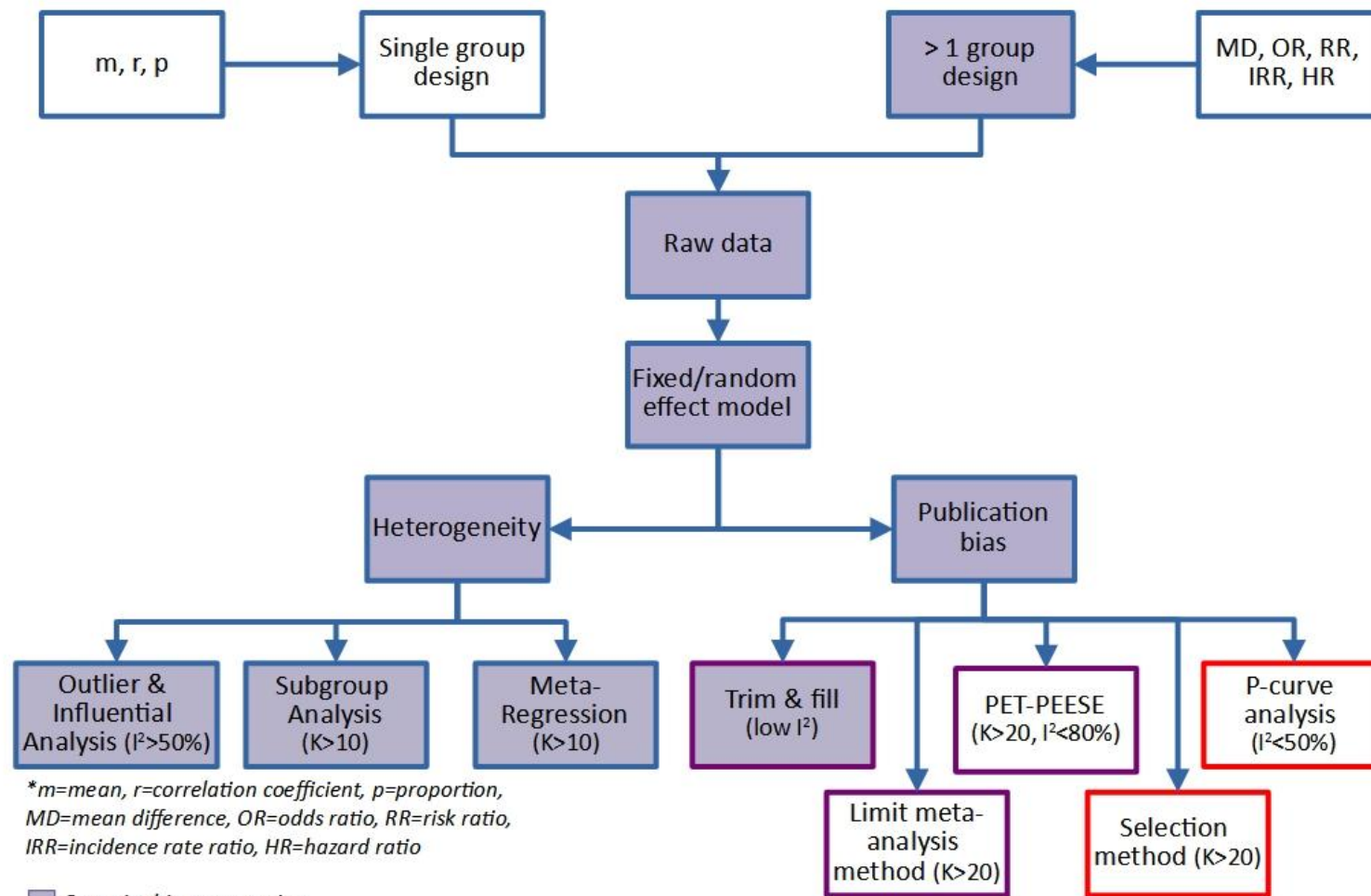


Jargons (cont.)

- Funnel plot



General framework



*m=mean, r=correlation coefficient, p=proportion,
MD=mean difference, OR=odds ratio, RR=risk ratio,
IRR=incidence rate ratio, HR=hazard ratio

 Cover in this presentation

 More specific to small study effect

 More specific to p-hacking

Type of meta-analysis

- **“General” meta-analysis (Intervention/observational study)**
 - Single group design: Pool mean, correlation coefficient, prevalence/proportion
 - >1 group design: Pool mean difference, OR, RR, IRR, HR
- **"Multilevel" meta-analysis**
 - There is 3rd level
- **Network meta-analysis**
 - Compare several treatment effect directly and indirectly
- **Dose response meta-analysis**
 - Quantify level of exposure effect to response

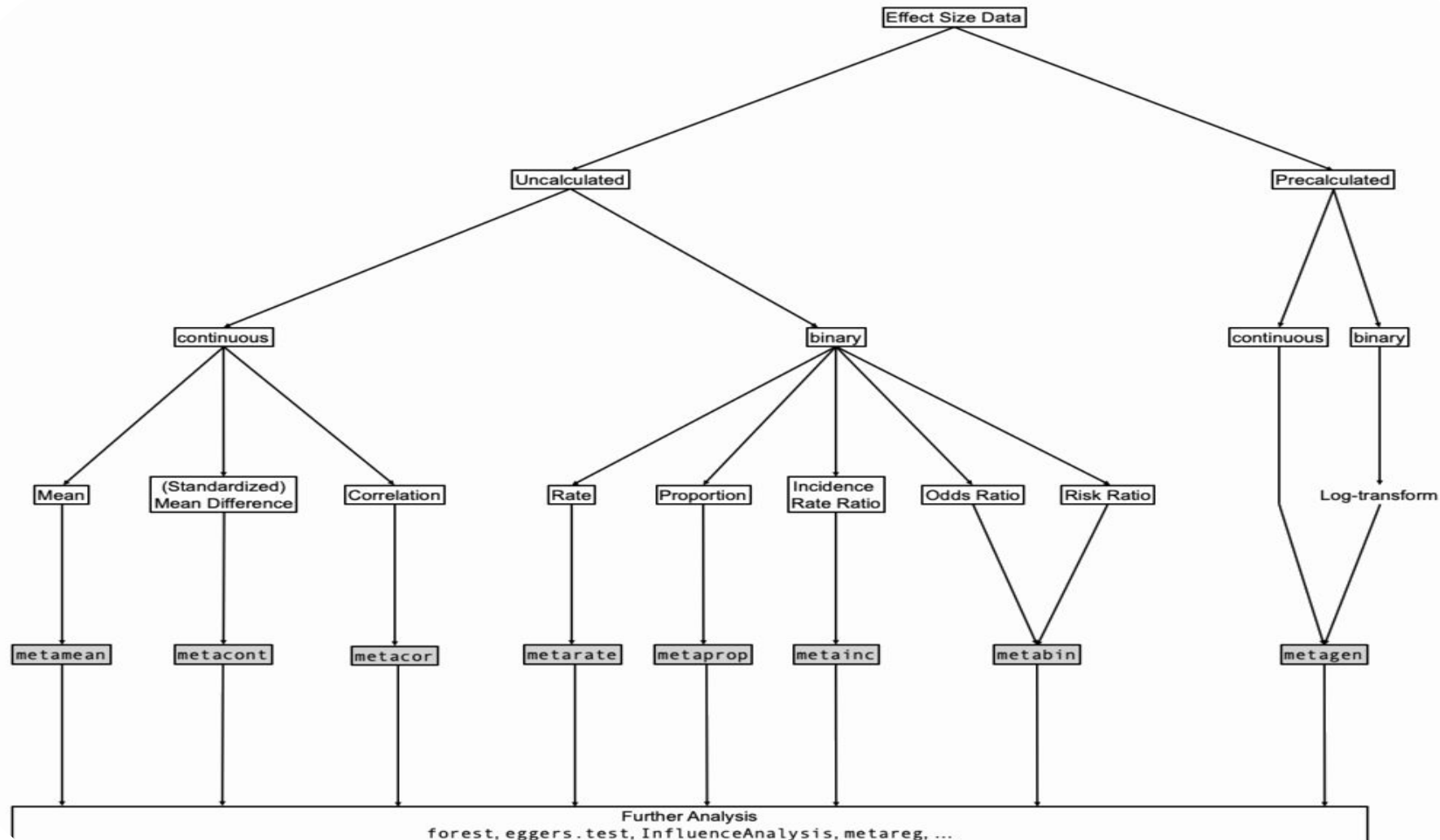
Type of meta-analysis (cont.)

- Diagnostic test accuracy meta-analysis
 - Pool sensitivity, specificity, AUC
- Multivariate/Anova/SEM meta-analysis
- Bayesian approach
- Genome meta-analysis

R packages for meta-analysis

- Main packages:
 - **meta**
 - metafor
- Other packages on [CRAN](https://cran.r-project.org/) (a lot !)
- Unofficial packages (in GitHub, etc):
 - **dmetar**
 - dmetatools
 - etc

Main functions in meta package



(Harrer et al., 2021)

References

- Borenstein, M., Hedges, L. V., Higgins, J. P. T. & Rothstein, H. R. A basic introduction to fixed-effect and random-effects models for meta-analysis. Res. Synth. Methods 1, 97–111 (2010).
- Harrer, M., Cuijpers, P., Furukawa, T.A., & Ebert, D.D. (2021). [Doing Meta-Analysis with R: A Hands-On Guide](#). Boca Raton, FL and London: Chapman & Hall/CRC Press. ISBN 978-0-367-61007-4.
- Rücker, G., Schwarzer, G., Carpenter, J. R. & Schumacher, M. Undue reliance on I² in assessing heterogeneity may mislead. BMC Med. Res. Methodol. 8, 1–9 (2008).

Question?

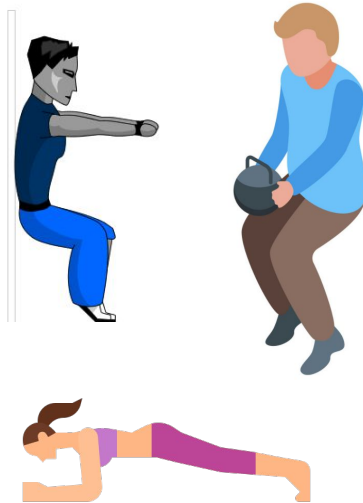


About data

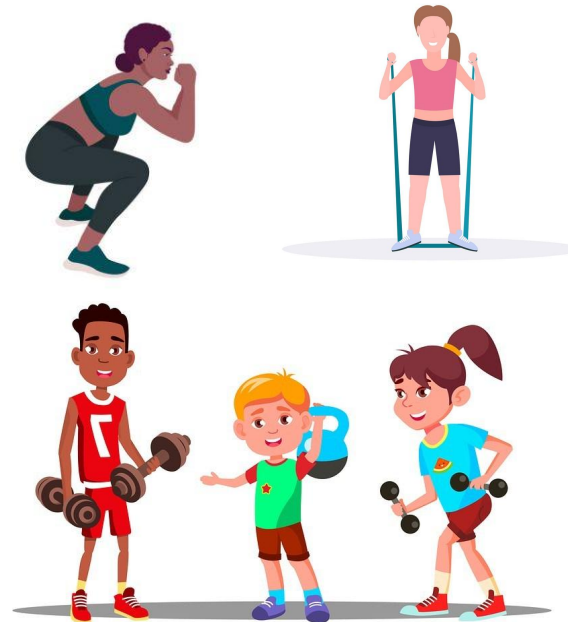
- Our aim - to assess the effectiveness of isometric resistance training (IRT) in reducing systolic blood pressure among hypertensive individuals
- Data:
 - Treatment - IRT regiment
 - Control - aerobic exercise, dynamic RT and non-exercise control (be physically active, etc)
- Study criterias:
 - Participants:
 - High-normal (SBP 130–139 mmHg or DBP 85–89 mmHg)
 - Grade 1 hypertension (SBP 140–159 mmHg or DBP 90–99 mmHg)
 - Grade 2 hypertension (SBP \geq 160 mmHg or DBP \geq 100 mmHg)
 - IRT - must be 3 weeks duration

About data (cont.)

- Resistance training - any exercise that causes muscle to contract against an external resistance



Isometric RT - involve muscle contraction without any movement of the surrounding joints



Dynamic RT - involves joint movement (imagine the pictures move)



Hands-on in R

