Introduction to Meta-Analysis

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Why to conduct a meta-analysis

- Research efforts usually study
  - a specific issue
  - In a specific sample of the population
- Usual problems are
  - Contradictory results _between_ studies
  - Can we generalize the results?

Why to conduct a meta-analysis

A meta-analysis synthesizes studies results to yield one conclusion about

- ❖ The <u>existence</u> of an effect
- ❖ The <u>direction</u> of the effect
- ❖ The <u>strength</u> of the relationship
- ❖ The <u>properties</u> of an effect

Example 1

- A baby should be accustomed to sleep on his stomach (Spock, 1950)

- 100.000 died of sudden infant death syndrome (SIDS) between 1950-1990

- SIDS decreased about 50% when babies put to sleep in their back

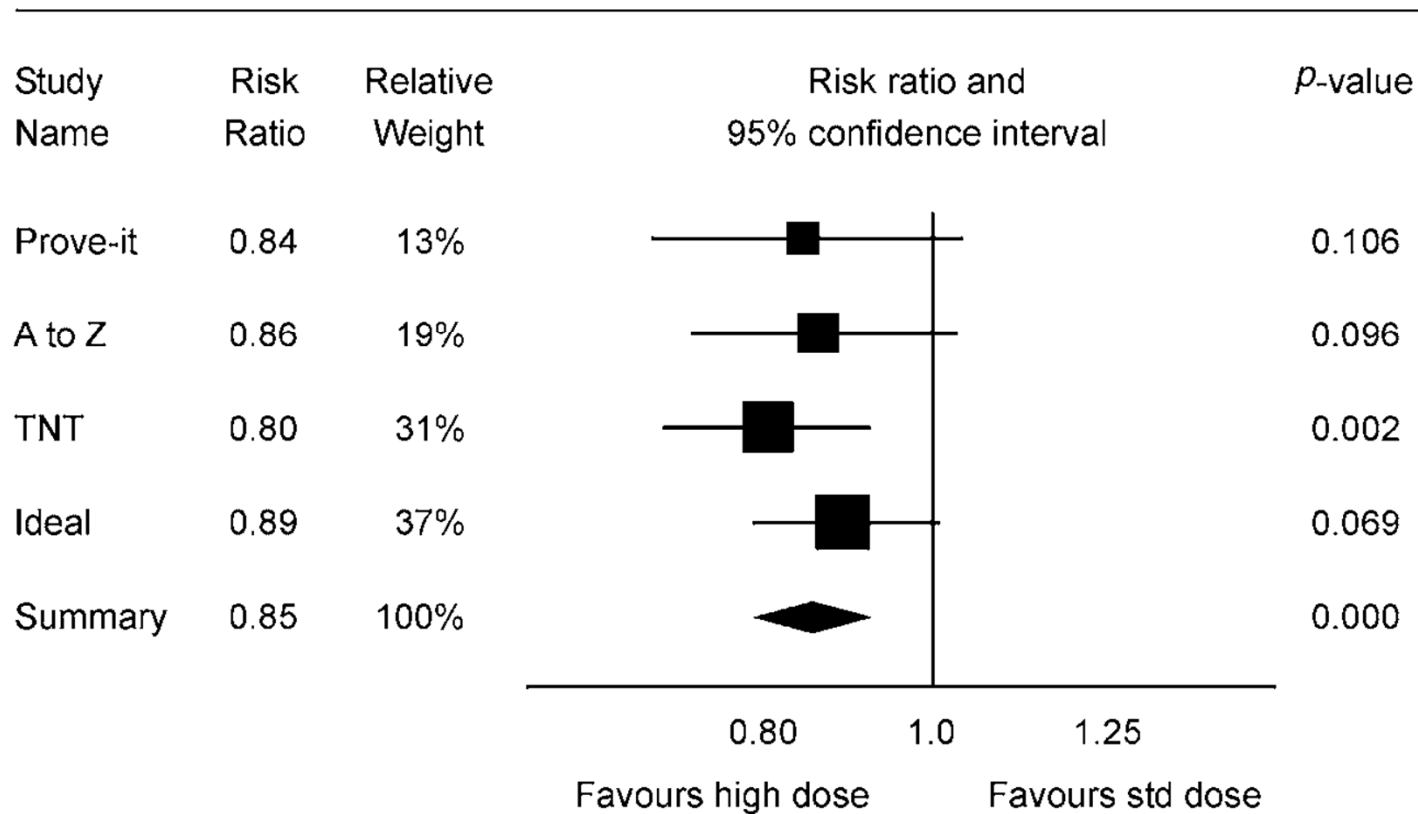 - ❖ Narrative analysis
  - ❖ Systematic analysis

Example 2

- Does psychotherapy have a treatment effect on depression?

- Do pharmaceutical interventions have a treatment effect on depression?

- Does a combination of the two have effect on depression?

- Which kind of psychotherapy (psychodynamic vs. CBT) or medicine (SSRI's or MAO)

Effect size

The effect size, a value which reflects the magnitude of the treatment effect or (more generally) the strength of a relationship between two variables, is the unit of currency in a meta-analysis.

Example

Impact of Statin Dose
On Death and Myocardial Infarction

Study Name	Risk Ratio	Relative Weight	Risk ratio and 95% confidence interval	p-value
Prove-it	0.84	13%		0.106
A to Z	0.86	19%		0.096
TNT	0.80	31%		0.002
Ideal	0.89	37%		0.069
Summary	0.85	100%		0.000

0.80   1.0   1.25

Favours high dose   Favours std dose

The heterogeneity of the effect sizes

- Real differences in effects
  - Because of the conditions in question (e.g. low dose vs. high dose)
  - because of different characteristics of distinct samples
- Random
  - Because of similar but not identical condition applied between studies
  - e.g., because of error in the measurement tool errors

In a meta-analysis, the relationships under scope can be based on

1. Correlations (one group)
2. Ratio (Binary data)
3. Means (raw, standardized, response rates)

The effect sizes in one form can be converted to another

Meta – analysis based on means

- Access on the M, SD, and N for each group of each study

- We compute out of it the effect size and variance – Easy

- In reality you will deal with <u>partial data</u>
  - ❖ <u>You have to back-compute</u> (a software does a lot of this job for you)

- Important to distinguish between
  - ❖ pre-post studies
  - ❖ Matched groups
  - ❖ Response Ratios
- You may include different designs in the same analysis
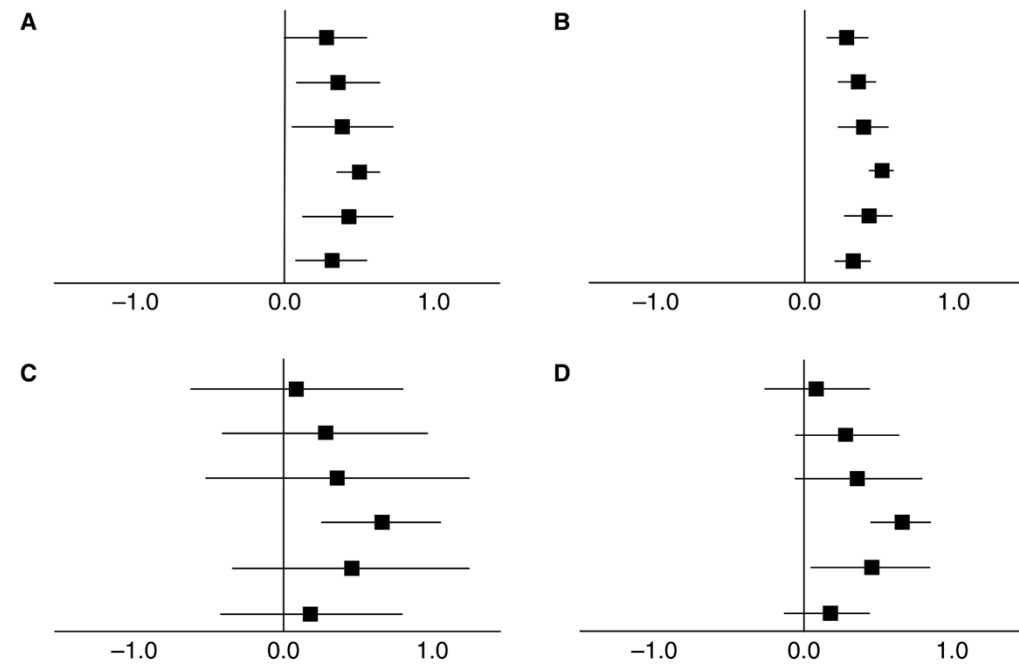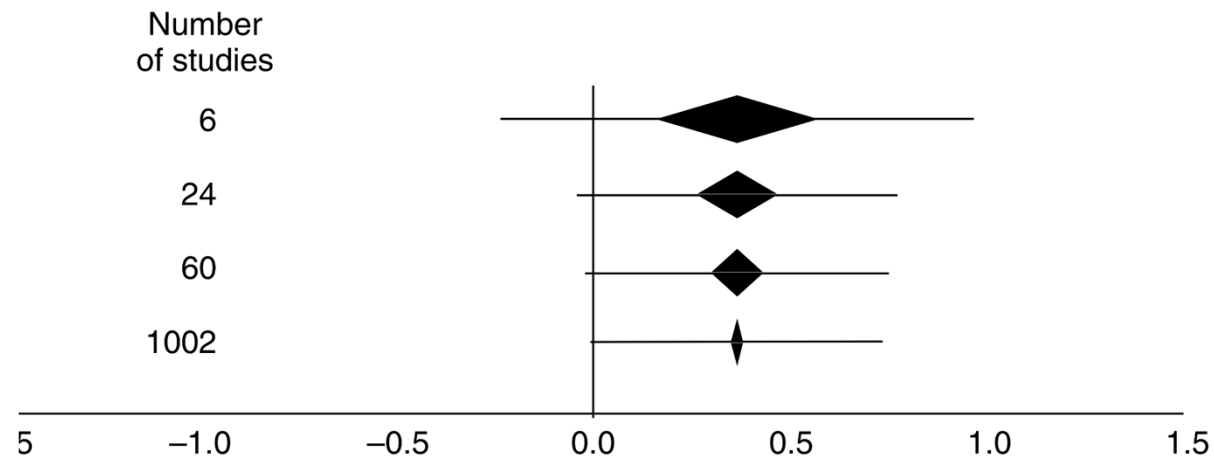
Homogeneity of true effects

Figure 16.1 Dispersion across studies relative to error within studies.

Confidence intervals and prediction intervals

.4 Impact of number of studies on confidence interval and prediction interval.
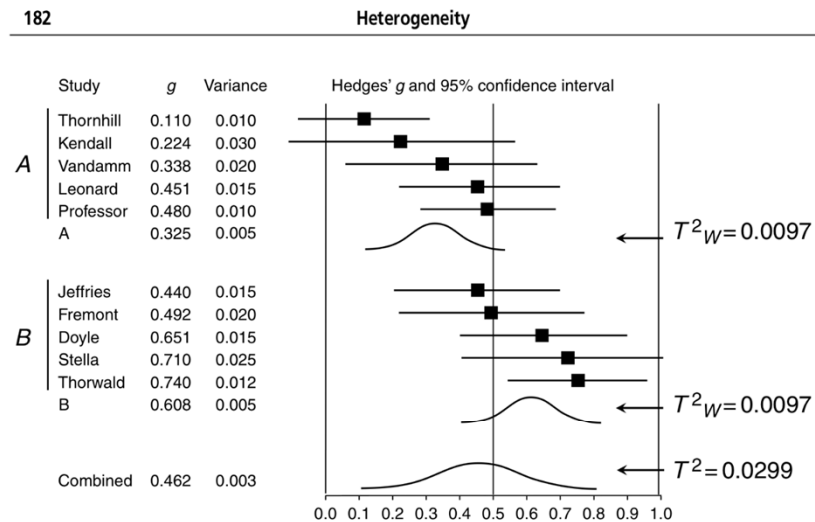
Comparing Subgroups

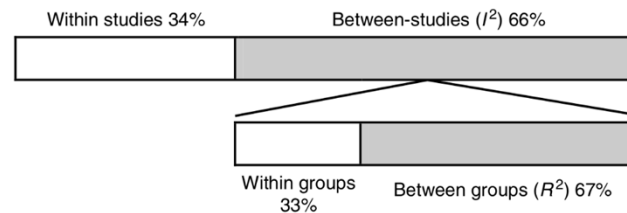Figure 19.12 Random-effects model – variance within and between subgroups.

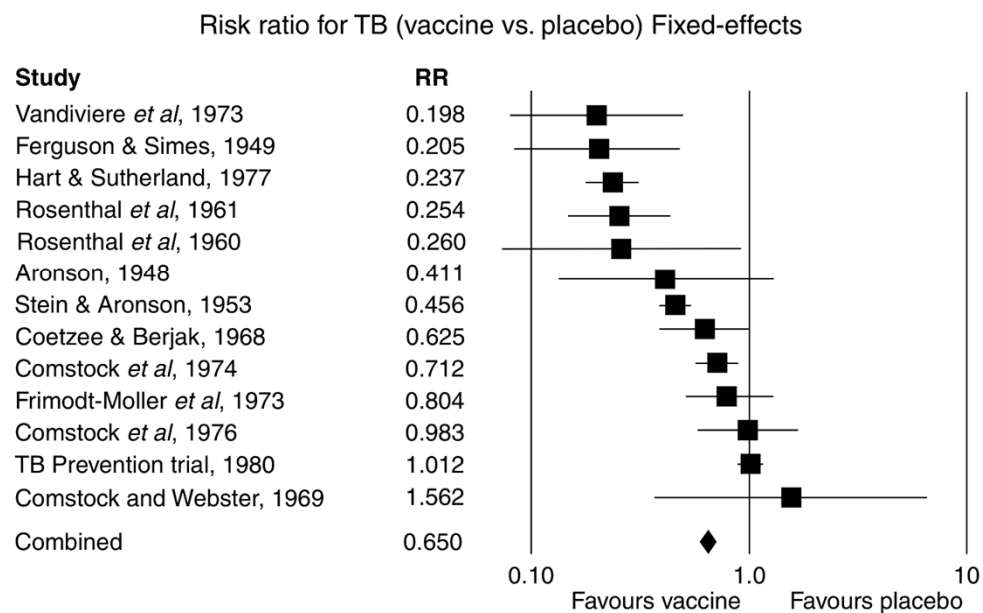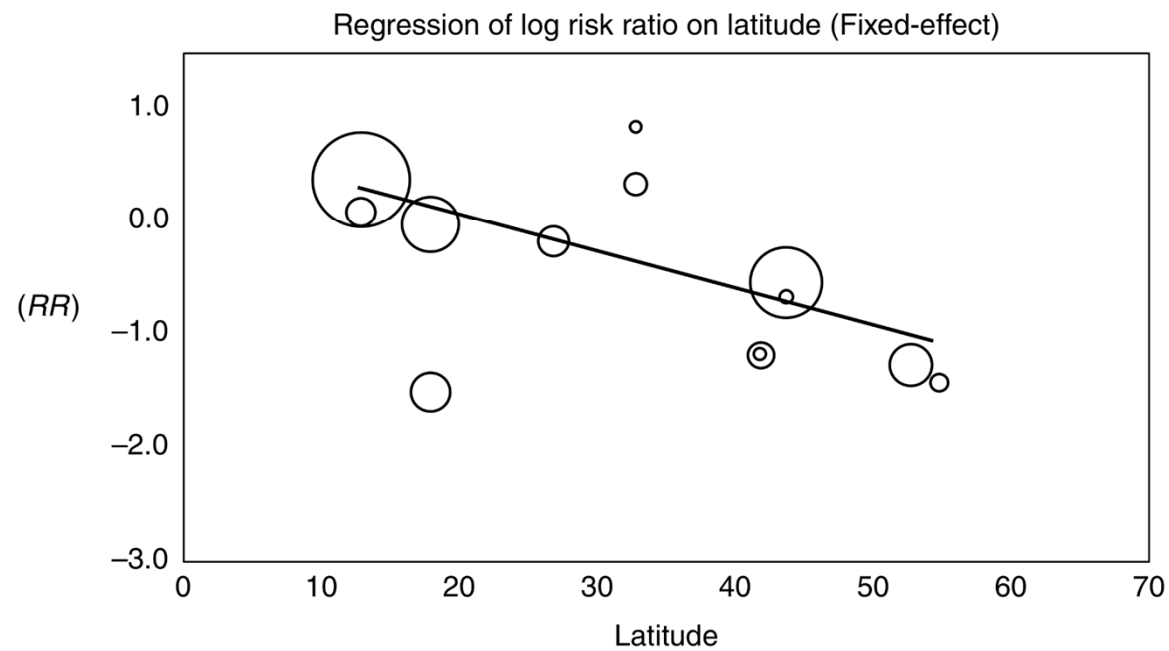Figure 19.13 Proportion of variance explained by subgroup membership.

Meta regression

Risk ratio for TB (vaccine vs. placebo) Fixed-effects

Study	RR
Vandiviere *et al*, 1973	0.198
Ferguson & Simes, 1949	0.205
Hart & Sutherland, 1977	0.237
Rosenthal *et al*, 1961	0.254
Rosenthal *et al*, 1960	0.260
Aronson, 1948	0.411
Stein & Aronson, 1953	0.456
Coetzee & Berjak, 1968	0.625
Comstock *et al*, 1974	0.712
Frimodt-Moller *et al*, 1973	0.804
Comstock *et al*, 1976	0.983
TB Prevention trial, 1980	1.012
Comstock and Webster, 1969	1.562
Combined	0.650

0.10　　　　1.0　　　　10

Favours vaccine　　　Favours placebo

Figure 20.1 Fixed-effect model – forest plot for the BCG data.

Meta regression

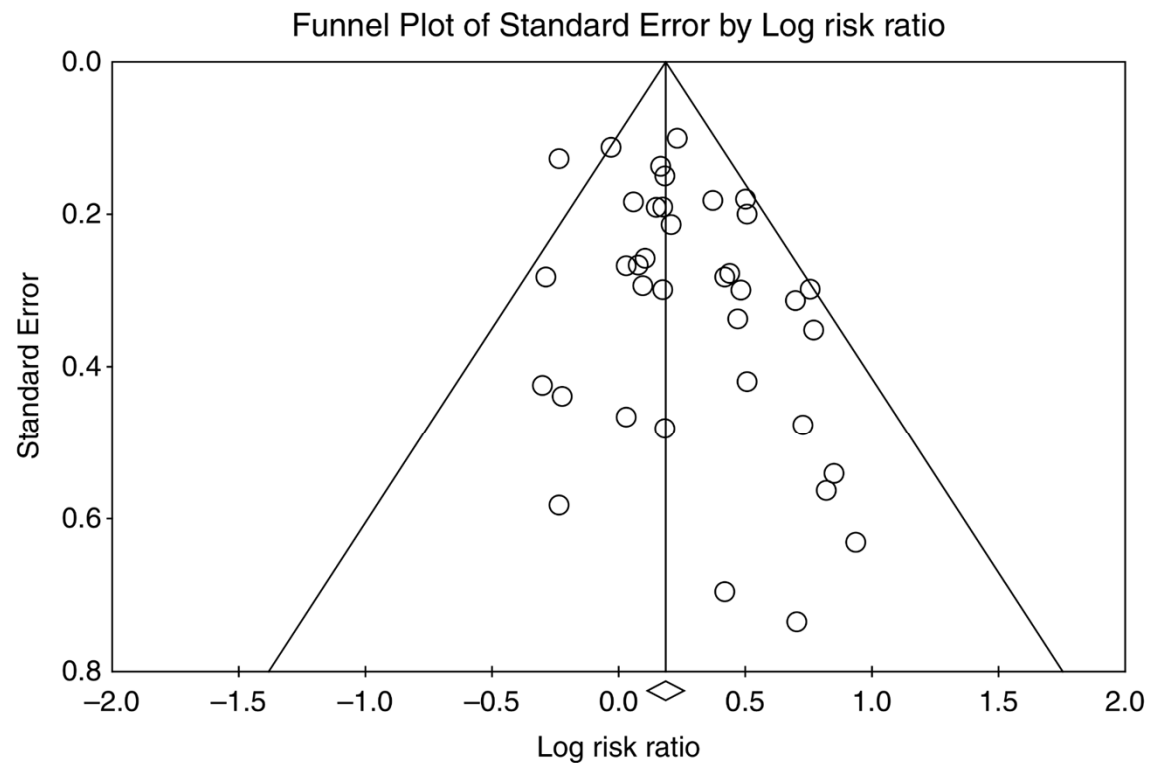Regression of log risk ratio on latitude (Fixed-effect)

Publication Bias

Figure 30.2 Passive smoking and lung cancer – funnel plot.