

Meta-analysis: the method of systematic review

- Very difficult. It requires very sophisticated manner of statistical thinking. You must pay substantial effort to learn. In this lecture, just a overview is given.
- The recommendable textbook (in Japanese) “メタアナリシス入門:エビデンスの統合を目指す統計手法” (Introduction to meta-analysis: the statistical technique to integrate various evidences), written by Dr. Toshiro Tango, Asakura-Shoten Pub., 2002.



Definition and history

- What “meta” means?
 - Something occurring later, more comprehensive, and is often used to name a new but related discipline designated to deal critically with the original one. (Egger et al., 1997)
- A statistical analysis to integrate the results of various previous studies.
- The trials to integrate or summarize the previously conducted studies are not new.
 - Sir Wright (1896) developed a new vaccine against typhoid fever and tested the effectiveness of the same vaccine in several different groups.
 - Karl Pearson (1904) re-evaluated the effectiveness of that vaccine ever used.



Karl Pearson’s calculation

➤ Data: <http://minato.sip21c.org/Pearson1.txt>

| StudyName | RecovV | DiedV | TotalV | RecovNV | DiedNV | TotalNV |
|--------------------|--------|-------|--------|---------|--------|---------|
| HospitalSA | 30 | 2 | 32 | 63 | 12 | 75 |
| GarrisonLadysmith | 27 | 8 | 35 | 1160 | 329 | 1489 |
| SpecialRegimenSA | 63 | 9 | 72 | 61 | 21 | 82 |
| SpecialHospitalSA | 1088 | 86 | 1174 | 4453 | 538 | 4991 |
| MilitaryHospitalSA | 701 | 63 | 764 | 2864 | 510 | 3374 |
| IndianArmy | 73 | 11 | 84 | 1052 | 423 | 1475 |

- Calculate the tetrachoric correlation coefficients for each study (cf. <http://www.personality-project.org/r/psych/R/tetrachor.R> [File] -> [Load script file] -> select all and submit)
- `tetrachoric(matrix(c(30,2,63,12),2,2))` gives 0.307
- Taking mean of 6 studies by `mean(c(0.307,-0.010,0.300,0.119,0.194,0.248))` gives 0.193
Pearson concluded “The effects is too small to recommend the vaccine”.



Using Odds Ratios for meta-analysis

- Each result can also be evaluated using odds ratio. For example, $(30/2)/(63/12)$ gives 2.86. It means vaccination raised the viability 2.86 times at the first study. Using `fisher.test(matrix(c(30,2,63,12),2,2))`, the odds ratio is 2.83.
- [Statistical analysis], [Metaanalysis and metaregression], [Metaanalysis and metaregression for proportions]
- Estimated combined odds ratio is 1.77 in fixed effect model and 1.79 in random effect model (both statistically significant at 5% level). “No heterogeneity” is not rejected ($p=0.235$).
- Forest plot is very convenient to see.

