
UNDERSTANDING FOREST AND FUNNEL PLOTS

WHAT'S A FOREST PLOT?

Forest plots are a graphic representation of the articles and findings in a meta-analysis. For more detailed information on a meta-analysis, please see the [AAPD Guide on Meta-Analyses](#)

PRO'S AND CON'S OF USING FOREST PLOTS

There are 3 main things that need to be assessed when reading a meta-analysis:

1. **Heterogeneity.** The differences in the results, methodology or study populations used in the included studies.
2. The **pooled result.** The overall combined result derived from combining ('pooling') the individual studies.
3. **Publication bias.** Although the intent of a meta-analysis is to find and assess all the relevant studies meeting the inclusion criteria, this mission is not always possible. Some studies can be missed because they are not written in English, or because they show non-significant results (so they have a lower chance of being published).

A forest plot is the most effective tool for showcasing the heterogeneity and the pooled results. However, it cannot display potential publication bias to readers. A funnel plot can do that instead.

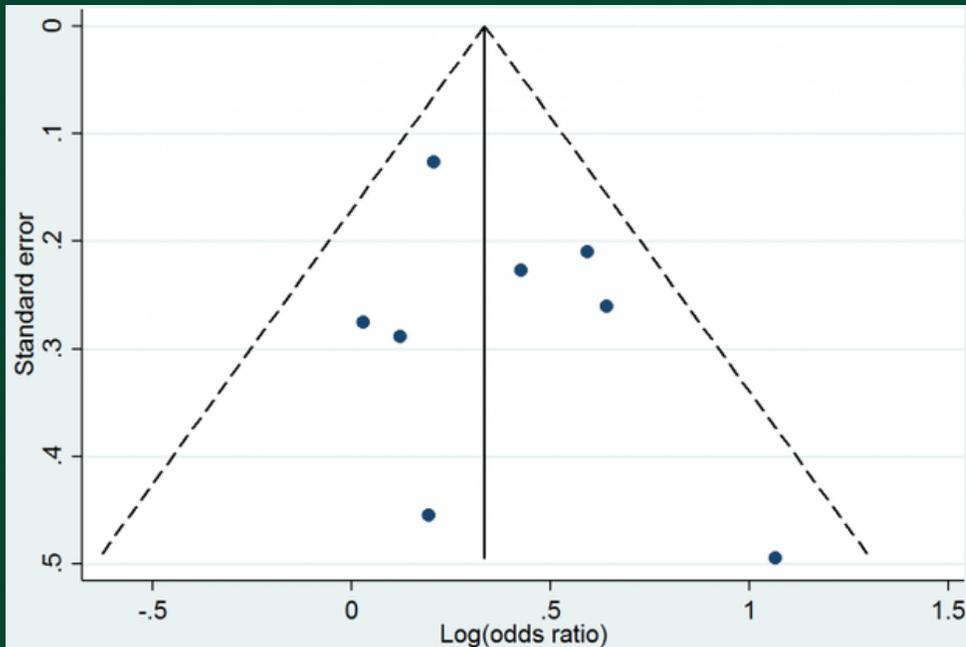
See pages 2 and 3 for more details on funnel plots.



For more information on interpreting forest and funnel plots, please contact AAPD Research Project Manager Rachel Wedeward, MLIS, AHIP at rwedeward@aapd.org.

WHAT'S A FUNNEL PLOT?

A (Begg's) funnel plot is a scatterplot used in meta-analyses to visually detect the presence of publication bias. An example of what a typical funnel plot looks like is presented below:



Significant results are published more frequently than negative findings. Thus, including more of the former could naturally sway the overall findings of the meta-analysis. An appropriate meta-analysis therefore includes all of the relevant studies, regardless of their findings. Other sources of bias include language, i.e. those written in English have a tendency to be included as opposed to other languages.

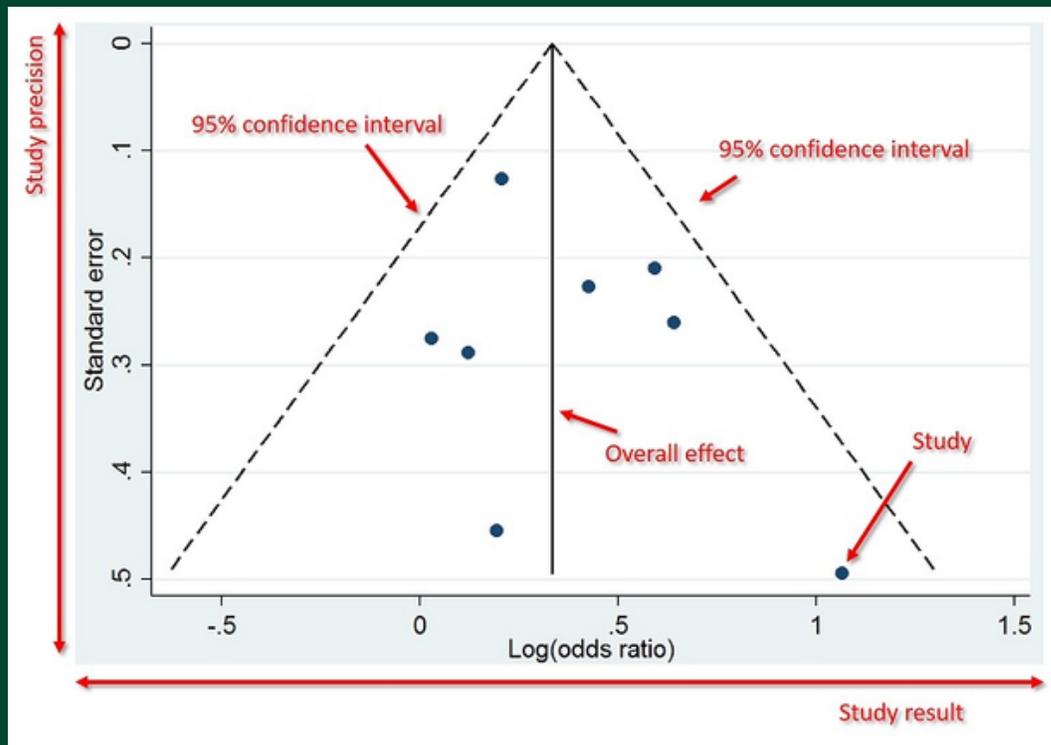
Results of the Egger's test are sometimes quoted alongside the funnel plot as a statistical measure of publication bias.



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HOW TO READ A FUNNEL PLOT

Below is an annotated version of the example funnel plot. The plot displays the studies results (x-axis) and precision (y-axis). In the example on page 2, the results are odds ratios (ORs) and the precision is the standard error of the OR. Each dot of the plot represents a separate study. The above example also has two dotted lines either side which represent the pseudo 95% confidence intervals. The middle solid line indicates the overall effect from the meta-analysis.



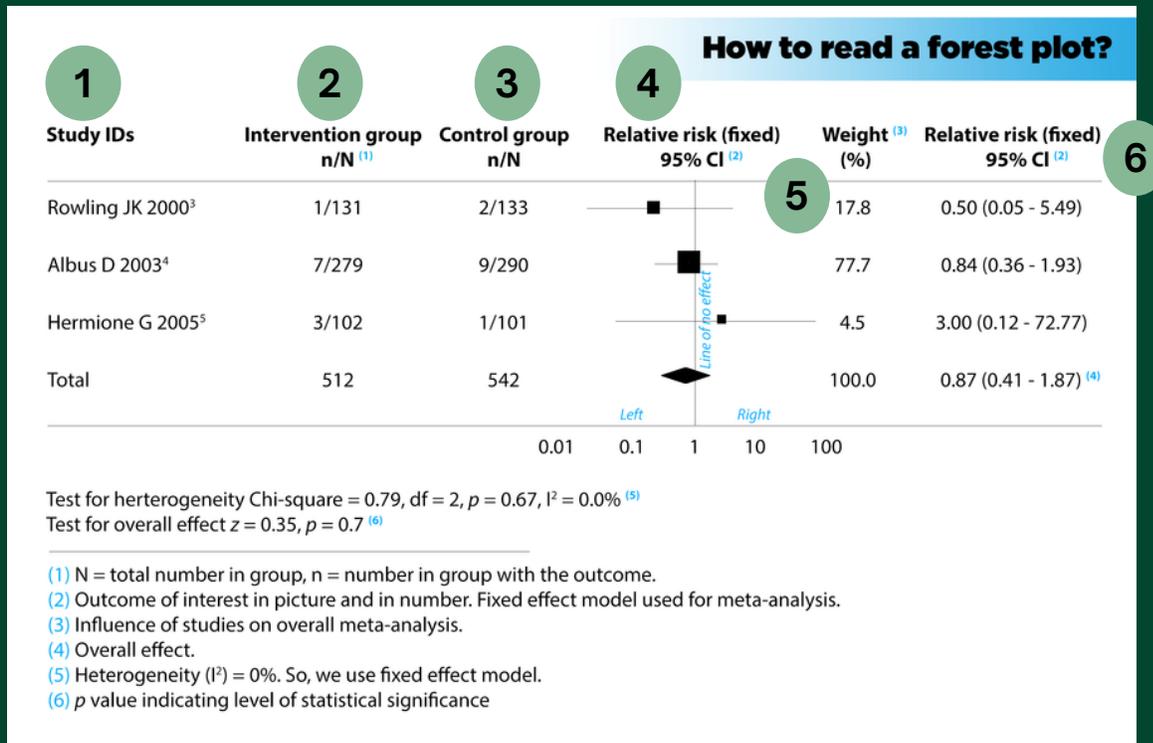
Typically, larger studies cluster around the top of the plot, whilst smaller studies are spread across the bottom of the plot.



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HOW TO READ A FOREST PLOT

Forest plots typically have 6 columns:



1 Column 1: Studies IDs

The leftmost column shows the identities (IDs) of the included studies. Studies are represented by the name of the first author and the year of publication, often arranged in time order.

2 Column 2 and 3 Column 3: Intervention group n/N and Control group n/N

Next, to the right, we meet some data from the intervention group and the control group from each study. n indicates the number of patients having the outcome of interest, while N represents the total number of patients in that group. For instance, in the study of Rowling et al (2000), 1 out of 131 participants in the intervention group has the outcome of interest, compared with 2 out of 133 participants in the control group.



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HOW TO READ A FOREST PLOT CONT.

4 Column 4: Relative risk (fixed) 95% CI

- The next column visually displays the study results. The boxes show the effect estimates from the single studies, while the diamond shows the pooled result.
- The horizontal lines through the boxes illustrate the length of the confidence interval. The longer the lines, the wider the confidential interval, the less reliable the study results. The width of the diamond serves the same purpose.
- The vertical line is the line of no effect (i.e. the position at which there is no clear difference between the intervention group and the control group).
- If the outcome of interest is adverse (e.g. mortality), the results to the left of the vertical line favors the intervention over the control. That is, if result estimates are located to the left, it means that the outcome of interest (e.g. mortality) occurred less frequently in the intervention group than in the control group (ratio < 1).
- If the outcome of interest is desirable (e.g. remission), the results to the right of the vertical line favors the treatment over the control. That is, if result estimates are located to the right, it means that the outcome of interest (e.g. remission) occurred more frequently in the intervention group than in the control group (ratio > 1).
- The last possibility: if the diamond touches the vertical line, the overall (combined) result is not statistically significant. It means that the overall outcome rate in the intervention group is much the same as in the control group. This is the case in the figure above.

5 Column 5: Weight (%)

- For the next column over, the weight (in %) indicates the influence an individual study has had on the pooled result. In general, the bigger the sample size and the narrower the confidence interval (CI), the higher the percentage weight, the larger the box, and more the influence the study has on the pooled result.

6 Column 6: Relative risk (fixed) 95% CI

- The rightmost column contains exactly the same information as is contained in the diagram in column 4, just in numerical format. So, we can observe the data both in picture and in number. This can be either the 95% CI of odds ratio (OR) or the 95% CI of relative risk (RR).
- The diagram above shows relative risk. When the 95% CI does not include 1, we can say the result is statistically significant. More information is found at the lower left corner of the plot.
- The **p-value** indicates the level of statistical significance. If the diamond shape does not touch the line of no effect, the difference found between the two groups was statistically significant. In that case, the p-value is usually < 0.05.
- The **I²** indicates the level of of heterogeneity. It can take values from 0% to 100%. **If I² is less than 50%, studies are considered homogeneous**, and a fixed effect model of meta-analysis can be used. **If I² is more than 50%, the heterogeneity is high**, and one should use a random effect model for meta-analysis. The difference between homogeneity and heterogeneity therefore lies in the different approaches taken to calculate the pooled result.

