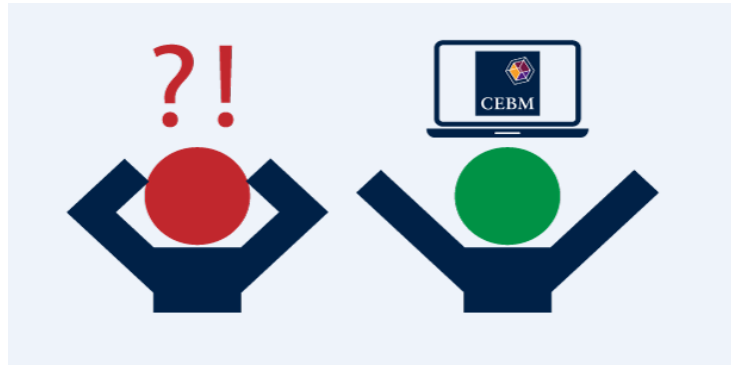


Tip for data extraction for meta-analysis – D3



How do I calculate a standard error of a beta coefficient?

Kathy Taylor

In post D1, I showed how to rescale hazard ratios (HRs) to a common change in a predictor variable, and in post D2 I showed how to deal with beta coefficients which are HRs (natural) log-transformed. We need to enter beta coefficients and their standard errors (SEs) into meta-analysis software. In this post I'll show how to calculate these SEs.

Beta coefficients may be reported with a SE or a t-value. HRs are usually reported with a confidence interval.

A bit of maths (see below if you're interested) shows us:

$$SE \text{ of } \beta = \frac{\text{beta}}{t \text{ value}}$$

$$SE \text{ of } HR_x = \frac{(\text{upper}CI_x) - (\text{lower}CI_x)}{3.92}$$

$$SE \text{ of } \beta_y = \frac{\ln(\text{upper}CI_y) - \ln(\text{lower}CI_y)}{3.92}$$

and rescaling from a change of x units to y units in the predictor variable

$$SE \text{ of } \beta_y = y \times SE \text{ of } \beta$$

$$SE \text{ of } \beta_y = y \times \frac{\text{beta}}{t \text{ value}}$$

and if the HR hasn't already been rescaled to y units

$$SE \text{ of } \beta_y = \frac{y}{x} \times \frac{\ln(\text{upper}CI_x) - \ln(\text{lower}CI_x)}{3.92}$$

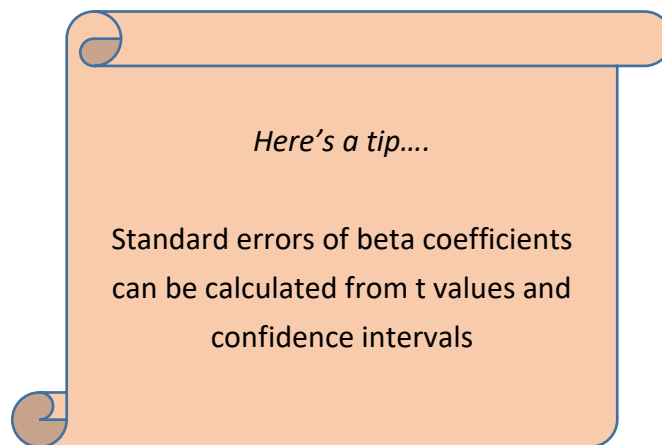
Let me show you some examples. Returning to the studies mentioned in my previous post. I had already scaled them to a 5mmHg increase in systolic blood pressure variability:

[study](#) by Mancia et al has a beta coefficient of -0.092 and its $SE = 0.033 \times 5 = 0.165$

[study](#) by Hansen et al has a beta coefficient of 0.01 and its $SE = \frac{\ln(1.04) - \ln(0.98)}{3.92} = 0.015$

[study](#) by Pringle et al has a beta coefficient of 0.16 with its $SE = \frac{\ln(2.13) - \ln(0.64)}{3.92} = 0.307$

So the data are ready for meta-analysis, but all these data cannot be pooled together. The data of Mancia et al may be pooled with the data of Hansen et al, or the data of Pringle et al, but not the data from both studies, because the patient populations of these two studies overlap – double counting patients can inflate the effect estimates. I'll return to the issue of overlapping patient populations in a later post.



In my next post I will show how to pool data from studies reporting categorical risk data with different numbers of categories and different thresholds.

Where did the equations come from?

(You can skip this if you are only interested in carrying out the calculations)

$$t \text{ value} = \frac{\text{beta}}{SE \text{ of beta}}$$

This can be rearranged to

$$SE \text{ of beta} = \frac{\text{beta}}{t \text{ value}}$$

A 95% confidence interval is $\text{mean} \pm 1.96 \times SE$

Therefore

$$\text{upperCI} = \text{mean} + 1.96 \times SE$$

$$\text{lowerCI} = \text{mean} - 1.96 \times SE$$

$$\Rightarrow \text{upperCI} - \text{lowerCI} = 3.92 \times SE$$

$$\Rightarrow SE = \frac{\text{upperCI} - \text{lowerCI}}{3.92}$$

This equation applies to any symmetric 95% confidence interval.

As HR_x has a confidence interval (lowerCI_x to upperCI_x)

$$SE \text{ of } HR_x = \frac{(\text{upperCI}_x) - (\text{lowerCI}_x)}{3.92}$$

As β_x has a confidence interval ($\ln(\text{lowerCI}_x)$ to $\ln(\text{upperCI}_x)$)

$$SE \text{ of } HR_x = \frac{\ln(\text{upper}_x) - \ln(\text{lowerCI}_x)}{3.92}$$

Rescaling beta coefficients from a change of x units to y units in the predictor variable,

$$SE \text{ of } \beta_y = y \times SE$$

$$SE \text{ of } \beta_y = y \times \frac{\text{beta}}{t \text{ value}}$$

both follow on from the explanation I gave in my last post ([EBHC KT blog post 5](#)) for

$$\beta_y = y \times \text{beta}$$

The same applies for

$$SE \text{ of } \beta_y = \frac{y}{x} \times \frac{\ln(\text{upperCI}_x) - \ln(\text{lowerCI}_x)}{3.92}$$

which follows on from the explanation given for

$$\beta_y = \frac{y}{x} \times \beta_x$$

Dr Kathy Taylor teaches data extraction in [Meta-analysis](#). This is a short course that is also available as part of our [MSc in Evidence-Based Health Care](#), [MSc in EBHC Medical Statistics](#), and [MSc in EBHC Systematic Reviews](#).

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