

Meta-Analysis of Clinical Prediction Models



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Incorporating published univariable associations in the analysis of individual patient data

Introduction

Currently, methods to combine univariable literature information with the (multivariable) analysis of newly collected individual patient data are underdeveloped. In addition, the few existing methods are unfamiliar to many researchers, causing them to ignore existing evidence when performing prediction research with new data.

Methods

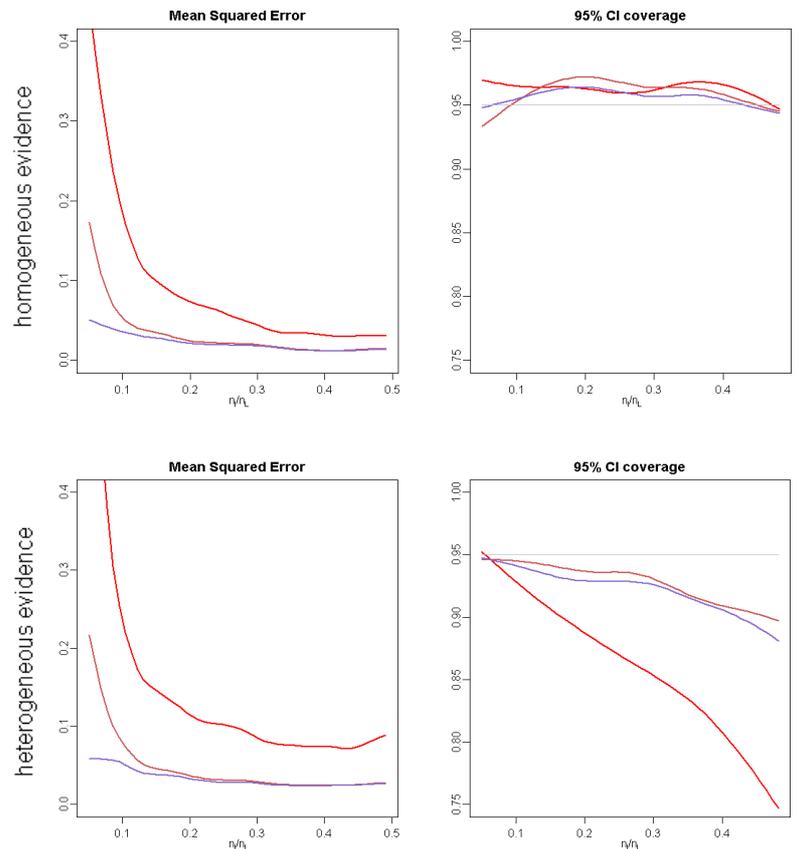
We introduce a novel method that first summarizes known univariable coefficients and then adapts the summary into a multivariable coefficient. This method can be viewed as an extension of the transformation method originally proposed by Greenland (1987) and Steyerberg et al. (2000). We compare three variants that adopt different perspectives on the updating of evidence. Methods were tested in simulation studies with different degrees of comparability between the available evidence, and different amounts of available evidence. Performance of the methods was measured by comparing the updated coefficients with predefined true values.

Results

Robustness of multivariable coefficients improves when incorporating known univariable coefficients. When few individual patient data are available, all adaptation methods clearly outperformed the classical approach ignoring the evidence from literature (Mean Squared Error (MSE) < 0.05 vs. $MSE = 0.44$ when ratio available/literature data = 0.05). Our novel method showed less bias in the estimated regression coefficients and more accurate coverage of their 95% confidence intervals. In large datasets all methods performed similarly ($MSE < 0.025$ when ratio available/literature data ≥ 0.50).

Results of a simulation study: MSE and coverage of the 95% confidence interval for estimated regression coefficients (IPD + 4 lit. studies of 500 patients each)

- No updating
- Adaptation method (Greenland, Steyerberg)
- Corr-Adj Adapt method (novel method)



Conclusion

Our novel method to incorporate previously published univariable coefficients as evidence in new multivariable analyses is superior to established approaches and is especially worthwhile when few individual patient data are available.

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