

Copas-Heckman-Type Sensitivity Analysis for Publication Bias in Rare-Event Meta-Analysis Under Generalized Linear Mixed Models

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Purpose

Publication bias (PB) is a serious threat to systematic reviews and meta-analyses. Almost all existing PB methods assume the normal-normal (NN) random-effects model, which performs poorly for rare-event meta-analysis. The purpose of this research is to make PB sensitivity analysis available for generalized linear mixed models (GLMMs), which use the exact within-study distribution of the number of events.

Outline

We propose a sensitivity analysis framework for evaluating the impact of PB in contrast-based GLMMs. Following the Copas-Heckman-type formulation, study-specific true effect sizes are related to a latent Gaussian selection variable defined on the study sample sizes, and the selection probability is controlled by interpretable sensitivity parameters. Because the exact within-study likelihood is retained, the methods completely avoid continuity corrections and can be implemented with standard software at low computational cost.

Result

Simulation studies show that the proposed methods successfully correct the bias of the pooled estimate and restore coverage of the confidence interval under rare-event settings, where existing NN-model-based PB methods are unstable. Several real-world examples of meta-analyses of odds ratios and proportions with rare-event outcomes confirm the broad applicability of the proposal in assessing how sensitive a conclusion is to potential publication bias.

Publication

Yi Zhou, Taojun Hu, Yuji Sakamoto, Ao Huang, Xiao-Hua Zhou, Satoshi Hattori. Copas-Heckman-Type Sensitivity Analysis for Publication Bias in Rare-Event Meta-Analysis Under Generalized Linear Mixed Models. *Statistics in Medicine*. 2026;45(10-12):e70595.

Computing system: SQUID

All the simulations of this research were run under the account of Yi Zhou (co-author); no SQUID resource was consumed under this account.

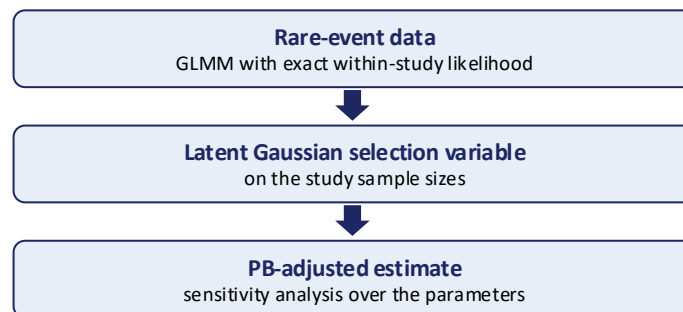


Image (schematic of the proposed framework)