**Epidemiological tool DisMod-MR robust to rate model choice**

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**Abstract**

**Background** The Global Burden of Disease, Injuries, and Risk Factors Study 2010 (GBD 2010 Study) required age-specific prevalence estimates for over 300 diseases, injuries, and risk factors for all countries. Results of systematic reviews were often very sparse and noisy, so DisMod-MR was used to combine all available data and create estimates of prevalence by year-age-sex-country using an age-standardizing mixed-effects negative binomial rate model. We investigate the robustness of this approach by comparing the negative binomial rate model to alternative rate models for out-of-sample predictive validity.

**Methods** We compared all disease and injury models analyzed with DisMod-MR from the GBD 2010 Study with more than 4 prevalence data points in the GDB 2010 Study geographic region of Western Europe with holdout cross-validation. For each disease/injury model, we generated 1000 replicates with the prevalence data partitioned into a random 75/25% train/test split. We fit an age-specific rate model to the training data and used the results to predict values for the test data. We compared the bias, median absolute error (MAE), coverage probability, and computation time for the negative binomial, binomial, normal, lognormal, and offset lognormal rate models.

**Findings** DisMod-MR year-age-sex prevalence estimates are not sensitive to rate model choice. Differences in bias and MAE are small and insignificant; however the binomial has a smaller MAE but is more biased and has the lowest coverage probability than the other rate models. The coverage probability is best for the normal model. With optimization, faster computation times can be achieved with the off-set lognormal.

**Interpretation** The results show that DisMod-MR is robust to rate type choice with the given quality of data. The binomial model is the least promising of the rate types tested while the negative binomial, lognormal, and offset lognormal models are more favorable choices.

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