Meta-Analysis

Bayesian Random Effects Results

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Abstract

Using Bayesian hierarchical (random effects) models for the meta-analysis with various priors for the heterogeneity parameter τ, it was found that there was a significant treatment effect for depressive symptoms (mean = 0.97, 95% CI), anxiety (), and worry symptoms. However, there was substantial heterogeneity present specifically in the depressive symptoms subgroup where *tau* was estimated to be between 0.58-1.12 where $\tau > 0.5$ is considered substantial. In short, as with the frequentist meta-analysis results, the treatments did appear to have an effect but there is much uncertainty surrounding the treatment effect size though the 95% credible interval suggests that this effect might be at least what Cohen would indicate as medium (e.g. 0.39-0.41 found for Bayesian and Frequentist results),

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Statistical Analysis

All statistical analyses were conducted using RStudio v 3.5.2 using the metafor [], bayesmeta and tidyverse [] packages. The analyses code can be viewed on https://github.com/alhostat/perinataldep2019.git. Due to the variability in study populations and experimental designs, a random effects meta-analysis model was used to analyse the data where each study is assumed to be drawn from a separate study population with its own treatment effect μ_i. Under this model, variability in study effects y_i has two levels of variability i.e. the variability due to sampling error σ^2 and the variability due to variability between the study population τ also known as study heterogeneity.
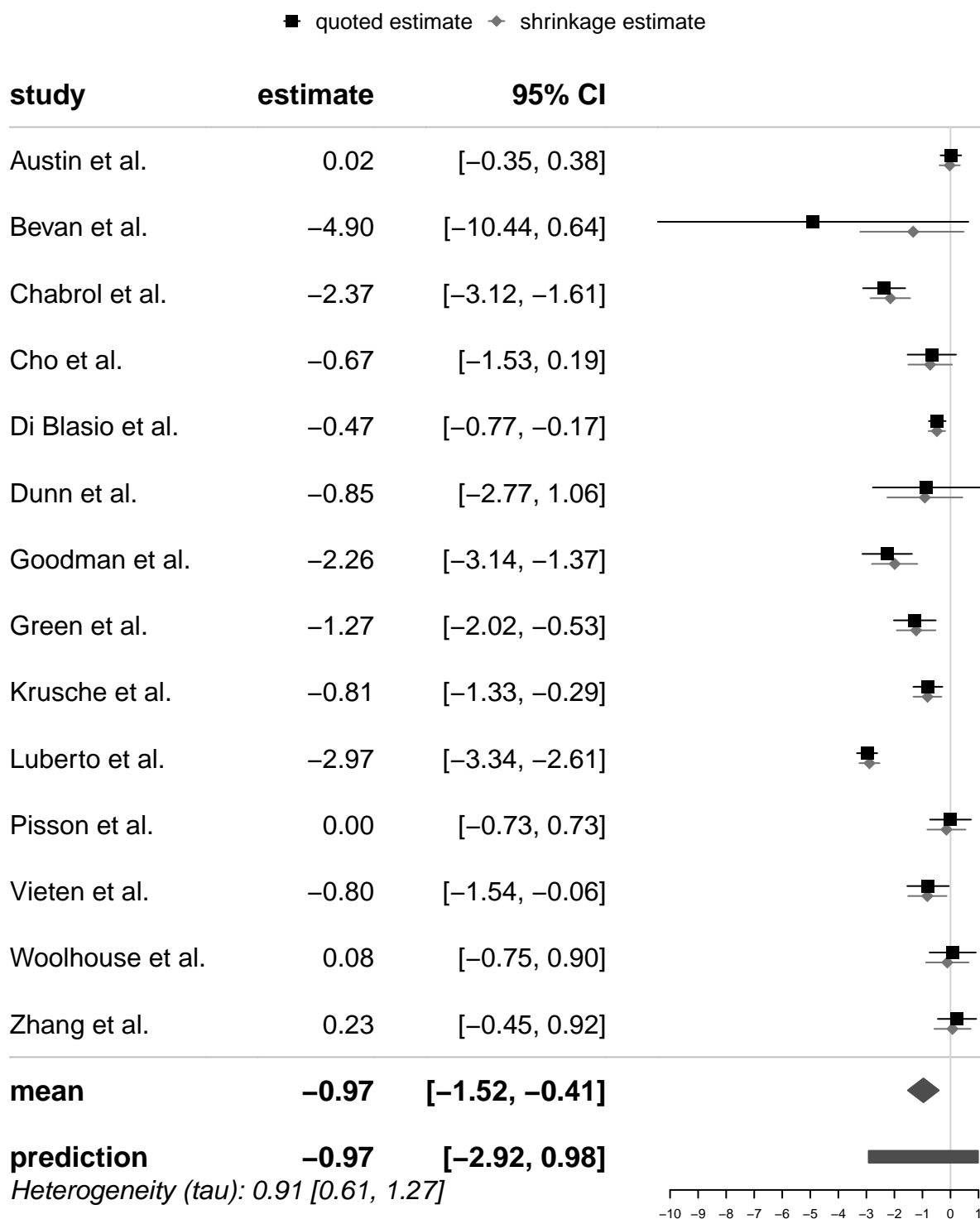
$$y_i|\theta_i, \sigma^2 \sim N(\theta_i, \sigma^2)$$
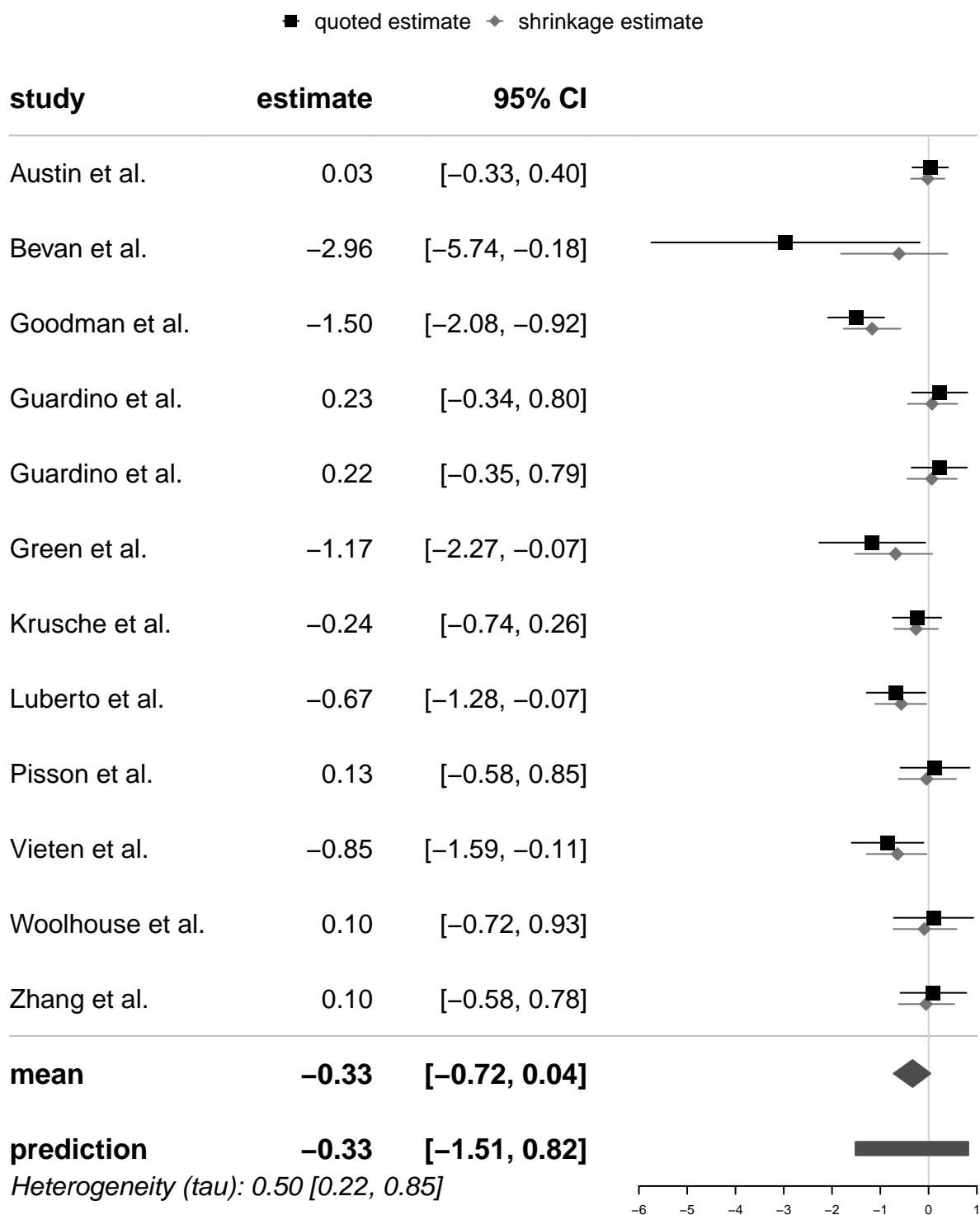
$$\theta_i|\mu, \tau \sim N(\mu, \tau^2)$$

The random effects model was conducted using both frequentist and bayesian methods. While the approaches are similar, the Bayesian methodology is more naturally geared towards random effects modelling specifically with the estimation of the heterogeneity parameter τ and the greater capacity to impose estimate shrinkage particularly on outlying studies with higher variability, smaller sample sizes or are of lower quality. For further details see .
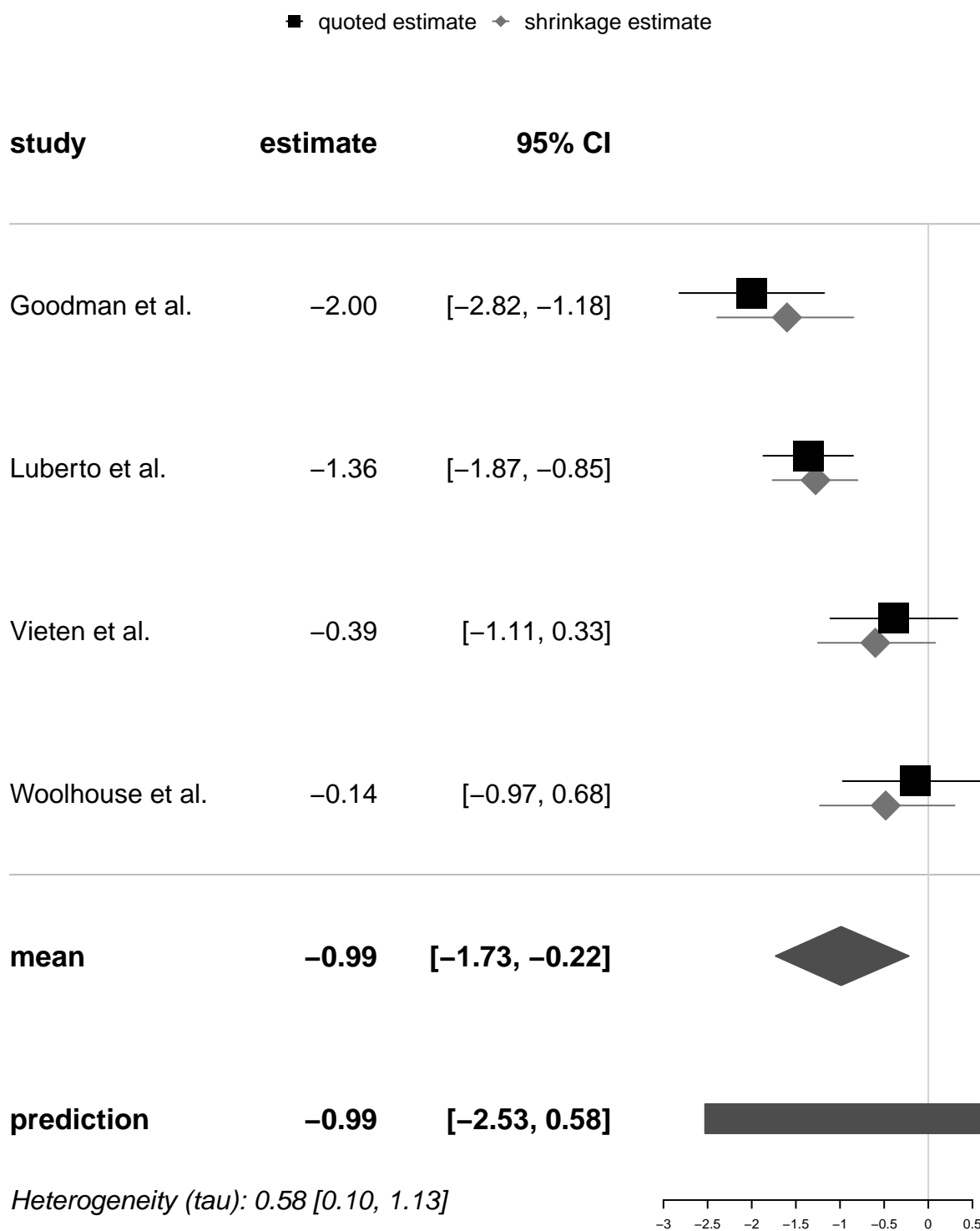
Results

Treatment effects on Depression

For the meta-analysis on depression, a normal noninformative prior mean treatment effect μ and an improper uniform prior for the heterogeneity parameter τ was used. Additional priors were also run as part of a sensitivity analysis.

Figure 1: Depression Forest Plot (mean +- 95% credible intervals)

■ quoted estimate ◆ shrinkage estimate

study	estimate	95% CI
Austin et al.	0.03	[−0.33, 0.40]
Bevan et al.	−2.96	[−5.74, −0.18]
Goodman et al.	−1.50	[−2.08, −0.92]
Guardino et al.	0.23	[−0.34, 0.80]
Guardino et al.	0.22	[−0.35, 0.79]
Green et al.	−1.17	[−2.27, −0.07]
Krusche et al.	−0.24	[−0.74, 0.26]
Luberto et al.	−0.67	[−1.28, −0.07]
Pisson et al.	0.13	[−0.58, 0.85]
Vieten et al.	−0.85	[−1.59, −0.11]
Woolhouse et al.	0.10	[−0.72, 0.93]
Zhang et al.	0.10	[−0.58, 0.78]
mean	**−0.33**	**[−0.72, 0.04]**
prediction	**−0.33**	**[−1.51, 0.82]**

Heterogeneity (tau): 0.50 [0.22, 0.85]

Figure 2: Anxiety Forest Plot (mean +- 95% credible intervals)

Figure 3: Worry Forest Plot (mean +- 95% credible intervals)