Article title: Spatial Distribution and Birth Prevalence of Congenital Heart Disease in Iran: A Systematic Review and Hierarchical Bayesian Meta-analysis

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Supplementary file 3. Bayesian Hierarchical Pooling of CHD Birth Prevalence

The posterior density is denoted by $p(\mu,\tau|y,\sigma)$. This is the conditional distribution of μ and τ and given the values of y and σ^1 .

Let Y_i denote the number of people with CHD in the i-th paper, N_i the corresponding total sample size, and p_i the underlying prevalence. First, Y_i follows a *Binomial* distribution, so we have $Y_i|p_i \sim Binomial(N_i, p_i)$. Next, we assume p_i is a random variable with a probability density function. Therefore, the logit transformation of p_i has a Normal distribution. We assume

$$logit(p_i) = log\left(\frac{p_i}{1-p_i}\right) = u_i \text{ and } u_i \sim Normal(\mu, \tau^2)$$

For the mean μ of the normal distribution of logarithm of odds a weakly informative normal prior distribution (with mean= 0 and variance = 100), and for the variance τ^2 a slightly more informative half-normal prior distribution (with variance=0.5)¹⁻³

Finally, We converted these estimates (logit¹) back to the prevalence with the following formula:

P = [exp(log odds)/(exp(log odds) + 1)]

^{1.} Röver C. An introduction to meta-analysis using the bayesmeta package. <u>https://cran.r-project.org/web/packages/bayesmeta/vignettes/bayesmeta.html</u>.

^{2.} Röver C, Bender R, Dias S, et al. On weakly informative prior distributions for the heterogeneity parameter in Bayesian random-effects meta-analysis. *Res Synth Methods*. 2021;12(4):448-474. doi:10.1002/jrsm.1475

^{3.} Mohammadi FS, Aslani S, Mostafaei S, Jamshidi A, Riahi P, Mahmoudi M. Are genetic variations in IL-21-IL-23R-IL-17A cytokine axis involved in a pathogenic pathway of rheumatoid arthritis? Bayesian hierarchical meta-analysis. *J Cell Physiol.* 2019;234(10):17159-17171. doi:10.1002/jcp.28495

¹ log odds