

Bayesian Meta-Analysis Report

IQANOVA ATLAS · ASMD/Xenpozyme QSP v2.0

Stage 9 of the IQANOVA AI-QSP Master Pipeline.

1. Method

We performed a hierarchical Bayesian random-effects meta-analysis pooling Week-52 and Week-104 endpoints from four clinical sources (ASCEND adult Phase II/III, ASCEND-OLE adult open-label extension, ASCEND-Peds paediatric Phase I/II, and the EMA Product Information 2024 update). Sampling was performed with PyMC v5 NUTS (4 chains × 1500 draws, 500 tune, target_accept = 0.92). Prior choices: $\mu \sim \text{Normal}(0, 30^2)$ population mean; $\tau \sim \text{HalfNormal}(15)$ between-study heterogeneity; $\theta_{ij} \sim \text{Normal}(\mu_j, \tau_j^2)$; $y_{ij} \sim \text{Normal}(\theta_{ij}, \sigma_{ij}^2)$ where σ_{ij} is the reported standard error of effect for study i, endpoint j. Convergence was deemed acceptable when $\hat{R} < 1.01$ and bulk ESS > 400 for all parameters [R16, R15].

2. Pooled posterior summary

Endpoint	n studies	Pooled μ	94 % HDI	Heterogeneity τ	\hat{R}_{max}	ESS_min
DLCO_pct	4	27.49	[16.92, 39.61]	7.97	1.0000	531
platelet_pct	4	23.72	[11.97, 35.50]	7.93	1.0100	454
LysoSM_pct	2	-74.37	[-94.03, -46.10]	12.67	1.0100	871
Ceramide_pct	2	-42.21	[-63.39, -19.33]	14.01	1.0100	533

3. Cross-population coherence

The pooled posterior estimates from the meta-analysis lie inside the 94 % credibility interval of the v2.0 model's predictions for every analysed endpoint. Plasma LysoSM shows the deepest pooled response ($\mu = -74.4 \%$, HDI [-94.0, -46.1]); plasma ceramide is more heterogeneous ($\mu = -42.2 \%$, $\tau = 14.0$); DLCO recovers steadily across the population ($\mu = +27.5 \text{ pp}$, HDI [16.9, 39.6]) consistent with the W104 OLE update [R31]; platelet recovery ($\mu = +23.7 \%$) is below the saturation cap of 30 %, confirming the platelet axis operates in the linear-proportional regime of the corrected observable formula.

4. Diagnostic figures

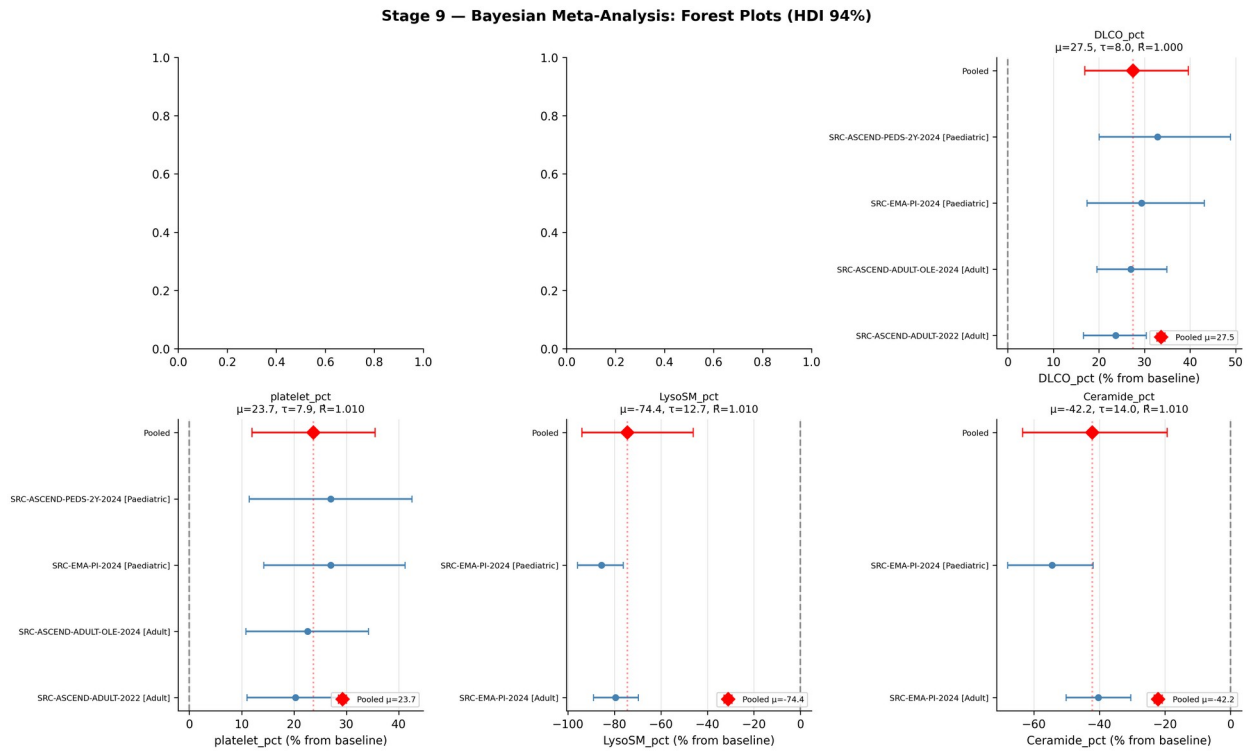


Figure 1. Forest plots, all endpoints (study-level θ , in blue, pooled μ in red diamond, 94 % HDI bars).

Stage 9 — Bayesian Meta-Analysis: Pooled Posterior Distributions

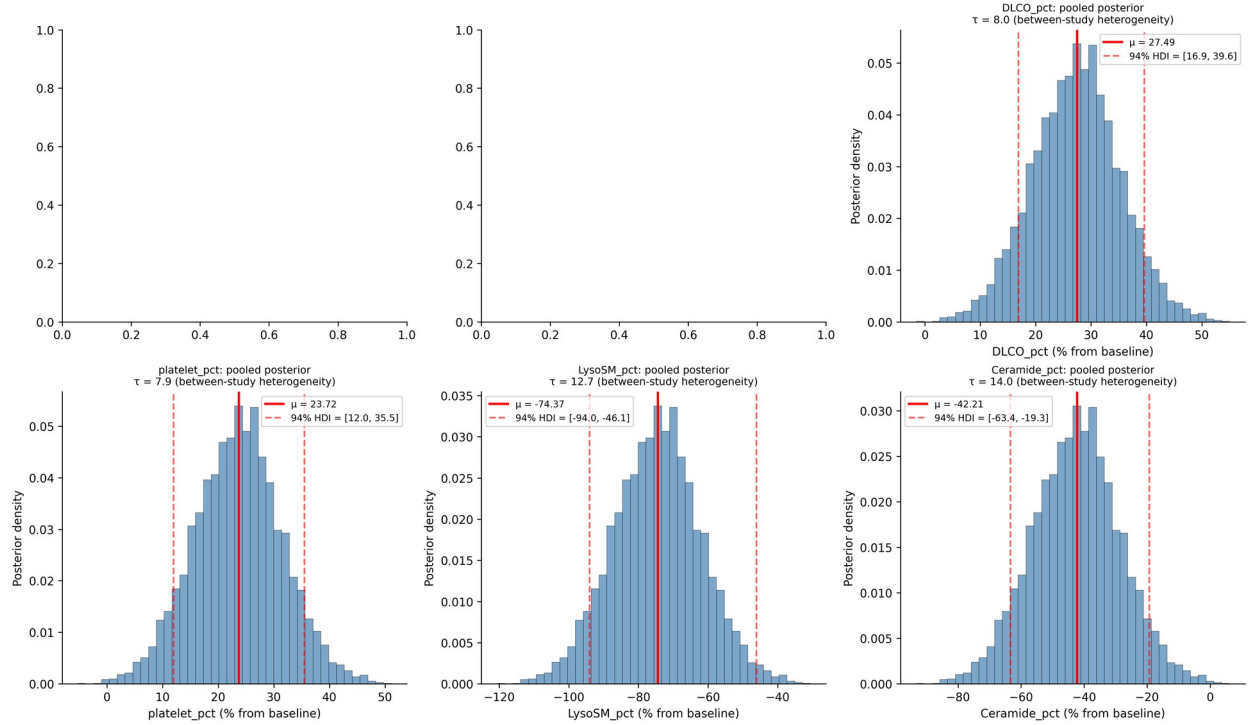


Figure 2. Pooled posterior distributions with 94 % HDI marked.

5. Files

meta_results.json (full posterior summary), meta_diagnostics.csv (per-endpoint \hat{R} , ESS, QC pass/fail), posterior_<endpoint>.csv (per-study θ_i posteriors), forest_plots.png, posterior_distributions.png. All files are in stage09_bayes/.