

Understanding the contribution of intervention components: A network meta-analysis approach to psychological preparation for surgery

Rachael Powell¹, Suzanne Freeman², Neil W Scott³, Alex Sutton², Nicola Cooper², Anne Manyande⁴, Claus Vögele⁵, Julie Bruce⁶, Lucie Byrne-Davis¹, Marie Johnston³

1 University of Manchester, UK; **2** NIHR Complex Reviews Support Unit, University of Leicester, UK; **3** University of Aberdeen, UK; **4** University of West London, UK; **5** University of Luxembourg, Luxembourg; **6** University of Warwick, UK.

Systematic review & meta-analysis

- Is there evidence for beneficial (or harmful) effects of psychological preparation for surgery?
- Which outcomes (pain, behavioural recovery, length of stay, negative affect) are improved (or worsened) following preparation?

Methods: inclusion criteria

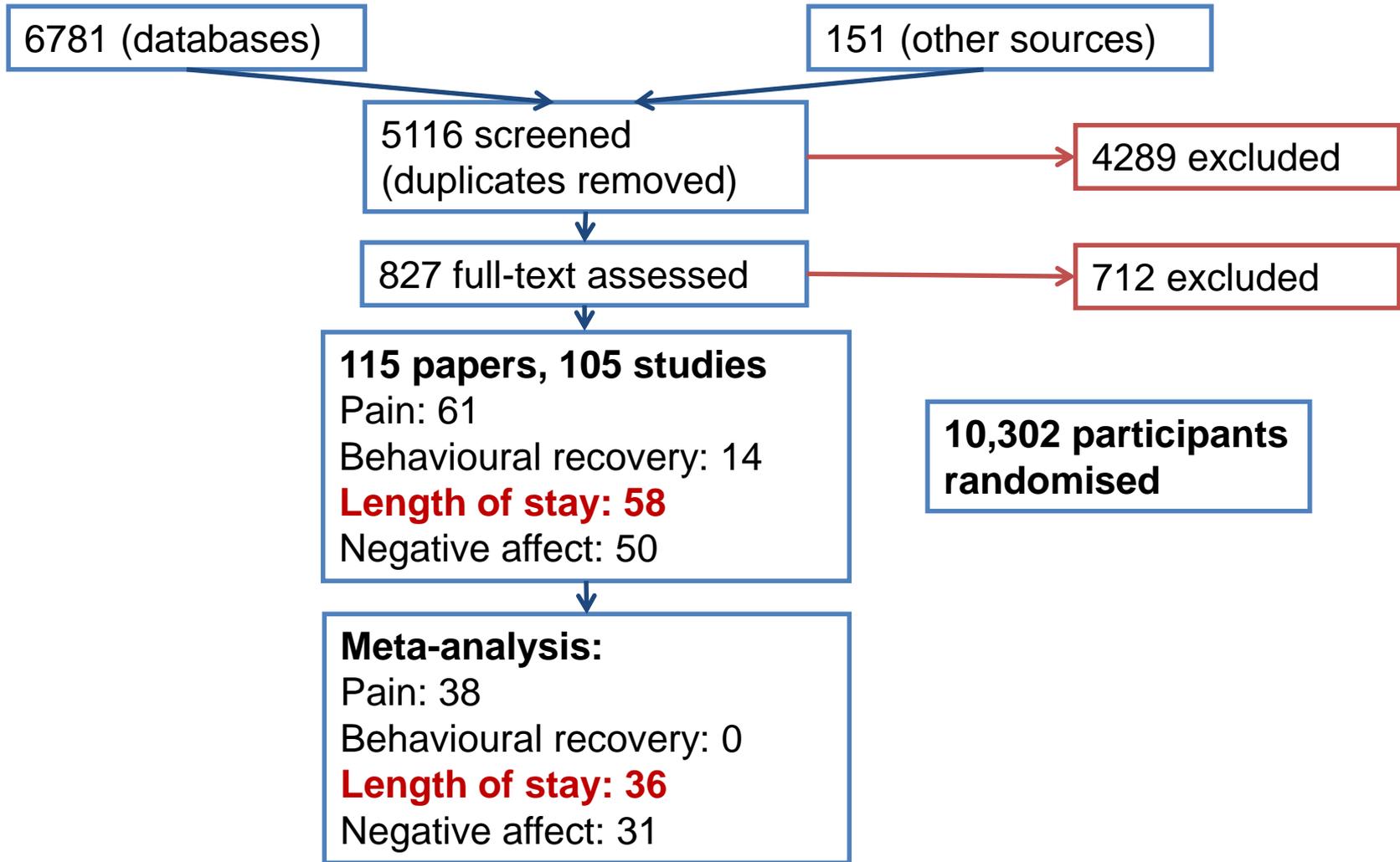
- Published and unpublished RCTs (NOT quasi-randomised); any language.
- Adults, elective surgery under general anaesthetic.

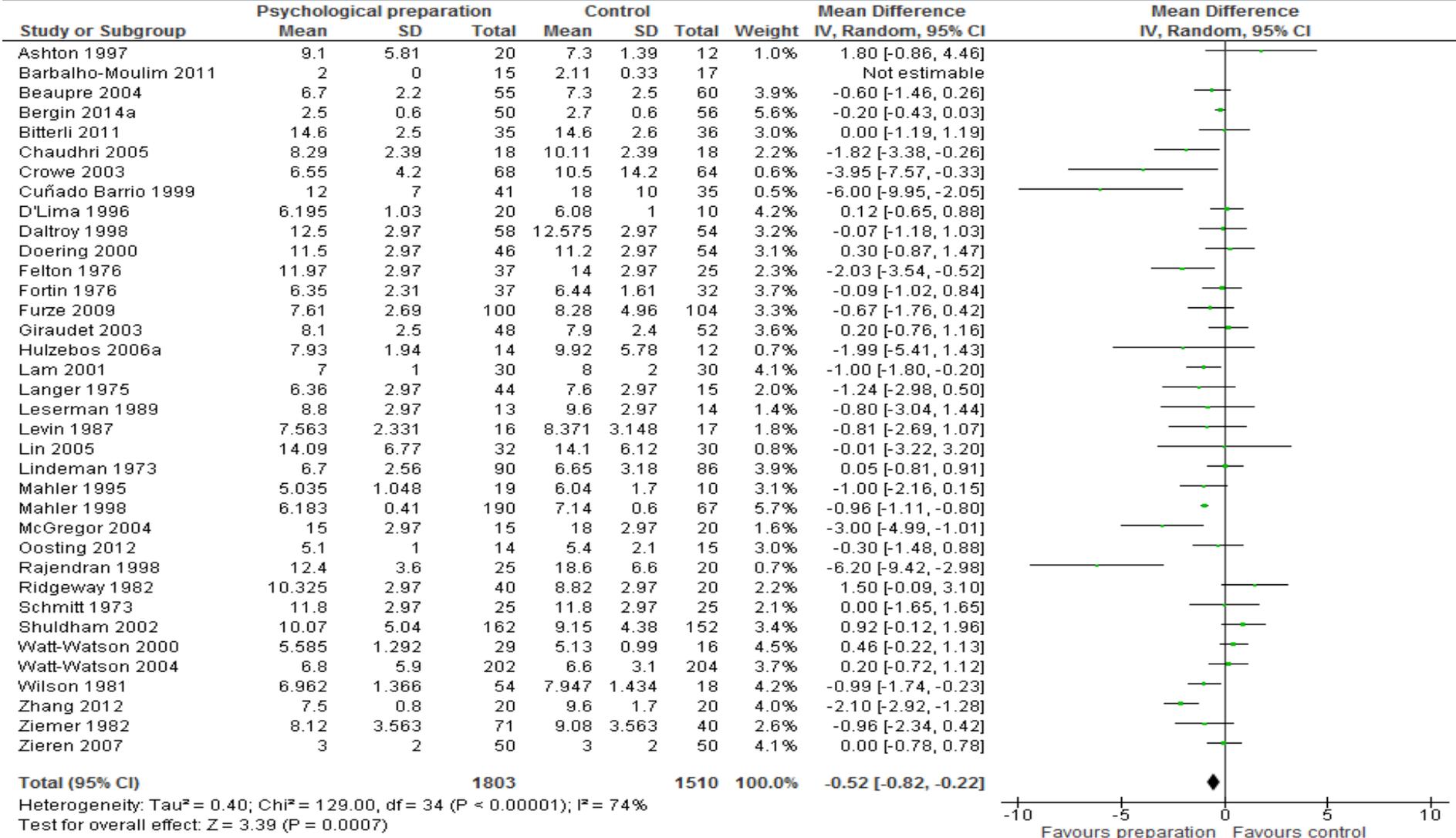
Intervention: pre-operative

- **P**rocedural information
- **S**ensory information
- **B**ehavioural instruction
- **C**ognitive intervention
- **R**elaxation
- **H**ypnosis
- **E**motion-focused intervention

Outcomes: post-operative

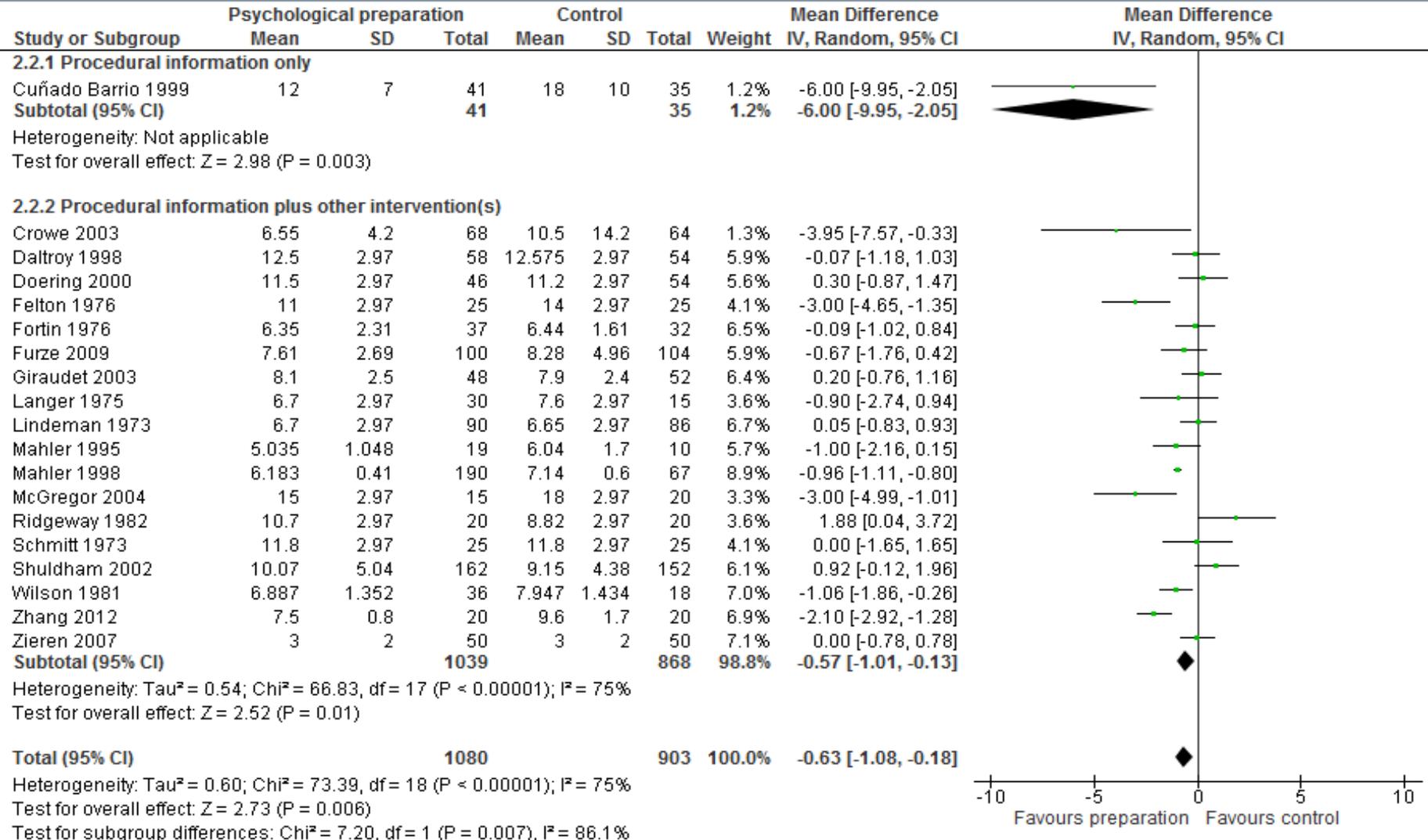
- Pain
- Negative affect
- **Length of stay**
- Behavioural recovery





Cochrane Review Meta-analysis Results

- **Post-surgery, compared with controls, patients receiving interventions experienced:**
 - **Lower pain** (Hedges' $g = -0.20$, 95%CI: -0.35 to -0.06)
 - **Lower negative emotion** (Hedges' $g = -0.35$, 95%CI: -0.54 to -0.16)
 - **Shorter length of stay** (mean difference = -0.52 days, 95% CI -0.82 to -0.22).
- **High heterogeneity** – studies not very similar (different interventions, surgical populations).



Limitations of analysis

- Could not effectively unpick impact of individual intervention components.
 - Interventions comprised 1 to 4 components.
- Need to explore causes of heterogeneity.

Secondary analysis: Network meta-analysis

- Statistical model using direct evidence (where two components are directly compared) and indirect evidence (where two components are each compared with a third treatment).
- Outcome: estimate effects for each comparison, whether or not the treatments have been directly compared.
- Can examine potential causes of heterogeneity (e.g. control group mean, type of surgery).
- Bayesian framework in WinBUGS v1.4.3.

Models

- **Model 1:** as for Cochrane review – compares all interventions with control.
- **Model 2:** each component has separate effect; total effect of an intervention = sum of component effects (e.g. **P+S**).
- **Model 3:** model 2 plus combinations of components (pairs of components when combined may have larger/smaller effect than if effects summed)(e.g. **P+S+PS**).
- **Model 4:** each possible combination treated as a separate intervention.

Model 2: role of components

- **Procedural info, Sensory info, Behavioural instruction, Cognitive intervention & Relaxation** each reduced length of stay; greatest effects:
 - **Relaxation** (MD -0.48, CrI: -1.35, 0.36) and
 - **Behavioural instruction** (MD -0.42, 95%CrI: -0.97, 0.06).
- In linear combination, reduction of approximately 1 day for
 - **P+S+B** (MD -0.96, 95% CrI: -1.62, -0.35) and
 - **P+S+R** (MD -1.02, 95%CrI: -2.00, -0.05).
- Evidence of heterogeneity ($\tau=0.81$).

Causes of heterogeneity 1

- Control group mean length of stay included as continuous covariate
 - **Control for typical length of stay for that operation, at that time, in that context.**
 - For every 1 day increase control LoS, mean reduction of 0.10 days in intervention group LoS (95%CrI -0.16, -0.04)
 - **As control LoS increases, benefit of intervention on LoS increases.**
 - Slightly reduced heterogeneity ($\tau = 0.76$).

Causes of heterogeneity 2

- **Type of surgery**: cardiovascular / orthopaedic / 'other'
 - Reduced heterogeneity ($\tau=0.68$)
 - **Procedural info** = most effective intervention for orthopaedic surgery (MD -3.63 95%CrI -5.87, -1.34);
 - **Sensory info** for cardiovascular surgery (MD-1.50, 95%CrI- 3.12, 0.13)
 - **Behavioural instruction** for 'other' surgery (MD -1.06, 95% CrI -1.93, -0.30)
- Including **type of surgery** AND **control group mean** reduced heterogeneity further ($\tau=0.54$).

Conclusions

- Component network meta-analysis → quantify effects for individual intervention components (not possible with standard Cochrane analysis).
- Possible to control for other covariates to further understand heterogeneity.
- Can model how effects of intervention components vary with covariates.