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

MCHP MANCHESTER CENTRE FOR HEALTH PSYCHOLOGY

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

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Cochrane
Anaesthesia, Critical and Emergency Care

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?

Powell, Scott, Manyande, Bruce, Vögele, Byrne-Davis, Unsworth, Osmer, Johnston (2016). *Cochrane Database of Systematic Reviews, Issue 5, Art.No.: CD008646.*

Methods: inclusion criteria

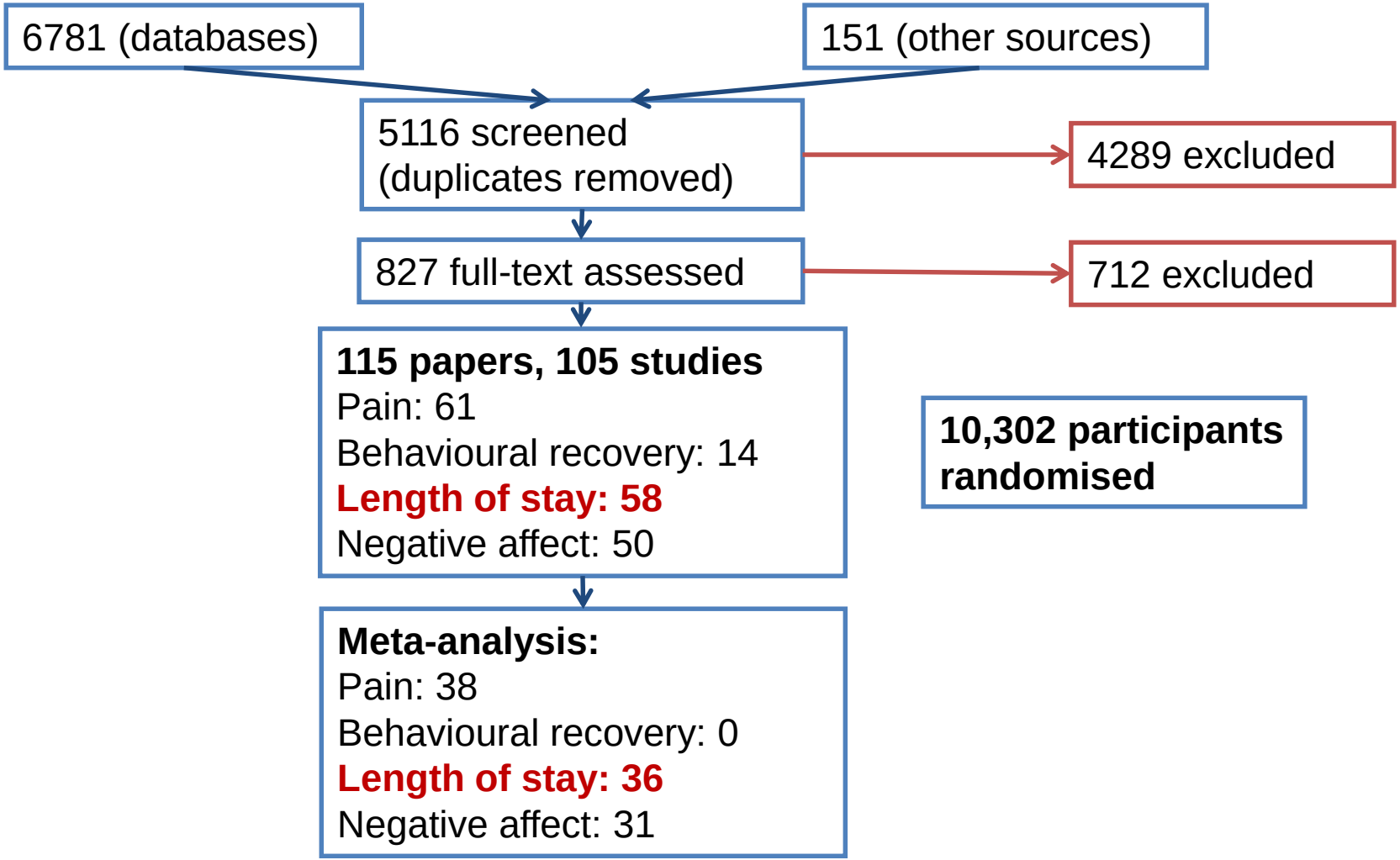
- Published and unpublished RCTs (NOT quasi-randomised); any language.
- Adults, elective surgery under general anaesthetic.

Intervention: pre-operative

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

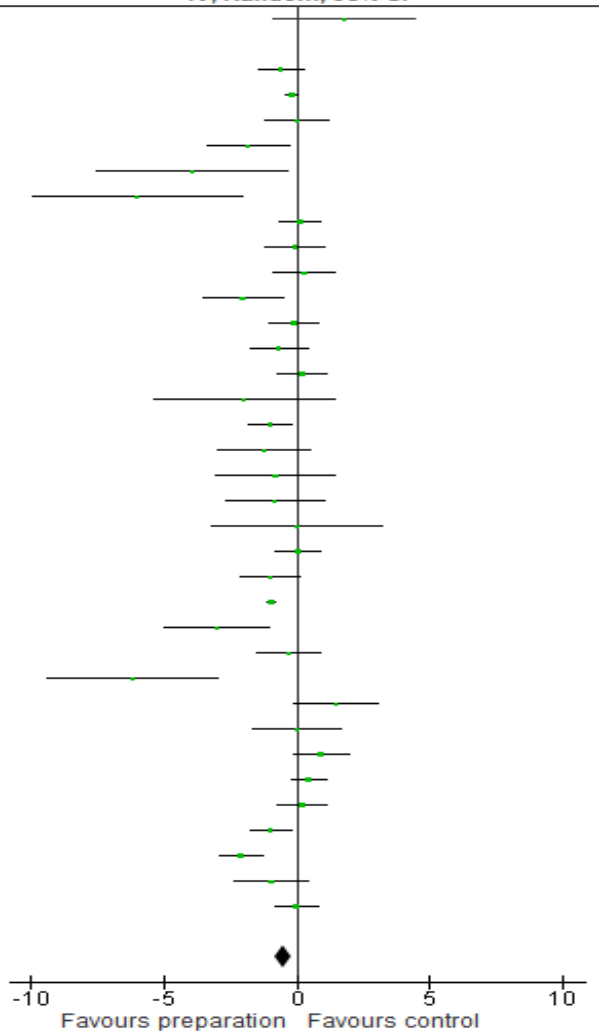
Outcomes: post-operative

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


6781 (databases)
151 (other sources)
5116 screened
(duplicates removed)
4289 excluded
827 full-text assessed
712 excluded
115 papers, 105 studies
Pain: 61
Behavioural recovery: 14
Length of stay: 58
Negative affect: 50
10,302 participants randomised
Meta-analysis:
Pain: 38
Behavioural recovery: 0
Length of stay: 36
Negative affect: 31

Study or Subgroup	Psychological preparation Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Ashton 1997	9.1	5.81	20	7.3	1.39	12	1.0%	1.80 [-0.86, 4.46]
Barbalho-Moulim 2011	2	0	15	2.11	0.33	17		Not estimable
Beaupre 2004	6.7	2.2	55	7.3	2.5	60	3.9%	-0.60 [-1.46, 0.26]
Bergin 2014a	2.5	0.6	50	2.7	0.6	56	5.6%	-0.20 [-0.43, 0.03]
Bitterli 2011	14.6	2.5	35	14.6	2.6	36	3.0%	0.00 [-1.19, 1.19]
Chaudhri 2005	8.29	2.39	18	10.11	2.39	18	2.2%	-1.82 [-3.38, -0.26]
Crowe 2003	6.55	4.2	68	10.5	14.2	64	0.6%	-3.95 [-7.57, -0.33]
Cuñado Barrio 1999	12	7	41	18	10	35	0.5%	-6.00 [-9.95, -2.05]
D'Lima 1996	6.195	1.03	20	6.08	1	10	4.2%	0.12 [-0.65, 0.88]
Daltroy 1998	12.5	2.97	58	12.575	2.97	54	3.2%	-0.07 [-1.18, 1.03]
Doering 2000	11.5	2.97	46	11.2	2.97	54	3.1%	0.30 [-0.87, 1.47]
Felton 1976	11.97	2.97	37	14	2.97	25	2.3%	-2.03 [-3.54, -0.52]
Fortin 1976	6.35	2.31	37	6.44	1.61	32	3.7%	-0.09 [-1.02, 0.84]
Furze 2009	7.61	2.69	100	8.28	4.96	104	3.3%	-0.67 [-1.76, 0.42]
Giraudet 2003	8.1	2.5	48	7.9	2.4	52	3.6%	0.20 [-0.76, 1.16]
Hulzebos 2006a	7.93	1.94	14	9.92	5.78	12	0.7%	-1.99 [-5.41, 1.43]
Lam 2001	7	1	30	8	2	30	4.1%	-1.00 [-1.80, -0.20]
Langer 1975	6.36	2.97	44	7.6	2.97	15	2.0%	-1.24 [-2.98, 0.50]
Leserman 1989	8.8	2.97	13	9.6	2.97	14	1.4%	-0.80 [-3.04, 1.44]
Levin 1987	7.563	2.331	16	8.371	3.148	17	1.8%	-0.81 [-2.69, 1.07]
Lin 2005	14.09	6.77	32	14.1	6.12	30	0.8%	-0.01 [-3.22, 3.20]
Lindeman 1973	6.7	2.56	90	6.65	3.18	86	3.9%	0.05 [-0.81, 0.91]
Mahler 1995	5.035	1.048	19	6.04	1.7	10	3.1%	-1.00 [-2.16, 0.15]
Mahler 1998	6.183	0.41	190	7.14	0.6	67	5.7%	-0.96 [-1.11, -0.80]
McGregor 2004	15	2.97	15	18	2.97	20	1.6%	-3.00 [-4.99, -1.01]
Oosting 2012	5.1	1	14	5.4	2.1	15	3.0%	-0.30 [-1.48, 0.88]
Rajendran 1998	12.4	3.6	25	18.6	6.6	20	0.7%	-6.20 [-9.42, -2.98]
Ridgeway 1982	10.325	2.97	40	8.82	2.97	20	2.2%	1.50 [-0.09, 3.10]
Schmitt 1973	11.8	2.97	25	11.8	2.97	25	2.1%	0.00 [-1.65, 1.65]
Shuldham 2002	10.07	5.04	162	9.15	4.38	152	3.4%	0.92 [-0.12, 1.96]
Watt-Watson 2000	5.585	1.292	29	5.13	0.99	16	4.5%	0.46 [-0.22, 1.13]
Watt-Watson 2004	6.8	5.9	202	6.6	3.1	204	3.7%	0.20 [-0.72, 1.12]
Wilson 1981	6.962	1.366	54	7.947	1.434	18	4.2%	-0.99 [-1.74, -0.23]
Zhang 2012	7.5	0.8	20	9.6	1.7	20	4.0%	-2.10 [-2.92, -1.28]
Ziemer 1982	8.12	3.563	71	9.08	3.563	40	2.6%	-0.96 [-2.34, 0.42]
Zieren 2007	3	2	50	3	2	50	4.1%	0.00 [-0.78, 0.78]
Total (95% CI)			**1803**			**1510**	**100.0%**	**-0.52 [-0.82, -0.22]**

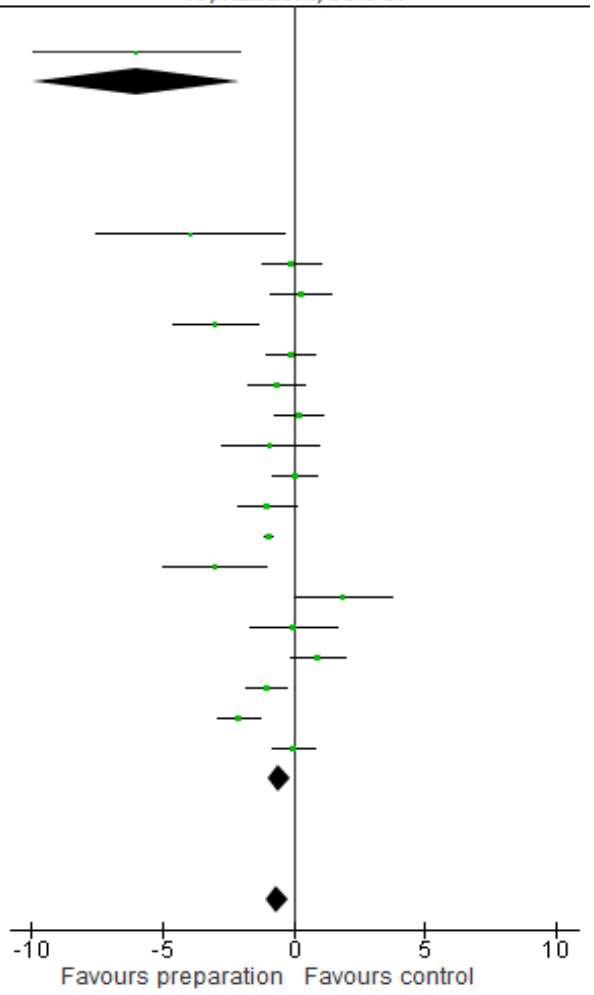
Heterogeneity: Tau² = 0.40; Chi² = 129.00, df = 34 (P < 0.00001); I² = 74%
Test for overall effect: Z = 3.39 (P = 0.0007)



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).

Study or Subgroup	Psychological preparation Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
2.2.1 Procedural information only								
Cuñado Barrio 1999	12	7	41	18	10	35	1.2%	-6.00 [-9.95, -2.05]
Subtotal (95% CI)			**41**			**35**	**1.2%**	**-6.00 [-9.95, -2.05]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 2.98 (P = 0.003)								
2.2.2 Procedural information plus other intervention(s)								
Crowe 2003	6.55	4.2	68	10.5	14.2	64	1.3%	-3.95 [-7.57, -0.33]
Daltroy 1998	12.5	2.97	58	12.575	2.97	54	5.9%	-0.07 [-1.18, 1.03]
Doering 2000	11.5	2.97	46	11.2	2.97	54	5.6%	0.30 [-0.87, 1.47]
Felton 1976	11	2.97	25	14	2.97	25	4.1%	-3.00 [-4.65, -1.35]
Fortin 1976	6.35	2.31	37	6.44	1.61	32	6.5%	-0.09 [-1.02, 0.84]
Furze 2009	7.61	2.69	100	8.28	4.96	104	5.9%	-0.67 [-1.76, 0.42]
Giraudet 2003	8.1	2.5	48	7.9	2.4	52	6.4%	0.20 [-0.76, 1.16]
Langer 1975	6.7	2.97	30	7.6	2.97	15	3.6%	-0.90 [-2.74, 0.94]
Lindeman 1973	6.7	2.97	90	6.65	2.97	86	6.7%	0.05 [-0.83, 0.93]
Mahler 1995	5.035	1.048	19	6.04	1.7	10	5.7%	-1.00 [-2.16, 0.15]
Mahler 1998	6.183	0.41	190	7.14	0.6	67	8.9%	-0.96 [-1.11, -0.80]
McGregor 2004	15	2.97	15	18	2.97	20	3.3%	-3.00 [-4.99, -1.01]
Ridgeway 1982	10.7	2.97	20	8.82	2.97	20	3.6%	1.88 [0.04, 3.72]
Schmitt 1973	11.8	2.97	25	11.8	2.97	25	4.1%	0.00 [-1.65, 1.65]
Shuldham 2002	10.07	5.04	162	9.15	4.38	152	6.1%	0.92 [-0.12, 1.96]
Wilson 1981	6.887	1.352	36	7.947	1.434	18	7.0%	-1.06 [-1.86, -0.26]
Zhang 2012	7.5	0.8	20	9.6	1.7	20	6.9%	-2.10 [-2.92, -1.28]
Zieren 2007	3	2	50	3	2	50	7.1%	0.00 [-0.78, 0.78]
Subtotal (95% CI)			**1039**			**868**	**98.8%**	**-0.57 [-1.01, -0.13]**
Heterogeneity: Tau² = 0.54; Chi² = 66.83, df = 17 (P < 0.00001); I² = 75%								
Test for overall effect: Z = 2.52 (P = 0.01)								
Total (95% CI)			**1080**			**903**	**100.0%**	**-0.63 [-1.08, -0.18]**
Heterogeneity: Tau² = 0.60; Chi² = 73.39, df = 18 (P < 0.00001); I² = 75%								
Test for overall effect: Z = 2.73 (P = 0.006)								
Test for subgroup differences: Chi² = 7.20, df = 1 (P = 0.007), I² = 86.1%								



Limitations of analysis

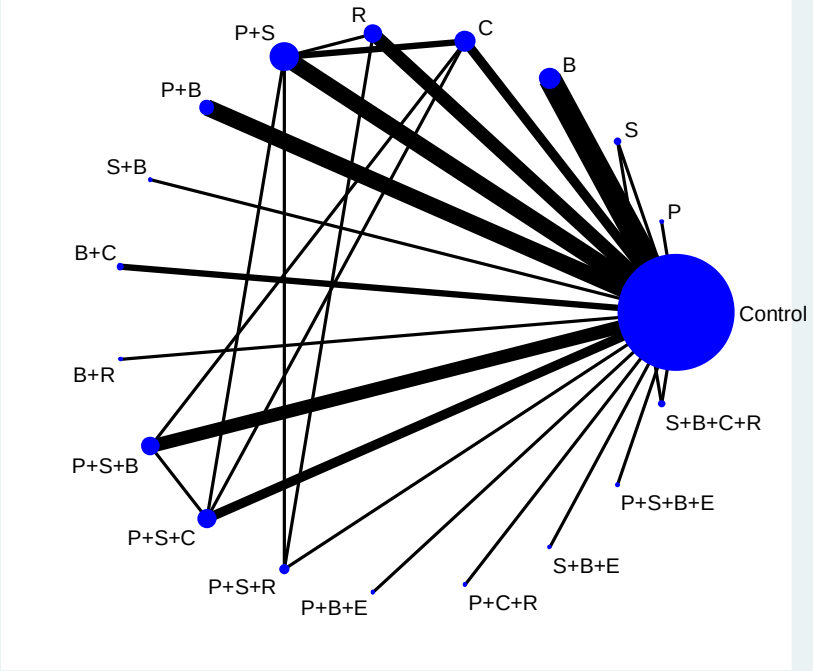
- Could not effectively unpick impact of individual intervention components.
  - Interventions comprised 1 to 4 components.
- Need to explore causes of heterogeneity.

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.

Freeman, S.C., Scott, N.W., Powell, R., Johnston, M., Sutton, A.J., Cooper, N.J. (In prep).

Length of stay network diagram



P = procedural information; S = sensory information; B = behavioural instruction; C = cognitive intervention; R = relaxation; E = emotion-focussed

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

- **P**rocedural info, **S**ensory info**, B**ehavioural instruction, **C**ognitive intervention & **R**elaxation 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 (τ=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 (τ =0.76).

Causes of heterogeneity 2

- **Type of surgery**: cardiovascular / orthopaedic / 'other'
  - Reduced heterogeneity (τ=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 (τ=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.