Using network meta-analysis to identify effective components of complex mental health interventions

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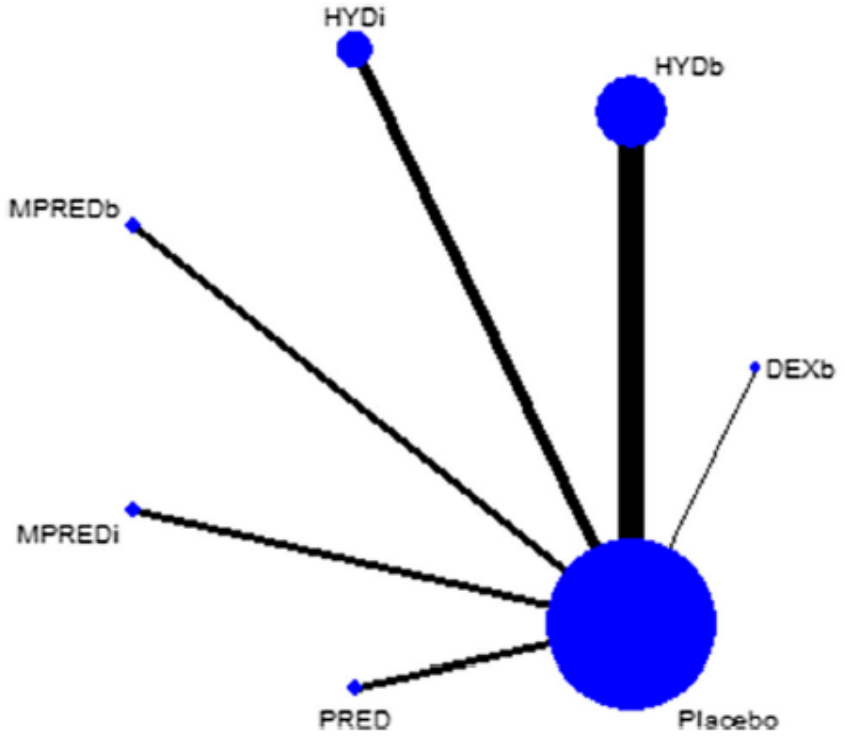
Network Meta-Analysis

- Network meta-analysis (NMA) allows pooling evidence on multiple interventions from a set of studies
- A “network” is constructed by displaying the interventions compared in each study
- Comparison of multiple interventions for a health condition enables to address relevant questions for practitioners and policy makers

Pair-wise vs. network meta-analysis

- Corticosteroids in septic shock
  - Annane and colleagues (2015) published a Cochrane review comparing the efficacy of **corticosteroids vs. placebo**
  - Gibbison and colleagues (2017) reanalysed the data from the review and conducted a **NMA to examine each corticosteroid separately**



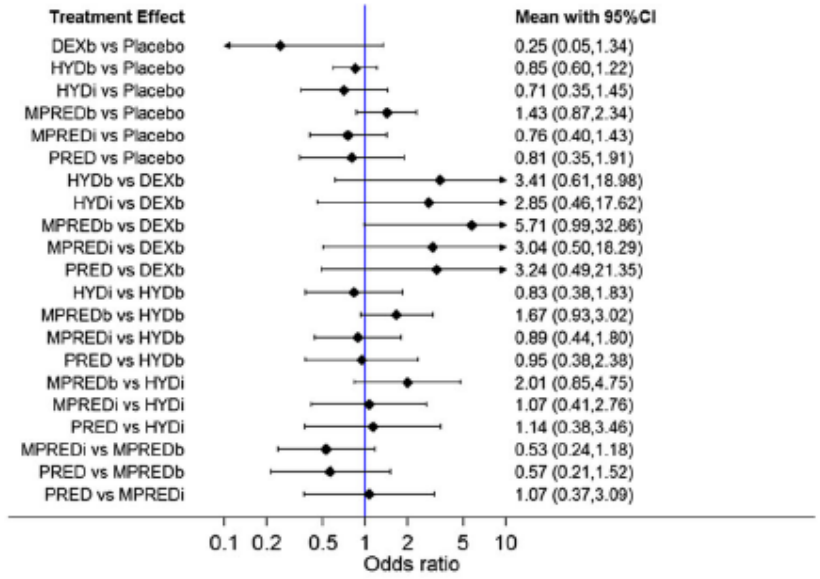


Fig. 2 Network plot (*left*) and network meta-analysis results (*right*) of mortality up to 28 days for the different interventions. ORs <1 favour the first intervention. *DEXb* Dexamethasone bolus, *HYDb* Hydrocortisone bolus, *HYDi* Hydrocortisone infusion, *MPREDb* Methylprednisolone bolus, *MPREDi* Methylprednisolone infusion, *PRED* Prednisolone

Complex interventions for mental health

- Systematic reviews of interventions in mental health and other areas often deal with **complex interventions** which include several active ingredients or “components”
- If each combination of components is considered as a separate intervention, then NMA could be used to simultaneously compare the different interventions
- However, this could lead to a very large number of interventions (and possibly to disconnected networks)

Component-Level NMA

- Component-level network meta-analysis methods have been developed within a Bayesian framework (Welton et al., 2009)
- Component-level NMA may be used to examine
  - Role of each individual component
  - Interactions between multiple components

Example 1: CBT for adult depression

- Depression represents a substantial public health concern worldwide
- Cognitive-Behavioural Therapy (CBT) is an effective psychological intervention for depression
- CBT interventions are complex
  - Multiple content components
  - Delivered in different ways

Example 1: Systematic review

- Inclusion criteria:
  - Randomised controlled trials
  - Examining CBT interventions
  - In depressed adults
- Primary outcome: Change in depressive symptoms at short term
- Effect size index: standardised difference in mean change (sDIMC)

Example 1: Included studies

- 91 studies reported one or more relevant outcomes
- Primary outcome: 76 studies, 6973 patients
- Large variability in
  - Publication year
  - Study size
  - Country

Example 1: Definition of comparators

- Treatment as Usual (TAU): 38 interventions
- No treatment: 7 interventions
- Wait list: 33 interventions
- Psychological/attention placebo: 14 interventions

Example 1: defining components

- Cognitive Techniques
- Behavioural Activation
- Psychoeducation
- Homework
- Problem Solving
- Social Skills Training
- Relaxation
- Goal Setting
- Final Session
- Mindfulness
- Acceptance & Commitment Therapy

Example 1: delivery methods

- Face-to-Face (F2F) CBT: 100 interventions
- Hybrid CBT: 7 interventions
- Multimedia CBT: 33 interventions

Example 1: Network meta-analysis models

- Full Interaction Model
- Main Effects Model
- Therapy Effects Model

Example 1: Full Interaction Model

- Standard Bayesian NMA (Dias et al., 2013)
- Each delivery format and combination of components is a unique intervention

Example 1: Main Effects Model

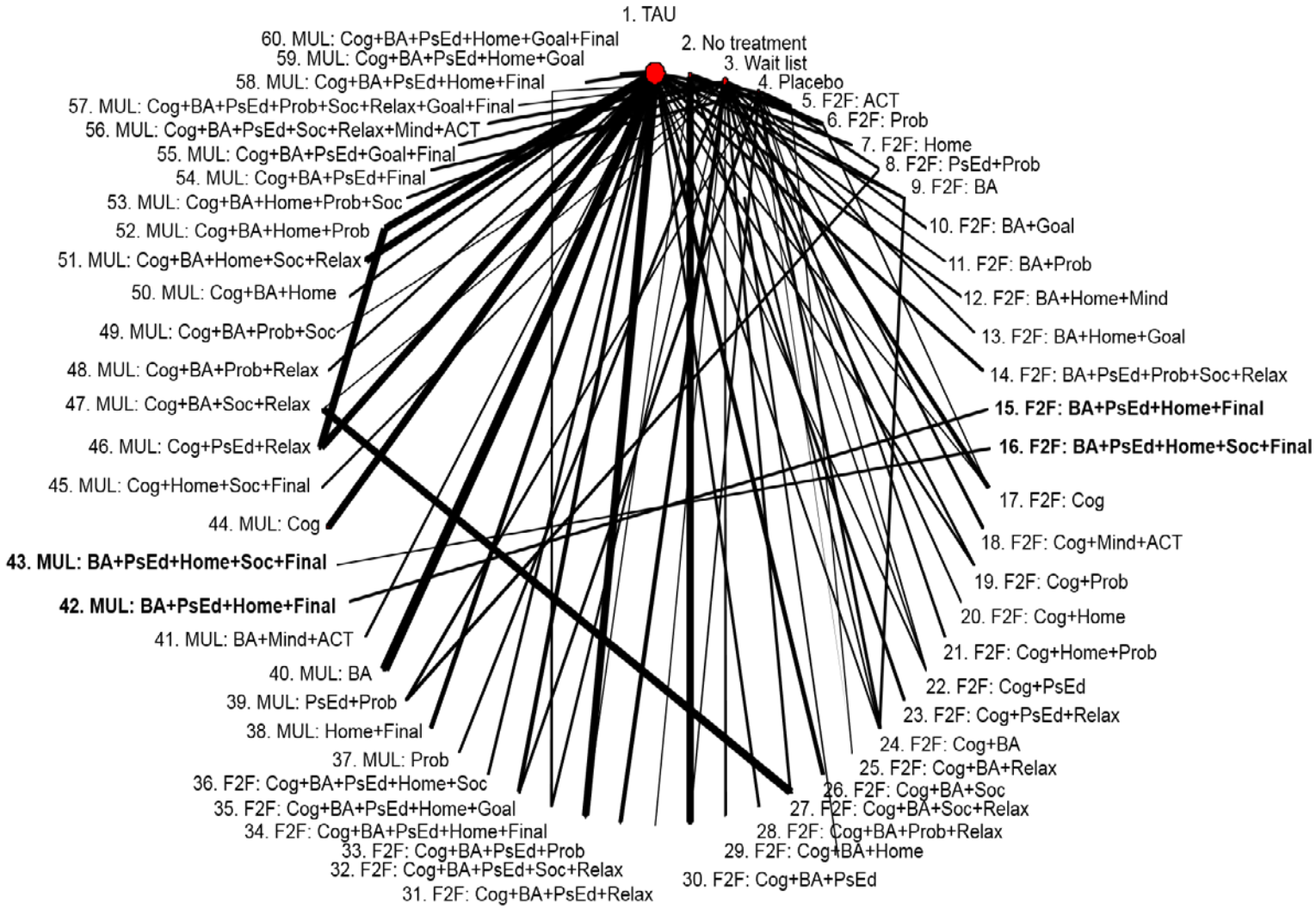
For a continuous outcome, treatment effect d_t is estimated from:

$$d_t = d_{CBT} + \beta_1 Multi_t + \beta_2 * Cog_t + \beta_3 * BA_t + \beta_4 * PsEd_t + \beta_5 * Home_t + \beta_6 * Prob_t + \beta_7 * Soc_t + \beta_8 * Relax_t + \beta_9 * Goal_t + \beta_{10} * Final_t$$

Example 1: Therapy Effects Model

- Standard Bayesian NMA (Dias et al., 2013)
- Treatments included
  - TAU
  - No treatment
  - Wait list
  - Psychological/Attention placebo
  - Face-to-face CBT
  - Hybrid CBT
  - Multimedia CBT

Example 1: Results for Full Interaction Model



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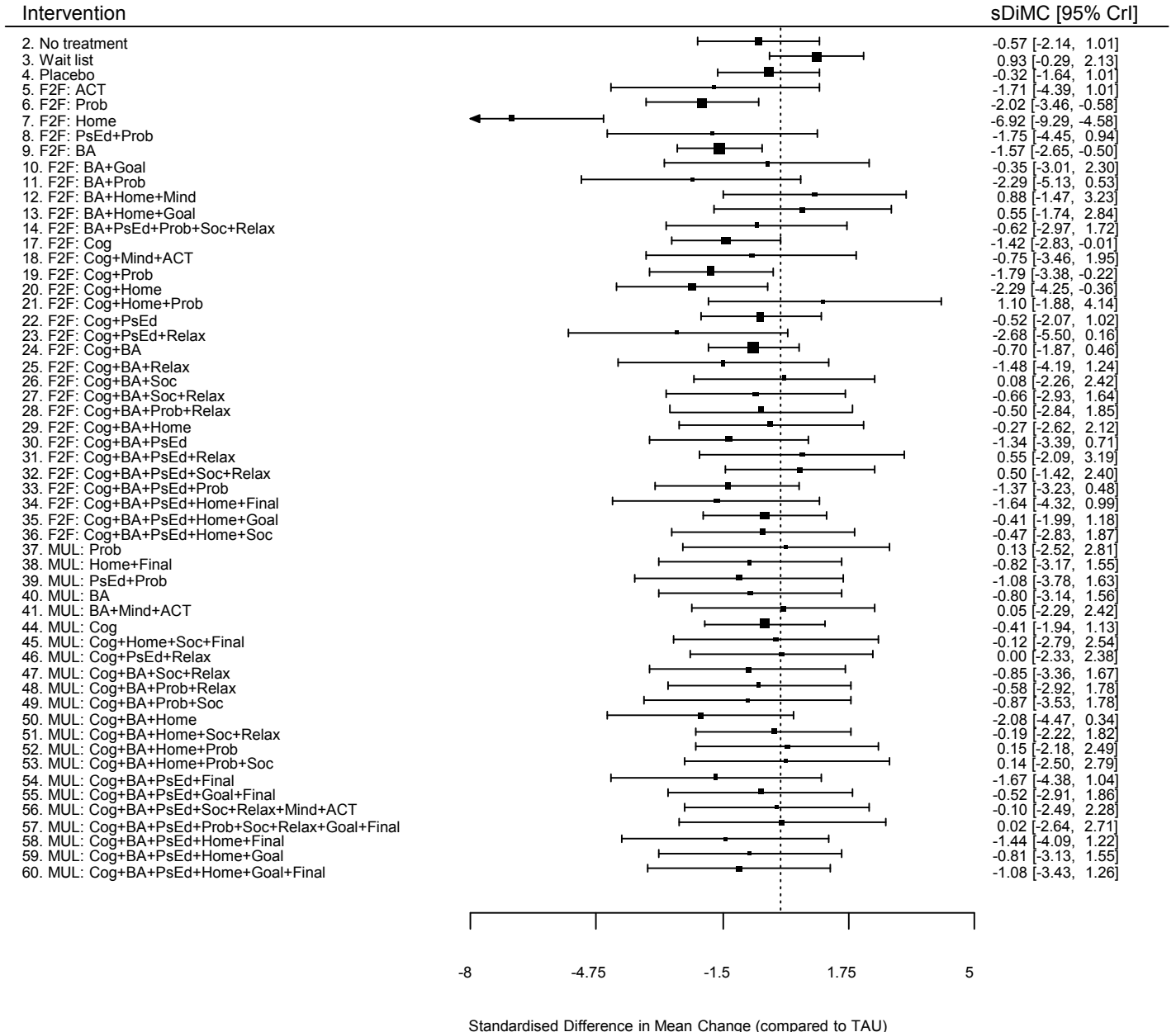

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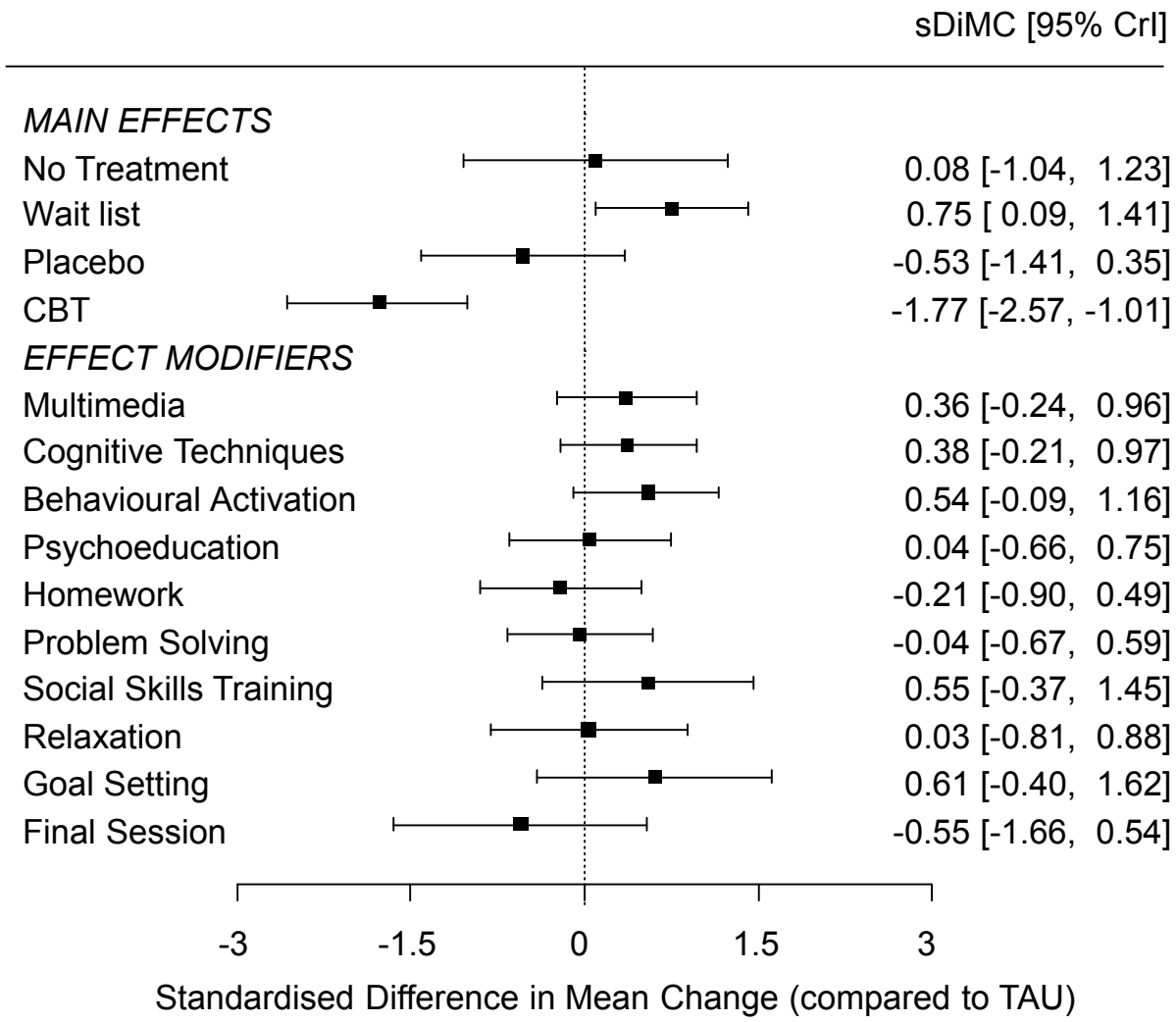
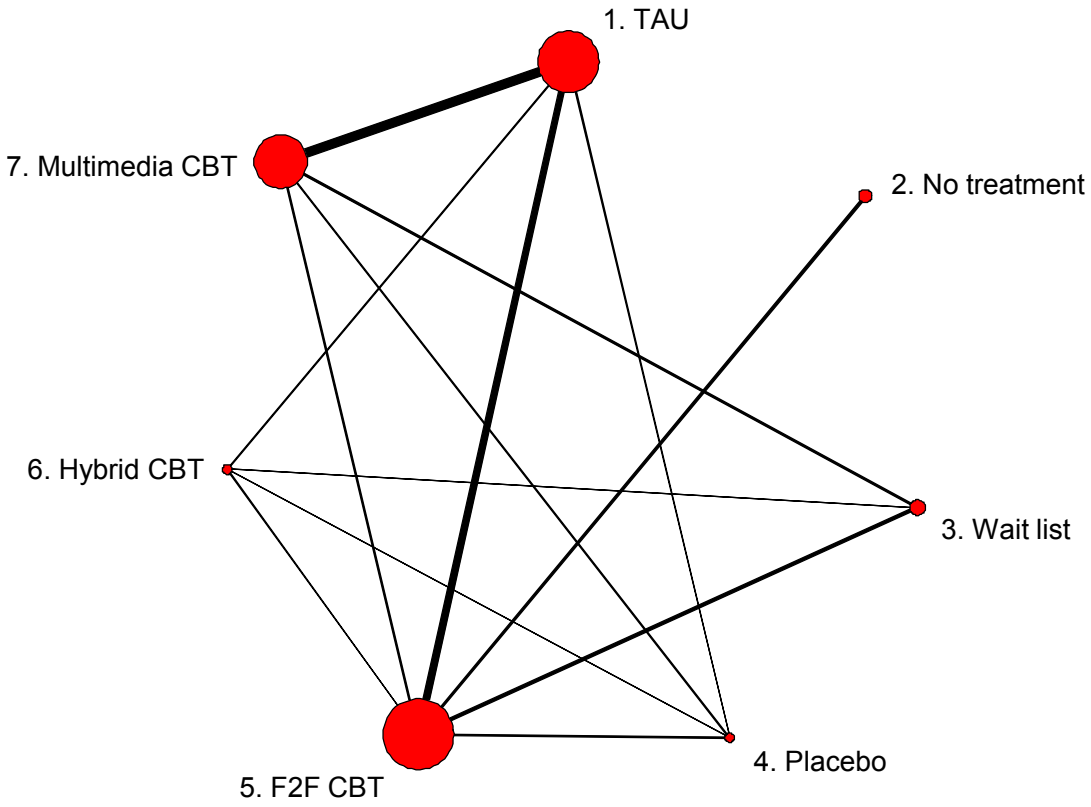
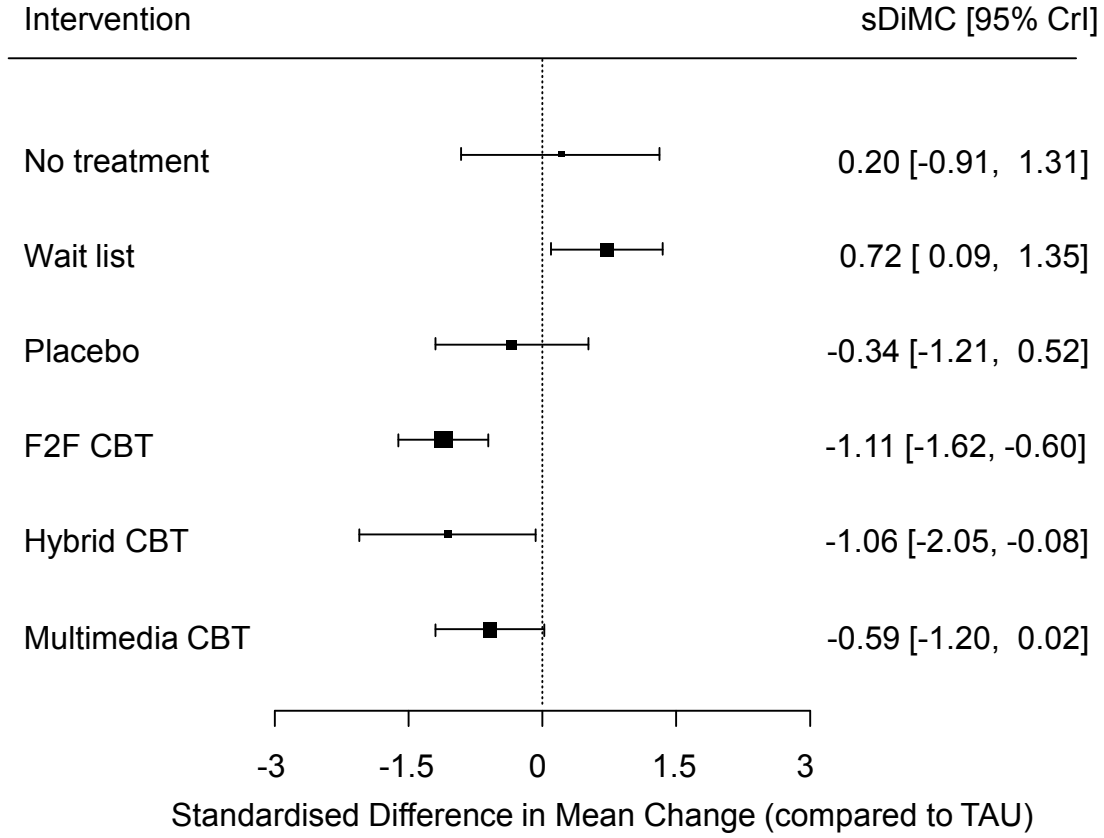


Example 1: Results for Therapy Effects Model





Example 2: School-based interventions to prevent mental-ill-health in children and young people

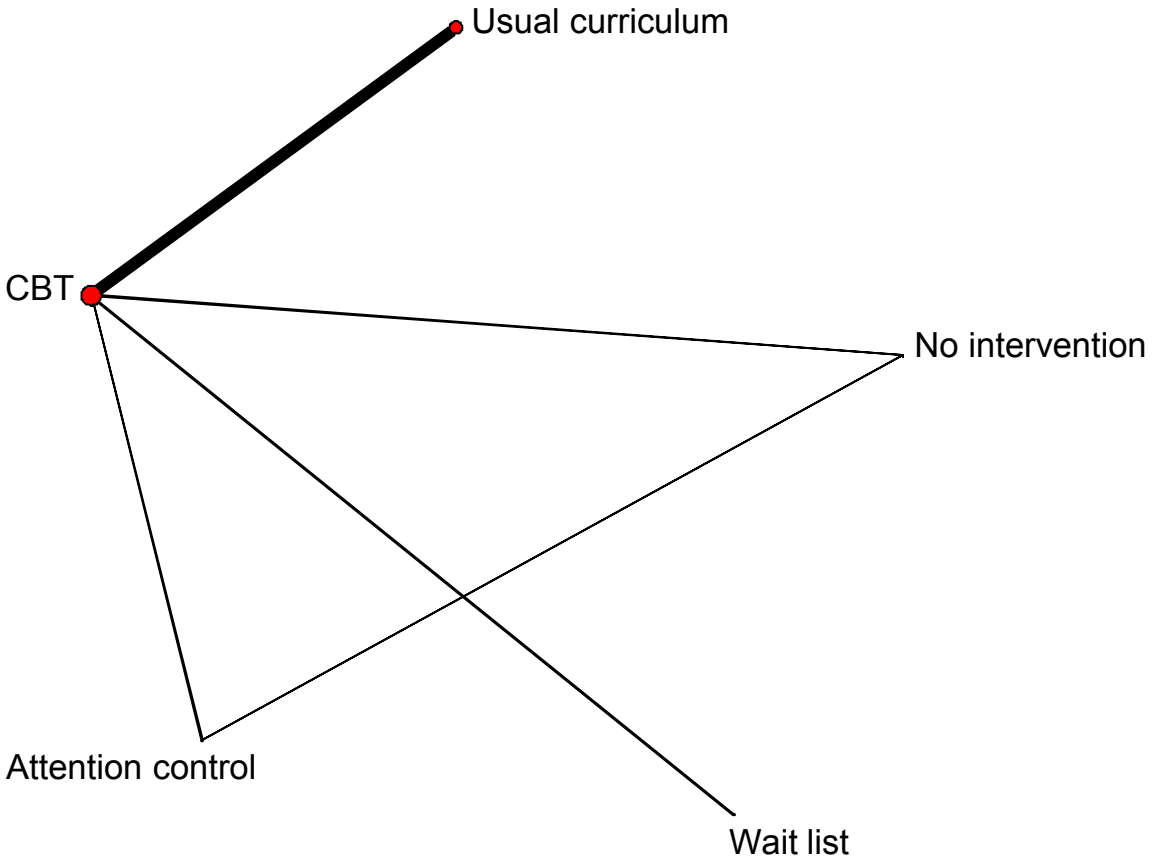
- Aim: to identify the most effective and cost-effective intervention component(s), or combination of components for prevention of common mental health problems in children and young people
- Protocol available at http://www.crd.york.ac.uk/prospero/display_record.php?RecordID=48184&VersionID=75497

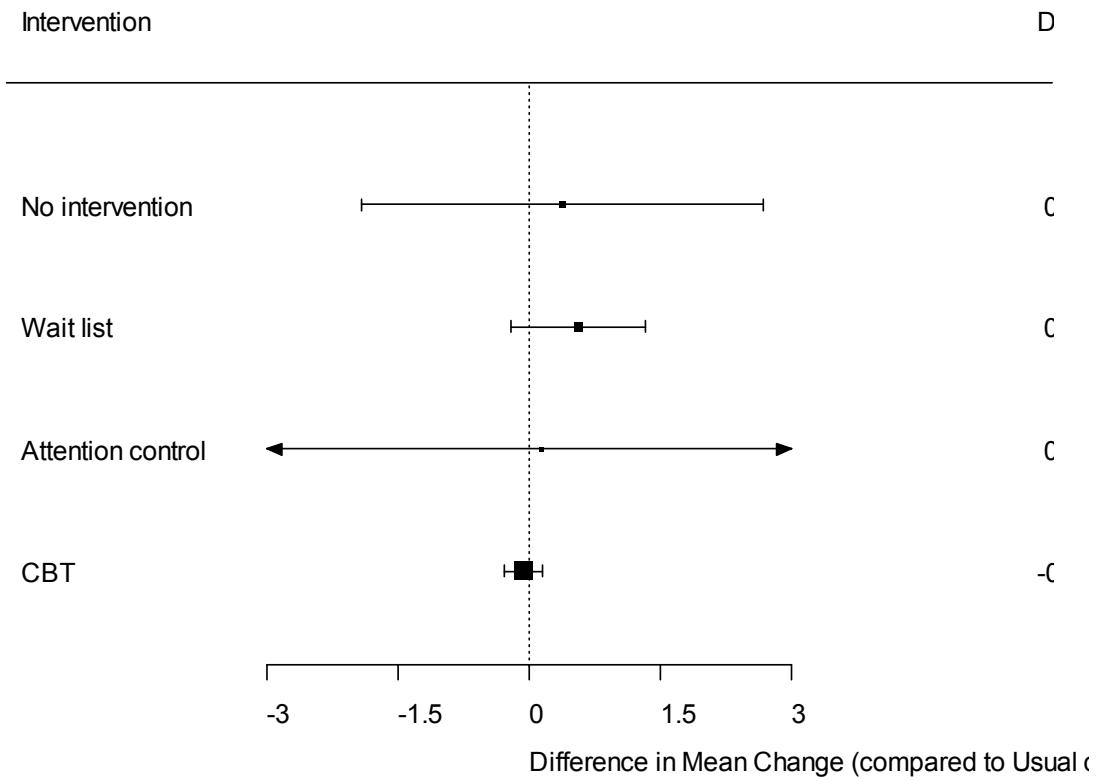
Example 2: School-based interventions to prevent mental-ill-health in children and young people

- Main outcomes
  - Self-reported anxiety
  - Self-reported depression
  - Conduct problems
- Effect size index: standardised difference in mean change (sDIMC)
- To be considered separately:
  - Population: universal, targeted (selective/indicated)
  - Context: primary, secondary, university
  - Time point

Example 2: results for therapy effects model

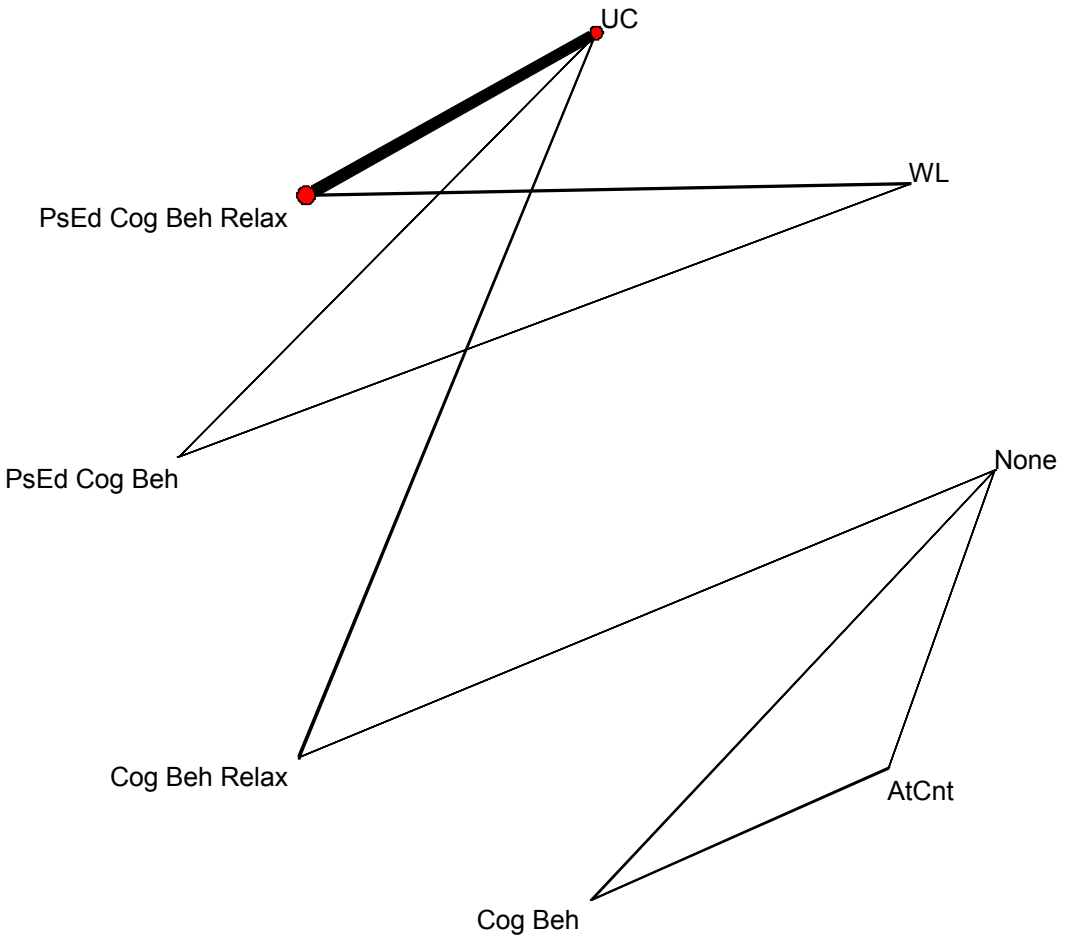
- Change in depression scores at mid term, universal, primary

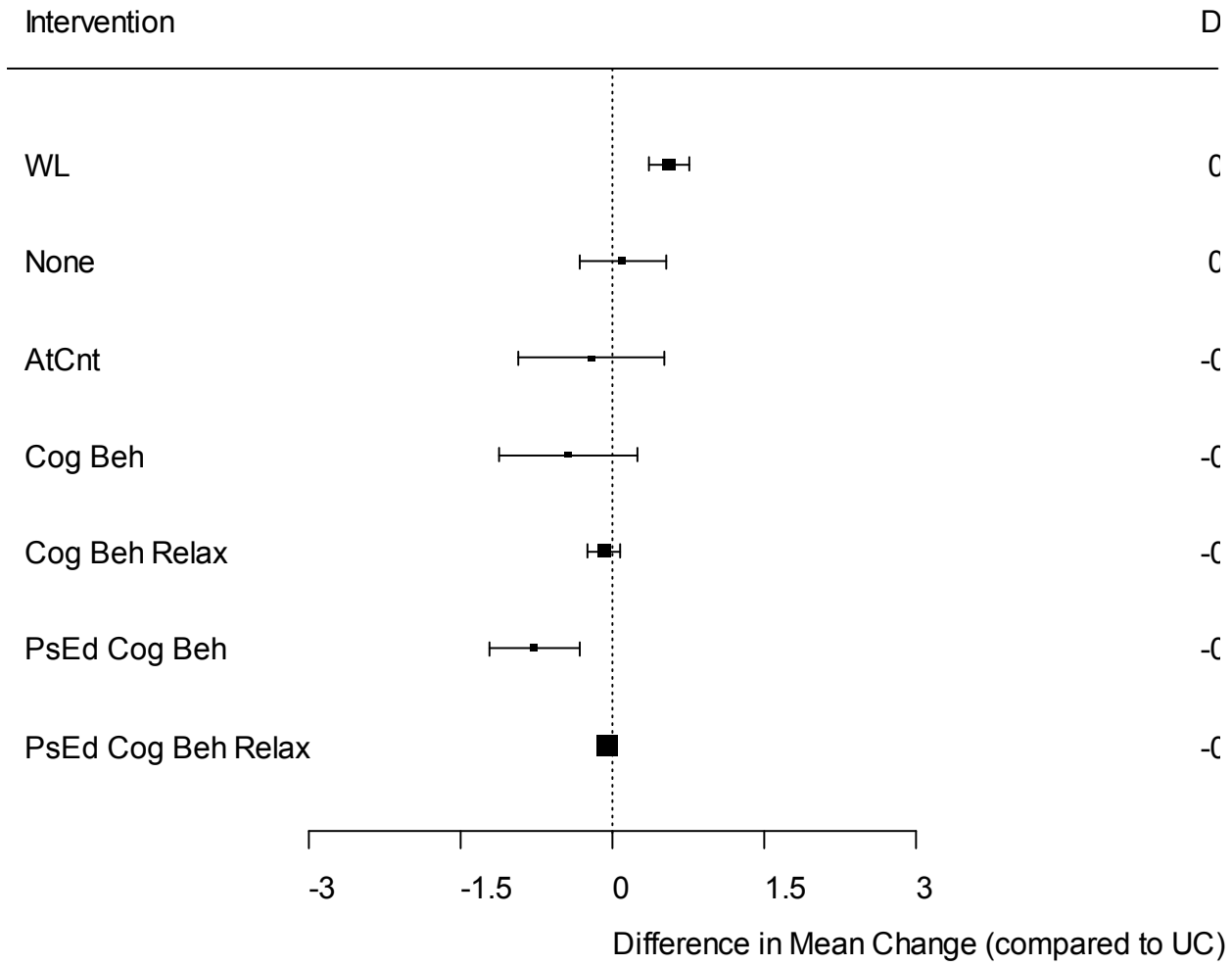




Example 2: results for full interaction model

- Change in depression scores at mid term, universal, primary





UC: Usual Curriculum; WL: Wait List; AtCnt: Attention Control; Cog: Cognitive; Beh: Behavioural; Relax: Relaxation; PsEd: Psychoeducation

Conclusions

- Component-level NMA is a promising approach with the potential to address relevant policy questions
- Adequate reporting of interventions is essential, as we rely on primary studies to characterize each intervention
- Further steps
  - Use Main Effects model to identify effective components
  - Simulation work to determine sample size required to obtain precise results

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