




Decluttering Minds: Psychological interventions for hoarding disorder - A systematic review and meta-analysis

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ABSTRACT

Background: Cognitive Behavioural Therapy (CBT) is conventionally considered the primary intervention for Hoarding Disorder (HD), yet various psychological interventions have recently emerged. This study, pre-registered at Prospero ([CRD42023427534](https://doi.org/10.1111/CRD4.2023427534)), aims to comprehensively assess a range of psychological interventions, including CBT, for reducing HD symptomatology.

Methods: A systematic literature search using PubMed and SCOPUS identified 41 eligible studies comprising 47 samples ($N = 1343$). Risk of bias for RCTs was assessed using the Cochrane RoB2 tool, and methodological quality for all studies was evaluated using the Psychotherapy Outcome Study Methodology Rating Form (POMRF).

Results: Pre-post effects revealed a large reduction in HD symptomatology ($g = -1.09$), sustained at follow-up in 18 studies ($g = -1.12$, $N = 588$). Additionally, 8 Randomized Controlled Trials (RCTs) demonstrated a substantial end-of-trial reduction in HD symptoms compared to controls ($g = -0.75$). Meta-regression found no moderating effects for: demographics, medication use, number of treatment sessions, or study quality. Similarly, no differences were observed between group and individual therapy, therapy with or without home visits, or CBT versus other psychological interventions.

Conclusion: This study confirms psychological therapies are effective in reducing hoarding symptoms, while indicating no superiority for CBT. Despite the benefits, symptoms often persist above the clinical cut-off for HD, highlighting the enduring clinical challenges in achieving symptomatic remission. The findings underscore the need to address methodological limitations and possible age and gender bias in future research to enhance the efficacy and inclusivity of psychological interventions for HD.

1. Introduction

Hoarding disorder (HD) presents a unique set of challenges characterised by excessive saving behaviours and difficulty discarding items, leading to profound distress and functional impairment. Initially recognised as a distinct psychiatric disorder by Frost and Hartl in 1996, HD gained diagnostic status in the DSM-5 in 2013. The prevalence of HD is estimated to be around 2.5% (Postlethwaite et al., 2019), with increasing severity observed with age (Dozier et al., 2016; Roane et al., 2017; Cath et al., 2017).

Psychological interventions play a crucial role in the multi-faceted approach to HD treatment. Among the various psychological interventions, Cognitive Behavioural Therapy (CBT) is the primary approach, involving sessions on sorting, discarding, exposure tasks, cognitive restructuring, and skill-building in decision-making, problem-

solving, and time management. Three meta-analyses (Tolin et al., 2015; Bodryzlova et al., 2019; Rodgers et al., 2021) have demonstrated the effectiveness of CBT, reporting substantial pre-post symptom reductions, with effect sizes ranging from 0.82 to 1.11. Specific hoarding symptoms, including clutter, difficulty discarding, and acquiring, also showed large effect sizes in response to CBT (Tolin et al., 2015).

The influence of moderator variables on CBT outcomes has undergone extensive scrutiny in prior meta-analyses, yielding occasionally inconsistent results. Bodryzlova et al. (2019) highlighted age as a significant predictor, noting that older samples exhibited greater effects. In contrast, Tolin et al. (2015) reported that samples with higher proportions of younger individuals and women showed superior outcomes. Moreover, they further reported that a greater number of CBT sessions and home visits were associated with improved outcomes, and patients on psychiatric medications demonstrated better outcomes in difficulty

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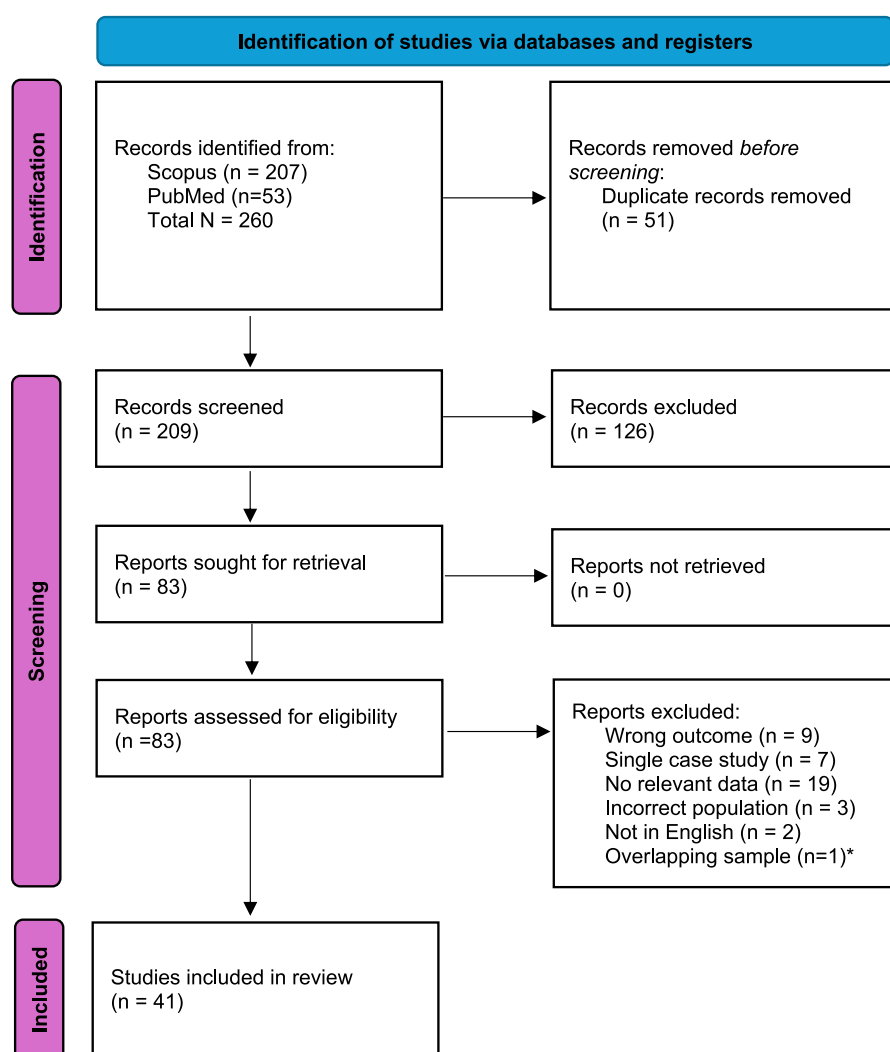
0022-3956/Crown Copyright © 2024 Published by Elsevier Ltd. All rights are reserved, including those for text and data mining, AI training, and similar technologies.

discarding. In a more recent meta-analysis by [Rodgers et al. \(2021\)](#), age did not moderate CBT effect sizes, but studies with a higher percentage of female participants correlated with more substantial effects. No significant moderating effects were found for treatment modality, therapist training, use of home visits, trial type, number of treatment weeks, or study quality. So, while age and gender may influence outcomes, the results are inconsistent, and many other factors have not been shown to significantly impact the effectiveness of CBT in HD. One limiting factor of previous meta-analyses is the small numbers of studies included, not just at estimating mean effect size but particularly when conducting meta-regression and subgroup analyses of potential moderator variables. Referring to the latter, the Cochrane group ([Thomas et al., 2023](#)) have suggested a minimum of 10 studies are required or a reliable meta-regression and at least 5 studies per group when running sub-group analyses. The previous meta-analyses by [Tolin et al. \(2015\)](#), [Bodryzlova et al. \(2019\)](#) and [Rodgers et al. \(2021\)](#) have no more than $K = 10$, 7 and 16 studies respectively, potentially limiting the reliability of the moderator analyses in previous meta-analyses.

Beyond CBT, other psychological interventions have been explored, although less frequently. Acceptance and Commitment Therapy (ACT) and Cognitive Rehabilitation and Exposure/Sorting Therapy (CREST)

have shown promise. ACT targets psychological inflexibility seen in hoarding, emphasizing making choices based on meaningful values. CREST, developed by Ayers et al. (2014) incorporates exposure therapy and cognitive training to address cognitive impairments associated with HD. Additionally, other interventions such as inference-based therapy, compassion-focused therapy, rational emotive behavioural therapy, peer-led groups, and virtual reality (VR) have also been used. Trials of other psychological interventions such as these have not been previously meta-analysed.

HD poses significant challenges for both affected individuals and mental health professionals. While CBT has been extensively studied as the primary psychological treatment for HD, this meta-analysis seeks to enhance comprehension by evaluating diverse psychological interventions. Several new CBT trials have been published since [Rodgers et al. \(2021\)](#) and so, would better estimate effect size at end-of-trial and at follow-up. Additionally, new analyses of more studies would crucially aid in determining the robustness of moderator variables. The current meta-analysis will also provide the first comparison of effect sizes for CBT and non-CBT psychological interventions; and finally, the first analysis of effect sizes from RCTs. This meta-analysis also aims to assess a broad range of potential moderator variables, including age, gender,



Note. *Muroff et al (2014) is a follow up of Steketee et al (2010)

Fig. 1. Prisma flow diagram depicting study selection and inclusion process.

publication year, individual vs. group therapy, and the use of home visits, to understand their potential impact on intervention outcomes. Given the evolving research landscape around HD interventions, timely updates to meta-analyses are crucial for informing clinical practice.

2. Method

The systematic review and meta-analysis was pre-registered with *International Prospective Register of Systematic Reviews*: PROSPERO (CRD42023427534). The review adhered to best-practice guidelines as outlined in the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) guidelines (Moher et al., 2009) – See Fig. 1.

2.1. Literature search and study selection

PubMed and Scopus were searched from inception to December 20, 2023, with reference lists of relevant reviews on hoarding also hand-searched. The search terms used were: (hoarding AND disorder) AND (intervention). We also searched the grey literature for unpublished articles using OpenGrey repository (<https://www.greynet.org/opengreyrepository.html>).

The criteria for studies to be included in this meta-analysis were as follows: a) participants have hoarding disorder as defined by the DSM-5, or hoarding symptoms (for studies predating DSM-5); b) the study includes a psychological intervention targeting hoarding disorder c) the study reports scores for a hoarding symptom severity measure i.e. the Saving Inventory – Revised (SI-R (Frost et al., 2004) or Hoarding Rating Scale (HRS; (Tolin et al., 2010)); and d) the study is written in English.

Data were independently extracted from the included studies by both reviewers (EOB and KRL) into an Excel spreadsheet. The focus was on hoarding symptom severity as the outcome measured by the Saving Inventory-Revised (SI-R) before and after psychological interventions (only one study assessed symptom severity through the HRS). Additional extracted information encompassed the following: study design, intervention type, duration of intervention, occurrence and frequency of home visits, participant demographics (age, gender), comorbidity, medication status, and the geographical location of the study.

2.2. Meta-analyses

The study utilized *Comprehensive Meta-Analysis Version 4* (Borenstein, 2022) to conduct analyses. For randomised controlled trials (RCTs) with control groups, end-of-trial Hedge's g effect sizes were calculated for hoarding symptomatology scores. Studies without control groups underwent pre-post effect size calculations using Hedge's g , with sensitivity analyses considering correlations of 0.3, 0.5, or 0.7. All analyses employed random-effect models.

Heterogeneity was assessed using the I^2 statistic and interpreted using Cochrane guidance (Cumpston et al., 2019) where 0%–40% might not be important, 30%–60% may represent moderate heterogeneity, 50%–90% may represent substantial heterogeneity, and 75%–100% represents considerable heterogeneity. Effect sizes were interpreted according to Cohen's (1992) criteria, with 0.2 considered small, 0.5 moderate, and 0.8 large.

For meta-regression and subgroup analyses, we followed the recommendations (Fu et al., 2011) of no fewer than 10 studies for a continuous variable and at least four studies per group for a categorical subgrouping variable. Funnell plots were visually inspected for small study effects and possible publication bias; and if present, we examined them further using Duval and Tweedie's trim and fill analysis (Duval and Tweedie, 2000).

2.3. Risk of bias and study quality

We assessed the risk of bias in RCTs using the Cochrane Risk of Bias tool version 2.0 (RoB2; Sterne et al., 2019). The RoB2 assesses bias that

may arise across five domains: bias from randomisation, deviations from intended interventions, missing outcome data, outcome measurement and bias in the selection of reported results.

All studies were assessed for quality using the *Psychotherapy Outcome Study Methodology Rating Form* (POMRF) (Öst, 2008). This 22-item measure was specifically designed to assess psychotherapy interventions. The items assess: (1) clarity of sample description, (2) severity/chronicity of the disorder, (3) representativeness of the sample, (4) reliability of the diagnosis in question, (5) specificity of outcome measures, (6) reliability and validity of outcome measures, (7) use of blind evaluators, (8) assessor training, (9) assignment to treatment, (10) design, (11) power analysis, (12) assessment points, (13) manualized, replicable, specific treatment programs, (14) number of therapists, (15) therapist training/experience, (16) checks for treatment adherence, (17) checks for therapist competence, (18) control of concomitant treatments, (19) handling of attrition, (20) statistical analyses and presentation of results, (21) clinical significance, (22) equality of therapy hours (for non-WLC designs only). Each item is rated as 0 = poor, 1 = fair, and 2 = good. The questionnaire shows good internal consistency (Cronbach's $\alpha = .86$); and inter-rater reliability for the scale is also good (Kappa coefficient mean = 0.75).

The mean POMRF quality score across all studies included here was 19.84 ($SD = 4.95$), with a range of 12–32. A systematic review by (Swain et al., 2013) has suggested that POMRF scores might be classified as: (range 0–9) *well below average study quality*; (range 10–17) *below average study quality*; (range 18–26) *above average study quality*; and (27 or greater) *well above average study quality*. Such a classification would rate the current studies as overall 'above average quality'. A finer breakdown shows that none were rated as "well below average"; 17 were "below average"; 26 were "above average" and 4 were "well above average".

3. Results

[Insert Fig. 1 about here]

3.1. Summary of literature search

Table 1 summarises the key characteristics of the 41 included studies (47 samples: $N = 1343$). Among these, eight studies (involving 10 comparisons) used a randomised controlled trial (RCT) design, with a total of $N = 278$ participants in psychological interventions and $N = 211$ controls. Fifteen studies reported follow-up scores, contributing to 18 effect sizes ($N = 588$). The overall mean age across all samples was 55.31, with most participants being women (76.5%) (see Table 1).

The psychological interventions employed included: CBT ($n = 32$), Cognitive Rehabilitation and Exposure/Sorting Therapy (CREST, $n = 4$), Acceptance & Commitment Therapy (ACT, $n = 3$), Inference Based Therapy and Virtual Reality (IBT + VR, $n = 1$), virtual ($n = 1$), exposure therapy ($n = 1$), Compassion Focussed Therapy (CFT, $n = 1$), Rational Emotive Behavioural Therapy (REBT, $n = 1$), Peer Facilitated Therapy (PFT, $n = 1$), Social Cognition and Intervention Training ($n = 1$) psychoeducation/workshop ($n = 1$). Fifteen studies reported follow-up scores, with 3 studies having 2 intervention groups, giving 18 effect sizes. A total of $N = 1315$ participants were tested at post-test and $N = 588$ at follow-up. Sensitivity analyses for pre-post effect size calculations identified no substantive differences for correlations of 0.3, 0.5, or 0.7 and so, we present the findings for 0.5.

3.2. RCTs

Eight studies (with 10 conditions) had a RCT design covering various psychological interventions: CBT (Steketee et al., 2010; Muroff et al., 2012; Tolin et al., 2019) Inference based therapy and VR (St-Pierre-Delorme and O'Connor, 2016); Exposure response therapy (Ayers, Dozier, Twamley, et al., 2018a); educational workshops (Aso et al., 2022); ACT (Fang et al., 2023; Krafft et al., 2023) and REBT (Fang

Table 1
Included studies.

Study Name	N	Intervention	Session summary	Group vs. Individual Session	Mean Age	% Female	Medication status	Home visits (no.)	Country of study	Design
Tolin et al. (2007)	10	CBT	26 sessions (7–12 months)	Individual	49.2	100	Not medicated	6	US	Pre-Post
Muroff et al. (2009)	32	CBT	Weekly 2-hr group (16–20 wks) 2 × 1.5 h home visits (wk 3 and 12)	Group & individual	53	90.6	N/A	2	US	Pre-Post
Muroff et al. (2010)	23	CBT	Online group for HD, members must post to show they are actively taking steps to reduce hoarding.	Group	49.73	92.7	87.50%	0	US	Self-identified Hoarders Non-random vs waitlist
Steketee et al. (2010)	41	CBT	26 × 1 h sessions (av. 44.8cwks 28–77), every 4th session 2hrs in home	Individual	54.5	75	0% in last month	6	US	RCT vs waitlist
Turner et al. (2010)	6	CBT	Some office visits & mainly in-home sessions approx weekly for 1.5–2hrs over 11–13 months	Individual	72	83	66%	35	US	Pre-Post
Ayers et al. (2011)	12	CBT	26x sessions, 2x weekly for first 20 sessions (16–17wks)	Individual	73.66	58	58.33%	6	US	Pre-Post
Frost et al. (2011a)	17	BiT (CBT)	13 × 2hr sessions, followed BiT chapters	Group	53.7	88.24	71%	0	US	Pre-Post
Frost et al. (2011b)	11	BiT (CBT)	13 × 2hr group sessions, followed BiT chapters	Group	61.3	81.81	55%	0	US	Pre-Post
Gilliam et al. (2011)	26	CBT	16x or 20x weekly 1.5hr sessions	Group	55.06	85.7	74%	0	US	Pre-Post
Frost et al. (2004)	37	BiT (CBT)	13x weekly sessions, peer facilitated, sessions followed BiT chapters	Group	57.0	94.4	24%	0	US	Pre-Post
Muroff et al. (2012)	11	CBT	Weekly 2hr sessions (20wks) with 8 × 1.5hr home visits	Group	55.0	90.9	Stable on meds	8	US	RCT: GCBT w/ non-clinician home; GCBT without HA or bibliotherapy As above
Muroff et al. (2012)	14	CBT	Weekly 2hr sessions (20wks) with 4 × 1.5hr home visits	Group	54.71	64.3	Stable on meds	4	US	
Tolin et al. (2012)	6	CBT	16x weekly 1.5hr sessions following CBT protocol	Group	52.83	33.3	17%	0	US	Non-random vs healthy controls
Ayers et al. (2014)	11	CREST	Cognitive rehab & exposure - 24 × 1hr sessions (22wks) with 3–6 home visits dependent on patient	Individual	66	81	18%	5	US	Pre-Post
Kellman-McFarlane et al. (2019)	14	CBT	12 × 2hr in home sessions for hoarders with mild intellectual disabilities	Individual	41.78	35.71	Stable on medications	12	UK	Pre-Post
Mathews et al. (2016)	31	CBT	16 × 2hr session (20wks) & 2 home visits	Group	41–60	48.3	N/A	2	US	Pre-Post – given choice of clinician CBT or peer-led groups
St Pierre et al. (2016)	7	IBT + VR	24 × 1.5hr group sessions and 5 × 1hr VR session (participant home)	Group and individual	50.71	85.7	43%	0	Canada	RCT
Ayers et al. (2017a)	25	CREST	26x sessions, 4 at home	Group	55.48	72	60%	4	US	Pre-Post
Ayers et al. (2017b)	35	Exposure therapy	26x sessions, 4 at home	Group	61.06	74.29	37.14%	4	US	[As above]
Levy et al. (2017)	62	CBT	26 × 1hr sessions, every 4th session in home	Individual	56.55	80.7	Not medicated	6	US	Pre-Post
Moulding et al. (2017)	41	CBT	12x weekly sessions, home visits could be requested (27% used home visits)	Group	53.5	85	N/A	varied	Australia	Naturalistic Pre-Post Could request home visit (n = 21)
Worden et al. (2017)	9	CBT	16x weekly 1.5hr session, monetary reward for hoarding improvement, case management aspects	Group	53.1	90	N/A	0	US	Pre-Post

(continued on next page)

Table 1 (continued)

Study Name	N	Intervention	Session summary	Group vs. Individual Session	Mean Age	% Female	Medication status	Home visits (no.)	Country of study	Design
Worden et al. (2017)	11	CBT	16x weekly 1.5hr session	Group	Not reported		N/A	0	US	[As above]
Ayers et al. (2018a)	31	CREST	26x weekly 1hr sessions, 3–6 home visits	Individual	66.95	70.69	32.26%	5	US	RCT
Fitzpatrick et al. (2018)	10	CBT	12x weekly sessions, 8 weeks online program	Group	55.20	90	50%	0	Australia	Pre-Post
Ivanov et al. (2018)	20	CBT	16x weekly 2.5hr sessions	Group	53.7	90	50%	0	Sweden	Pre-Post
Linkovski et al. (2018)	5	BiT (CBT)	15 BiT workshop sessions & 10 × 2hr in-home sessions	Group	Md = 59 (42–69)	100	N/A	10	US	Pre-Post
Mathews et al. (2018a)	160	CBT	16 sessions (20wks) and 2 × 30min home visits, led by psychologist.	Group	59.0	73.13	41.80%	2	US	RCT
Mathews et al. (2018b)	163	PFT	15 sessions (20wks), led by peer with lived experience.	Group	58.9	76.07	47.50%	0	US	[As above]
Muroff et al. (2018)	7	CBT	3 clients received weekly CBT-W for average of 35wks & 4 received more intensive treatment averaging 23wks.	Individual	59	71.43	None	0	US	Pre-Post
O'Connor et al. (2018)	16	CBT	18 × 2hr group sessions and 2 × 1hr individual sessions	Group and individual	53.12	64.7	On stable medications	0	Canada	Pre-Post
Chandler et al. (2019)	20	CBT	12 × 2hr sessions over 6 months, starting with weekly sessions.	Group	57.8	75	70.80%	2	UK	Pre-Post
Tolin et al. (2019)	46	CBT	16 × 1.5hr sessions weekly	Group	53.93	80.4	19.6	0	US	RCT
Chou et al. (2020)	13	CFT	16x weekly 2hr sessions	Group	63.0	46.15	No info	0	US	Pre-Post
Chou et al. (2020)	7	CBT	15 × 2hr sessions	Group	64.0	100	No info	0	US	[As above]
Crone et al. (2020)	6	CBT & Clutter Buddies	8x weekly 2hr home sessions	Group	49	83.33	No info	8	Australia	Pre-Post
Rowa et al. (2020)	37	CBT	12 × 1hr sessions weekly	Group	55	89.5	48.7	0	Canada	Naturalistic setting RCT
Aso et al. (2022)	30	Workshop Educational program	4 × 2.5hr workshop sessions for hoarding (5wks) and 1 home visit	Individual	42.2	90	No information	1	Japan	
Ong et al. (2021)	6	ACT	Up to 20 sessions in-person or over video, patients discharged when set goals were met.	Individual	59.33	100	On stable medication	0	US	Pre-Post
Pittman et al. (2021)	15	CREST	A mobile intervention, incorporated other services, at home sessions.	Individual	68.73	68	No information		US	Pre-Post
Grisham et al. (2012)	103	CBT	12 × 2hr sessions based on BiT, 3 sessions on emotion regulation & tolerance.	Group	60.87	74	No information	0	Australia	Naturalistic Pre-Post
Yap et al. (2022)	5	BiT (CBT)	15 × 2hr weekly video teleconferencing then 6 session support group	Group	59.78	90	No information	0	Australia	Pre-Post
Chen et al. (2023)	12	SCIT	12 × 1.5hr sessions weekly, with a one-week booster	Individual	60	83	None		Australia	Pre-Post
Fang et al. (2023)	45	ACT	8 × 1.5hr weekly sessions	Group	19.71	51.11	Not medicated	0	China	RCT
Fang et al. (2023)	47	REBT	8 × 1.5hr weekly sessions	Group	19.72	21.06	Not medicated	0	China	Student samples [As above]
Krafft et al. (2023)	38	ACT	Website consisted of 16x brief self-help sessions taking 15–20 min each to complete.	Individual	50	84	6.85	0	US	RCT
Raila et al. (2023)	9	BiT & Virtual	7 weeks into the BiT sessions, 8x weekly 1h VR sessions (one for orientation; 7 using VR)	Individual	64	56	66	0	US	Pre-Post

Note. BiT = Buried in Treasure; CBT = Cognitive behavioural Therapy; VR = Virtual Reality; REBT = Rational Emotive Behavioural Therapy; SCIT = Social Cognition and Intervention Training; ACT = Acceptance & Commitment therapy; CREST = Cognitive Rehabilitation and Exposure/Sorting Therapy; CFT = Compassion Focussed Therapy; PFT = Peer Facilitated Therapy; IBT = Inference Based Therapy.

et al., 2023).

A random effects meta-analysis was used to calculate end-of-trial effect sizes for RCTs comparing psychological interventions versus controls (see Fig. 2). This analysis revealed a large reduction in hoarding symptoms at end-of-trial ($g = -0.75$ [95%CI -1.07 to -0.43]; $k = 10$) and heterogeneity was substantial ($I^2 = 62.92$). The true effect size in 95% of all comparable populations falls in the interval between -1.74 and 0.24. While the funnel plot displayed no asymmetry or small study effects, the limited number of effect sizes ($k = 10$) might raise reliability concerns, emphasizing the need for cautious interpretation.

3.3. Drop-out rates for RCTs

The mean attrition rate for RCTs was 0.11 (95%CI 0.04 to 0.26) with a prediction interval of 0.003–0.81.

3.4. Risk of bias for RCTs

Each RCT was assessed for risk of bias using the Cochrane risk of bias tool version 2.0 (RoB2: Sterne et al., 2019). All trials were at high risk of bias in domain 4 (*measurement of outcome*) – as in trials of psychological interventions, participants cannot, of course, be blind to their condition and the RCTs included here also used a non-blind assessment (self-assessment) of hoarding behaviour (See Figs. 3 and 4).

3.5. Pre-post change

A random effects meta-analysis on the pre-post symptom scores identified a large effect size ($g = -1.09$ [95% CI -1.20 to -0.98, $k = 47$]), with a prediction interval of -1.64 to -0.54 (see Fig. 5). Heterogeneity across studies was moderate, $I^2 = 54.92$. The funnel plot shows some asymmetry (see Fig. 6), and Duval and Tweedie's Trim and Fill analysis identified five potentially missing effect sizes, marginally reducing the effect size ($g = -1.03$ [95%CI -1.15 to -0.91]).

3.6. Pre-post drop-out

Data on attrition were presented for pre-post studies ($K = 45$) at the trial endpoint (see Fig. 7). The analysis revealed a combined event rate

of 0.19 (95%CI 0.15 to 0.23) with a prediction interval spanning from 0.05 to 0.48. When comparing the rates between CBT trials (0.20; $k = 30$) and trials involving other psychological interventions (0.16; $k = 15$), no significant difference in drop-out was observed ($Q = 0.98$, $df = 1$, $p = .32$).

3.7. Pre-follow-up

The substantial effect size observed in the pre-post comparison remained consistent in the pre-follow-up assessment ($g = -1.12$ [95% CI: 1.52 to -0.97], $K = 18$; see Fig. 8), exhibiting low-moderate heterogeneity ($I^2 = 34.08$). The prediction interval was -1.52 to -0.73. Notably, the duration of the follow-up period, ranging from 1 month to 1 year, displayed an inversely proportional relationship with the effect size ($Z = 2.48$, $p = .03$; analog $R^2 = 0.70$).

Follow-up effect sizes were not moderated by age ($Z = 0.90$, $p = .37$; $k = 19$) or proportion of female participants ($Z = -0.96$, $p = .35$; $k = 19$). We also analysed pre-follow-up change for trials ($k = 10$) using CBT and found a large effect size ($g = -1.3$ [95%CI -1.28 to -0.99]) with low heterogeneity ($I^2 = 0$).

4. Moderator analyses

4.1. Meta regression

Meta-regression analyses using a Method of Moments approach identified no significant effect size for mean study age ($Z = 0.70$, $p = .48$, $k = 46$), proportion of female patients per sample ($Z = 0.43$, $p = .66$, $k = 46$), mean number of therapy sessions ($Z = 1.22$, $p = .22$; $k = 43$) the proportion of medicated patients ($Z = 0.92$, $p = .36$; $k = 30$) or study quality ($Z = -0.89$, $p = .37$, $k = 47$). The effect size was however moderated by the year of publication ($Z = -2.13$, $p = .034$, $k = 47$) with pre-post effect sizes being larger in more recent studies (see Table 2).

4.2. Subgroup analyses

4.2.1. CBT

The most common psychological intervention of CBT ($k = 32$; $N = 856$) was compared with all other psychological interventions ($k = 15$;

Forest plot for RCTs examining psychological interventions for HD

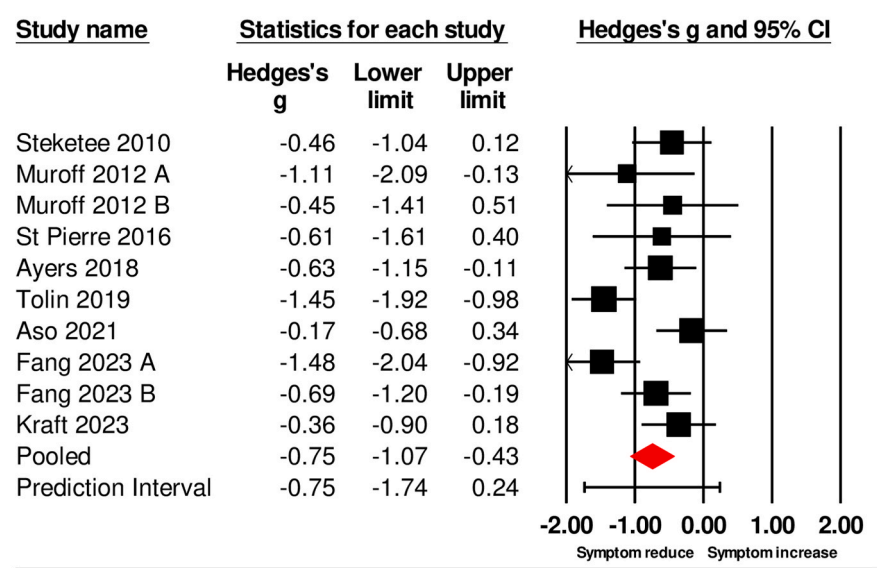


Fig. 2. End-of-Trial RCT effect sizes for hoarding symptoms following psychological interventions.

Risk of bias for individual studies

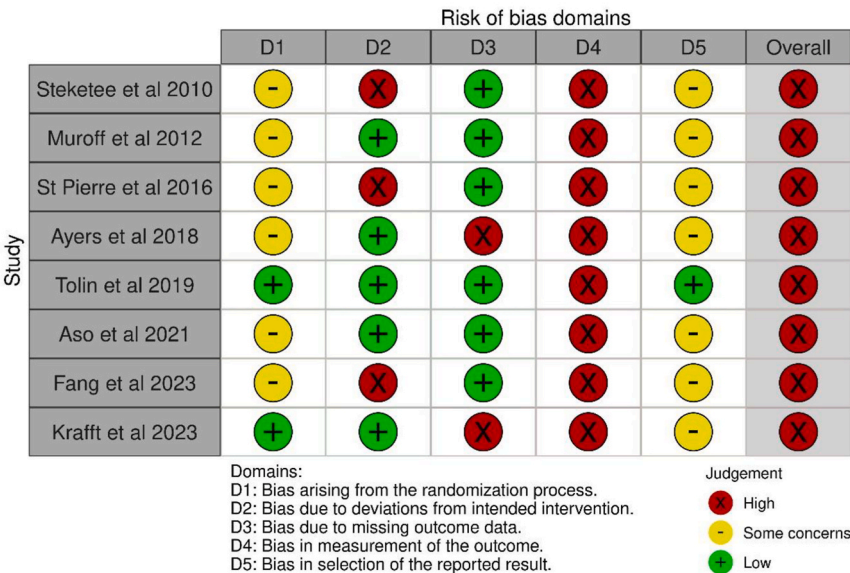


Fig. 3. Risk of Bias ratings for RCTs using the Cochrane RoB2 Tool.

Percentage of studies showing risk of bias in the five domains

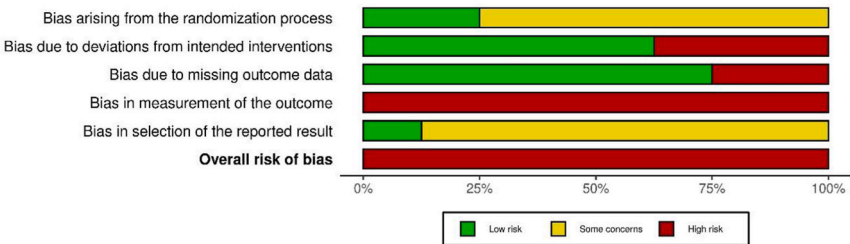


Fig. 4. Distribution of Risk of Bias ratings across domains.

$N = 487$) (see Table 3). Studies were classified as CBT if the authors referred to the involvement of some aspect(s) of CBT in the delivery of the intervention e.g. the ‘Buried in Treasure’ approach was included with CBT. The mean quality rating for CBT (19.42 [SD = 4.86]; $k = 32$) and non-CBT studies (21.08 [SD = 5.40]; $k = 15$) did not differ significantly.

A random effects meta-analysis showed that CBT produced a large pre-post reduction in hoarding ($g = -1.05$ [−1.18 to −0.92], $k = 32$; see Fig. 9), with moderate heterogeneity ($I^2 = 49.43$), which did not differ ($Q = 0.77$, $df = 1$, $p = .38$) from all other psychological interventions combined ($g = -1.16$ [−1.38 to −0.95, $k = 15$), with moderate heterogeneity ($I^2 = 63.59$).

4.2.2. Therapy delivery (group versus individual)

Group ($k = 27$), individual ($k = 14$) and mixed (group and individual: $k = 6$) therapy. Group ($g = -1.14$ [−1.29 to −0.99]; $I^2 = 61.45$), individual ($g = -1.09$ [−1.24 to −0.94]; $I^2 = 0$) and mixed ($g = -0.86$ [−1.22 to −0.49; $I^2 = 61.15$]) all produced large significant effects and no effect size differences ($Q = 2.27$, $df = 2$, $p = .32$).

4.2.3. Home visits

Effect size did not differ for studies that employed home visits versus those that did not ($g = -1.07$ [−1.23 to −0.90]; $k = 20$) and ($g = -1.10$ [−1.26 to −0.94]; $k = 27$; $Q = 0.08$, $df = 1$, $p = .78$).

4.2.4. Online delivery versus face-to-face

We also performed an exploratory analysis comparing studies that used online interventions ($k = 7$) versus those delivering face-to-face therapy ($k = 40$); and found no significant effect difference ($g = -0.92$ [95%CI -1.28 to −0.55 vs $g = -1.11$ [95%CI -1.23 to −1.00]; $Q = 1.01$, $df = 1$, $p = .31$).

4.2.5. DSM-5 diagnosis vs earlier criteria

No effect size differences emerged for 21 studies using DSM-5 criteria for diagnosing hoarding disorder versus 26 that did not ($g = -1.16$ [95%CI -1.32 to −0.99]; $I^2 = 55.97$) vs -1.03 [95%CI -1.17 to −0.89; $I^2 = 45.71$; $Q = 1.28$, $df = 1$, $p = .26$).

5. Discussion

The present meta-analysis evaluates the effectiveness of diverse psychological interventions for Hoarding Disorder (HD), encompassing CBT, ACT, Rational Emotive Therapy, Exposure Therapy, Compassion Focused Therapy, Peer-Facilitated Interventions, and virtual reality. Across 47 samples, psychological interventions result in a substantial pre-post reduction in hoarding symptoms ($g = -1.09$), persisting in the 18 samples assessing follow-up ($g = -1.12$). Despite the identification of only 8 RCTs (with 10 comparisons), a significant end-of-trial symptom reduction ($g = -0.75$) was observed for psychological interventions compared to controls.

Pre-post effect sizes for hoarding symptoms following psychological interventions.

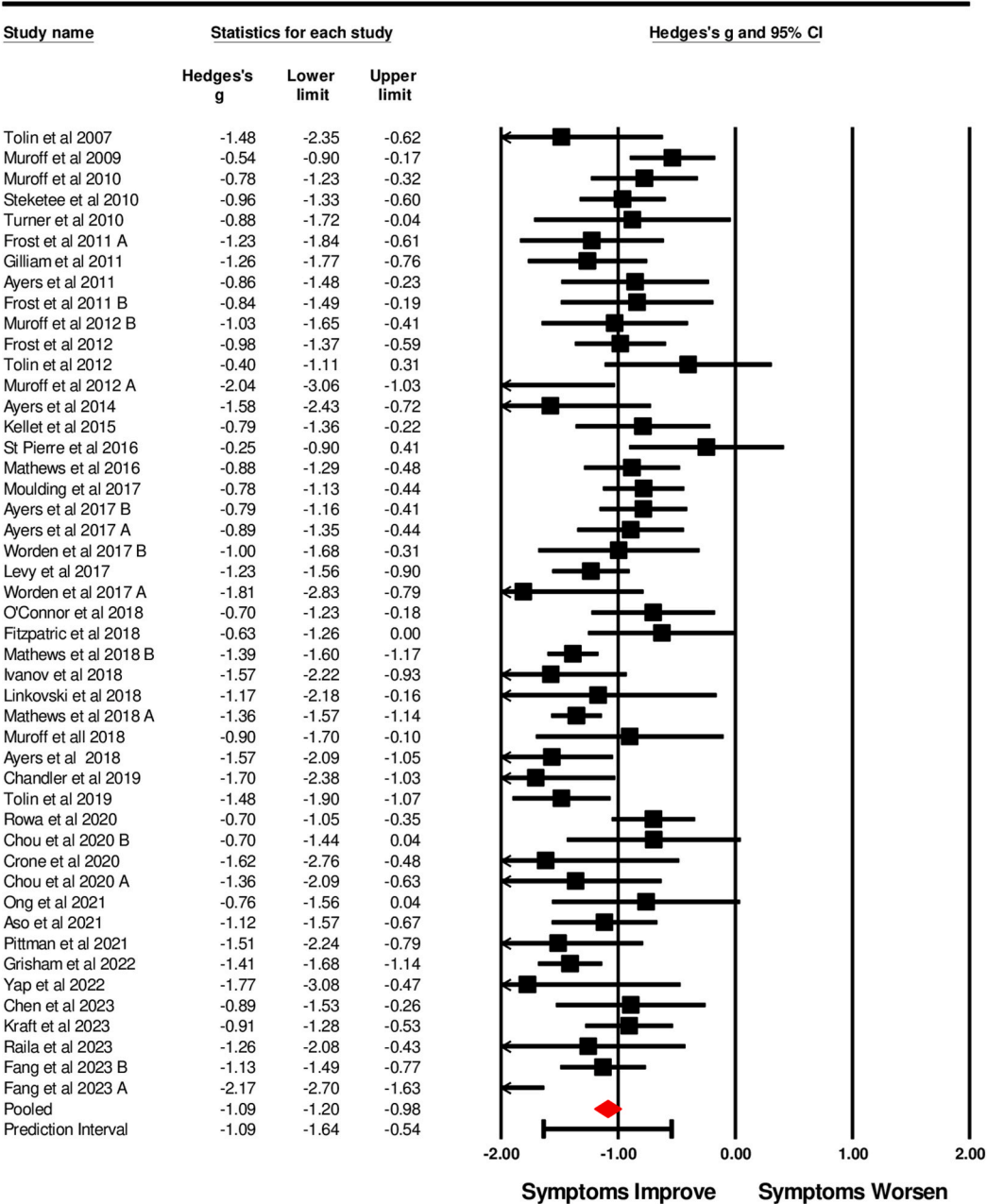


Fig. 5. Pre-Post hoarding symptom change scores for psychological interventions.

Despite CBT being the most frequently examined and advocated intervention for HD, the current analyses show that the pre-post effect size for CBT does not exceed that for other psychological interventions. Various psychological interventions, including those beyond CBT, demonstrate a large, significant pre-post reduction in HD symptoms. All other forms of psychological intervention (except for inference-based therapy with VR: (St-Pierre-Delorme and O'Connor, 2016)) also showed a large, significant pre-post reduction of HD symptoms. Nevertheless, many of these interventions typically represent the outcomes of small individual studies and require replication in adequately powered samples.

Almost all studies (45 of 47) employed the SI-R and this revealed a mean pre-post reduction of 14.78 (95%CI -16.71 to -12.85) with a prediction interval of -26.53 to -3.03. Although our analyses reveal a large benefit for psychological interventions, in more than three-quarters (37 of 45: 82%) of the studies assessed here, SI-R hoarding symptoms remained above the range for clinically significant hoarding i. e. above 41 (Tolin et al., 2010; see also Kellman-McFarlane et al., 2019 who propose scores of 39+). Using a standardized approach based on Jacobson and Truax's two-step method (Jacobson and Truax, 1991; Norberg, Chasson and Tolin, 2021; Grisham et al., 2012) calculated cut-offs for clinically significant change on the Saving Inventory-Revised

Funnel plot for pre-post effect sizes

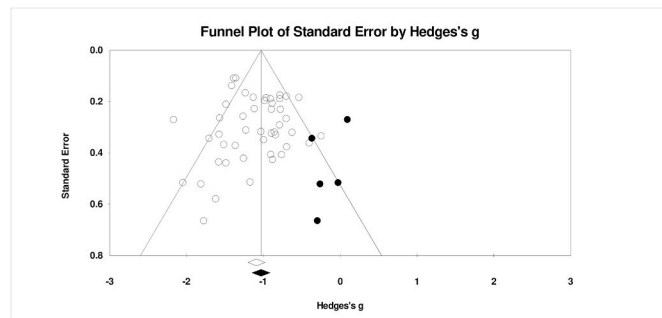


Fig. 6. Funnel plot assessing publication bias for pre-post psychological interventions.

(SI-R). They proposed that for those whose SI-R total scores reduced by at least 20 points and post-treatment scores are 38 or lower be classified as 'recovered'. Those whose total SI-R score decreases by 20 points or more, but whose post-treatment score remains above 38, should be classified as 'improved' but not recovered. Using these criteria, only three studies included in the current analyses would lead to mean SI-R scores associated with *recovery* (Ayers et al., 2018a; Worden et al., 2017; Yap et al., 2022) and three to mean SI-R levels associated with *improvement* (Chandler et al., 2019; Linkovski et al., 2018; Chou et al., 2020). Although we applied these criteria to group averages rather than individual's responses, our findings do highlight the need to identify adaptations of existing psychological interventions or to develop additional approaches to help promote increased levels of improvement and recovery.

Our comprehensive exploration of moderators, encompassing both continuous and categorical variables, failed to identify significant patient or therapeutic factors moderating treatment outcomes. Neither patient demographics (mean age, gender distribution, proportion of medicated participants) nor therapy-related variables (number of sessions, study quality, therapy format) significantly impact treatment trajectory. The meta-analysis also explores various factors like group vs. individual therapy, home visits, DSM-5 criteria, and the mode of therapy delivery (face-to-face vs. online), again revealing no significant moderating influence. Our findings regarding potential moderators largely concurs with (Rodgers et al., 2021), since they also found that treatment modality (individual vs. group), use of home visits, participant age, and number of sessions did not moderate treatment outcome. Our exploratory analyses largely concur with those of Tolin et al. (2015) by showing that reduction in overall hoarding severity was predominantly related to changes in clutter related behaviour and, to a lesser extent, by change in acquiring and discarding behaviours. The failure to find significant moderators is unlikely to reflect study quality given that this was above average according to the POMRS and crucially, not significantly associated with effect size. The lack of significant individual or therapeutic moderator variables might point to a robust and universal impact of psychological interventions on outcome, irrespective of diversity in participant characteristics, study designs, or other factors.

Previous meta-analyses present inconsistencies concerning the impact of age on therapeutic outcome. Tolin et al. (2015) noted a positive association between a younger mean age and better outcomes, while (Bodryzlova et al., 2019) reported substantial reductions in HD symptoms for older samples. However, the limited age range (50–55) and a small sample for meta-regression in Bodryzlova et al.'s (2019) analysis may have influenced their results. Conversely, Rodgers et al. (2021) more recently found no significant association between age and effect size for symptom reduction. Our analysis aligns with Rodgers et al. (2021) revealing no significant moderating influence of age on the effect sizes for psychological interventions, including CBT. In this study, as in preceding meta-analyses, the mean age across samples is approximately

55 years. Notably, our searches identified only one study (Fang et al., 2023) featuring a sample with a mean age of <40 years, specifically a student sample. Although hoarding behaviours often emerge during the teenage years, clinically significant hoarding issues and help-seeking tend to be more prevalent in middle age (Zaboski et al., 2019). It is crucial to recognise that individuals volunteering for hoarding research trials may differ from clients seen in the community, with volunteers more likely to be female and younger than community samples (Woody et al., 2020). Given that few trials have achieved clinically significant levels of recovery or even improvement, future trials might study younger samples with the aim of being both more clinically representative and potentially examine whether earlier intervention produces better outcomes.

Gender-related outcomes in Hoarding Disorder (HD) research exhibit some inconsistency. Tolin et al. (2015) and Rodgers et al. (2021) reported markedly better outcomes in overall HD severity, encompassing discarding, clutter, and acquiring, for samples with a higher proportion of women. Conversely, Bodryzlova et al. (2019) found no evidence of gender impact on effect size although their regression analyses involved a small number of studies ($k = 8$). Our meta-regression analyses, conducted with a much larger sample of studies, however also did not find gender to be a moderating factor of treatment effect sizes. Nevertheless, like previous meta-analyses, the current study uncovers a significant over-representation of women in trials (approximately 75% of participants), despite epidemiological data indicating no gender difference in HD prevalence (Postlethwaite et al., 2019). This incongruity underscores the imperative need for improved representation of men in future HD studies. Our finding of clutter change was the strongest predictor of overall outcomes might partly reflect an over-representation of women in trials to date.

Although few studies have assessed potential gender differences in HD, some evidence suggests that gender-related concerns may originate from the primary outcome measure used in most studies (i.e., SI-R scores). Studies have occasionally reported that women score higher on clutter and acquisition items, but not on difficulties in discarding of the SI-R (Timpano et al., 2023; Wheaton et al., 2008). A key question is whether any differences between genders are authentic or arise from gender response bias in clutter, difficulties discarding, and acquiring questions. Using item-response theory (Timpano et al., 2023), showed that some SI-R items showed evidence of differential item functioning (DIF) across gender. Therefore, understanding whether gender interacts with symptomatic outcomes and the reasons for the underrepresentation of men in psychological trials is imperative.

High dropout rates, often attributed to low motivation and treatment ambivalence among Hoarding Disorder (HD) patients, are highlighted in the literature (Tolin et al., 2007; Chasson et al., 2014). The overall dropout rate calculated here for pre-post studies is substantial, at around 1 in 5, and notably, no significant difference emerged between CBT and other psychological interventions. The drop-out rate for RCTs was somewhat lower at 11%. Future research may be required to enhance strategies to enhance patient commitment and participation in HD treatment, regardless of the therapeutic approach employed.

6. Limitations

The strengths of this study lay in the extensive analysis of various psychological interventions and the inclusion of RCTs. Nevertheless, certain limitations impact the interpretation, including: the elevated risk of bias observed in RCTs; the small numbers of studies examining non-CBT interventions makes it currently impossible to make specific head-to-head comparisons; and the prevalence of symptoms persisting above the clinically significant threshold in most trials. The findings underscore the need for cautious interpretation and highlight areas for future research, such as addressing the efficacy of alternatives to CBT, participant attrition and refining interventions for sustained effectiveness. Overall, this meta-analysis contributes valuable insights into the

Pre-post drop-out

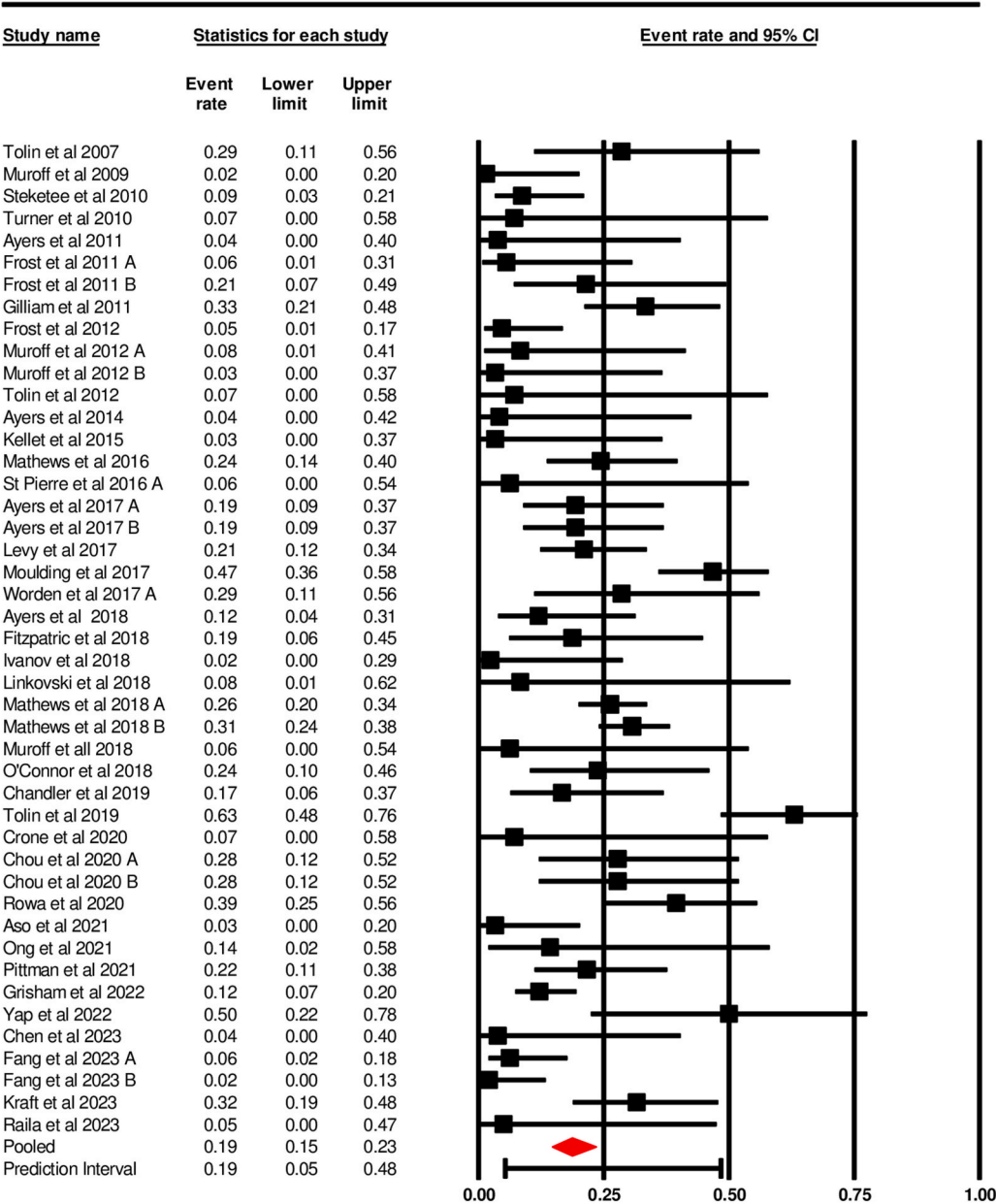


Fig. 7. Drop-out rates in pre-post studies.

efficacy of psychological interventions for HD, providing a foundation for further investigation and improvement in treatment strategies.

Although many trials have now assessed psychological interventions for HD, with most assessing CBT, few have been RCT designs. Hence, most studies do not adequately differentiate between effects potentially attributable to the treatment versus any natural changes e.g. spontaneous remission. We also note that baseline and post-test scores are non-independent and since the pre-post correlation in any study is unknown, it must be estimated. While our sensitivity analysis identified no difference across various correlations, greater uncertainty exists around both the estimation of pre-post effect sizes and the ability to identify therapy-specific effects (Cuijpers et al., 2017).

The large effect size of 0.75 reported here for RCTs indicates that future trials would require approximately 30 participants in both the intervention and the control groups to achieve power of 0.8. The mean sample size for intervention and control groups in the 10 existing RCTs is 28 and 21, indicating that some studies are likely to be underpowered and thus, likely to inflate reported effect sizes and heterogeneity levels (Inthout et al., 2015).

Four in five studies assessing psychological interventions for HD have to-date employed a pre-post design; and so, are likely to inflate effect size estimations because of the lack of a control (Cuijpers et al., 2017). Although we show for the first time that large symptomatic reduction emerges in RCTs, all were at overall high risk of bias. A

Effect sizes for pre-follow-up

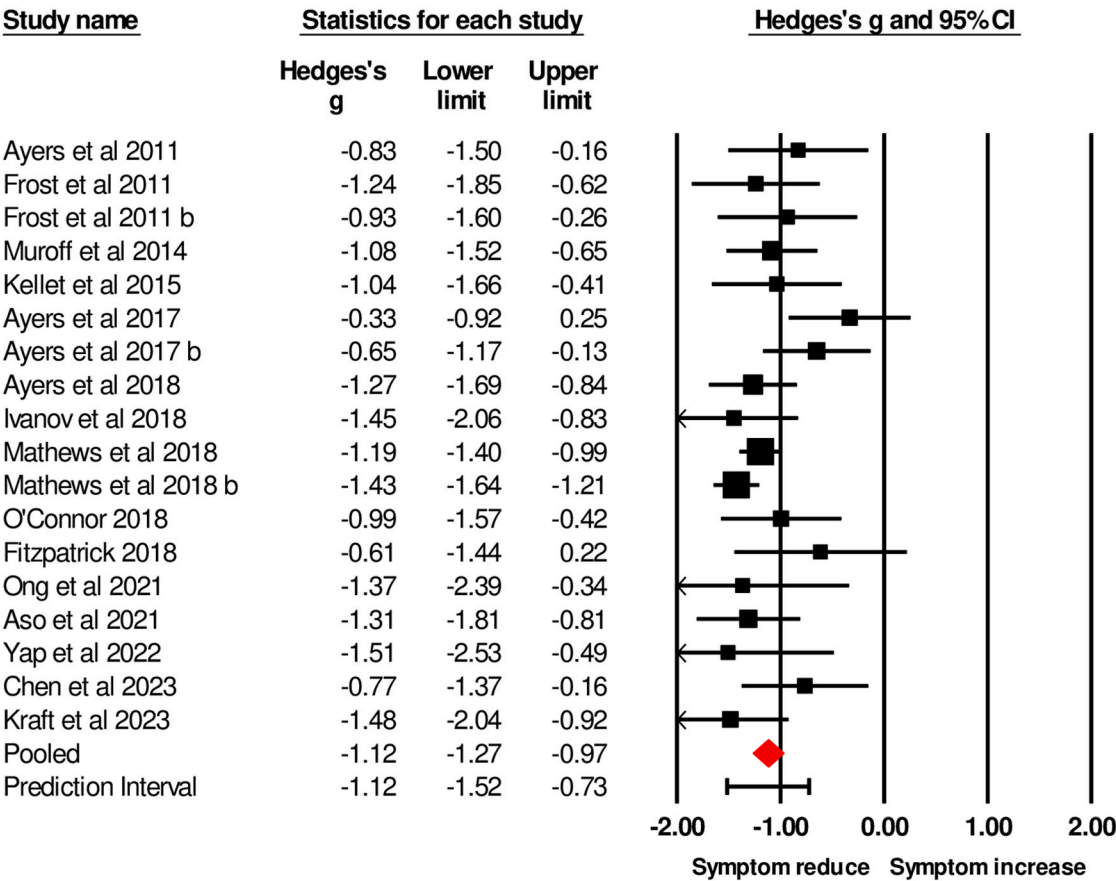


Fig. 8. Pre-Follow-up hoarding symptom changes scores.

Table 2
Meta-regression moderator variables.

	Range	Number of Studies	Z -value	
Age	20–74	k = 46	Z = 0.70, p = .48	
Proportion female	21–100	k = 46	Z = 0.43, p = .66	
Proportion medicated	0–87.5	k = 30	Z = 0.92, p = .36	
Study Quality (POMRF)	12–32	k = 47	Z = –0.89, p = .37	
Mean number of sessions	3–35	k = 43	Z = 1.22, p = .22	
Year of publication		k = 47	Z = –2.13, p = .034	Analog R ² = 0.19
Clutter change		k = 27	Z = –3.15, p = .002	Analog R ² = 0.74
Acquiring change		k = 27	Z = –2.11, p = .03	Analog R ² = 0.36
Discarding change		k = 27	Z = –2.02, p = .04	Analog R ² = 0.38

Exploratory meta-regression analyses of SR-I hoarding subcategories (change scores for: clutter, discarding, and acquiring) predicted SR-I effect sizes.

significant component of this bias reflects the fact that psychological interventions cannot have blind delivery. Nonetheless, existing studies have invariably also used unblinded symptom assessment

Table 3
Pre-post effect sizes for psychological interventions.

Group	k	Hedges's g	Lower limit	Upper limit	Z-value
CBT	32	–1.05	–1.18	–0.92	–15.85
CREST	4	–1.29	–1.79	–0.80	–5.11
ACT	3	–1.29	–2.19	–0.40	–2.84
IBT + VR	1	–0.25	–0.90	0.41	–0.74
Exposure/Sorting Therapy	1	–0.79	–1.16	–0.41	–4.13
PFT	1	–1.39	–1.60	–1.17	–12.67
REBT	1	–1.13	–1.49	–0.77	–6.11
SCIT	1	–0.89	–1.53	–0.26	–2.75
CFT	1	–1.36	–2.09	–0.63	–3.66
Virtual	1	–1.26	–2.08	–0.43	–2.97
Workshop	1	–1.12	–1.57	–0.67	–4.88

Note. k = the number of studies.
CBT = Cognitive behavioural Therapy; CREST = Cognitive Rehabilitation and Exposure/Sorting Therapy; ACT = Acceptance & Commitment Therapy; IBT = Inference Based Therapy; VR = Virtual Reality; PFT = Peer Facilitated Therapy; REBT = Rational Emotive Behavioural Therapy; SCIT = Social Cognition and Intervention Training; CFT = Compassion Focussed Therapy.

(self-assessment on the SI-R: Frost et al., 2004). Of the 8 RCTs, 3 were preregistered (Tolin et al., 2019; Ayers, Dozier, Twamley, et al., 2018b; Krafft et al., 2023). Clearly, more RCTs are required, and these would benefit from preregistration and potentially using blind outcome assessment.

Pre-post effect sizes for CBT

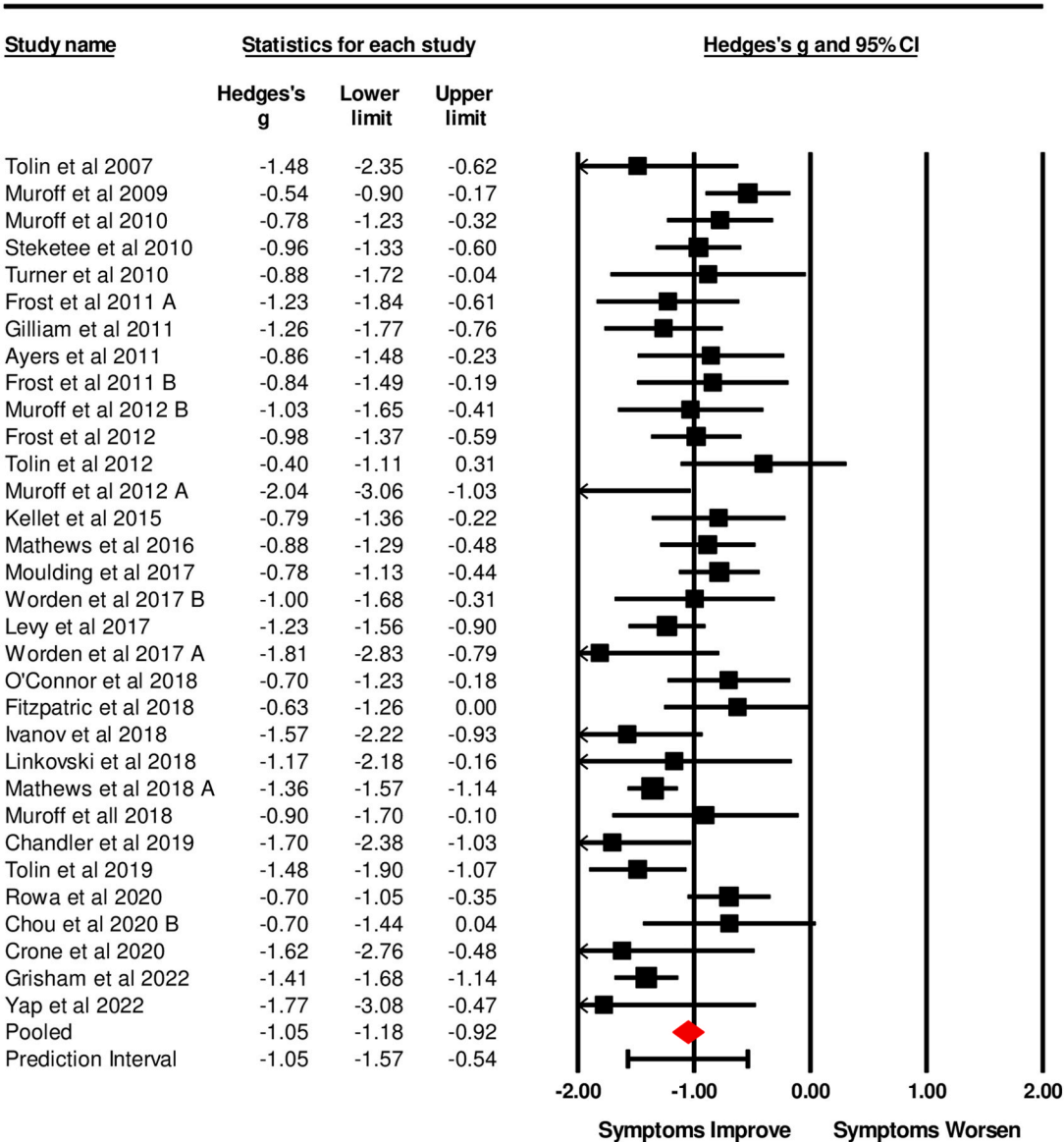


Fig. 9. Pre-post effect sizes for Cognitive Behavioural Therapy.

7. Conclusion

This meta-analysis is the first to comprehensively investigate psychological interventions in randomised and non-randomised trials for HD, extending beyond CBT. Psychological interventions exhibit substantial pre-post effect sizes at the conclusion of the trial and during follow-up, with no discernible distinctions between CBT and alternative psychological interventions. Despite most trials documenting positive outcomes, few achieve an average clinically significant improvement in HD symptoms, emphasizing the need for more effective interventions or a multifaceted approach.

Although significant hoarding symptom reduction occurs in RCTs, the high-risk of bias and over-representation of women in trials highlight the need for improved study designs and participant diversity in HD research. Dropout rates, substantial at around 20%, emphasize the

importance of addressing motivational challenges in HD treatment. Despite moderate heterogeneity across studies, our efforts to discern patient-based or therapy-based moderation effects on pre-post effect sizes proved unfruitful. The observed lack of significant variation in the treatment effect across explored factors suggests a potential universal impact, perhaps minimally influenced by participant demographics, study design, or other pertinent influencing factors. Given that therapy-linked differences do not appear to impact efficacy, patient preference emerges as a critical consideration, indicating scope for more personalized treatment plans that align with individual preferences i.e. the specific therapy format, whether in group or individual format, with or without home visits, delivered face-to-face or virtually and so on.

CRediT authorship contribution statement

Emily O'Brien: Writing – review & editing, Writing – original draft, Formal analysis, Data curation, Conceptualization. **Keith R. Laws:** Writing – review & editing, Writing – original draft, Methodology, Formal analysis.

Declaration of competing interest

We have no interests to declare.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jpsychires.2024.12.029>.

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