

Review Article

Beliefs about possessions associated with Hoarding Disorder: A systematic review and meta-analysis

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A B S T R A C T

There is substantial evidence highlighting the importance of beliefs about possessions in understanding and treating Hoarding Disorder. Despite this, there has not yet been a comprehensive review of this topic. The aim of the current pre-registered systematic review and meta-analysis was to synthesise the evidence base concerning the association between hoarding beliefs and hoarding symptom severity. Meta-analytic techniques were used to pool effect sizes concerning the association between hoarding beliefs and symptom severity (r , d) and narrative synthesis was applied to data which could not be included in the meta-analysis. 30 studies were eligible for inclusion in the review, with 24 studies contributing data for meta-analyses. Meta-analysis results indicated a small-medium significant association between beliefs about possessions and hoarding severity. This was generally consistent when considering specific belief types (i.e., emotional attachment, responsibility, memory, control) and specific hoarding symptoms (i.e., acquiring, difficulty discarding, clutter). Narrative synthesis confirmed that a range of beliefs about possessions were associated with hoarding symptoms amongst those with clinically significant hoarding symptoms. Results also suggested that, compared to other psychological constructs (e.g., emotional dysregulation), beliefs about possessions generally had more consistent and stronger associations with hoarding severity, or acted as mediators for constructs that had a large association with hoarding severity. Overall, the results provide support for the importance of beliefs about possessions in the future research and treatment of Hoarding Disorder.

Individuals who meet criteria for Hoarding Disorder (HD) are assessed as having difficulty discarding possessions and living spaces that cannot be used for their intended purpose (American Psychiatric Association, 2013). HD has an estimated prevalence rate of 2.5 % (Postlethwaite et al., 2019) and has been associated with occupational and social impairment (Archer et al., 2019; Tolin et al., 2008) and significant risks including fires, falls, poor hygiene and health, and pests (Diefenbach et al., 2013; Frost et al., 2000).

Specialised cognitive behavioural therapy (CBT) for hoarding has been developed (e.g., Steketee and Frost, 2006), which aims to target the maintenance factors implicated in the cognitive behavioural model for HD (Frost and Hartl, 1996). The model suggests that the symptoms of hoarding (i.e., acquiring, difficulty discarding and clutter) result from interactions between information processing difficulties, beliefs about possessions (e.g. emotional attachment, control, responsibility) and emotional reactions, which positively or negatively reinforce the continuation of hoarding. Although CBT for hoarding is associated with symptom improvement (O'Brien and Laws, 2025; Rodgers et al., 2021), many individuals who engage with treatment continue to experience

clinically significant symptoms at the end of treatment (O'Brien and Laws, 2025). Consistent with the implications of the Cognitive Behavioural model (Frost and Hartl, 1996), beliefs about possessions have been found to reduce following CBT treatment (Ivanov et al., 2018) and further, their reduction has been found to mediate changes in hoarding symptom severity during treatment (Levy et al., 2017; Tolin et al., 2019).

Different aspects of the cognitive behavioural model for HD have been reviewed (e.g. information processing, see Gledhill et al., 2021), yet despite the central role of beliefs about possessions in the cognitive behavioural model (Frost and Hartl, 1996; Steketee and Frost, 2006), and the extensive research conducted in this area, a comprehensive synthesis of what is known about beliefs about possessions in HD has not been conducted. Indeed, as noted by Wheaton (2016), "Perhaps the most thoroughly researched area of the CBT model of HD concerns the cognitive factors that drive the remarkable attachment to possessions..." (p. 45). Beliefs about possessions have been investigated using multiple measures. The Savings Cognitions Inventory (Steketee et al., 2003) identified possession beliefs (emotional attachment, control, memory

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and responsibility) consistent with those proposed by Frost and Hartl (1996), and although it is the most frequently used measure of beliefs about possessions, there are a range of self-report and interview tools that have also been designed and used to capture this construct (e.g. Dozier and Ayers, 2014; Frost et al., 2015; Gordon et al., 2013; Hartl et al., 2005). The association between HD and beliefs about possessions has been investigated using a range of methodologies and analyses, including group comparisons (i.e., comparing scores on belief measures between people with hoarding disorder (PwHD) and clinical or community comparisons) (e.g., Steketee et al., 2003; Wheaton et al., 2013). In addition to investigating how overall belief strength is associated with hoarding severity (e.g., Grisham et al., 2018), including severity of specific symptoms of acquiring, difficulty discarding and clutter (e.g., Dozier et al., 2017), studies have also considered whether distinct belief types (e.g., beliefs about the emotional significance vs wasting a potentially useful object) have stronger/weaker associations with specific symptoms of hoarding (e.g., Dozier and Ayers, 2014). There are also studies that have looked at how the association between possession beliefs and hoarding severity compares to the association between other psychological constructs (e.g., experiential avoidance) and hoarding severity (e.g., Wheaton et al., 2013).

Due to the central role of beliefs about possessions in both the cognitive behavioural model of hoarding (Frost and Hartl, 1996; Steketee and Frost, 2003), and the emerging CBT trial data for beliefs about possessions (e.g. Ivanov et al., 2018; Levy et al., 2017; Tolin et al., 2019), it is important to review the relationship between beliefs about possessions and hoarding severity. This will enable the synthesis of both the strength of the association between beliefs and hoarding severity, and the importance and specificity of beliefs about possessions in hoarding (i.e., are they specific to those who experience clinically significant hoarding difficulties or do non-clinical and clinical comparison groups experience them to the same degree?). An understanding of the beliefs about possessions that are more specific in hoarding may support CBT treatments to become more targeted, analogous to the advancements that were made in treatments for panic disorder (e.g., Clark et al., 1997) and other anxiety disorders (e.g., LoSavio et al., 2017), as a consequence of understanding problem specific cognitions. This review aimed to answer the following questions: 1) What possession beliefs are related to HD severity? 2) Is there evidence that particular possession beliefs are related to specific aspects of hoarding (i.e., acquisition, difficulty discarding or clutter)? and 3) How does the strength of the relationship between possession beliefs and hoarding severity compare to that for other investigated psychological constructs and hoarding severity?

1. Method

This systematic review and meta-analysis was pre-registered using Prospero (<https://www.crd.york.ac.uk/PROSPERO/view/CRD42023346300>) and conducted in line with the Preferred Reporting Items for Systematic reviews and Meta-analyses (PRISMA; Page et al., 2021a; Page et al., 2021b).

1.1. Eligibility criteria

To be included in the review, studies had to measure and quantify the relationship between beliefs about possessions and hoarding severity. This included:

1. For a hoarding group, reporting the relationship between beliefs about possessions and hoarding severity (e.g., correlational, regression or mediation analysis).
2. Reporting group differences on measures of beliefs about possessions.

Studies had to include adults (18 years or older) with clinically

significant hoarding, which was defined as either being assessed as meeting diagnostic criteria for HD according to DSM-5 (American Psychiatric Association, 2013) or ICD-11 (World Health Organization, 2019) or scoring above a justified threshold on a validated hoarding symptom severity measure (e.g., Hoarding Rating Scale, Tolin et al., 2010). Studies had to be written in English. Published and unpublished studies (e.g., dissertations) were eligible for inclusion. To be included in the meta-analysis, studies had to report at least one of the following:

1. Sample size (n), hoarding severity (M , SD) and severity or intensity of beliefs about possessions (M , SD) for both a hoarding group and a comparison group (clinical or non-clinical).
2. For a hoarding group, sample size (n) and the correlation (r) between hoarding symptom severity and beliefs about possessions.

Studies were excluded if participants only hoarded animals, if they hoarded for other reasons (e.g., dementia, brain injury, neurological disorders, other mental health problems) or if they were only categorised into a hoarding group using an Obsessive-Compulsive Disorder (OCD) related measure (e.g., hoarding subscale of the Obsessive-Compulsive Inventory-Revised, Foa et al., 2002). Finally, studies were excluded if they only utilised qualitative methods to describe the relationship between beliefs about possessions and hoarding.

1.2. Search strategy

Three databases (Embase, APA PsycInfo, PubMed) were searched in November 2023, with no filters or limits applied. The searches were re-run in May 2024 to capture any recently published relevant data prior to data analysis. The search strategies can be seen in Supplement 1. Prevalent authors within the HD research field were also contacted via email in March 2024 to request unpublished data that fit the eligibility criteria. The reference lists of eligible studies were also reviewed to identify further potentially relevant studies.

1.3. Identification of eligible studies

Following the searches, deduplication of results was completed by first using Endnote's deduplication function (Endnote 20.6), then as recommended by Kwon et al. (2015), checked manually. Search results were then inputted into Rayyan (Ouzzani et al., 2016), a systematic review management tool. The primary author then sifted all titles and abstracts to identify potentially eligible articles, which were then reviewed at full text to determine inclusion or exclusion based upon the eligibility criteria. A second independent reviewer sifted through 18 % of the titles and abstracts (325 records) and screened 10 % of the full text articles (20 papers). Agreement between the two reviewers on title and abstract screening was substantial, $\kappa = 0.64$, 95 % CI [0.52, 0.76], $p < .001$, with an observed agreement of 91.7 %. Agreement between the two reviewers on full text screening was almost perfect, $\kappa = 0.90$, 95 % CI [0.75, 1.00], $p < .001$, with an observed agreement of 95 %.

1.4. Data extraction

The primary author applied a pilot data extraction tool to an eligible paper before data was extracted from the remaining papers. Where available, data was extracted for the following variables: title of publication, authors and date of publication, study setting, study design, participant groups, sample size, demographics of sample (age, gender, ethnicity), inclusion and exclusion criteria, interview or self-report measures used, study procedure (for experimental or longitudinal studies), analysis strategy, M/SD on interview or self-report measures, results (i.e., correlations, regression models, group differences, mediation analysis).

For the meta-analysis specifically, the following data was extracted where available: sample size (n), overall hoarding severity (M , SD) and

severity (M , SD) of acquiring, difficulty discarding and clutter. The correlation between hoarding severity and hoarding beliefs (r) was also extracted. As well as overall severity or intensity of beliefs about possessions (M , SD , r), data was extracted for specific hoarding-related beliefs about possessions, including those relating to: (1) emotional attachment, (2) control, (3) responsibility and (4) memory. Where data was not reported, but was available based on study methodology, authors were contacted with a request to provide the additional data. Authors were given at least one week to respond. Four authors responded, providing additional data that was not reported in the initial publications (Diefenbach et al., 2013; Dozier et al., 2017; Pardini et al., 2023; Wheaton et al., 2013). For severity of hoarding symptoms, the Saving Inventory-Revised (SI-R; Frost et al., 2004) was prioritised, such that if studies used more than one hoarding symptom severity measure, only data (i.e., M , SD) relating to the SI-R was extracted for the meta-analysis. In comparison, if studies included more than one measure of beliefs about possessions, or if they reported data related to both subscales and totals of belief measures, all data was extracted. Where possible, missing data was calculated based on that available within manuscripts. For example, if studies only reported mean and standard deviation for belief subscales, this data was used to calculate an estimated overall hoarding beliefs severity (M , SD).

1.5. Data synthesis

1.5.1. Meta-analysis

The metafor package (Viechtbauer, 2010) within R (4.4.1) (R Core Team, 2024) was used to run the meta-analysis. Many studies utilised the SCI (Stekette et al., 2003) to assess hoarding related beliefs about possessions. Therefore, in addition to investigating the relationship between hoarding and overall strength or intensity of beliefs about possessions, it was also possible to investigate the relationship between hoarding and specific belief types as assessed by the SCI (i.e., emotional attachment, responsibility, control, memory). Where possible, other belief measures or subscales used by studies included in the meta-analysis were mapped onto the subscales of the SCI for pooling of effect sizes (Supplement 2).

Due to some studies contributing more than one effect size per analysis, multi-level meta-analytic models (i.e., three-level meta-analysis) were applied. Multi-level models allow all information (i.e., effect sizes) to be included, whilst acknowledging that effect sizes from the same study may have shared dependencies (Assink and Wibbelink, 2016). Cochran's Q-test and Higgin's and Thompson's I^2 statistic were used to assess heterogeneity of effect sizes. Potential publication bias was investigated by visual inspection of funnel plots, the Egger's test and where appropriate, Kendall's tau was also calculated.

To investigate the correlation between hoarding severity and overall strength of beliefs about possessions, Pearson product-moment correlations were first standardised by transforming them into Fisher's z , before they were pooled using a three-level meta-analysis model. This process was repeated but considering only those correlations between belief sub-scales and hoarding severity (i.e., overall severity and severity of acquiring, difficulty discarding and clutter specifically). This enabled us to investigate whether the relationship between beliefs and hoarding severity depended on type of belief (i.e., emotional attachment, control, responsibility or memory) using three-level mixed-effects models.

Finally, three-level meta-regression models were used to investigate whether group differences in hoarding beliefs were associated with group differences in hoarding severity. Comparison groups included clinical or non-clinical groups, but not where the comparison groups had known hoarding co-morbidity (e.g., Gordon et al., 2013; Mataix-Cols et al., 2013; Phung et al., 2015). Group differences were standardised using Cohen's d before they were pooled. A three-level meta-regression mixed effect model was used to investigate whether the association differed depending on type of belief.

1.5.2. Narrative synthesis

Narrative synthesis was used to summarise and interpret study results which could not be incorporated into the meta-analysis. This included studies which only reported results related to the role of beliefs as mediators or only reported on the predictive ability of beliefs about possessions within multiple regression analysis. It was also applied to studies which compared distinct hoarding groups to one another and did not compare them to a non-clinical or clinical comparison group. Studies were included in the narrative synthesis, but not the meta-analysis, if they had pooled results from multiple studies to complete their analysis or if the sample was already included in the meta-analysis separately (i.e., separate publications had used the same sample of participants). Narrative synthesis was also applied to studies which were included in the meta-analysis if they had additionally reported results that could not be incorporated into the meta-analysis. Finally, narrative synthesis was used for study results which compared the relationship between possession beliefs and hoarding severity to the relationship between other psychological constructs (e.g., experiential avoidance) and hoarding severity.

1.6. Quality assessment

The assessment tool for observational cohort, cross-sectional studies and case control studies was used to rate study quality in the current review (National Heart Lung and Blood Institute, 2013). All questions were answered 'Yes', 'No', 'Cannot determine' (CD), 'Not Reported' (NR) or 'Not Applicable' (N/A). When applying the quality assessment tool, *exposure/risk* was defined as beliefs about possessions, *outcome* was defined as hoarding severity, *cases* were defined as those meeting criteria for clinically significant hoarding and *controls* were defined as referring to community and/or clinical comparison groups. In line with the recommended use of each tool, after applying all relevant questions each study was given an overall rating of 'poor', 'fair' or 'good'. Due to the number of questions dedicated to whether studies were cross-sectional or longitudinal, studies which only provided cross-sectional data could not be rated above 'fair'. This ultimately applied to all studies included in the review and therefore no studies were given a quality rating of 'good'. Considering all other question items, studies were given a quality rating of 'poor' if they scored 'No', 'CD' or 'NR' on over 50 % of the remaining applicable items. A second independent reviewer completed the quality assessment tool for six papers (20 %). Agreement between the two reviewers on overall quality ratings was perfect, $\kappa = 1.0$, 95 % CI [1.00, 1.00], $p < .001$.

2. Results

2.1. Search results

The process of identifying eligible studies via database searching and other methods is shown in Fig. 1. The database search strategy resulted in 2833 total records. Following deduplication, 1822 titles and abstracts were screened to identify potentially suitable studies. Eligibility criteria were subsequently applied to 201 full text articles, with 28 studies retained for inclusion in the review. Two further studies were identified via alternative methods: one via citation searching, and one provided by the primary author (unpublished data).

2.2. Study characteristics

Characteristics of the studies which were included in the review can be seen in Table 1. Most studies were based in the USA (1, 3–7, 9–10, 15–16, 20–21, 23, 27, 30), followed by the UK (12, 14, 22, 24–26, 28–29), Australia (2, 8, 11, 13), Italy (19) and Singapore (17). One study was based in several countries (18), with Nordsletten et al. (2018) comparing hoarding groups across London and Rio de Janeiro.

Although publication dates ranged from 2003 to 2024, the majority

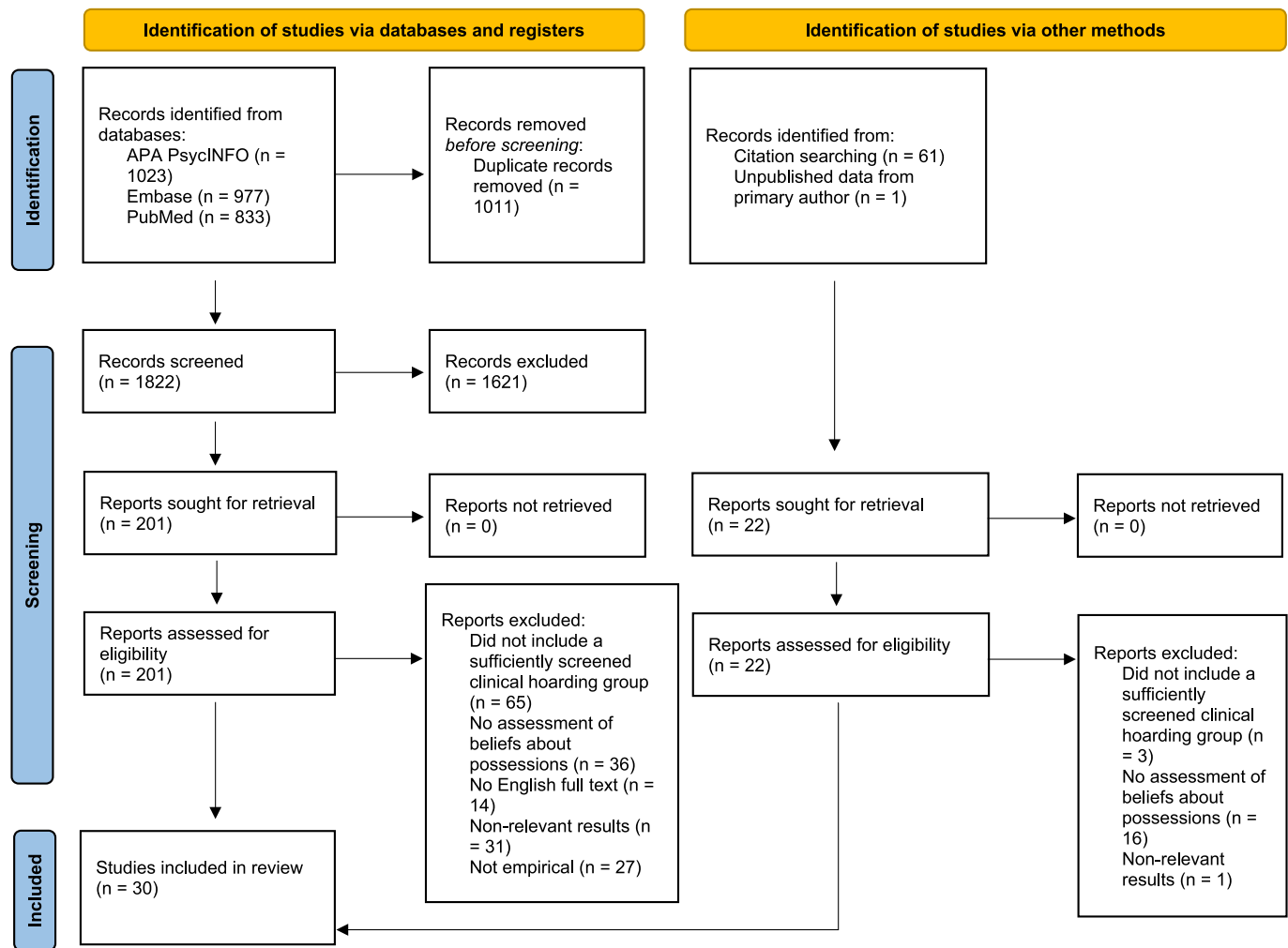


Fig. 1. Process to identify eligible studies for the review.

were published from 2013, with only four studies being published prior to 2013 (20–21, 27–28). This likely reflects the fact that HD did not become a distinct mental health condition in DSM-5 until 2013 (APA, 2013). With the exception of three doctoral theses (9, 10, 29), all studies were published in peer-reviewed journals. Although a few studies had longitudinal designs (e.g., 19), all data included in this review was cross-sectional in nature.

Hoarding group sample sizes varied from 15 to 217. The average age of hoarding participants was 52.8 (11.5) and the majority were female (73 %), women (69 %) and white (85 %). Regarding the criteria used to assign hoarding group status, twelve of the studies assessed participants using DSM-5 HD criteria (2–3, 5–7, 9, 12, 14–15, 18, 23, 30). Five studies had also applied the proposed HD criteria (1, 4, 16, 25–26), prior to its publication in the DSM-5 (APA, 2013). In addition to these interview methods, cut off scores on self-report measures were used to assign hoarding group status. Three studies (10, 22, 29) applied a cut-off score of 14 on the Hoarding Rating Scale - Self Report (Tolin et al., 2010). The Saving Inventory-Revised (SI-R; Frost et al., 2004) was also frequently used to identify those who experienced clinically significant hoarding (8, 11, 13, 17, 19, 21, 24, 27–28). A score of 39 has been suggested as the optimal cut-off score for the SI-R (Kellman-McFarlane et al., 2019). Two studies used this cut-off score (8, 11) and three applied more conservative cut-offs (13, 17, 28). Lower cut-off scores on the SI-R (i.e., <39) were used by four studies to identify hoarding participants (19, 21, 24, 27) and one study used an earlier version of the Saving Inventory to identify hoarding participants (20). These papers were included due to

the cut off scores being justified and/or additional methods being used to confirm hoarding symptomatology.

Eligible studies had applied a range of measures of beliefs about possessions. Across the meta-analysis and narrative synthesis, data was included from self-report measures including the Saving Cognitions Inventory (2, 4–11, 13–14, 16–21, 24–26), Saving Cognitions Inventory – modified (23), Motives for Saving and Acquiring questionnaire (1), Possessions Comfort Scale (15, 27), Beliefs about Hoarding Questionnaire (12, 24) and Hoarding Disorder Beliefs Inventory (29). Interview techniques were also used, with Frost et al. (2015) and Timpano et al. (2020) interviewing participants on motives for saving and acquiring using the Hoarding Interview. Pertusa et al. (2008) also used an interview methodology to assess reasons for hoarding, and Tinlin et al. (2022) used q-sort methodology to group participants based on beliefs they held about possessions.

Regarding group comparisons, most studies compared a hoarding group to a community comparison group (3–5, 9–10, 12–17, 19–21, 23–30). Community comparison groups were diverse and alongside those considered to be healthy, non-clinical or community controls, also included those who were collectors (14, 15) and those who had sub-clinical levels of hoarding (26). Six studies included clinical group comparisons, five of which compared PwHD to an OCD group (3, 19–20, 24, 28) and one which compared PwHD to an anxiety disorder group (28). Additionally, two studies included both a hoarding only and a hoarding with OCD group (24, 28). Both studies compared these groups to an OCD only and community control group. One also compared these

Table 1
Study characteristics.

ID	Study	Setting	Study design	Analysis	Hoarding criteria	Sample (n =)	Gender/sex %	Age (M, SD)	Ethnicity (% White)
1	(Dozier and Ayers, 2014)	USA	Cross-sectional correlational within-groups	Zero-order correlations, paired sample t-tests, multiple regressions	SI-R ≥ 41 ; UHSS ≥ 21 and proposed DSM-5 criteria	Hoarding (n = 84)	75 % female 25 % male	(63.8, 8.1)	No data
2	(Grisham et al., 2018)	AUS	Cross-sectional correlational	Zero-order correlations, mediation	DSM-5 HD	Hoarding (n = 73)	75 % women 25 % men	(64.1, 9.3)	No data
3	(Frost et al., 2015)	USA	Cross-sectional correlational mixed methods	Mixed model ANOVAs, zero-order correlations, linear multiple regressions	DSM-5 HD	Hoarding (n = 217) OCD (n = 96) CC (n = 130)	Hoarding: 77 % female, 23 % male OCD: 48 % female, 52 % male CC: 70 % female, 30 % male	Hoarding (52.6, 10.3) OCD (34.5, 13.7) CC (52.6, 13.5)	Hoarding (88 %) OCD (86 %) CC (88 %)
4	(Wheaton et al., 2013)	USA	Cross-sectional correlational between-groups	t-tests, ANCOVAs, zero-order correlations, multiple regression	HRS-I ≥ 14 and proposed DSM-5 criteria	Hoarding (n = 33) HC (n = 30)	Hoarding: 70 % women, 30 % men HC: 63 % women, 37 % men	Hoarding (48.8, 15.6) HC (42.2, 14.0)	Hoarding (73 %) HC (80 %)
5	(Hallion et al., 2015)	USA	Cross-sectional between-groups	t-test	DSM-5 HD	Hoarding (n = 32) HC (n = 26)	69 % female	Hoarding (54.2, 7.4) HC (52.5, 7.8)	91 %
6	(Chou et al., 2018b)	USA	Cross-sectional correlational	Mediation	DSM-5 HD	Hoarding (n = 104)	23 % male	(59.9, 9.0)	No data
7	(Dozier et al., 2017)	USA	Cross-sectional correlational	Zero-order correlations	DSM-5 HD	Hoarding (n = 20)	40 % female 60 % male	(59.4, 13.3)	50 %
8	(Fontenelle et al., 2021b)	AUS	Cross-sectional correlational	Spearman's correlations	SI-R ≥ 39	Hoarding (n = 117)	90 % female, 6 % male, 2 % non-binary, 1 % gender not listed	(48.4, 12.7)	No data
9	(DeJong, 2016)	USA	Cross-sectional correlational between-groups	Zero-order correlations, independent t-tests	DSM-5 HD	Hoarding (n = 18) Non-hoarding (n = 20)	Hoarding: 83 % female Non-hoarding: 75 % female	Hoarding (47.5, 13.5) Non-hoarding (42.4, 12.6)	No data
10	(Frisse, 2014)	USA	Cross-sectional correlational between-groups	Zero-order correlations, independent t-tests	HRS-SR ≥ 14	Hoarding (n = 23) NC (n = 78)	Hoarding: 52 % female, 43 % male NC: 63 % female, 31 % male	Hoarding (21.4, 3.4) NC (22.5, 7.2)	Hoarding (57 %) NC (55 %)
11	(Fontenelle et al., 2021a)	AUS	Cross-sectional correlational	Linear regression	SI-R ≥ 39	Hoarding (n = 117)	90 % female, 6 % male, 2 % non-binary, 1 % gender not listed	(48.4, 12.7)	No data
12	(Walji and Salkovskis, 2024)	UK	Cross-sectional correlational mixed methods	Mixed model ANOVAs, zero-order correlations	DSM-5 HD	HWD (n = 24) HND (n = 24) CC (n = 26)	HWD: 87 % female, 8 % male, 4 % other HND: 71 % female, 25 % male, 4 % other CC: 85 % female, 12 % male	HWD (60.5, 10.2) HND (54.4, 12.2) CC (51.4, 19.0)	HWD (88 %) HND (88 %) CC (81 %)
13	(Phung et al., 2015)	AUS	Cross-sectional between-groups	t-tests	SI-R ≥ 42	High hoarding (n = 34) Low hoarding (n = 116)	72 % female	(29.1, 9.2)	No data
14	(Drury et al., 2014)	UK	Cross-sectional between-groups	ANOVA or student's t-tests	DSM-5 HD	Hoarding (n = 37) Collectors (n = 51) Hoarding relatives (n = 55) Collectors relatives (n = 25)	Hoarding: 16 % male Collectors: 67 % male Hoarding relatives: 22 % male Collectors relatives: 24 %	Hoarding (54.1, unreported) Collectors (52.4, unreported) Hoarding relatives (40.3, unreported) Collectors relatives (45.4, unreported)	No data

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Table 1 (continued)

ID	Study	Setting	Study design	Analysis	Hoarding criteria	Sample (n =)	Gender/sex %	Age (M, SD)	Ethnicity (% White)
15	(Chou et al., 2018a)	USA	Cross-sectional between-groups	t-tests	DSM-5 HD	Hoarding (n = 24) HC (n = 40)	Hoarding: 17 % male HC: 40 % male	Hoarding (54.21, 11.9) HC (46.4, 16.7)	No data
16	(Diefenbach et al., 2013)	USA	Cross-sectional between-groups	t-tests	HRS-I and proposed DSM-5 criteria	Hoarding (n = 55) HC (n = 39)	No data	Hoarding (64.1, 4.1) HC (68.5, 6.4)	Hoarding (96 %) HC (92 %)
17	(Ong et al., 2016)	SGP	Cross-sectional between-groups	Independent t-tests	SI-R $\geq$ 41	Hoarding (n = 102) Non-hoarding (n = 240)	56 % male	(35.3, 10.1)	No data
18	(Nordsletten et al., 2018)	LDN RIO	Cross-sectional between-groups	Kruskal-Wallis tests	DSM-5 HD	London (n = 29) Rio de Janeiro (n = 15)	London: 55 % female Rio de Janeiro: 40 % female	London (56.6, 13.6) Rio de Janeiro (55.0, 11.1)	No data
19	(Pardini et al., 2023)	ITA	Cross-sectional between-groups	ANOVAs	SI-R $\geq$ 37	High hoarding (n = 53) Low hoarding (n = 55)	High hoarding: 58 % women Low hoarding: 42 % women	High hoarding (28.3, 9.3) Low hoarding (26.9, 9.8)	No data
20	(Steketee et al., 2003)	USA	Cross-sectional between-groups	ANOVAs/ ANCOVAs	SI > One SD above mean	Hoarding (n = 61) OCD (n = 21) CC (n = 40)	Hoarding: 31 % male OCD: 19 % male CC: 28 % male	Hoarding (52.0, 11.0) OCD (36.7, 10.9) CC (42.0, 13.8)	Hoarding (97 %) OCD (91 %) CC (90 %)
21	(Steketee et al., 2012)	USA	Cross-sectional between-groups	ANOVAs	Hoarding Interview & SI-R $\geq$ 30	Hoarding (n = 25) Non-hoarding (n = 28)	Hoarding: 72 % female Non-hoarding: 79 % female	Hoarding (71.7, unreported) Non-hoarding (77.2, unreported)	No data
22	(Tinlin et al., 2022)	UK	Cross-sectional correlational	By-person factor analysis	HRS-SR $\geq$ 14	Hoarding (n = 32)	91 % female 9 % male	(45.0, 14.6)	No data
23	(Frost et al., 2016)	USA	Cross-sectional between-groups	t-tests	DSM-5 HD	Hoarding (n = 103) CC (n = 66)	Hoarding-CR: 67 % women Hoarding-TL: 74 % women CC: 77 % women	Hoarding-CR (52.7, 8.0) Hoarding-TL (51.4, 10.8) CC (53.9, 13.5)	90 %
24	(Gordon et al., 2013)	UK	Cross-sectional between-groups	t-tests, ANOVAs	Frost and Hartl (1996) hoarding definition SI-R $\geq$ 31	Hoarding (n = 24) OCD (n = 22) Hoarding + OCD (n = 21) CC (n = 21)	Hoarding: 71 % female OCD: 68 % female Hoarding+OCD: 62 % female CC: 62 % female	Hoarding (59.0, 13.8) OCD (32.5, 8.1) Hoarding+OCD (50.6, 11.7) CC (51.4, 9.4)	Hoarding (88 %) OCD (91 %) Hoarding+OCD (86 %) CC (95 %)
25	(Nordsletten et al., 2013a)	UK	Cross-sectional between-groups	Wilcoxon rank-sum tests, ANOVAs	CIR and proposed DSM-5 criteria (SIHD)	Hoarding (n = 29) Collectors (n = 20)	Hoarding: 45 % male Collectors: 75 % male	Hoarding (56.6, 13.6) Collectors (55.5, 10.8)	No data
26	(Mataix-Cols et al., 2013)	UK	Cross-sectional between-groups	Student's t-tests	CIR and proposed DSM-5 criteria (SIHD)	Hoarding (n = 29) Subclinical hoarding (n = 16)	Hoarding: 55 % female Subclinical hoarding: 75 % female	Hoarding (56.6, 13.6) Subclinical hoarding (56.6, 10.3)	No data
27	(Hartl et al., 2005)	USA	Cross-sectional between-groups	Independent samples t-tests, MANOVAs	Frost and Hartl (1996) hoarding definition SI-R $\geq$ 37	Hoarding (n = 26) Non-hoarding (n = 36)	Hoarding: 85 % female Non-hoarding: 88 % female	Hoarding (54.3, 10.3) Non-hoarding (50.2, 8.7)	Hoarding (96 %) Non-hoarding (100 %)
28	(Pertusa et al., 2008)	UK	Cross-sectional between-groups	Descriptive statistics only	Clinical interview SI-R $\geq$ 40	Hoarding (n = 27) OCD (n = 71) Hoarding+OCD (n = 25) AD (n = 19) CC (n = 21)	Hoarding: 85 % female OCD: 44 % female Hoarding+OCD: 68 % female AD: 68 % female CC: 57 % female	Hoarding (53.7, 9.7) OCD (37.0, 11.1) Hoarding+OCD (45.0, 12.2) AD (37.8, 9.5) CC (49.4, 17.1)	Hoarding (96 %) OCD (96 %) Hoarding+OCD (83 %) AD (95 %) CC (100 %)
29	Smith et al. (unpublished results)	UK	Longitudinal correlational between-groups	Zero-order correlations, ANOVAs	HRS-SR $\geq$ 14	Hoarding (n = 45) OCD (n = 63) HC (n = 54)	Hoarding: 91 % female, 4 % male, 2 % gender non-conforming OCD: 79 %	Hoarding (49.3, 18.9) OCD (24.5, 10.7) HC (33.4, 17.4)	Hoarding (89 %) OCD (70 %) HC (89 %)

(continued on next page)

Table 1 (continued)

ID	Study	Setting	Study design	Analysis	Hoarding criteria	Sample (n =)	Gender/sex %	Age (M, SD)	Ethnicity (% White)
							female, 21 % male HC: 93 % female, 7 % male		
30	(Timpano et al., 2020)	USA	Cross-sectional between-groups	t-tests	DSM-5 HD	Hoarding (n = 217) CC (n = 130)	Hoarding: 77 % female CC: 70 % female	Hoarding (52.6, 13.5) CC (52.6, 10.3)	Hoarding (88 %) CC (88 %)

Note. AUS = Australia, SGP = Singapore, LDN = London, RIO = Rio De Janeiro, ITA = Italy. SI-R = Saving Inventory-Revised (Frost et al., 2004), UHSS = UCLA Hoarding Severity Scale (Saxena et al., 2007), HRS-I = Hoarding Rating Scale-Interview (Tolin et al., 2010), HRS-SR = Hoarding Rating Scale - Self Report (Tolin et al., 2010), SI = Saving Inventory (Steketee et al., 2003), CIR = Clutter Image Rating (Frost et al., 2008), SIHD = Structured Interview for Hoarding Disorder (Nordsletten et al., 2013b). OCD = Obsessive Compulsive Disorder, CC = Community controls, HC = Healthy controls, NC = Non-clinical, HWD = Hoarding with early material deprivation, HND = Hoarding without early material deprivation, Hoarding-CR = Hoarding Cognitive Restructuring condition, Hoarding-TL = Hoarding Thought Listing Condition, AD = Anxiety Disorder.

groups to an anxiety disorder comparison group (28). Overall, comparison group size varied from 16 to 240. The average age of comparison participants was 52.77 (12.2) and the majority were female (70 %), women (61 %) and white (87 %).

2.3. Assessments of quality

Five papers were given an overall quality assessment of ‘Fair’ (2, 11, 12, 17, 29), with all others being assessed as ‘Poor’. In relation to the individual elements of the quality assessment tool, the studies generally scored positively (‘Yes’) on questions relating to: (1) Studies having clearly stated objectives, (2) Using appropriate methods to assess exposure (i.e., Beliefs about possessions) and outcome (i.e. Hoarding symptom severity) and (3) Case vs control criteria clearly differentiating groups that were compared to one another. There were mixed results when it came to assessing whether studies had clearly described the study population, often because manuscripts did not state the time frame of recruitment, which can impact upon the reproducibility of the methodology (NHBLI, 2013). As already stated, no papers were assessed as ‘Good’ quality overall, due to the lack of longitudinal data. Therefore, a general weakness of included studies was that it was not possible to establish a potential causal link between hoarding beliefs (exposure) and

hoarding symptom severity (outcome). Additionally, studies generally scored negatively (‘No’) on the items concerning pre-registration of study methodology and whether the study had discussed the rationale or justification for the sample size.

2.3.1. What possession beliefs are related to HD severity?

2.3.1.1. Meta-analysis. Nine studies (1–4, 7, 9–10, 12, 29) contributed 10 effect sizes (r) to the correlation between overall strength of hoarding severity and beliefs about possessions (Fig. 2). Pooling the effect sizes revealed a statistically significant correlation of medium effect size between beliefs about possessions and overall hoarding severity ($r = 0.43$, 95 % CI [0.31, 0.53], $t(9) = 7.80$, $p < .001$), with evidence of low heterogeneity ($I^2 = 25.4$ %, $Q(9) = 12.04$, $p = .21$). Visual inspection of the funnel plot (Fig. 3) did not indicate publication bias. This was supported by a non-significant Egger’s test ($Z = 1.74$, $p = .08$) and Kendall’s Tau ($\tau_b = 0.270$, $p = .281$).

Seven studies (1, 3–4, 7, 9, 12, 29) also reported on the correlation (r) between specific belief types (emotional attachment, control, responsibility and/or memory) and overall hoarding severity, contributing twenty-five effect sizes in total. Pooling these effect sizes, a significant correlation was once again found between beliefs about possessions and

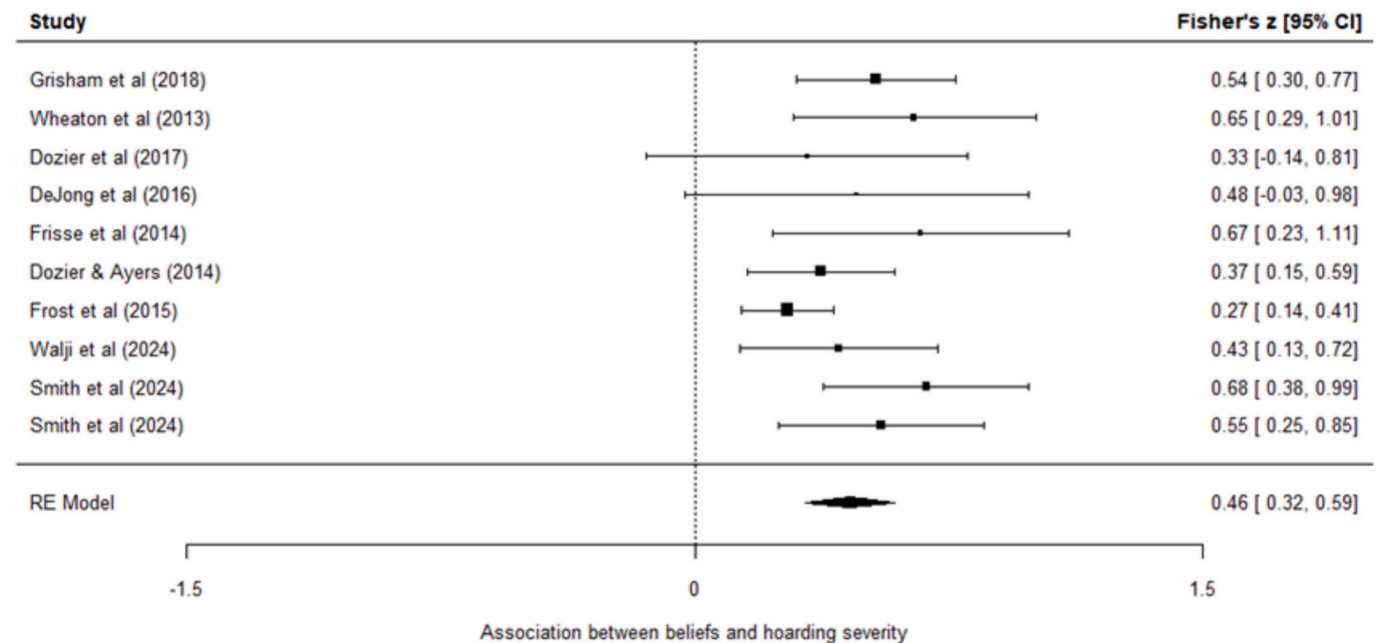


Fig. 2. Association between overall hoarding severity and hoarding beliefs.

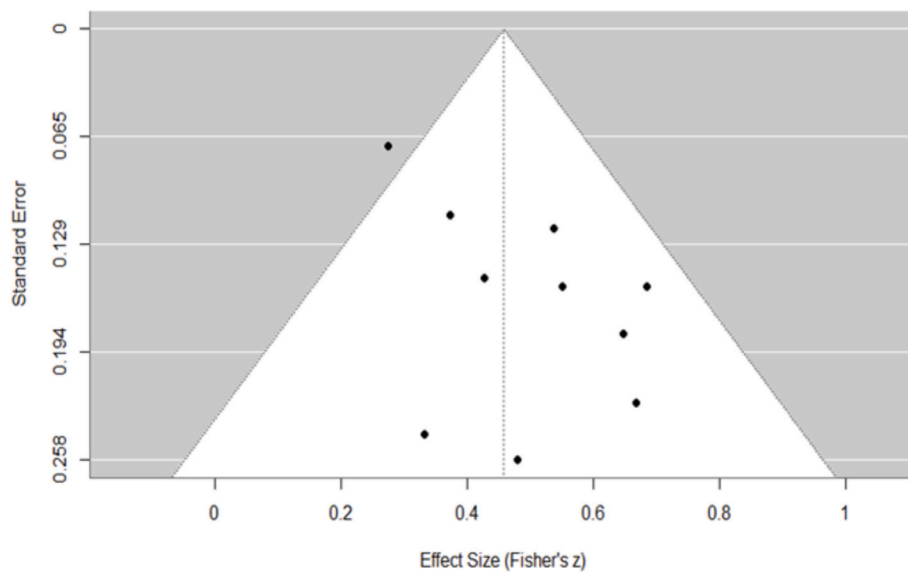


Fig. 3. Funnel plot for the association between overall hoarding severity and hoarding beliefs.

hoarding severity ($r = 0.36$, 95 % CI [0.29, 0.44], $t(24) = 9.08$, $p < .001$). Although results indicated relatively low levels of heterogeneity ($I^2 = 22.7\%$, $Q(24) = 35.13$, $p = .07$), because we had a priori intentions to explore whether belief types had differential relationships with overall hoarding severity ($H_0 = \text{emotional attachment} = \text{control} = \text{responsibility} = \text{memory} = 0$) we also conducted sub-group analyses on particular belief types. Consistent with the low levels of heterogeneity, there was a significant correlation between each type of belief and overall hoarding severity, with small correlations found for beliefs related to control ($r = 0.27$, 95 % CI [0.06, 0.46], $t(21) = 2.60$, $p = .02$) and memory ($r = 0.27$, 95 % CI [0.14, 0.40], $t(21) = 4.19$, $p < .001$), and medium correlations found for beliefs related to emotional attachment ($r = 0.41$, 95 % CI [0.30, 0.51], $t(21) = 7.32$, $p < .001$) and responsibility ($r = 0.41$, 95 % CI [0.30, 0.51], $t(21) = 6.86$, $p < .001$).

Pooling between-group differences in hoarding severity highlighted a large effect size ($d = 3.58$, 95 % CI [3.02, 4.14], $t(26) = 13.22$, $p < .001$), with substantial heterogeneity ($I^2 = 89.03\%$, $Q(26) = 209.94$, $p < .001$). Therefore, between-group differences in beliefs about possessions was entered as a predictor variable through meta-regression, with

18 studies providing 27 effect sizes (4–5, 9–10, 12, 14–17, 19–21, 23–25, 27, 29–30). Between-group differences in hoarding beliefs were found to be positively associated with between-group differences in hoarding severity ($F(1, 25) = 15.40$, $p < .001$), such that as between-group differences in hoarding beliefs increased, so did between-group differences in hoarding severity. The funnel plot (Fig. 4) highlights clustering of studies towards the bottom of the y-axis, with some bias of studies towards the left. However, the Egger's test did not indicate publication bias ($Z = 0.97$, $p = .33$).

For papers which had additionally provided between-group differences on belief subscales (i.e., emotional attachment, control, responsibility, memory), it was possible to run a similar meta-regression model, with the addition of belief type as a subgroup (moderator) variable; 16 studies (4–5, 12, 14–17, 19–21, 23–25, 27, 29–30) contributed 72 effect sizes. Results indicated that between-group differences in beliefs relating to control ($d = 3.09$, 95 % CI [2.43, 3.75], $t(67) = 9.37$, $p < .001$), emotional attachment ($d = 2.97$, 95 % CI [2.30, 3.65], $t(67) = 8.81$, $p < .001$), memory ($d = 2.87$, 95 % CI [2.16, 3.58], $t(67) = 8.12$, $p < .001$) and responsibility ($d = 2.85$, 95 % CI [2.13, 3.56], $t(67) = 7.98$,

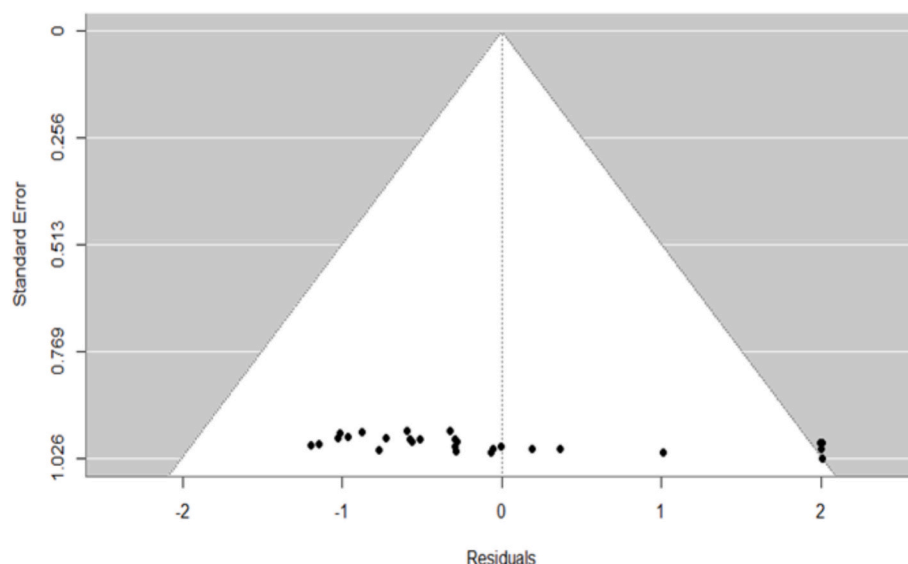


Fig. 4. Funnel plot for the association of between-group differences in hoarding severity with between-group differences in hoarding beliefs.

$p < .001$) were significantly associated with between-group differences in hoarding severity ($F(5, 67) = 37.08, p < .001$).

2.3.1.2. Narrative synthesis. Mataix-Cols et al. (2013) compared those who met proposed DSM-5 HD criteria to those with subclinical symptoms of hoarding. Despite the comparison group experiencing some level of hoarding symptoms, the hoarding group were found to score significantly higher on the SCI overall, and on three of its subscales (responsibility, memory, emotional attachment). Similarly, Phung et al. (2015) focused on the emotional attachment subscale only and found a high hoarding group (SI-R score > 41) to score significantly higher on this subscale compared to a low hoarding group (SI-R score < 42). When beliefs about possessions have been compared internationally, Nord-sletten et al. (2018) found that Brazilian and UK HD groups did not differ on three of the SCI subscales (control, responsibility, memory), but that the UK group scored significantly higher on SCI total and the SCI emotional attachment subscale.

There were additional possession beliefs which could not be included in the meta-analysis due to the low number of studies that have investigated them (1, 3, 12, 24–25, 28–30) (Table 2). Saving or acquiring due to an item being beautiful or aesthetically pleasing had a medium correlation with overall hoarding severity ($r = 0.37$ – $0.43, p < .001$) (1) and hoarding groups were found to score significantly higher on this belief type compared to OCD (3) and community controls (3,30). Using regression analysis, Dozier and Ayers (2014) (1) found four reasons for acquiring and saving (lost information, sentimental or emotional significance, wasting a potentially useful object and aesthetic appeal) to be significantly correlated with overall hoarding severity. Additionally, when controlling for gender and all other reasons to save, waste avoidance and emotional/sentimental significance were significant predictors of additional variance. For reasons to acquire, avoiding wasting a potentially useful object was the only reason found to predict significant additional variance in hoarding severity after controlling for all other reasons and gender. This is consistent with interview findings from other studies showing avoidance of waste and sentimental value as the main reasons for saving items reported by people with HD (28) and that these beliefs distinguish people with HD from collectors (25). Dozier and Ayers (2014) also investigated gender differences, finding that women scored higher than men for possessions needing to be acquired for being ‘beautiful or aesthetically pleasing’ and to avoid ‘losing important information’, and women scored higher than men for possessions needing to be saved for being ‘beautiful or aesthetically pleasing’, which contrasts with Frost et al. (2015) who, using a similar interview, found that men reported acquiring to avoid waste more often than women, but that there were no other significant differences.

Tinlin et al. (2022) used a Q-methodology approach and by-person factor analysis to extensively assess beliefs about possessions amongst those meeting criteria for clinically significant hoarding. They found four distinct factors of beliefs about possessions: 1) the role of possessions in representing aspects of the self, including that related to the past, present or future (Expressions of Identity factor); 2) being responsible for the proper use and care of objects, and the avoidance of waste (Morality and Responsibility factor); 3) objects being reliable and predictable (Stability and Predictability Factor) and 4) anthropomorphism type beliefs (Objects as emotional and meaningful beings). Using the SI-R (Frost et al., 2004), Tinlin et al. (2022) found that hoarding severity did not differ between the factors. Using a novel measure (Beliefs about Items in Hoarding Disorder, BIHD; Ragan et al., in press) evidence for possessions representing self-identity has also been found (29), showing a medium correlation with hoarding severity; and PwHD were found to score significantly higher on this belief type compared to a community and clinical comparison group. Using the Beliefs about Hoarding questionnaire, PwHD more highly endorse beliefs concerning harm avoidance and fear of material deprivation than control groups (12, 24), with only the latter differentiating HD and OCD groups (24).

Table 2

Narrative synthesis data: review questions (1) and (2).

ID - study	What possession beliefs are related to HD severity?	Is there evidence that particular possession beliefs are related to specific aspects of hoarding (i.e., acquisition, difficulty discarding or clutter)?
1 - Dozier and Ayers (2014)	Correlations Beautiful or aesthetically pleasing (reason for saving) & SI-R total: $r = 0.37, p < .001$. Beautiful or aesthetically pleasing (reason for acquiring) & SI-R total: $r = 0.43, p < .001$. Regressions Four reasons for saving and acquiring (losing important information, sentimental or emotionally significant, wasting a potentially useful object, beautiful or aesthetically pleasing) were significant predictors of SI-R total, after gender was controlled for ($p < .001$) Two reasons for saving (wasting a potentially useful object, sentimental or emotionally significant) were significant predictors of additional variance, once gender and all other reasons for saving were controlled for ($p < .05$) One reason for acquiring (wasting a potentially useful object) was a significant predictor of additional variance, once gender and all other reasons for acquiring were controlled for ($p < .05$)	Correlations Beautiful or aesthetically pleasing (reason for saving) & SI-R acquisition: $r = 0.35, p < .01$. Beautiful or aesthetically pleasing (reason for saving) & SI-R difficulty discarding: $r = 0.46, p < .001$. Beautiful or aesthetically pleasing (reason for saving) & SI-R clutter: $r = 0.05, p > .05$. Beautiful or aesthetically pleasing (reason for saving) & CIR: $r = 0.08, p > .05$. Beautiful or aesthetically pleasing (reason for acquiring) & SI-R acquisition: $r = 0.54, p < .001$. Beautiful or aesthetically pleasing (reason for acquiring) & SI-R difficulty discarding: $r = 0.47, p < .001$. Beautiful or aesthetically pleasing (reason for acquiring) & SI-R clutter: $r = -0.00, p > .05$. Beautiful or aesthetically pleasing (reason for acquiring) & CIR: $r = 0.11, p > .05$. Regressions For SI-R difficulty discarding and SI-R acquisition, and with gender controlled for, all reasons for saving and acquiring (losing important information, sentimental or emotionally significant, wasting a potentially useful object, beautiful or aesthetically pleasing) were significant predictors ($p < .001$). When considering SI-R clutter, gender and all reasons for saving and acquiring were not significant predictors $p = .31$.
3 - Frost et al. (2015)	Between-groups Hoarding Interview Acquire for aesthetics: HD $>$ OCD=CC, $p < .001$. Hoarding Interview Saving for aesthetics: HD $>$ CC $>$ OCD, $p < .001$.	Correlations Acquire for aesthetics & SI-R acquisition: $r = 0.32, p < .01$. Save for aesthetics & SI-R difficulty discarding: $r = 0.13, p = .13$. Regressions Acquiring to avoid waste and for aesthetic reasons

(continued on next page)

Table 2 (continued)

ID - study	What possession beliefs are related to HD severity?	Is there evidence that particular possession beliefs are related to specific aspects of hoarding (i.e., acquisition, difficulty discarding or clutter)?
		were significant predictors of SI-R acquisition ($p < .01$) when all four reasons for acquiring were entered together (i.e., acquiring for information, for emotion, to avoid waste and for aesthetics). With the exception of saving for aesthetic reasons, all other reasons for saving (save for emotion, information, to avoid waste) were significant predictors of SI-R difficulty discarding ($p < .05-.01$) when these were entered simultaneously.
12 - Walji and Salkovskis (2024)	Between-groups BAH Harm Avoidance: HWD=HND > CC, $p < .01$ BAH Fear of Material Deprivation: HWD=HND > CC, $p < .001$	Correlations* BAH Harm avoidance & SI-R clutter: $r = 0.29$, $p < .05$ BAH Harm avoidance & SI-R difficulty discarding: $r = 0.38$, $p < .01$ BAH Harm avoidance & SI-R acquisition: $r = 0.48$, $p < .001$ BAH Fear of material deprivation & SI-R clutter: $r = 0.24$, $p > .05$ BAH Fear of material deprivation & SI-R difficulty discarding: $r = 0.54$, $p < .001$ BAH Fear of material deprivation & SI-R acquisition: $r = 0.59$, $p < .001$ *Bonferroni correction applied, therefore significance level set at $p < .0056$.
24 - Gordon et al. (2013)	Between-groups BAH Harm Avoidance: CHOC>CH=OCD > CC, $p < .001$ BAH Fear of Material Deprivation: CH=CHOC>OCD=CC, $p < .001$	No relevant data
25 - (Nordsletten et al., 2013a)	Between-groups Reasons for difficulty discarding: Useful in future: C = HD, $p = .22$ Sentimental attachment: C = HD, $p = .97$ Monetary value: C = HD, $p = .55$ Avoid waste: HD > C, $p = .001$ Object is unique: C = HD, $p = .32$ Misuse of personal information: HD > C, $p = .006$ Taught to save: C = HD, $p = .64$ Item part of personal identity: C = HD, $p = .56$ Fear bad consequence: C = HD, $p = .14$ Reasons for acquiring items: Useful in future: HD > C, $p < .001$ Compelled to acquire it: C = HD, $p = .22$	No relevant data

Table 2 (continued)

ID - study	What possession beliefs are related to HD severity?	Is there evidence that particular possession beliefs are related to specific aspects of hoarding (i.e., acquisition, difficulty discarding or clutter)?
	Compulsive shopper: C = HD, $p = .050$ Semi-structured clinician-administered hoarding interview showed that hoarding participants reported intrinsic (i.e., items are valuable or may come in handy in the future) and/or emotional (i.e., sentimental attachment to possessions) reasons for hoarding.	
28 - Pertusa et al. (2008)	Correlations BIHD Identity & SI-R Total: $r = 0.32$, $p < .05$ Between-groups BIHD Identity: HD > OCD > CC, $p < .001$.	Correlations BIHD Identity & SI-R Acquisition: $r = .11$, $p > .05$ BIHD Identity & SI-R Difficulty discarding: $r = .37$, $p < .05$ BIHD Identity & SI-R Clutter: $r = .32$, $p < .05$ No relevant data
29 - Smith et al. (unpublished results)	Correlations BIHD Identity & SI-R Total: $r = 0.32$, $p < .05$ Between-groups BIHD Identity: HD > OCD > CC, $p < .001$.	
30 - Timpano et al. (2020)	Between-groups Hoarding Interview aesthetics: HD > HC, $p < .001$.	

Note. SI-R = Saving Inventory Revised (Frost et al., 2004), CIR = Clutter Image Rating (Frost et al., 2008), BAH = Beliefs about Hoarding (Gordon et al., 2013), BIHD = Beliefs about Items in Hoarding Disorder (Ragan et al., in press). OCD = Obsessive Compulsive Disorder, CC = Non-clinical/Community Controls, HWD = Hoarding with early material deprivation, HND = Hoarding without deprivation, CH = Compulsive Hoarding, CHOC = Compulsive Hoarding with co-existing OCD, C = Collectors.

2.3.2. Is there evidence that particular possession belief domains are related to specific aspects of hoarding (i.e., acquisition, difficulty discarding or clutter)?

2.3.2.1. Meta-analysis. Seven studies (1, 3–4, 7, 9, 12, 29) contributed eight effect sizes (r) for the correlation between excessive acquiring and overall strength of beliefs about possessions (e.g., SCI total), and difficulty discarding and overall strength of beliefs about possessions. After pooling effect sizes, a medium correlation was found between possession beliefs and acquiring ($r = 0.38$, 95 % CI [0.26, 0.48], $t(7) = 7.05$, $p < .001$) and between possession beliefs and difficulty discarding ($r = 0.40$, 95 % CI [0.27, 0.51], $t(7) = 6.85$, $p < .001$). For both acquiring ($I^2 = 12.9$ %, $Q(7) = 5.73$, $p = .57$) and difficulty discarding ($I^2 = 20.4$ %, $Q(7) = 7.62$, $p = .37$), statistics indicated low heterogeneity. Six studies (1, 4, 7, 9, 12, 29) contributed seven effect sizes (r) for the correlation between clutter and beliefs about possessions, with a small correlation being found ($r = 0.23$, 95 % CI [0.02, 0.41], $t(6) = 2.68$, $p < .05$) and indication of moderate heterogeneity ($I^2 = 37.0$ %, $Q(6) = 8.71$, $p = .19$). Visual inspection of the funnel plots (Fig. 5) and Egger's tests indicated potential publication bias for acquiring ($Z = 2.04$, $p = .042$) and difficulty discarding ($Z = 2.02$, $p = .044$) results. However, this was not supported by Kendall's Tau for either acquiring ($\tau_b = -0.182$, $p = .533$) or difficulty discarding ($\tau_b = -0.036$, $p = .901$). For clutter results, visual inspection of the funnel plot (Fig. 5) did not indicate publication bias. This was supported by a non-significant Egger's test ($Z = -0.07$, $p = .947$) and Kendall's Tau ($\tau_b = 0.098$, $p = .761$).

Studies also reported on the correlation between belief types and the specific symptoms of hoarding (i.e., acquiring, difficulty discarding, clutter). Pooling 25 effect sizes from seven studies (1, 3–4, 7, 9, 12, 29) indicated a medium correlation between pooled SCI sub-indices (i.e., emotional attachment, control, responsibility, memory) and both

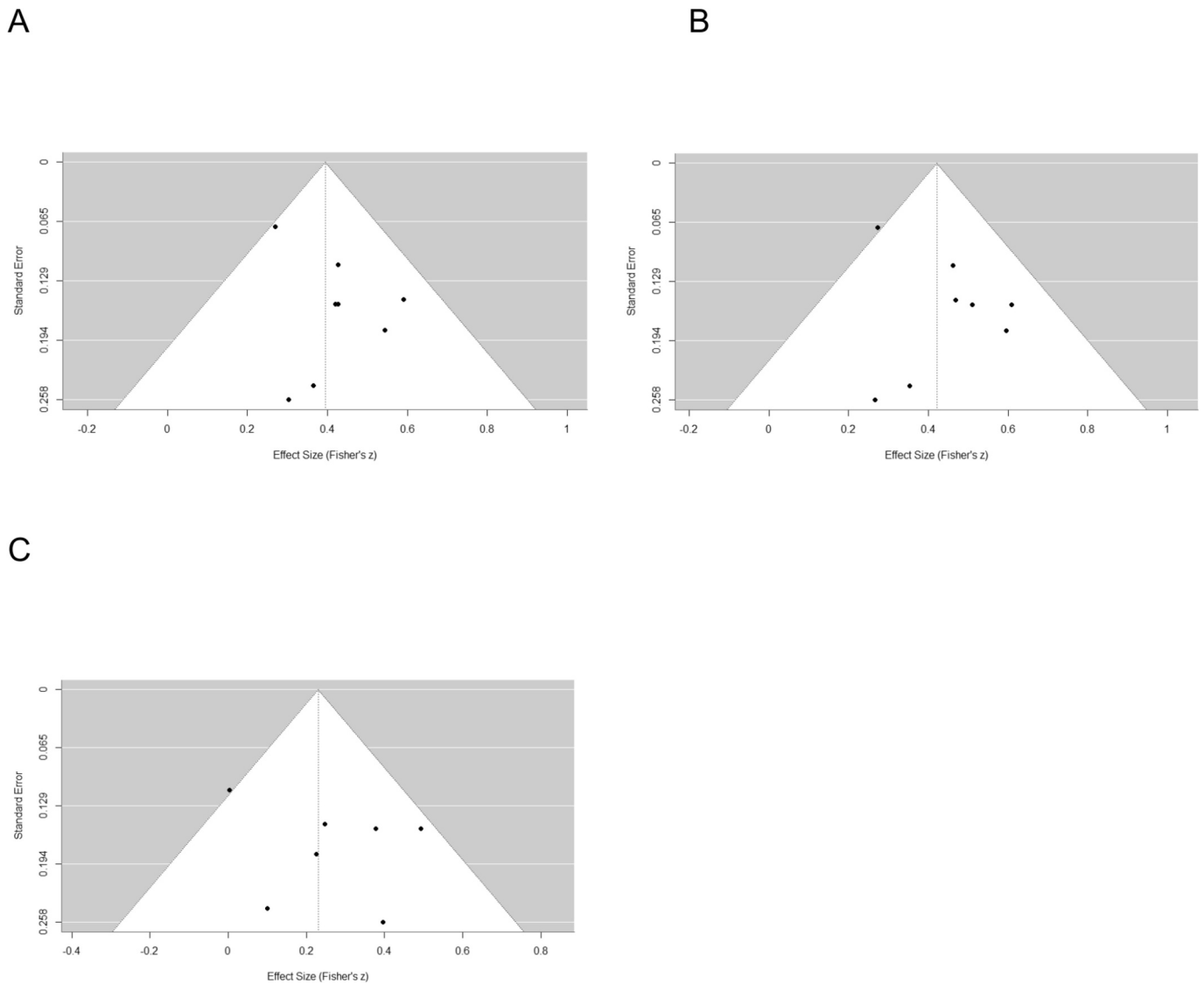


Fig. 5. Funnel plots for the association between hoarding beliefs and hoarding symptom severity (acquiring, difficulty discarding and clutter). Note. Funnel plots of Effect Size (Fisher's z) against Standard Errors for the association between beliefs about possessions and (A) Acquiring, (B) Difficulty Discarding and (C) Clutter.

acquiring ($r = 0.32$, 95 % CI [0.25, 0.39], $t(24) = 8.93$, $p < .001$) and difficulty discarding ($r = 0.36$; 95 % CI [0.30, 0.41], $t(24) = 12.25$, $p < .001$). Pooling 22 effect sizes from six studies (1, 4, 7, 9, 12, 29) indicated a small correlation ($r = 0.16$, 95 % CI [0.03, 0.28], $t(21) = 2.56$, $p = .018$) between combined belief types and clutter. Heterogeneity was very low for difficulty discarding ($I^2 = 2.5$ %), suggesting that the correlation does not depend on the type of belief being assessed and therefore subgroup analysis of belief type was not indicated for difficulty discarding. Heterogeneity was low for acquiring ($I^2 = 14.1$ %) and moderate for clutter ($I^2 = 26.0$ %). Through subgroup analysis, each belief type was found to be related significantly to acquiring, with beliefs related to emotional attachment and responsibility having a medium correlation ($r = 0.37$ – 0.38) and beliefs about control and memory having a small correlation ($r = 0.21$ – 0.22). For clutter, only responsibility beliefs were significantly related, with a small correlation being found ($r = 0.21$). These results are presented in Table 3.

2.3.2.2. Narrative synthesis. Studies (see Table 2) reported additional information regarding specific belief types and their correlation with acquiring, difficulty discarding and clutter, which could not be pooled in the meta-analysis. Acquiring or saving because an item is beautiful/

Table 3

Correlation between beliefs and hoarding symptoms (acquiring and clutter), with belief type as a moderator.

Symptom type	Belief type	Moderating effect of belief type
Acquiring	Control	$r = 0.21$, 95 % CI [0.00, 0.40], $t(21) = 2.09$, $p = .049$
	Emotional attachment	$r = 0.38$, 95 % CI [0.28, 0.47], $t(21) = 7.58$, $p < .001$
	Memory	$r = 0.22$, 95 % CI [0.10, 0.33], $t(21) = 3.83$, $p = .001$
	Responsibility	$r = 0.37$, 95 % CI [0.27, 0.47], $t(21) = 6.98$, $p < .001$
Clutter	Control	$r = 0.10$, 95 % CI [-0.13, 0.33], $t(18) = 0.93$, $p = .36$
	Emotional attachment	$r = 0.16$, 95 % CI [-0.01, 0.32], $t(18) = 2.03$, $p = .06$
	Memory	$r = 0.13$, 95 % CI [-0.06, 0.31], $t(18) = 1.39$, $p = .18$
	Responsibility	$r = 0.21$, 95 % CI [0.03, 0.38], $t(18) = 2.49$, $p = .02$

aesthetically pleasing was found to have medium-large correlations with both acquiring ($r = 0.35\text{--}54$, $p < .01$), and difficulty discarding ($r = 0.46\text{--}47$, $p < .001$), but non-significant correlations with clutter ($r = 0\text{--}0.11$) (1). Whilst [Frost et al. \(2015\)](#) (3) also found a significant medium correlation between SI-R acquisition and acquiring for aesthetic reasons ($r = 0.32$, $p < .01$), they did not find a significant correlation between saving for aesthetic reasons and SI-R difficulty discarding. Two studies used multiple regression to evaluate the role of four specific belief types as predictors of individual hoarding symptoms (1,3). [Dozier and Ayers \(2014\)](#) did not find any reasons for saving or acquiring to be predictive of clutter (1). By comparison, in both studies, reasons for saving and acquiring (lost information, sentimental or emotional significance, wasting a potentially useful object and aesthetic appeal) assessed through self-report (1) and interview (3) format were found to be significant predictors of difficulty discarding and acquisition.

Using the BAH ([Gordon et al., 2013](#)), difficulty discarding was correlated with beliefs related to fear of material deprivation ($r = 0.54$, $p < .001$) but not those concerning harm avoidance ($r = 0.38$, $p < .01$; Bonferroni correction applied) (12). Acquiring was correlated with both fear of material deprivation ($r = 0.59$, $p < .001$) and harm avoidance beliefs ($r = 0.48$, $p < .001$), whereas clutter had a non-significant correlation with both types of belief ($r = 0.24\text{--}29$) (12). One unpublished study (29) contributed data concerning the relationship between beliefs about items representing identity and acquiring/difficulty discarding/clutter. These beliefs had a medium correlation with both difficulty discarding ($r = 0.37$, $p < .05$) and clutter ($r = 0.32$, $p < .05$) but not acquiring ($r = 0.11$).

2.3.3. How does the strength of the relationship between possession beliefs and hoarding severity compare to that for other investigated psychological constructs and hoarding severity?

2.3.3.1. Narrative synthesis. Please see Supplement 3 for relevant data. In addition to higher scores on measures of possession beliefs, group comparison data shows that scores on measures assessing trauma (15, 27), emotional vulnerabilities (4, 13, 16, 19), information processing constructs (5,16, 20, 27) and social support (16) differentiate PwHD from controls (clinical or non-clinical). For example, [Wheaton et al. \(2013\)](#) (4) found that PwHD scored higher than a non-clinical control group on both measures of possession beliefs and experiential avoidance, but when controlling for anxiety, depression and stress, group differences remained for beliefs about possessions but were no longer significant for experiential avoidance.

Amongst PwHD, possession beliefs have generally been found to have a stronger correlation with hoarding severity (through larger effect sizes or significant correlations with a greater number of specific symptoms) when compared to measures of intolerance of uncertainty (2), anxiety sensitivity (2), traumatic experiences (8), perceived social support (8) and experiential avoidance (4). Whilst distress tolerance has been found to have a large correlation with hoarding severity, mediational analysis suggests that the relationship is partially mediated by beliefs about possessions (and specifically emotional attachment beliefs) (2). Beliefs about possessions acting as a mediator is also consistent with research finding that possession beliefs (and specifically beliefs about responsibility) fully mediate the correlation between both self-criticism and shame and hoarding severity (6).

There are however mixed results from regression studies regarding the predictive role of beliefs about possessions in comparison to other psychological constructs of interest. [Wheaton et al. \(2013\)](#) (4) found possession beliefs, but not experiential avoidance, to be predictive of overall hoarding severity, difficulty discarding and acquiring. Possession beliefs also predicted a broader range of hoarding symptomatology compared to distress tolerance, which was only found to be predictive of acquiring. However, in a study exploring the impact of coronavirus, [Fontenelle et al. \(2021a\)](#) (11) found covid-related helplessness and

sadness, and depression and anxiety symptoms to be predictive of hoarding severity, whereas this was not the case for possession beliefs, covid-related trauma, attentional deficits, self-efficacy, internalised stigma or social support. Both of these studies assessed beliefs using the SCI ([Steketee et al., 2003](#)) and hoarding severity using the SI-R ([Frost et al., 2004](#)). However, [Wheaton et al. \(2013\)](#) entered SCI total as the predictor, whereas [Fontenelle et al. \(2021a\)](#) entered the subscales of the SCI separately.

3. Discussion

This review provides robust evidence for the significant relationship between beliefs about possessions and hoarding severity. Meta-analysis models demonstrated generally consistent significant results when pooling both between-group comparison (d) and correlation (r) data. With few exceptions, this was the case when considering the relationship between (a) overall hoarding severity, acquiring, clutter or difficulty discarding and (b) overall hoarding beliefs or specific belief types. These results were also supported by narrative synthesis of data not eligible for inclusion in meta-analysis.

3.1. Question 1: what possession beliefs are related to HD severity?

Meta-analysis results suggested that greater severity of hoarding symptoms amongst PwHD compared to non-clinical or clinical comparison groups could be explained by higher scores on measures of beliefs about possessions. Four types of beliefs about possessions were found to be significantly related to hoarding symptom severity, through meta-analysis of correlational and group comparison data. These include emotional attachment to possessions and beliefs related to control, memory and responsibility. There was evidence to suggest that beliefs about responsibility and emotional attachment had a marginally stronger relationship with hoarding severity, compared to beliefs concerning control or memory. Support for this came from moderator analysis of belief type during meta-analysis, but also narrative synthesis of regression and mediation results. In addition to these four belief types, narrative synthesis highlighted that a range of other possession beliefs are associated with hoarding severity. These include beliefs about: (a) objects being beautiful or aesthetically pleasing ([Dozier and Ayers, 2014](#); [Frost et al., 2015](#); [Timpano et al., 2020](#)), (b) possessions representing parts of identity (Smith et al., unpublished results; [Tinlin et al., 2022](#)), (c) fear of material deprivation ([Gordon et al., 2013](#); [Walji and Salkovskis, 2024](#)) and (d) objects being safe and comforting due to their stability/predictability ([Tinlin et al., 2022](#)). Although several items within the SCI ([Steketee et al., 2003](#)) overlap with these constructs, some are missing entirely (e.g. aesthetic value; fear of material deprivation). There are also concerns that distinct constructs are not easily identifiable within the SCI – for example, usefulness and wastefulness appear to feature within the responsibility category of the SCI, and beliefs relating to anthropomorphism and objects being representative of the self appear to feature within the emotional attachment subscale of the SCI ([Yap and Grisham, 2019](#)). This is consistent with the concerns that have been raised regarding the structural validity of the SCI (see [Ong et al., 2021](#)). This might explain why constructs emerge in studies using alternative measures to the SCI, which is important as otherwise potentially relevant constructs could be obscured by the belief categories within the SCI. Given that the SCI items were derived (see [Steketee et al., 2003](#)) from hypothesised constructs from the [Frost and Hartl \(1996\)](#) model, the evidence of possessions beliefs available at the time of the development of the measure and clinical observation, it is important that researchers develop and evaluate possession belief questionnaires that comprise this wide range of belief categories and that are based upon the reports of people with hoarding difficulties (e.g. [Kings et al. \(2021\)](#); Smith et al. (unpublished results)).

3.2. Question 2: is there evidence that particular possession belief are related to specific aspects of hoarding (i.e., acquisition, difficulty discarding or clutter)?

Through meta-analysis, results indicated that clutter had a weaker (albeit still significant) correlation with beliefs about possessions, whereas both difficulty discarding and acquiring had medium significant correlations with these beliefs. Due to the low heterogeneity of effect sizes when pooling correlations, results suggested that each belief type (i.e., emotional attachment, control, responsibility, memory) was significantly correlated with difficulty discarding, and therefore the relationship did not depend on belief type. Although all belief types were significantly correlated with acquiring, consistent with the findings for overall hoarding severity, a stronger correlation was found for beliefs relating to emotional attachment and responsibility, compared to control and memory. A different picture emerged for clutter, with beliefs about responsibility being the only belief type to be significantly correlated. The narrative synthesis was consistent with this pattern of generally weaker correlations between specific belief types and clutter, compared to that with acquiring or difficulty discarding. The findings suggest that it is important for clinicians to understand that the profiles of beliefs underpinning acquisition and saving may not be the same, and therefore need assessing separately. The weaker relationship between possession beliefs and clutter is likely attributable to it being a consequence of the relationship between beliefs and behaviours. Clutter can also be subject to numerous external factors (e.g. size of the living space; help/interference from others; socioeconomic status (i.e. ability to rent storage), and physical health (i.e. limited ability to move possessions)), that may impact upon the volume of items in the immediate living space at any one time.

3.3. Question 3: how does the strength of the relationship between possession beliefs and hoarding severity compare to that for other investigated psychological constructs and hoarding severity?

Data were extracted that allowed us to compare the strength of the relationship between beliefs about possessions and hoarding severity to that between hoarding severity and other psychological constructs of interest, many of which were factors found in the cognitive model of hoarding (Frost and Hartl, 1996). We observed that, compared to other psychological constructs of interest (e.g., emotional vulnerabilities, trauma experiences, experiential avoidance), beliefs about possessions generally had more consistent and stronger relationships with hoarding severity. Additionally, for psychological constructs that were found to be significantly associated with hoarding severity (e.g. distress tolerance; self-criticism), mediation analysis suggests that beliefs about possessions are still highly relevant as they are found to partially mediate this relationship (Grisham et al., 2018; Chou et al., 2018b).

Several systematic reviews have investigated constructs implicated in the cognitive behavioural model (Frost and Hartl, 1996), for example information processing difficulties (Gledhill et al., 2021; Woody et al., 2014) and emotional regulation (Akbari et al., 2022). However, considering evidence relating to HD patients only, Gledhill et al. (2021) reported that impairments in information processing may not be as diverse as those suggested in Frost and Hartl's (1996) model. Akbari et al. (2022) used meta-analytic techniques to estimate the relationship between hoarding severity and emotion dysregulation and found a significant medium correlation between emotion dysregulation and hoarding severity ($r = 0.43$). Although this is the same as the pooled correlation we found between beliefs about possessions and hoarding ($r = 0.43$), Akbari et al. (2022) had included both clinical and non-clinical samples, and through moderation analysis they noted this correlation was smaller for clinical samples compared to non-clinical samples. Taken together, the findings for question 3 represent preliminary evidence for there being a stronger relationship between beliefs about possessions and hoarding severity compared to that for other

psychological constructs. However, it is possible that this due to the shared variance between measures of beliefs about possessions and hoarding severity.

3.4. Clinical and research implications

Consistent with Frost and Hartl (1996), the findings suggest beliefs about possessions should be an important component of psychological therapists' approach to assessing, formulating and treating people with hoarding difficulties. Due to our findings that a range of beliefs are related to hoarding severity, with some evidence for the prominence of responsibility and emotional attachment, clinicians can anticipate needing to assess a wide range of beliefs about possessions to formulate and plan treatment. Further, it might be important to not only understand the range of beliefs that someone holds about possessions in relation to acquiring and saving, but also to consider these in relation to the specific categories of items (e.g. clothing, food, paperwork etc) that they apply to (see Tinlin et al., 2022) and why people hold these meanings for these possession categories. Therapists can then adapt their cognitive-behavioural approach according to the underpinning meaning of these possession categories, either to directly change their meaning and/or to understand what alternative competing meanings/representations may be needed (see Brewin, 2006). For example, one possession category might trigger beliefs about wastefulness that could be targeted using cognitive restructuring techniques, whereas other categories of items might be more connected with emotional attachment/identity and would benefit from supporting people to engage in activities that promote psychosocial connections beyond their possessions.

Whilst these results show that beliefs about possessions are important in HD, and that there are a range of relevant belief types, further research is required to show how they are best targeted in treatment. Research is beginning to understand whether alternative techniques, for example thought listing versus cognitive restructuring, make a difference to acquiring and discarding decision making (Frost et al., 2016; Levy et al., 2019); however, studies of this type do not target specific possession beliefs associated with object stimuli, which is an important area for future research. This would be akin to the investigation of cognitive-behavioural interventions used in clinical practice to target specific meanings implicated in the maintenance of a problem, like the approach taken in, for example, treatments for Panic Disorder (see Clark and Ehlers, 1993).

3.5. Limitations

During meta-analysis, data availability meant that moderator analysis of belief type was limited to the possession beliefs categories captured in the SCI (Steketee et al., 2003), specifically, beliefs relating to emotional attachment, control, memory and responsibility. However, data was extracted from multiple measures for these dimensions, therefore the SCI was not the only source of input into the meta-analysis. Further, belief types that could not be incorporated into moderator analyses were narratively synthesised and therefore still included in the review.

Most of the papers included in this systematic review used self-report measures and overall do not represent an exhaustive synthesis of data related to all available measures of beliefs about possessions. There are additional measures of beliefs about possessions that have not been included in the current review, particularly those that focus on specific types of beliefs about possessions, such as anthropomorphism (e.g., Burgess et al., 2018; Neave et al., 2016), material scrupulosity (e.g., Frost et al., 2018), possessions as extensions of self (e.g., Kings et al., 2021; Yap and Grisham, 2019) and insecure object attachment (e.g., Grisham et al., 2009; Norberg et al., 2015). Although identified through the search strategy, these papers were excluded at full text stage after applying our eligibility criteria.

The data captured within this review was cross-sectional in nature. Therefore, whilst a strong relationship between beliefs about possessions and hoarding is evident, it is not possible to make causal links. It is also unclear how generalisable the findings are to the wider population of people with hoarding difficulties. For example, the hoarding groups in the included studies were reported as being primarily female (73 %), women (70 %) and white (85 %). Also, people with hoarding difficulties who participate in research can differ from the wider community on factors such as insight into the severity and consequences of hoarding (Woody et al., 2020).

4. Conclusion

This review provides a comprehensive summary of the extensive data for the relationship between beliefs about possessions and hoarding severity. Applying both meta-analytic techniques and narrative synthesis, we have demonstrated a strong and consistent relationship between beliefs about possessions and hoarding severity. We have also observed that beliefs about possessions are specific to those experiencing clinically significant hoarding symptoms and that they have a greater relationship with hoarding severity than other psychological constructs. The results provide support for both the cognitive model of hoarding and CBT treatment of hoarding.

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CRedit authorship contribution statement

Alisha Smith: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Falguni Nathwani:** Writing – review & editing, Supervision, Methodology, Formal analysis, Conceptualization. **Tom Barry:** Writing – review & editing, Methodology, Formal analysis. **James D. Gregory:** Writing – review & editing, Supervision, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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