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Behavioral Activation for Depression in Older People: A Systematic Review and Meta-
Analysis of Randomised Controlled Trials

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Abstract

Background: Behavioral activation (BA) is an effective treatment for depression in the general adult population but it is unclear if it is effective for older people.

Aims: To systematically review randomised controlled trials (RCTs) of BA for depression in older people.

Method: We searched MEDLINE, EMBASE, PsycINFO, CINAHL and on line trial registers for RCTs of BA for depression in older people.

Results: Eighteen trials were included in the meta-analyses. BA reduced mean depression scores for older people living in the community as a stand-alone treatment (standardised mean difference (SMD) -0.72; 95% confidence interval (CI) -1.04 to -0.41). It was also effective as part of a multicomponent intervention (SMD -0.44; 95% CI -0.56 to -0.32).

Conclusions: BA significantly reduces depressive symptoms in older people in the community, however given most studies are small and with significant bias results should be interpreted with caution. Further high quality trials of BA for older people are needed.

Key words: behavioral activation, behavioral therapy; depression, older people, dementia, cognitive impairment, multicomponent behavioral activation, activity scheduling, pleasant events; meta-analysis; randomised controlled trials;

Declarations of interest

The first and last authors are Principal Investigators of an ongoing trial. There are no other known conflicts of interest.

Depression in older people is a prevalent and disabling condition with major depressive disorder affecting approximately 5-15% of older people living in the community (1). Estimates of prevalence of mild symptoms of depression, often referred to as subsyndromal depression (SSD) are much higher ranging from 5% to 37% (2). Untreated symptoms even when mild, can contribute to poor physical and psychiatric outcomes such as increasing the number and severity of medical illness, and the risk of developing major depression (3). Depression diminishes older adults' quality of life, exacerbates functional deficits, and increases risk of morbidity and mortality (4). Depression is the major contributor of poor outcomes in older people contributing heavily to healthcare costs (5). Depression in late life is often under detected and untreated (1), and may be resistant to antidepressants (6). Many studies of psychological treatments have few or no older participants. It is estimated that preventing and treating depressive symptoms in older people may result in significantly reduced health care utilisation and cost savings (7). With an increasing ageing population it is important to find out what strategies are effective for managing depression for older people and addressing needs of those with cognitive impairment.

Behavioral explanations of low mood and depressive affect are rooted in learning theory models of depression, which argue that increasing positively reinforcing behaviors, leads to more positive consequences for individuals, thereby improving mood (8). The lack of events associated with positive outcomes in the person's environment is a key contributor to the emergence or maintenance of depressive symptoms (9). According to behavioral models of depression in late life (10), depressive symptoms may be intensified or maintained by the absence of positive feelings resulting from participation

in enjoyable and meaningful activity. Interventions, therefore, that target activities may theoretically be particularly helpful in preventing or treating depression in older people.

Behavioral activation (BA) is an effective treatment for depression for adults, with recent studies indicating that it is as effective as Cognitive Behavioral Therapy (CBT), and potentially less costly (11). Despite evidence of clinical effectiveness for younger adults, evidence of effectiveness for older people is less clear. Although there are several studies evaluating BA in older people, there are no systematic reviews bringing the evidence together. In the present paper, our aim was to evaluate worldwide evidence on the clinical effectiveness of BA for depression in older people and report on its quality.

Method

We searched all related BA and behavior therapy terms in MEDLINE, EMBASE, CINAHL, PsycINFO and the Cochrane library for ongoing trials, national and international trial registers, and specialised databases of psychological treatments of depression (www.evidencebasedpsychotherapies.org) to December 2017 (see Supplementary On line Material for details of search terms). We scanned reference lists of all included studies and 136 reviews relevant to the area identified by the search (psychological therapies in older people with or without cognitive impairment/dementia).

Inclusion criteria were: (1) RCTs comparing BA with treatment as usual (or any other treatment), (2) older people (aged ≥ 55) in any setting (community, inpatient or long-term care), (3) studies in older people with or without cognitive impairment or dementia, (4) outcome was either depressive symptoms or depression remission. Secondary outcomes were function, quality of life and anxiety symptoms.

We defined BA as a brief structured psychotherapeutic approach that aimed to: increase engagement in adaptive activities (often associated with pleasure and mastery) through a) structured activity scheduling and b) monitoring of mood (association of mood and activities), and/or other behavioral strategies such as relaxation/stress reduction techniques, social skills enhancement, or hierarchical construction of goals (12). Some studies also included additional interventions. Activity interventions which did not satisfy these criteria or had a high exercise component were defined as BA-related. We divided interventions according to where they took place (community, inpatient/24 hour care settings, care homes); and by short term (4-12 weeks) or long term effectiveness (8-12 months). We also tested whether publication bias was present.

Two reviewers (VO, JB) worked independently to identify RCTs that met the inclusion criteria, and extracted data independently. Disagreements were discussed with the third author (GL). We contacted authors of primary trials if there were missing data. We employed the Cochrane Handbook for Systematic Reviews of Interventions approach for assessing risk of bias (addressing the domains of sequence generation, allocation concealment, blinding, incomplete outcome data, selective reporting and other issues). We used a random-effects model to represent overall estimate effects, and standardised mean differences when studies used different outcome scales. We quantified heterogeneity by using the I^2 statistic. All calculations were conducted using Review Manager (RevMan) 5.2 for Windows (Cochrane Collaboration, Oxford UK; www.cochrane.org/RevMan). We used the GRADE approach to summarise overall quality of evidence. We performed a sensitivity meta-analysis on high quality studies only.

Results

We identified 7248 references through database searching, with thirty three additional references identified via other sources (see Figure 1 Study flow chart). After removal of duplicates and clearly irrelevant articles, we retrieved 391 full text records. Of these 327 were excluded at this stage as not relevant, leaving 64 full text references to be fully assessed for eligibility. Of these, 36 studies were excluded as not meeting inclusion criteria (see Table 2 of Excluded Studies Supplementary On line Material), because they evaluated BA in family carers (8 studies); were not RCTs (14 studies); the intervention did not fulfil our criteria of BA (12 studies); there was no control comparison group (1 study), and data were not available (1 study). A total of 28 studies were eligible for inclusion, of which 7 are ongoing (13-19) (see Supplementary On line Material Table 1 for main study characteristics including description of elements of interventions).

Description of studies

We were able to pool data from 18 studies. There were 9 studies in older people living in the community, 3 RCTs in inpatient settings, and 6 studies in older people living in care homes of whom some had cognitive impairment. We pooled data from 5 RCTs on BA only (20-24; community settings), and 4 trials on multicomponent BA (25-28; community settings) for depressive symptoms. All of the multicomponent BA studies provided data on remission of symptoms. We pooled data from all 3 RCTs evaluating BA in inpatient settings (29-31), and all the 6 studies of BA in older people living in care homes (32-37). Although there were three studies in people with dementia that aimed to increase activity, none of these met the inclusion criteria. These studies were in community-dwelling people with dementia, and evaluated interventions with a strong physical activity component and activity scheduling was not structured. We classified

these as BA-related (38-40). We judged these studies as too different to be pooled in a meta-analysis. We used the Chi² test to detect and report on heterogeneity.

Primary outcomes

Depressive symptoms

Meta-analysis on effects of BA on depressive symptoms, showed that results significantly favoured BA (5 studies, 175 participants, standardised mean difference (SMD) -0.72; 95% confidence interval (CI) -1.04 to -0.41, efficacy at 4-12 weeks) in reducing depressive symptoms for older people living in the community (with a diagnosis of depression or subthreshold depressive symptoms), with no heterogeneity between the studies ($I^2 = 0\%$) (see Figure 2). Multicomponent BA reduced depressive symptoms in comparison to treatment as usual, in the short term (4 studies, 2523 participants, SMD -0.44; 95% CI -0.56 to -0.32, efficacy at 3-6 months, Figure 3), but not long-term (4 studies, 2300 participants, SMD -0.30; 95% CI -0.59 to 0.00, efficacy at 8-12 months, Figure 4). There was moderate ($I^2 = 39\%$) to high heterogeneity ($I^2 = 88\%$) in both of these analyses.

Remission of depressive symptoms

Multicomponent BA improved remission of depressive symptoms both short term (3 studies, 2733 participants, odds ratio (OR) 2.66, 95% CI 1.46 to 4.87, efficacy at 3-6 months, $I^2 = 81\%$, Figure 5 Supplementary On line Material), and long-term (3 studies, 2458 participants, OR 3.06, 95% CI 1.94 to 4.82, efficacy at 8-12 months, $I^2 = 63\%$, Figure 6 Supplementary On line Material).

BA in inpatient and long-term care settings

We found no significant differences between the intervention and treatment as usual groups for older people in psychiatric inpatient (3 studies, 74 participants, SMD -0.11; 95% CI -0.57 to 0.35, efficacy at 2-8 weeks, $I^2 = 0\%$), or long-term care settings (6 studies, 302 participants with and without dementia, SMD -0.43; 95% CI -0.87 to 0.01, efficacy at 6-12 weeks, $I^2 = 65\%$).

Secondary outcomes

Quality of life, function and anxiety symptoms

Multicomponent BA improved quality of life compared to treatment as usual (2 studies, 1806 participants, SMD 0.33; 95% CI 0.12 to 0.54, efficacy at 3-6 months, $I^2 = 54\%$), and decreased functional disability for older people living in the community (2 studies, 1806 participants, SMD -0.24; 95% CI -0.33 to -0.15, efficacy at 3-6 months, $I^2 = 0\%$). There was a significant effect of multicomponent BA in comparison to treatment as usual, on reduction of anxiety symptoms in the short term (2 studies, 761 participants, SMD -0.30; 95% CI -0.44 to -0.15, efficacy at 4 months, $I^2 = 0\%$), which was not maintained at long-term follow-up (2 studies, 739 participants, SMD -0.16; 95% CI -0.38 to 0.06, efficacy at 8-12 months, $I^2 = 43\%$).

None of the studies reported or described adverse events.

Quality of studies

Risk of bias, publication bias and overall quality of evidence

Bias was detected predominantly in the domains of sequence generation and allocation concealment, with one study being at high risk in the domain of blinding of outcome assessment (for detailed ratings see Figure 7 Supplementary On line Material). We assessed publication bias via a funnel plot (Figure 8 Supplementary On line Material)

which appeared to be approximately symmetrical, indicating no association between standardised effect size and standard errors of effects, confirmed by the Egger's test ($t = -1.326$; $P = 0.203$). Using the GRADE approach, the overall quality of evidence of effectiveness of BA for depressive symptoms was judged as moderate.

We also considered the potential bias and overestimation of effects by running analyses only on high quality studies as judged by predetermined criteria used in previous meta-analyses of psychotherapy trials (41). Only studies on multicomponent BA (4 studies) and BA in care homes (3 studies) qualified to be included in the analyses which showed that the SMD was -0.40 ; 95% CI -0.48 to -0.32 , $I^2 = 48\%$ (7 studies, 2676 participants).

Discussion

In this study, we aimed to establish the most up-to-date and accurate estimate of effectiveness of BA for older people. We also evaluated the quality of the evidence and presence of publication bias. We found that overall there is evidence of effects for both BA and multicomponent BA, in the range usually regarded as clinically significant (42), ranging from $SDM = 0.40$ to $SDM = 1.05$ for BA and $SDM = 0.37$ to $SDM = 0.81$ for multicomponent BA for older people living in the community. When only high quality studies on BA and multi-component BA were considered the effect size was still 0.4. Five RCTs with a total of 175 participants (96 receiving behavioral activation, 79 treatment as usual) showed that BA reduces depressive symptoms in community dwelling older people. These results compare favorably with studies of CBT for depression in older people, and are in line with recent data on comparable effectiveness of BA in all adults (11). However, given the paucity of trials and methodological limitations, there is still some uncertainty about this result.

Three studies showed that multicomponent BA approaches benefit older people in the community with symptom remission in the short term and approximately a year later. In terms of symptom reduction, multicomponent BA approaches were effective only short-term, with differences no longer being significant in the longer-term, indicating that effects are less stable. Further studies are required to confirm these results.

Our analyses did not find that adding other care components such as case management or collaborative care adds to effectiveness of BA approaches and this is similar to evidence in adult depression (43). Only multicomponent approaches evaluated remission of symptoms. Although only a few studies were pooled for secondary outcomes multicomponent BA improved functional outcomes, quality of life, and anxiety in the short term. It will be important for future trials to assess long-term effectiveness of BA for older people as a stand-alone intervention.

Data on effectiveness of BA in inpatient and long-term care settings did not show that BA decreased depressive symptoms, however the majority of studies were small and of lower quality. We found three trials evaluating BA-related interventions for people with dementia. These studies however did not employ theoretically driven and structured approaches of BA, or included strong components of physical activity thereby limiting the conclusions of effectiveness of BA per se.

We found that the studies evaluating BA for older people differed in terms of inclusion criteria. Although using broad inclusion criteria can be an advantage producing treatments that are more generalisable, the participants in the studies varied between people with or without a depression diagnosis and intervention delivery of BA (delivered by mental health workers versus self-help interventions). Self-help BA may be an

impractical intervention for the most severely depressed people who are particularly lacking in energy and motivation and may be restricted in going out from care settings because of concerns about self-harm. Our multicomponent BA, inpatient and long-term care meta-analyses included studies with varied participants in terms of medical comorbidity, and cognitive impairment. It has been argued that this complex interactive factors of medical morbidity, cognitive impairment, and psychological factors may make depression in late life difficult to treat. Therefore our findings are important in that they are suggestive that BA interventions may be able to address the complexity of preventing and treating depressive symptoms in older people.

Quality of the evidence

Risk of bias was unclear for multiple domains in some of the studies, with published information sometimes insufficient to determine risk of bias. Only the area of selective reporting was judged as low risk in all studies. Most of the studies had uncertainties on the areas of random sequence generation, and allocation concealment. Based on the GRADE system, we have classified the quality of the evidence as 'moderate'. Although publication bias did not have a significant effect on the results, we found that the effects of BA may be overestimated when including small studies. However, our analyses are based on a limited number of trials overall, and we were unable to conduct other sensitivity analyses because of lack of power of potential comparisons.

This review has several limitations. The studies had a relatively low age criteria with many including adults aged 55 and over and the highest age criteria being aged over 65. Many participants would therefore be less likely to have the typical circumstances of older people including multiple physical comorbidities and no longer working. Our test of

publication bias does not provide direct evidence of no bias present; therefore it is likely that the studies overestimate the true effect size of BA for older people.

Some of the studies investigated bibliotherapy as a treatment for late life depressive symptoms which may limit its use in some settings. Although all studies used central components of BA approaches such as structured pleasant activity scheduling and mood monitoring, some report on the use of additional behavioral strategies which limits our understanding of which specific components are important (12). High heterogeneity may have contributed to our lack of group differences in some of the outcomes and the comparison to waiting-list control conditions in some of the studies may have overestimated the effects. We also could not find information on co-existent anxiety disorders. Although there was a wide range of depression severity within studies, this range may enable findings to be generalisable to a large proportion of older people who are likely to seek treatment.

Implications for practice and research

This is the first systematic review of BA for depression in older people which followed guidelines set out by the Cochrane Collaboration. We used a comprehensive and sensitive strategy to identify studies, and selection of studies, data extraction, and assessments of risk of bias were independently conducted by two authors. Our findings are in line with evidence that BA may be associated with medium to large effects, being observed in relatively few sessions delivered by junior mental health workers (11). Most of the studies included an average of 8-10 sessions across all settings of BA, implemented primarily by non-mental health specialists. We also found that BA interventions

improved other outcomes such as quality of life, functional disability, and decreased anxiety symptoms in the short-term.

Currently, management of late-life depression with or without cognitive impairment is limited to the prescription of antidepressants where there may be poor adherence or inconclusive evidence of effectiveness (6, 44). Our data show that high quality mental health care for treating or preventing clinically significant symptoms of depression in older people may benefit from individualised treatments that emphasise pleasant activities. There is a need however for well-designed multicentre RCTs which adhere to high standards of methodology and reporting. These trials should focus on theoretically driven BA interventions.

The lack of follow-up data poses limitations in terms of informing evidence-based policy about how best to deliver BA for older people, and there are no data on cost-effectiveness. Future studies should examine long-term effects. There remains a need for carefully designed studies of interventions for older people with cognitive impairment and dementia, and considering evaluation of BA separately for older people with and without cognitive impairment as findings may differ.

Conclusion

Results showed that BA interventions are superior to usual care in reducing depressive symptoms in older people living in the community, although we were not able to investigate whether they are superior to active controls. Multicomponent BA reduced depressive symptoms post treatment, and improved remission both short term and long-term. On the basis of this meta-analysis we conclude that although BA may be a potentially effective treatment for mild or subthreshold symptoms and major depression

in older people, evidence remains limited. Our review suggests that additional components to BA such as care collaboration or case management may not add to effectiveness. Given the small number of RCTs and presence of bias in studies, effects associated with BA should be interpreted with caution. Future large scale studies are necessary to establish effectiveness of these approaches for older people.

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Conflicts of Interest:

The first and last authors are Principal Investigators of an ongoing trial. There are no other known conflicts of interest.

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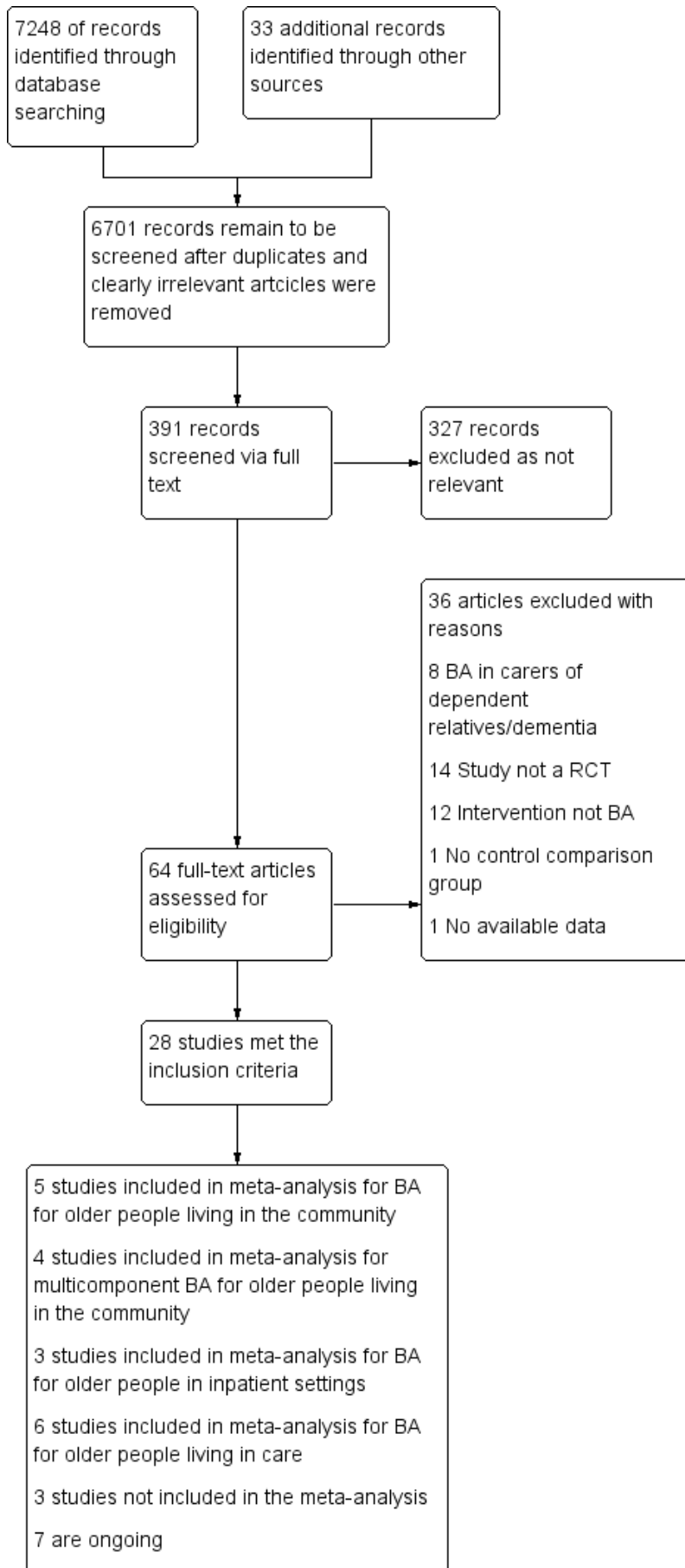


Figure 1

Study flow diagram

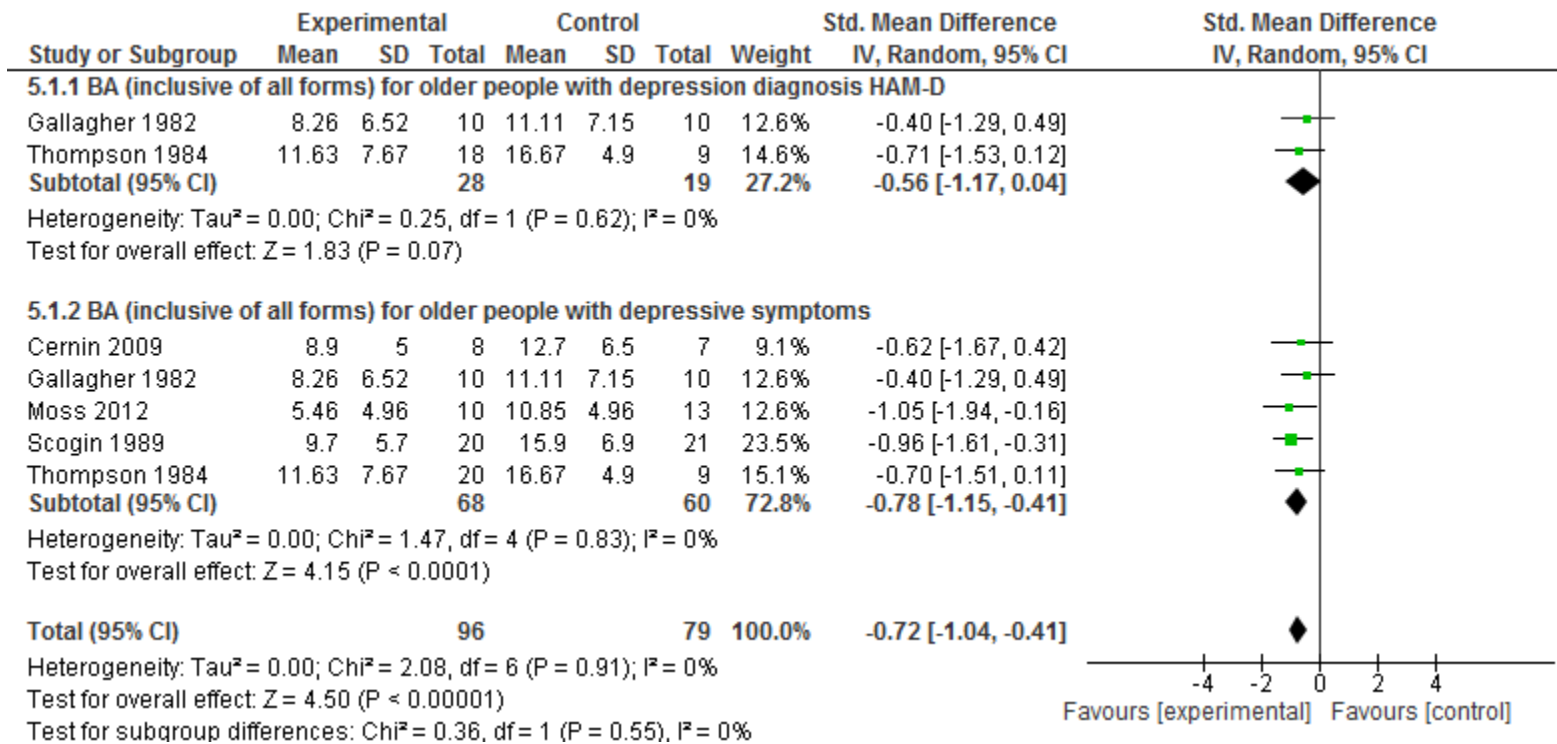


Figure 2: Forest plot of BA versus treatment as usual for older people living in the community with a diagnosis of depression or depressive symptoms. Outcome: Depressive symptoms (4-12 weeks).

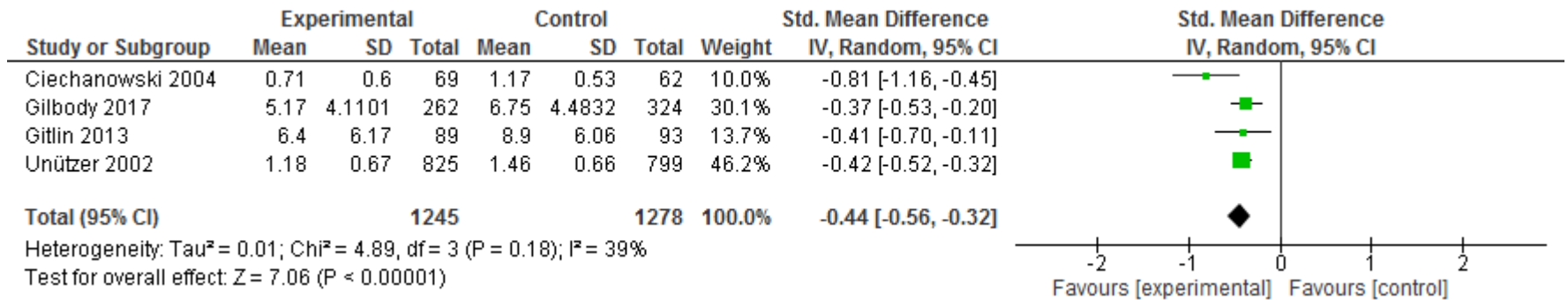


Figure 3: Forest plot of multicomponent BA versus treatment as usual for older people living in the community with a diagnosis of depression or depressive symptoms. Outcome: Depressive symptoms (3-6 months).

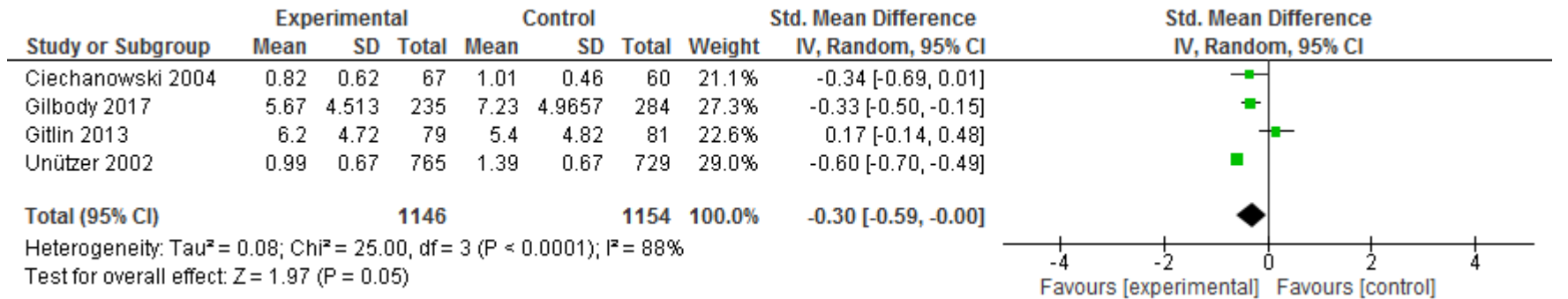


Figure 4: Forest plot of multicomponent BA versus treatment as usual for older people living in the community with a diagnosis of depression or depressive symptoms. Outcome: Depressive symptoms (8-12 months).

Search Strategy of the Review

1. (behavio\$ adj activati\$).ti,ab.
2. (activity adj scheduling).ti,ab.
3. (pleasant event\$ or pleasant activit\$ or daily diar\$).ti,ab.
4. (behavio\$ adj therap\$).ti,ab.
5. exp behavior therapy/
6. 1 or 2 or 3 or 4 or 5
7. exp Aged/
8. Elder*.mp.
9. Geriatri*.mp.
10. Senil*.mp.
11. Older.mp.
12. Old Age.mp.
13. Late Life.mp.
14. Aged, 80-And-Over.mp.
15. 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14
16. randomized controlled trial.pt.
17. controlled clinical trial.pt.
18. randomized.ab.
19. randomised controlled trial.tw.
20. random*.ab.
21. randomly.ab.
22. trial.ab.
23. groups.ab.
24. 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23
25. 6 and 15 and 24

Table 1 Characteristics of Included Studies

Study	Sample	Method	Measures	Intervention	Outcome Data Timepoints
BA in older people living in the community (with depressive symptoms or a diagnosis of depression) vs TAU or other psychological intervention (one study only)					
Gallgher & Thompson 1982	n = 30 <u>Inclusion criteria</u> 1) aged ≤ 55 2) MMSE ≤ 25 3) BDI < 17 /HRSD < 17	RCT <u>Control group</u> Brief relational insight therapy	<u>Primary outcome</u> HAM-D	<i>Intervention</i> BA (referred to as behaviour therapy) – Increasing pleasant events daily, monitoring of mood, relaxation & social skills training <i>Duration</i> 16 individual sessions over 12 weeks (90 mins)	Outcome data included in the Review 3 months
Thompson & Gallagher 1984	n = 43 <u>Inclusion criteria</u> 1) aged ≤ 60 2) MDD (RDC) 6) MMSE ≤ 25	RCT <u>Control group</u> Delayed treatment control	<u>Primary outcome</u> HAM-D	<i>Intervention</i> BA (referred to as behaviour therapy) – Increasing pleasant events daily, monitoring of mood, relaxation & social skills training <i>Duration</i> 16-20 individual sessions over 6 weeks	Outcome data included in the Review 6 weeks
Scogin 1989	n = 40 <u>Inclusion criteria</u> 1) HRSD ≤ 10 2) MSQ ≤ 8	RCT <u>Control group</u> Delayed treatment control	<u>Primary outcome</u> HRSD	<i>Intervention</i> BA bibliotherapy (Control Your Depression – Lewinsohn et al), pleasant activity scheduling, learning to relax, social skills, modification of self-defeating thoughts <i>Duration</i> Several ‘chapters’ over 4 weeks	Outcome data included in the Review 4 weeks
Moss et al 2012	n = 26 <u>Inclusion criteria</u> 1) aged ≤ 55 2) GDS ≤ 5 3) TICS-M ≤ 33	RCT <u>Control group</u> Delayed treatment control	<u>Primary outcome</u> HRSD	<i>Intervention</i> BA bibliotherapy (Addis & Martell’s Overcoming depression one step at a time), pleasant activity scheduling and mood monitoring <i>Duration</i> Self-paced course over 4 weeks	Outcome data included in the Review 4 weeks
Cernin 2009	n = 15 <u>Inclusion criteria</u> Older adults living in assisted living housing	RCT <u>Control group</u> Waiting list	<u>Primary outcome</u> GDS	<i>Intervention</i> Pleasant activities scheduling, monitoring of mood, controlled breathing, visual imagery (Lichtenberg et al.) <i>Duration</i>	Outcome data included in the Review 3 months

36 sessions over 12 weeks (lasting 30 minutes)

Multicomponent BA for older people in the community

Ciechanowski 2004	n = 138 (mostly homebound & medically ill) <u>Inclusion criteria</u> 1) aged ≤ 55 2) DSM-IV minor depression or dysthymia	RCT <u>Control group</u> TAU	<u>Primary outcome</u> HSCL-20	<i>Intervention</i> PEARLS (Program to Encourage Active, Rewarding Lives for Seniors), medication review, increasing pleasant activities, monitoring of mood, PST, increasing physical and social activity <i>Duration</i> 8 sessions over 19 weeks on average (of 50 minutes)	Outcome data included in the Review 6 & 12 months
Unützer 2002	n = 1801 <u>Inclusion criteria</u> 1) aged ≤ 60 2) SCID major depression and/or dysthymia	RCT <u>Control group</u> TAU	<u>Primary outcome</u> SCL-20	<i>Intervention</i> IMPACT (Improving Mood-Promoting Access to Collaborative Care Treatment), care management, biopsychosial history, pleasant activity scheduling, medication review and/or PST <i>Duration</i> Weekly contact for an average of 6-8 weeks	Outcome data included in the Review 3 & 12 months
Gitlin et al. 2013	n = 208 (African Americans) <u>Inclusion criteria</u> 1) aged ≤ 55 2) PHQ-9 ≤ 5 3) MMSE ≤ 24	RCT <u>Control group</u> Wait-list control	<u>Primary outcome</u> <i>Depression severity</i> PHQ-9	<i>Intervention</i> BTB (Beat the Blues) incorporating care management, pleasant activity goals, mood monitoring, addressing environmental barriers, stress reduction <i>Duration</i> 10 in home sessions (1 hour) weekly	Outcome data included in the Review 4 & 8 months
Gilbody et al. 2017	n = 705 <u>Inclusion criteria</u> 1) aged ≤ 65 2) DSM-IV subthreshold depression (MINI)	RCT <u>Control group</u> Usual primary care	<u>Primary outcome</u> <i>Depression severity</i> PHQ-9	<i>Intervention</i> CASPER (Collaborative Care for Screen Positive Elders) incorporating care management, pleasant activity scheduling, monitoring of mood and rewarding activities, addressing avoidance of social interactions <i>Duration</i> 6 sessions (1 face to face and subsequent sessions by phone) weekly	Outcome data included in the Review 4 & 12 months
BA in older people in inpatient settings					
Sood 2003	n =14 (inpatients of rehabilitation unit) <u>Inclusion criteria</u> 1) aged ≤ 60	RCT <u>Control group</u> Standard occupational	<u>Primary outcome</u> <i>Depression</i> GDS	<i>Intervention</i> GWP (Geriatric Welleness Program), increasing pleasurable activities, mood monitoring, relaxation/ stress reduction (controlled breathing, visualisation	Outcome data included in the Review Post intervention (no further

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		therapy		exercises)	details provided)
Norton 2010	n = 50 (inpatients of psychiatric hospital) <u>Inclusion criteria</u> 1) aged ≤ 65 2) GDS ≤ 9 /TICS-m ≤ 20	RCT <u>Control group</u> Treatment as usual	<u>Primary outcome</u> <i>Depression</i> GDS	<i>Duration</i> 4 sessions weekly (30-60 minutes) over 7.5 weeks <i>Intervention</i> BATD (Brief Behavioral Activation Therapy), monitoring of pleasant activities and mood, identifying life areas of improvement <i>Duration</i> 8 group sessions over 2 weeks	Outcome data included in the Review Post intervention (no further details provided)
Snarks 2011	n = 50 (inpatients with mild/moderate cognitive impairment) <u>Inclusion criteria</u> 1) aged ≤ 65 2) GDS-S ≤ 3 3) MMSE ≤ 18	RCT <u>Control group</u> Treatment as usual	<u>Primary outcome</u> <i>Depression</i> GDS-S	<i>Intervention</i> Increasing frequency and duration of activities in line with life goals, mood monitoring, setting goal hierarchies <i>Duration</i> 8 sessions, biweekly (30-60 minutes) over 4 weeks	Outcome data included in the Review 4 weeks
BA for older people living in care					
Lichtenberg 2005	n = 20 older people with AD or other dementia diagnosis <u>Inclusion criteria</u> Not specified	RCT <u>Control group</u> TAU	<u>Primary outcome</u> <i>Depression</i> GDS	<i>Intervention</i> Increasing pleasant activities, mood monitoring, breathing relaxation/imagery exercises <i>Duration</i> 3 times a week (20-30 minutes sessions) over 3 months	Outcome data included in the Review 3 months
Meeks et al 2008	n = 20 <u>Inclusion criteria</u> 1) SADS & DSM-IV major depressive disorder/minor depressive disorder 2) GDS ≤ 11 3) MMSE < 13	RCT <u>Control group</u> TAU	<u>Primary outcome</u> <i>Depression</i> HDRS	<i>Intervention</i> BE-ACTIV (Behavioral Activities-based intervention), scheduling and increasing pleasant events, goal re-evaluation, confronting obstacles, maintaining gains <i>Duration</i> 10 individual 30-40 minutes sessions weekly over 10 weeks	Outcome data included in the Review 6 weeks
Hyer et al., 2009	n = 25 <u>Inclusion criteria</u> 1) DSM-IV depression diagnosis 2) GDS-S ≤ 5 3) MMSE ≤ 18	RCT <u>Control group</u> Treatment as usual	<u>Primary outcome</u> <i>Depression</i> GDS-S	<i>Intervention</i> GIST (Group, Individual and Staff Therapy), increasing positive mood through pleasant activities, goal setting, & social support <i>Duration</i> 13 group & 2 individual sessions (75 to 90 minutes)	Outcome data included in the Review Post intervention (approximately at 13 weeks)

Dozeman 2011	n = 129 <u>Inclusion criteria</u> 1) CES-D \leq 8	RCT <u>Control group</u> Usual care (regular activities in the home)	<u>Primary outcome</u> <i>Depression</i> CES-D	weekly over 13 weeks <i>Intervention</i> Self-help BA (Activity Scheduling of the Coping with Depression – CWD course - Haringsma et al 2006), pleasurable activity scheduling and monitoring of mood <i>Duration</i> Self-paced over 4 weeks	Outcome data included in the Review 3 months
Verkaik 2011	n = 97 older people with dementia <u>Inclusion criteria</u> 1) dementia diagnosis 2) PDC-dAD depression 3) verbal communication	RCT <u>Control group</u> TAU	<u>Primary outcome</u> <i>Depression</i> CSDD	<i>Intervention</i> Increasing pleasant activities, decreasing unpleasant events and maintain activities in every day life <i>Duration</i> Several sessions mostly training of nurses over 11 weeks (no further details provided)	Outcome data included in the Review 12 weeks
Meeks et al., 2015	n = 82 <u>Inclusion criteria</u> 1) aged \leq 55 2) DSM-IV depressive disorder or GDS \leq 11	Cluster RCT <u>Control group</u> TAU (staff training in dementia/ managing behaviour problems)	<u>Primary outcome</u> <i>Depression</i> GDS	<i>Intervention</i> BE-ACTIV (Behavioral Activities Intervention), reinforcing pleasant activities, depression management, confronting obstacles <i>Duration</i> Weekly individual sessions over 10 weeks	Outcome data included in the Review 12 weeks
BA-related interventions in people with dementia living in the community (encouraged activities not in line with BA model and associated behavioral strategies)					
Teri 1997	n = 72 <u>Inclusion criteria</u> 1) dementia diagnosis 2) DSM-III-R/RDC major/minor depressive disorder	RCT <u>Control group</u> TAU	<u>Primary outcome</u> <i>Depression</i> CSDD & HRDS	<i>Intervention</i> BT-PE (Behavior Therapy-Pleasant Events), teaching carers behavioural strategies to address problem behaviors including depression, increasing pleasant events, problem-solving, addressing carer stress and burden <i>Duration</i> 9 (60 minutes) sessions over 9 weeks	Outcome data Post intervention 9 weeks
Teri 2003	n = 153 <u>Inclusion criteria</u> 1) NINDS-ADRDA criteria 2) family carer 2) living in the community	RCT <u>Control group</u> TAU (routine medical care)	<u>Primary outcome</u> <i>Depression</i> CSDD & HRDS	<i>Intervention</i> RDAD (Reducing Disability in Alzheimer's disease), increasing pleasant events, and modifying problem behaviours, increasing exercise, carer psychoeducation <i>Duration</i> 12 (1 hour) sessions over 3 months	Outcome data 3 months
	n = 209	RCT	<u>Primary outcome</u>	<i>Intervention</i>	Outcome data

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Giltin 2010	<u>Inclusion criteria</u>	<u>Control group</u>	<i>Function</i>	COPE (Care of Persons with Dementia in their Environments), reducing environmental stressors, identifying deficits and capabilities, engaging patients in activities based on strengths and interests	4 months
	1) dementia diagnosis or MMSE < 24 2) required assistance with daily activities/behaviour symptoms	Education materials	FIM	<i>Duration</i> 10 sessions over 4 months	

Note: MMSE - Mini-Mental State Examination; BDI-II - Beck Depression Inventory-II; HAM-D/HRSD/HDRS - Hamilton Rating Scale for Depression; MDD - Major Depressive Disorder; RDC - Research Diagnostic Criteria; MSQ - Mental Status Questionnaire; GDS – Geriatric Depression Scale; TICS-M - Modified Telephone Interview for Cognitive Status; DSM-IV - Diagnostic and Statistical Manual of Mental Disorders-Fourth Edition; HSCL-20 - Hopkins Symptom Checklist Depression Scale; SCID-5 - Structured Clinical Interview for DSM-5; SCL-20 - Symptom Checklist Depression Scale; PHQ-9 - Patient Health Questionnaire; MINI – Mini International Neuropsychiatric Interview; GDS-S - Geriatrics Depression Scale Short-Form; SADS - Schedule for Affective Disorders and Schizophrenia; CES-D - Center for Epidemiological Studies-Depression; PDC-dAD - Provisional Diagnostic Criteria for Depression of Alzheimer disease; CSDD – Cornell Scale for Depression in Dementia; DSM-III-R - Diagnostic & Statistical Manual of Mental Disorders–3rd Edition Revised; NINCDS-ADRDA - National Institute of Neurological and Communicative Disorders and Stroke and the Alzheimer's Disease and Related Disorders Association; FIM – Functional Independence Measure.

Table 2 Excluded Studies

Study	Reason for Exclusion
1 Steffen 2016	RCT of a behavioural intervention incorporating BA, relaxation and management of behaviour problems in dementia in carers of people with neurocognitive disorder
2 Egede 2015	Randomised controlled open-label, non-inferiority trial, of telemedicine-delivered vs face to face BA in veterans
3 Alexopoulos 2015	Not a RCT (open treatment trial), Problem Solving Therapy (PST) in older adults with major depression compared with historical comparison group
4 Kiosses 2015	RCT of Problem adaptation therapy vs supportive therapy in older adults with cognitive impairment
5 Choi 2014	RCT of tele-PST vs in person PST vs telephone support calls in depressed low income homebound older adults
6 Moore 2013	RCT of BA vs information support in family carers of people with dementia
7 Acierno 2012	Controlled before-and-after study of BA and therapeutic exposure for bereavement in older adults with MDD and PTSD
8 Losada 2011	RCT of BA and cognitive restructuring in carers of people with dementia
9 van't Veer-Tazelaar 2015	RCT of minimally supported self-help CBT, problem-solving treatment, and referral to a primary care physician for medication for older people with subthreshold depression or anxiety
10 Alexopoulos 2011	PST vs supportive therapy for older people with major depression and executive dysfunction
11 Sriwattanakomen 2008	RCT of PST with BA components vs a dietary education control condition in older black and white older adults with subthreshold depressive symptoms no data available
12 Gant 2007	RCT of BA in family carers of people with dementia incorporating improving mood through pleasant activities and managing problem behaviours
13 Götestam 1990	RCT of prompting and reinforcing activities in people with dementia vs prompting only vs control in which activities were not based on a BA model but on general activity training
14 Prick 2015	Multicomponent dyadic intervention in dementia caregiving dyads incorporating BA for the person with dementia, evaluated carer outcomes only
15 Lichtenberg 1996	Controlled trial (non RCT) of 2 behavioural treatments (selecting pleasant events, planning positive reinforcement strategies, and receiving support and reinforcement) in older inpatients with hip fracture, arthritis, and gait disturbances
16 Brand 1992	Controlled trial (non RCT) of group behavior therapy vs control in inpatient older adults with major depression
17 Clignet 2012	Case study of implementation of the Systematic Activation Method (SAM) incorporating activity scheduling as a nursing intervention in inpatients
18 Turner 2010	Case studies of BATA (Behavioral Activation Treatment of Anxiety) in older people
19 Guirguis-Younger 2008	Before-after experimental series design study of a behavioural-based intervention incorporating reinforcement of pleasant

		activities for older adults with depression
20	Thompson & Gallagher 1983	Before after study testing feasibility of a behaviourally oriented course of mood monitoring and learning to identify, record and monitor everyday pleasant activities in older adults
21	Teri 1991	Case studies investigating the relationship between pleasant activities and depression in people with dementia and depression by teaching carers to increase pleasant experience for the patient and decrease behavioural disturbances
22	Floyd 2004	RCT of cognitive bibliotherapy vs individual cognitive psychotherapy vs delayed treatment control in older people with depression
23	Yon & Scogin 2009	Before and after study of BA in older adults with depression
24	Teri 1991	Case study of behavioural treatment of depression in older people
25	Gallagher 1981	RCT of a behavioural intervention aimed at improving social skills and increasing the frequency of engagement of pleasant activities vs supportive group psychotherapy in older people with moderate to severe depression (no control group), no data available
26	Scogin 1987	Before and after study of cognitive bibliotherapy in older people with depression
27	Breckenridge 1987	Feasibility before and after study of the Life Satisfaction Course in older people with dysphoria
28	Jimenez 2015	Ongoing RCT of a health promotion intervention incorporating BA with a large physical activity component for older Latinos with subthreshold depression or anxiety
29	Quijano 2007	Controlled before-and-after study of an intervention incorporating education, referral and linkage with services and BA in high-risk older adults provided by case managers
30	Au 2015	RCT of telephone-assisted BA in Chinese family carers of people with dementia vs psychoeducation
31	Mausback 2014	RCT of BA in family carers of people with dementia vs support vs information
32	Sallis 1983	Controlled trial of depression management based on BA vs usual care
33	Vázquez 2015	RCT of BA vs CBT vs TAU in family carers of dependent family members
34	Lovett 1998	RCT evaluating the Life Satisfaction course focusing on increasing pleasant events in carers of dependent older adults vs waiting list
35	Alexopoulos 2003	RCT PST vs supportive therapy for older people with major depression and executive dysfunction
36	Rokke 1999	Self-help BA vs Cognitive Therapy (CT) for older people with depression, not all participants randomised

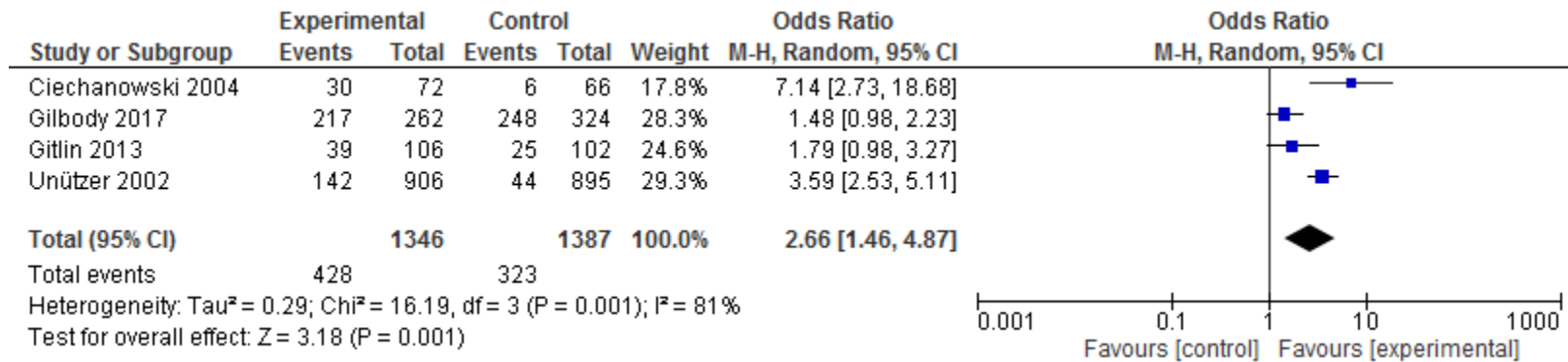


Figure 5: Forest plot of multicomponent BA versus treatment as usual for older people living in the community with a diagnosis of depression or depressive symptoms. Outcome: Remission of depressive symptoms (3-6 months).

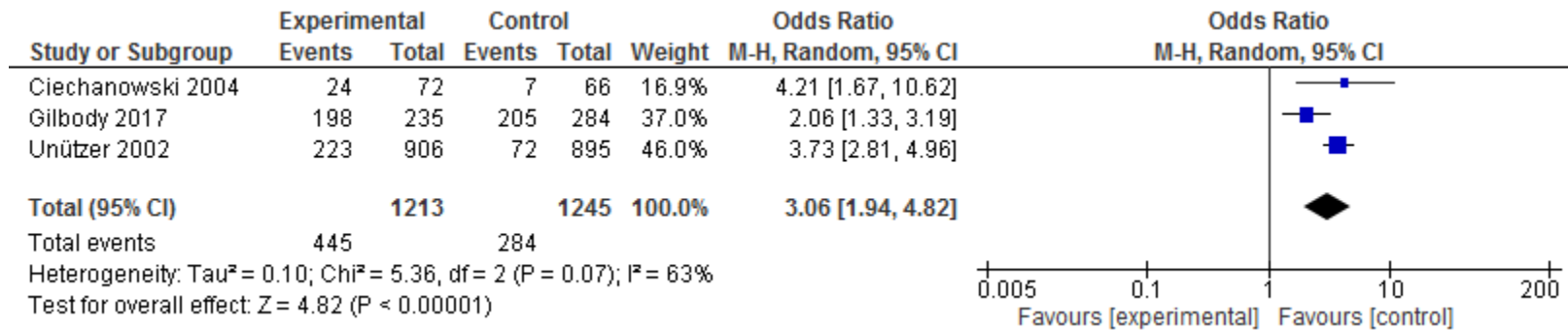


Figure 6: Forest plot of multicomponent BA versus treatment as usual for older people living in the community with a diagnosis of depression or depressive symptoms. Outcome: Remission of depressive symptoms (8-12 months).

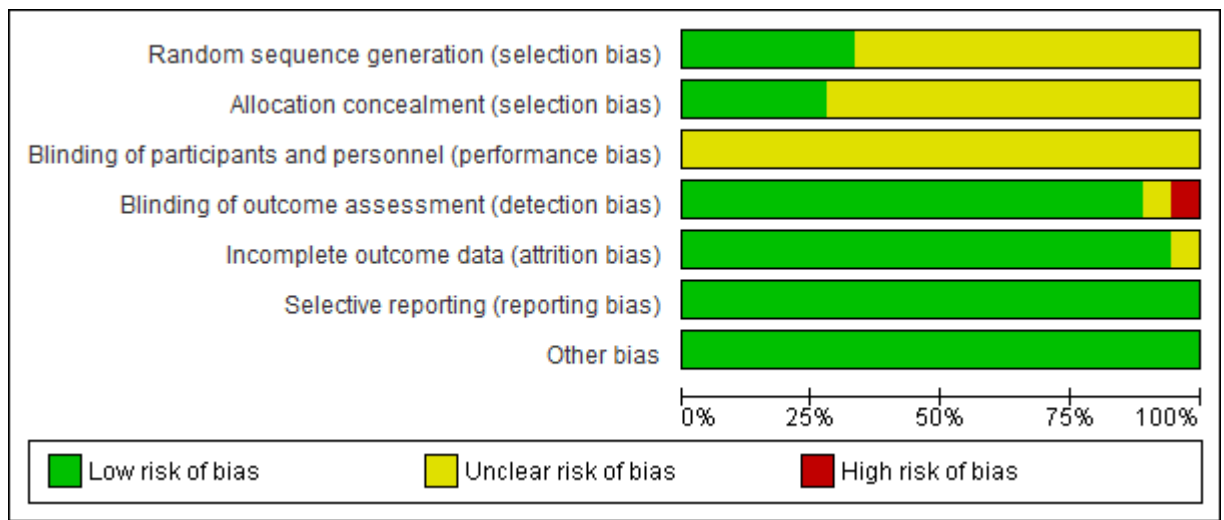


Figure 7. Risk of bias graph: review authors' judgements about each risk of bias item presented as percentages across all included studies.

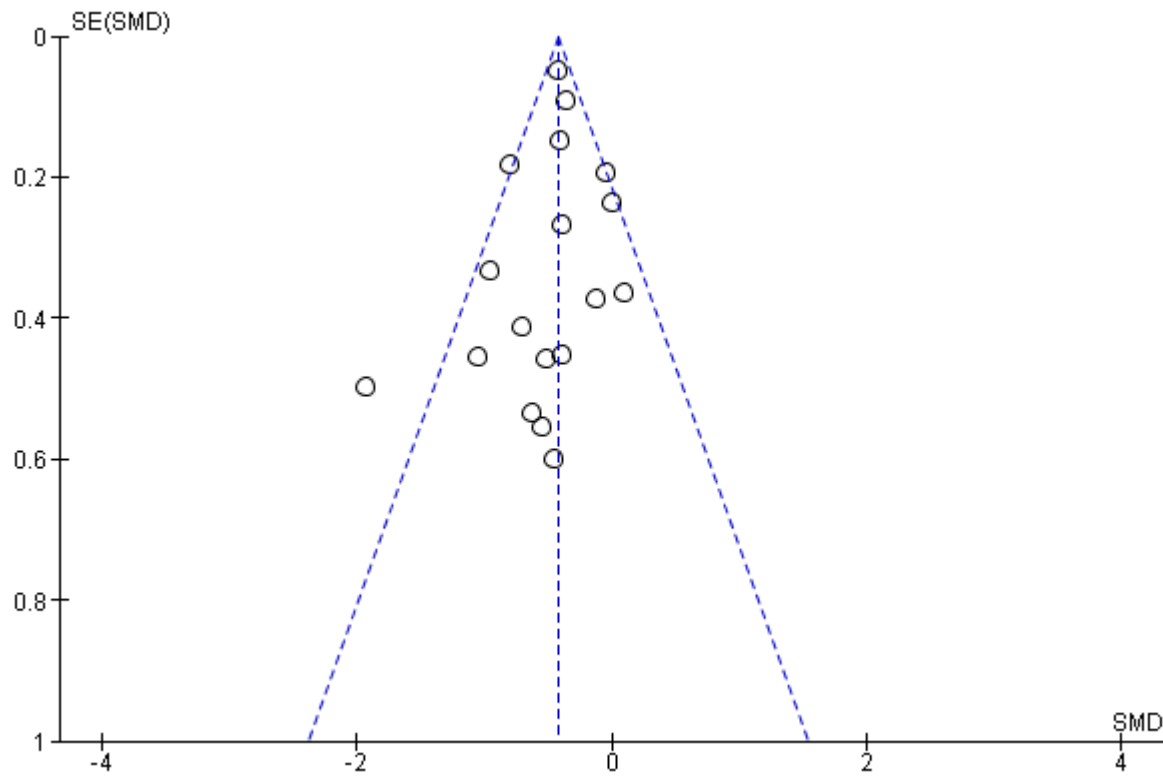


Figure 8: Funnel Plot as indicator of publication bias: All BA studies in older people, without imputed studies