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Degree of personalisation in tailored activities and its effect on behavioural and psychological symptoms and quality of life among people with dementia: a systematic review and meta-analysis

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ABSTRACT

Objectives To understand and assess the degree of personalisation of tailored activities for people with dementia (PWD); and to estimate the magnitude of the effects of levels of personalisation on reducing behavioural and psychological symptoms of dementia (BPSD), improving quality of life (QoL) and level of engagement.

Design Systematic review with meta-analysis.

Data sources ProQuest, PubMed, Ovid, Cochrane Library, Web of Science and CINAHL were searched from the start of indexing to May 2020.

Eligibility criteria We included randomised controlled trials and quasi-experimental studies assessing the effects of tailored activities for people aged 60 years or older with dementia or cognitive impairment on the outcomes of BPSD, QoL, depression and level of engagement with control groups.

Data extraction and synthesis Two researchers screened studies, extracted data and assessed risks of bias. A rating scheme to assess the degree of personalisation of tailored activities was developed to classify tailored activities into high/medium/low groups. Effect sizes were expressed using standardised mean differences at 95% Confidence Interval (CI). Subgroup analyses were conducted to assess whether the degree of personalisation of tailored activities affected outcomes of interest.

Results Thirty-five studies covering 2390 participants from 16 countries/regions were identified. Studies with a high-level of personalisation interventions (n=8) had a significant and moderate effect on reducing BPSD (standardised mean differences, SMD=−0.52, p<0.05), followed by medium (n=6; SMD=−0.38, p=0.071) and low-level personalisation interventions (n=6; SMD=−0.15, p=0.076). Tailored activities with a high-level of personalisation had a moderate effect size on improving QoL (n=5; SMD=0.52, p<0.05), followed by a medium level (n=3; SMD=0.41, p<0.05) of personalisation.

Conclusions To develop high-level tailored activities to reduce BPSD and improve QoL among PWD, we recommend applying comprehensive assessments to identify and address two or more PWD characteristics in designed tailored activities and allow modification of interventions to respond to changing PWD needs/circumstances.

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Strengths and limitations of this study

- The major contribution of this systematic review and meta-analyses is developing a rating scheme to assess the level of personalisation for interventions.
- To assess whether the degree of personalisation of the tailored activities affects reduction of behavioural and psychological symptoms of dementia and improves quality of life among people with dementia or cognitive impairment.
- Exclusion of papers not published in English may mean that important additional findings are missed.

INTRODUCTION

Dementia is particularly common among older adults, affecting 5%–8% of people aged 60 and over at any given time worldwide.[1] Behavioural and psychological symptoms of dementia (BPSD) are common among people living with dementia (PWD), such as agitation, depression and resistance to care,[2] which occur throughout the disease process, associated with decreased quality of life (QoL).[3]

Non-pharmacological interventions are recommended as first-line treatments over pharmacological approaches to treat BPSD and have less adverse effects.[4] Tailored activities for PWD are promising non-pharmacological approaches that reduce BPSD and increase QoL. Two recently published National Institute for Health and

Care Excellence (NICE) guidelines recommend that healthcare professionals offer activities to promote QoL that are tailored to personal preferences and consider using a structured tool to assess their likes, dislikes, routines and personal history.[5 6]

To our knowledge, six systematic reviews and meta-analyses (summarised in online supplemental table 1) have synthesised the effects of tailored activities on reducing BPSD and enhancing QoL among PWD, based on tailored strategies, activity types, personal characteristics, and frequency and duration of delivery.[7–12] The first of these, incorporating studies published between 2000 and 2011, focused on the effectiveness of various tailored strategies to foster activity engagement and reduce BPSD in PWD.[7] Changes to tools and materials used in activities were most common but yielded mixed outcomes of BSPD reduction; modifications to space and social demands were rarely tested but yielded consistently positive outcomes.[7] In addition, a systematic review of studies published between 2000 and 2012 found that personalised pleasant activities yielded strong evidence for treating BPSD but limited evidence for physical and music activities.[8]Another meta-analysis found that individualised recreational activities were effective for reducing BPSD.[9] Recently, Möhler and colleagues conducted three meta-analyses regarding the effects of tailored activities among PWD living in care facilities, communities and home settings, respectively, and found that, compared with usual care, tailored activities slightly reduced BPSD.[10–12] However, no differences in other desired outcomes between intervention and control groups among different specific types of activity or duration of delivery were evident. Although different activity components (eg, activity types, PWD characteristics, frequency and duration of delivery) were discussed,[7–12] no review further investigated the degree of personalisation among the tailored activities and synthesised its associations with the desired outcomes.

Understanding the degree of personalisation of tailored activities is important. We define the degree of personalisation of tailored activities as the extent to which non-pharmacological interventions are tailored, individualised or personalised for PWD. The conceptualisation of the degree of personalisation echoes the rationales and principles of effective interventions working on BPSD, level of engagement and QoL, embedded in occupational therapy,[13] engagement in meaningful activities[14] and person-centred care.[15] Occupational therapy emphasises the fit between PWD capabilities and the occupation (eg, activities or roles) through task simplification and removing barriers in the physical and social environment.[13] Environmental docility theory suggests that both underloading and overloading of external stimulations (e.g., cognitive activities and social interactions) may lead to PWD disengagement or excessive disability.[16] Thus, maintaining PWD engagement in meaningful activities through tailored activities based on their physical strength, mental state and psychosocial needs is essential.[14] The person-centred care approach stresses service providers' and caregivers' autonomy to determine specific ways of delivering care to maintain participants' engagement during the intervention.[15] These theories imply that the degree of personalisation can significantly influence the effectiveness of tailored activities for PWD. Thus, the degree of personalisation could depend on the assessment of PWD characteristics and their environment, the design of tailored activities based on PWD characteristics, and interventionists' autonomy to address PWD spontaneous needs.

Conceptualising and quantifying the levels of personalisation of existing tailored activities can advance our knowledge on developing a high level of personalisation of tailored activities for PWD, deciding on the appropriate 'dose' of tailoring, and translating this cumulative evidence into clinical practice. However, existing literature provides little knowledge about assessing the degree of personalisation among tailored activities and their effectiveness on targeted outcomes.

Objectives

This systematic review and meta-analysis aimed to: (1) assess the degree of personalisation of existing tailored activities for PWD; (2) estimate the magnitude of the effects of existing tailored activities on reducing BPSD, improving QoL and the level of engagement among PWD and (3) assess whether the degree of personalisation of tailored activities affects the outcomes of interest.

METHODS AND ANALYSIS

We conducted the review in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) procedure.[17] Eligibility criteria required studies to: (1) include participants with dementia or cognitive impairment and aged 60 years or older; (2) include activities tailored to at least one of the participants' characteristics (eg, needs, physical or/and mental ability, present or previous preferences for particular activities or interests, habits and physical living environments like housing conditions and caregiver management style); (3) report BPSD (measured by multi-domain scales, such as the Neuropsychiatric Inventory (NPI), and scales specific to agitation and depression/anxiety, such as the Cohen-Mansfield Agitation Inventory and the Cornell Scale for Depression in Dementia),[18–20] QoL and level of engagement as outcomes; (4) include randomised controlled trials or quasi-experimental study design and (5) apply a control group (CG) (eg, usual care, wait-list, attention control, etc). The review included studies published in English from the start of indexing to May 2020.

We searched ProQuest (e.g., APA PsycInfo), PubMed, Ovid (e.g., Embase), Cochrane Library, Web of Science and CINAHL, using the search terms: (1) "cognitive impairment" OR "cognitive disorder" OR "dement*" OR "Alzheimer"; (2) "tailor*" OR "engag*" OR "individual*" OR "personal*"; and (3) "activit*" OR "program*" OR

"therap*" OR "intervention*" OR "treatment*". The full search strategy is shown in online supplemental table 2.

SL and AYZ independently completed the title/abstract review and full-text review. We conducted title/abstract screening using Rayyan (https://www.rayyan.ai/) and full-text review using Endnote. The two researchers discussed disagreements in the title/abstract screening and full-text review to reach consensus. Data were extracted and checked by SL and MSLM. Where there were disagreements, data were rechecked for relevance and accuracy. Where available, raw data (eg, clinical interventions, strategies, outcomes and results) were extracted and entered into a spreadsheet.[21] For each intervention, we additionally extracted the following information: PWD (including older people with cognitive impairment) characteristics taken into account, intervention delivery, and information about the tailoring process (the data extraction form is shown in online supplemental appendix 1).

Patient and public involvement

No patient involved.

Developing the tailoring and classification scheme

The authors formed an expert panel to develop a scheme for the level of personalisation interventions based on the included studies, comprising AYZ (a licensed social worker in Hong Kong with 2 years clinical experience of dementia care and 5 years research experience focusing on the mechanisms of non-pharmacological interventions for PWD), TLiu, JCPC and SL (each of whom had over 10-year experience in psychology and elderly care).

Based on the theories and approaches mentioned above, we hypothesised that tailoring is embedded in the whole process at three inter-related phases: assessment, design and implementation, and the degree of personalisation is determined by these three dimensions: (1) how to assess PWD characteristics before designing the intervention; (2) the extent to which interventions are tailored according to PWD characteristics and (3) the level of the interventionists' autonomy to address PWD needs, as suggested by occupational therapy, engagement in meaningful activities, and the person-centred care approach (online supplemental figure 1).[13–15] To this end, we developed three corresponding criteria to rate levels of personalisation (online supplemental table 3).

First, the level of assessment for tailoring refers to how comprehensive the PWD characteristics were considered and how systematically the assessment results were used for designing tailored activities. Operationally, we rated the level of assessment as 'unclear/incomprehensive', 'semi-structured' or 'structured'. 'Unclear/incomprehensive' indicated that preassessment was missing/not clearly described, only a single domain of PWD characteristics was assessed, or no description of how the assessment results were used to inform the tailored activities design. 'Semi-structured' referred to preassessments conducted by unstructured/semi-structured interviews, with some descriptions on how the assessment results were used for activities design, 'structured' preassessments employed structured interviews with clear and detailed descriptions on how the assessment results were systematically used for the activities design.

Second, individualisation in intervention design refers to how the intervention design accounted for individuals' uniqueness and variations of their needs. To avoid counting the number or arbitrarily weighting specific PWD characteristics, we distinguished the degree of individualisation based on whether the protocol tailored for one versus two or more PWD characteristics.

Third, the degree of person-centred care in implementation refers to how the interventionists were able to adjust the intervention based on their clinical knowledge and observation of participants' performance in the intervention to maintain participants' engagement and respond to participants' spontaneous needs during the implementation. Intervention with a standardised protocol of tailored activities regardless of spontaneous needs of PWD were rated as low flexibility for pursuing person-centred care, and interventions encouraging and allowing great flexibility for interventionists to adjust the tailored activities based on clinical knowledge and observation of participants' performance were rated as high flexibility.

Based on the dimensions mentioned above, we rated the level of personalisation of tailored activities as high, medium or low. A study was rated as high level only if it met all the following criteria: (1) structured assessments were used for systematically tailored activities plan; (2) interventions targeted two or more domains (eg, capabilities, preferences, interests, life experience and external environment) and (3) allowed the interventionists to exercise flexibility to adjust the intervention in accordance with PWD spontaneous needs. A study was rated as medium if: (1) unstructured/semi-structured assessments on participants' characteristics were performed; (2) interventions targeted two or more domains and (3) some flexibility and modifications were allowed for adjusting the intervention in response to PWD needs. A study was rated as low if: (1) assessment was unclear/incomprehensive, or there was no clear description on how assessment results informed tailoring; (2) interventions targeted only one domain of participants' characteristics and (3) low/marginal flexibility to pursue person-centred care for interventionists was allowed. AYZ and SL independently rated the level of personalisation for the included tailored activities. The inter-rater reliability was 88.8% in the initial stage of rating. Conflicting ratings were resolved through discussion.

Data synthesis and analysis

Given that outcomes in our review were continuous, effect sizes were expressed using standardised mean differences (SMD) at 95% CI,[20] interpreted as Cohen's d.[22] Specifically, the values of 0.2, 0.5 and 0.8 reflected small, moderate and large effect sizes, respectively.[22] Due to differences in settings and methods, we used the

random-effects model to pool the results. Heterogeneity was determined by χ^2 and I^2 statistics.[23 24] We classified subgroup analyses of the effectiveness of tailored activities according to the levels of personalisation of the interventions. All meta-analyses were conducted using Comprehensive Meta-Analysis Software. Where raw data are not provided, summary results are given in the text but not the forest plots. The meta-analyses included results from randomised controlled studies (RCTs) only because the findings from quasi-experimental studies were not comparable to those from RCTs. Sensitivity analyses were conducted to check the robustness of the findings.

Quality appraisal

SL and MSLM independently assessed the risk of bias for the studies using a revised Cochrane risk of bias tool for randomised trials,[23 25] including: (1) bias arising from the randomisation process; (2) deviations from intended interventions; (3) bias due to missing outcome data; (4) bias in measurement of the outcome and (5) bias in selection of the reported results. Risk of Bias in Non-randomised Studies of Interventions was used to categorise the risk of bias as 'low,' 'high' or 'some concerns' for non-RCT studies.[22] Conflicting results were resolved through discussions.

RESULTS

Summary of search results

The search and study selection process is summarised in the PRISMA flow diagram (online supplemental figure 2). In the identification phase, 14 238 abstracts were identified and imported into Endnote; 7471 duplicate articles were removed. In the screening phase, the titles and abstracts of 6767 articles were screened, and 6476 irrelevant articles were excluded. In the eligibility phase, full-text screening was conducted for 291 articles according to the inclusion and exclusion criteria, and 35 studies were finally included in this review.

Included studies were conducted in 16 countries/regions: Australia, Brazil, Mainland China, Denmark, France, Germany, Hong Kong, Italy, Japan, Korea, the Netherlands, Norway, Switzerland, Taiwan, the UK and the USA, published between 2000 and 2020. The average age of participants ranged from 62.1 to 89.2 years. Twenty-nine studies included participants with dementia only, and the remaining studies included participants with mild to moderate levels of cognitive impairment. The total size of the intervention groups (IGs) was 1248 (range=6–158), and the total size of the CGs was 1142 (range=5–107). Fourteen studies (40%) had no more than 20 participants for each arm. Thirty studies were RCTs. Five applied a quasi-experimental study design. Twenty-two applied usual care as the comparison, and the remaining applied placebo control, active control or wait-list control. Twenty-four studies were conducted in care facilities (such as a nursing home, geriatric health service facility or hospital), and the remaining studies were conducted in community settings or home-based settings (online supplemental table 4).

Description of the interventions

The components of activities can be categorised into four groups: physical (n=3),[26–28] cognitive (n=2),[29 30] music (n=7)[31–37] and multiple activities (n=23).[16 38–59] Twenty-three studies reported their interventions as individual mode, five reported group-based mode and six reported mixed modes, while the remaining studies did not provide details. Intervention was provided by specialists (eg, occupational therapists, clinicians, psychologists, physical therapists and speech therapists), researchers and trained nursing home caregivers and staff. A detailed description of interventions is shown in online supplemental table 5.

Level of personalisation

Based on the three-dimension rating scheme for the personalisation of tailored activities, we identified 12 studies as high level,[16 26 35 39 40 46 49 51 53–56] 11 as medium[34 36 38 42 44 45 47 52 57–59] and 11 as low.[27–33 37 43 48 50] One was rated as mixed because it had three-arm IGs with one medium and two low levels of tailoring activities for comparison.[41] Table 1 shows the level of personalisation among the interventions reported in the reviewed studies.

Level of assessment for tailoring

Sixteen studies assessed the full picture of PWD characteristics using structural assessments.[16 26 35 38–42 46 49 51 53–56 59] For instance, five studies followed the protocol of the Tailored Activity Programme (TAP) incorporating the Progressive Lowered Stress Threshold Model.[60] This posits that with disease progression, dementia patients become increasingly vulnerable to their environment and experience lower thresholds for tolerating stimuli that can result in behavioural disturbances. TAP applied systematic approaches to discern PWD and their caregivers' daily routines, identify previous and current activity interests and collect information about dyadic communication and home environmental features to design activities for participants.

Degree of individualisation in design

Activities tailored according to PWD characteristics included cognitive or/and physical capacities (n=22),[26–28 30 38 39 41–47 49 51 53–59] personal experience and history (n=2),[34 48] role identity (n=3),[39 51 55] preferences and interests (n=20)[26 29 31–33 35–37 40–42 46 47 50 53–57 59] habits (n=2),[51 54] cultural backgrounds (n=1)[47] and living environment (n=5).[49 51 53 54 56] Five studies also considered caregivers' characteristics.[46 51 53 54 56] Twelve studies tailored the intervention for a single aspect of PWD characteristics only, while the remainder tailored the activities for at least two. One study used a four-arm study design (three IGs plus one CG), with one tailoring both for PWD capacity and interests, the second only tailoring for the capacities yet opposite to PWD preference, and the third only tailoring for the interests yet challenging to PWD' capacity in the three IGs.[41]

Table 1 Level of personalisation of tailored activities

No.	Author	Level of assessment for tailoring	Degree of individualisation in design	Degree of person-centred care in intervention delivery	Level of personalisation
1	Orsulic-Jeras *et al*[38]	Structured assessments of participants' preferences using the Montessori-Based Assessment System developed by the authors for selecting appropriate activities for participants	Preserved abilities and preference (Two and above)	No description	Medium
2	Cohen-Mansfield *et al*[39]	Structured assessments for tailoring relating to participants' medical history, self-identity and social functioning	Identity roles, the severity of dementia and ability (Two and above)	High flexibility. The choice of intervention was affected by availability of materials, family members' cooperation and the practicability of the intervention	High
3	Garland *et al*[31]	No preassessments for tailoring	Music preference (One)	No description	Low
4	Cohen-Mansfield *et al*[40]	Structured assessments for tailoring regarding participants' medical history, self-identity and social functioning	Ability, history and preference (Two and above)	High flexibility. The study clearly indicated that flexibility was essential element of intervention	High
5	Gitlin *et al*[16]	Semi-structured interviews to discern daily routines, and the Pleasant Event Schedule to identify previous/current activity interests. Interventionists observed dyadic communication and home environmental features and assessed dementia patients	Capabilities, previous roles, habits, interests, home environment and dyadic communication (Two and above)	High flexibility. Activity prescriptions were reviewed and modified if necessary, during the implementation	High
6	Lam *et al*[26]	Structured assessments for tailoring. Individual functional profiles were mapped with personal selection	Abilities, preference and needs (Two and above)	High flexibility. Training content was dynamic and adjusted to the changing needs of PWD	High
7	Dechamps *et al*[58]	Semi-structured assessments on physical/psychological functions	Abilities (One)	Some flexibility	Medium

Continued

Table 1 Continued

No.	Author	Level of assessment for tailoring	Degree of individualisation in design	Degree of person-centred care in intervention delivery	Level of personalisation
8	Gitlin *et al*[51]	Structured assessments of PWD capabilities, medical testing, home environment, caregiver communication and caregiver-identified concerns. Interventionists interviewed caregivers to identify patient's routines, previous/current roles, habits and interest	Home environment, caregiver-identified concerns and capabilities, routines, previous/current roles, habits and interests (Two and above)	High flexibility	High
9	Sung *et al*[32]	Semi-structured assessments of participants' preferences and information on the importance of music to life	Music preference (One)	Low	Low
10	Kolanowski *et al*[41]	Structured assessments of capacities and personality of interest	Capacity and preference (Two and above)	High flexibility. Great flexibility was allowed to use staff's own clinical judgement and knowledge to implement individualised activities	Medium
a			Capacity (One)	No description	Low
b			Preference (One)	No description	Low
11	Lin *et al*[33]	Semi-structured preassessment of participants' music preference	Music preference (One)	No description	Low
12	Cohen-Mansfield *et al*[59]	Structured assessments of participants' medical history, self-identity and social functioning	Past identity, ability and preferences (Two and above)	Some flexibility. Interventionists were allowed to seek approval for possible adjustment if needed	Medium
13	van der Ploeg *et al*[42]	Structured assessments (Myers Menorah Park/Montessori-Based Assessment System) for tailoring	Preserved abilities and interest (Two and above)	High flexibility. Flexibility to respond to patients' perceived level of interest was allowed	Medium
14	Ridder *et al*[34]	Semi-structured interviews to elicit life-story information either from journal or relatives	Life-story/history, psychosocial needs (Two and above)	Low/some flexibility. No specific description	Medium

Continued

Table 1 Continued

No.	Author	Level of assessment for tailoring	Degree of individualisation in design	Degree of person-centred care in intervention delivery	Level of personalisation
15	Sakamoto *et al*[35]	Structural assessments for tailoring to analyse participants' personal life history, and interview with each participant and family member	Music preference, special memories (Two and above)	High flexibility	High
16	Van Haitsma *et al*[57]	Incomprehensive preassessments	Interest and ability (Two and above)	Some flexibility. The intervention was adjusted according to the time when residents need stimulation	Medium
17	Yoon *et al*[43]	Incomprehensive preassessments	Ability (One)	Low flexibility	Low
18	Toba *et al*[44]	Preassessment of individuals' abilities and disabilities to evaluate how to enhance abilities and compensate for disabilities	Abilities (One)	No description	Medium
19	Holthoff *et al*[27]	Incomprehensive preassessments	Ability (One)	Low flexibility	Low
20	Telenius *et al*[28]	Incomprehensive preassessments	Ability (One)	No description	Low
21	Davison *et al*[29]	Preassessment. The researchers met with participants and their families to determine the preferred materials	Interest only (One)	Low flexibility	Low
22	Giuli *et al*[30]	Incomprehensive preassessments on patients' cognitive status	Cognition (One)	No description	Low
23	Lu *et al*[45]	Preassessments on PWD functional ability, types and frequencies of meaningful activity, perceived barriers to engaging in activities	Functional ability, types and frequencies of meaningful activity (Two and above)	No description	Medium
24	Prick *et al*[46]	Structured assessments for tailoring	Physical capacities, information about pleasant activities for the dyad (Two and above)	Medium to high	High
25	Bailey *et al*[52]	No preassessments for tailoring	Interest and history (Two and above)	High flexibility. The group leaders had the flexibility to develop and tailor the individualised behavioural activity programmes during implementation	Medium

Continued

Table 1 Continued

No.	Author	Level of assessment for tailoring	Degree of individualisation in design	Degree of person-centred care in intervention delivery	Level of personalisation
26	Li *et al*[47]	The preliminary survey was implemented to investigate participants' preferences, cultural background, cognitive function and abilities	Interest and capacities (Two and above)	Some flexibility. The interventionist was allowed to choose activities to match PWD ability and interest during personalised activity	Medium
27	Gitlin *et al*[53]	Structured assessments of participants' capacities, fall risk, daily routines, interests, caregivers (routines, employment, readiness) and environments (lighting, seating, clutter, noise)	Capabilities, functioning, interest, environment, caregivers (Two and above)	High flexibility (prescriptions were reviewed and modified if necessary during implementation)	High
28	Tanaka *et al*[48]	Incomprehensive preassessments	Personal history (One)	No description	Low
29	Novelli *et al*[54]	Structured assessments to identify preserved capacities, previous interests, frequency/intensity of BPSD in the PWD, daily care routines of caregivers and home environment features	Capabilities, previous interests, frequency and intensity of BPSD in PWD, daily care routines of the caregiver and home environment (Two and above)	High flexibility. Interventionists are allowed to tailor and adjust the chosen activities to match participants' capabilities during implementation	High
30	Kwak *et al*[36]	Unstructured interviews with participants and their family members as the best sources for identifying an individual's music preferences	Music preference and songs significant to PWD life experience (Two and above)	High flexibility. The intervention allowed flexibility for facility staff to use their own clinical judgement and knowledge to tailor and implement the intervention	Medium
31	Jeon *et al*[49]	Comprehensive individual assessment (physical, medical and psychosocial) and their environment, medication review and adherence, a review of communication with health service providers and cognitive needs and existing strategies.	Capacities/needs, environment (Two and above)	High flexibility. A multidisciplinary and interdisciplinary plan tailored to meet the client's needs to enhance self-care ability using person-centred goal setting	High

Continued

Table 1 Continued

No.	Author	Level of assessment for tailoring	Degree of individualisation in design	Degree of person-centred care in intervention delivery	Level of personalisation
32	*de Oliveira et al*[55]	Structured assessments. Semi structured investigator-developed interview to identify daily routines, and the Pleasant Event Schedule to identify previous and current activity interests	Cognitive and functional capacities, previous abilities, interests and roles (Two and above)	High flexibility (prescriptions were reviewed and modified if necessary during the implementation)	High
33	O'Connor *et al*[56]	Structured assessments of participants' capacities, fall risk, daily routines, interests, caregivers (routines, employment, readiness) and environments (lighting, seating, clutter, noise)	Capabilities, functioning, interest, environment, caregivers (Two and above)	High flexibility (prescriptions were reviewed and modified if necessary during implementation)	High
34	Weise *et al*[37]	Preassessment of participants' personal music preference from family members, nursing staff and directly from participants	Preference for music (One)	Low flexibility	Low
35	Huber et al[50]	Incomprehensive preassessments	Preference (One)	Low flexibility	Low

One=the intervention design was tailored for only one aspect of PWD characteristics; Two and above=the intervention design was tailored for two and above aspects of PWD characteristics.
PWD, people with dementia.

Degree of person-centred care in delivery

Twenty-six studies indicated the level of flexibility for modification of activities during the intervention. Sixteen studies explicitly permitted the interventionists to review and modify the intervention according to participants' spontaneous needs and circumstances,[16 26 35 36 39–42 46 49 51–56] thus were rated as offering a high degree of person-centred care. Five allowed some flexibility for adjusting interventions during implementation,[34 47 57–59] thus were rated as offering some flexibility. Five studies enabled relatively limited adjustment of intervention to take account of changed PWD needs or circumstances.[27 32 34 37 50] The remaining studies provided insufficient information to judge the extent of flexibility allowed during the intervention.

Quality appraisal

The risk bias of 10 RCT studies was judged as low, while that of 12 was rated as high, and the remainder was judged as giving some concern (online supplemental figure 3). Nineteen RCT studies reported the method of random sequence generation (eg, computer-generated programmes, random list generator, random allocation by an external researcher and block randomisation).[16 28–30 33 34 37 41–43 46 49 51 53–56 58 59] Eleven were rated as high risk of deviation from intended intervention as they were judged as high risk of blinding participants, personnel and appropriate analysis used to estimate the effect of assignment to intervention.[27–30 33 36 40 42 43 48 52] Five quasi-experimental studies were excluded from the meta-analysis since none were rated at low risk of bias and thus comparable to RCTs (online supplemental figure 4).

Meta-analysis: the effects of tailored interventions

Twenty-six studies reported the outcomes of BPSD measured by multi-dimension or specific scales of agitation (figure 1).[16 27–29 31 33–37 39–42 44 46 47 50 51 53–59] The measurements used for BPSD included the NPI, the Agitation Behavior Mapping Instrument, the Cohen-Mansfield Agitation Inventory, the Agitated Behaviors in Dementia Scale, the Behavioral Pathology in Alzheimer's Disease rating scale and the short version of the Dementia Behavior Disturbance Scale.[18 20 61–64] A higher score indicates more BPSD. According to our meta-analysis, 18 RCTs with 20 tailored activities had an overall small effect on BPSD at postintervention (SMD_{pooled}=−0.38; 95% CI −0.54 to −0.22, p<0.001), although significant heterogeneity was found (I^2=64.17%, p<0.001). Eight studies were excluded from the meta-analysis either because of their quasi-experimental design or for not reporting the raw data.[31 36 37 44 47 50 55 57] Four of these identified no differences in reducing BPSD between IG and CG.[31 36 37 50]

Nine studies reported the outcome of QoL (figure 2).[16 34 48 49 51 52 54 56 58] The measurements used for QoL included Quality of Life-Alzheimer's Disease, the 3-Level version of the EuroQol five dimensions, the EuroQol 5-D, and the Health-related Quality of Life Questionnaire for the Elderly with Dementia.[65–67] A higher score indicates higher QoL. Tailored interventions had an overall small effect on QoL at postintervention (SMD_{pooled}=0.45; 95% CI 0.25 to 0.64, p<0.001), and no significant heterogeneity was found (I^2=11.56%, p>0.05).

Sixteen studies reported the outcome of depression,[16 26 28–30 32 39 43–46 48–50 52 58] measured by the Cornell Scale for Depression in Dementia, the Geriatric Depression Scale, the Multidimensional Observation Scale for Elderly Subjects, the Geriatric Depression Scale, the NPI subscale for depression or Patient Health Questionnaire-9.[18 19 68–70] A higher score indicates more depression. Thirteen RCT studies with 14 tailored activities indicated those activities had a small overall effect on depression at postintervention (SMD_{pooled}=−0.29; 95% CI −0.45 to −0.13, p<0.001), and no significant heterogeneity was found

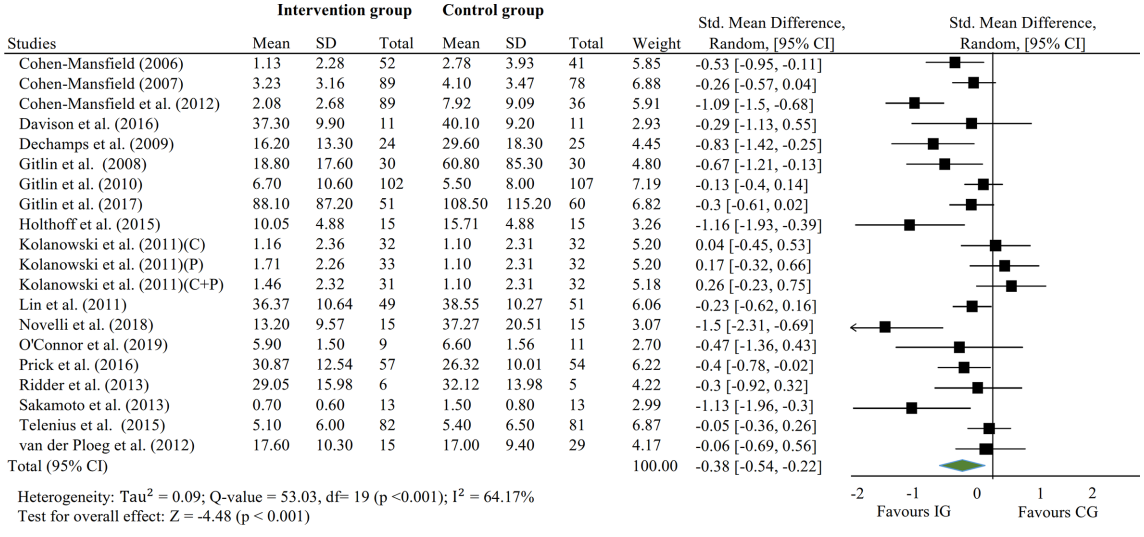

Figure 1 Effects of tailored interventions on challenging behaviour at postintervention (N=20). C=activities tailored for capacities of participants only, P=activities tailored for preference of participants only, C+P=activities tailored for capacities and preference of participants. Fixed effect: SMD_{pooled}=−0.32, 95% CI −0.42 to −0.22, p<0.001. CG, control group; IG, intervention group.

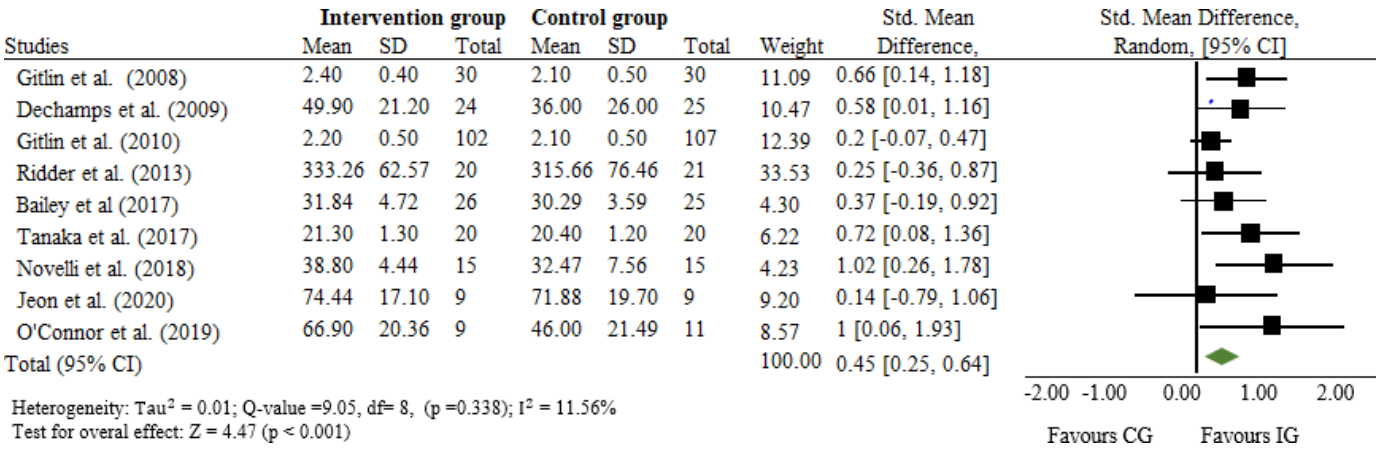

Figure 2 Effects of tailored interventions on quality of life at postintervention (N=9). Fixed effect: SMD_{pooled}=0.42, 95% CI 0.24 to 0.59, p<0.001. CG, control group; IG, intervention group.

(online supplemental figure 5). The remaining three studies were excluded from the meta-analysis because of their quasi-experimental design or lack of comparable data,[32 44 50] and only one study found no difference in reducing depression between IG and CG.[44]

Seven studies with nine interventions reported the outcome of engagement.[16 38 39 41 42 51 52] The measurements of engagement included one item on the ABMI, the Menorah Park Engagement Scale, direct observation or caregiver report.[61 71] A higher score indicates a higher level of engagement. The meta-analysis indicated that tailored interventions of eight matched IGs and CGs in six studies had an overall large effect on the level of engagement at postintervention (SMD_{pooled}=0.86; 95% CI 0.23 to 1.48, p<0.001) (online supplemental figure 6). Significant heterogeneity was found, primarily generated by the outlier study whose intervention specifically targeted participants' self-identity roles and which reported large effects on engagement (SMD=3.52; 95% CI 2.87 to 4.17, p<0.001).[39] Removal of this study resulted in lower and non-significant heterogeneity with a significant small effect size ($SMD_{adjusted\ pooled}$=0.47; 95% CI 0.23 to 0.60, p<0.001). One study with a quasi-experimental design reported increased engagement postintervention.[38]

Subgroup analysis

Subgroup analysis was performed to test the difference of the effects of tailored activities with different levels of personalisation on outcomes (figures 3 and 4). Studies with a high level of personalisation tailored activities had a significant and the largest effect size regarding the reduction of BPSD (SMD_{pooled}=−0.52, 95% CI −0.74 to −0.29, p<0.001) with non-significant heterogeneity, followed by medium (SMD_{pooled}=−0.38, 95% CI −0.79 to 0.03, p=0.071) and low groups (SMD_{pooled}=−0.15, 95% CI −0.44 to 0.14, p=0.076), although both the latter two groups had marginally significant effect sizes and significant heterogeneity. The high group had a moderate effect size on improvement in QoL (SMD_{pooled}=0.52, 95% CI 0.16 to 0.89, p<0.01), followed by the medium group (SMD_{pooled}=0.41, 95% CI 0.07 to 0.74, p<0.05). Only one study with a low level of personalisation tailored activities reported the outcome of QoL with moderate effect size (SMD=0.72, 95% CI 0.08 to 1.36, p<0.05).

Subgroup analysis was performed to test the difference of the effects of the level of personalisation on depression and engagement (online supplemental figures 7 and 8). The medium group had a moderate effect size regarding reduction in depression (SMD_{pooled}=−0.64, 95% CI −1.14 to −0.15, p<0.05), followed by the high group (SMD_{pooled}=−0.33, 95% CI −0.54 to −0.12, p<0.01). The three studies with a medium level of personalisation of tailored activities all involved social or group interaction components that have beneficial effects on PWD mental health. Only one study rated high on tailoring had a large effect on improving engagement level postintervention (SMD=0.85, 95% CI 0.32 to 1.38, p<0.01). The medium group had a small effect size (SMD_{pooled}=0.44, 95% CI 0.07 to 0.80, p<0.05), followed by the low group (SMD_{pooled}=0.39, 95% CI 0.04 to 0.74, p<0.05).

Sensitivity analysis

We conducted a series of sensitivity analyses that excluded studies that combined participants with dementia and those with cognitive impairment. No substantial differences were found between the findings of studies focussing exclusively on PWD and studies that included participants with dementia and participants with cognitive impairment (online supplemental table 6). Sensitivity analyses were also conducted to examine whether the effect sizes of tailored activities on the outcomes of interest were associated with each study's sample size. The only significant association was found between sample size and effect size on QoL. We also tested whether a study's intervention mode (individual, group and mixed with mixed mode set as the reference group) would be associated with its findings. No significant associations were found between intervention mode and the outcomes.

DISCUSSION

Our systematic review aimed to assess the degree of personalisation of tailored activities and estimate the effect of levels of personalisation of tailored activities

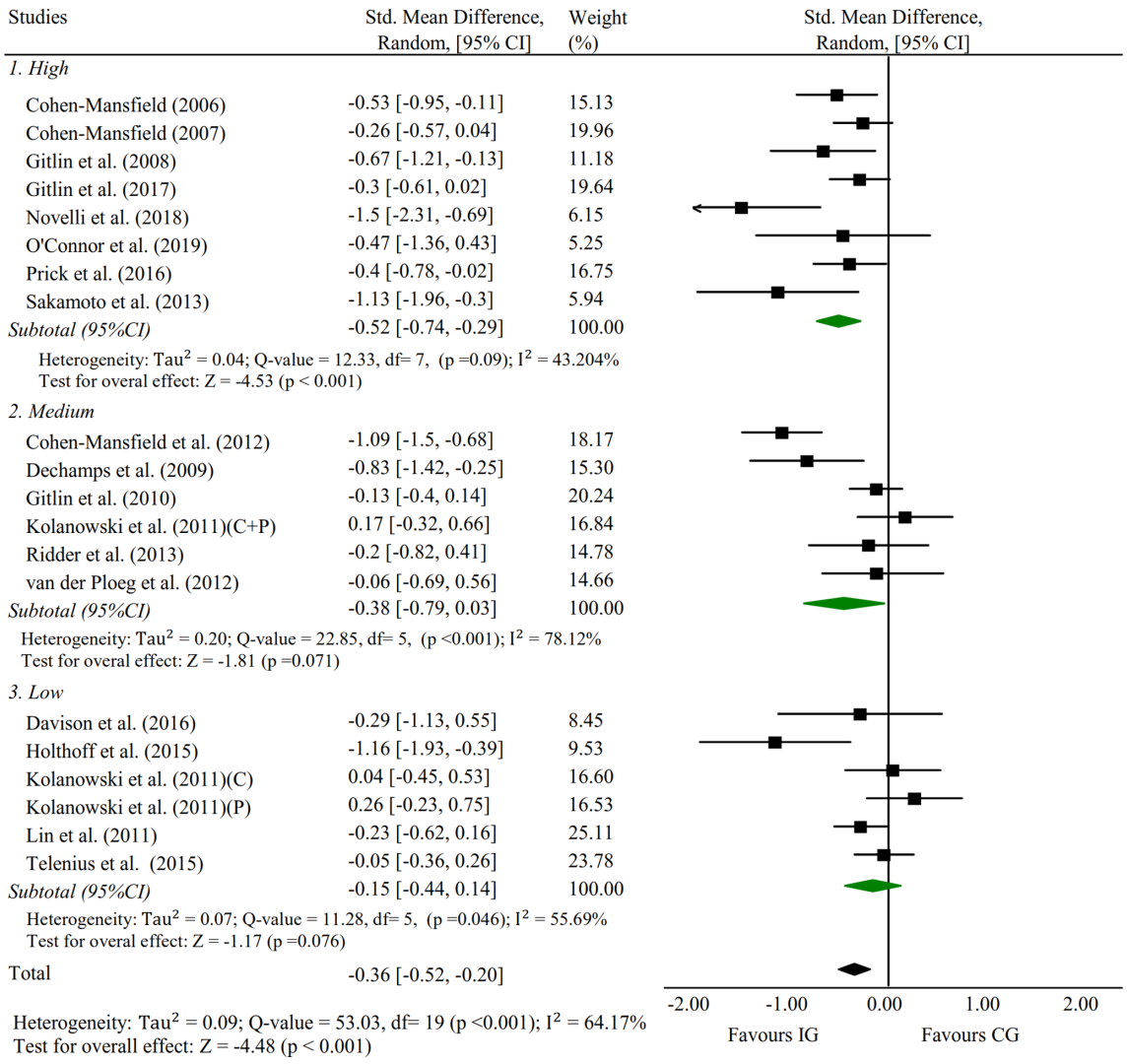

Figure 3 Subgroup analysis: effects of tailored interventions on challenging behaviour at postintervention by level of personalisation (N=20). C=activities tailored for capacities of participants only, P=activities tailored for preference of participants only, C+P=activities tailored for capacities and preference of participants. (1) High group. Fixed effect: SMD_{pooled}=−0.46, 95% CI −0.62 to −0.30, p<0.001; middle group. Fixed effect: SMD_{pooled}=−0.34, 95% CI −0.51 to −0.16, p<0.001; low group. Fixed effect: SMD_{pooled}=−0.11, 95% CI −0.30 to 0.08, p=0.254. (2) Test for the difference across three subgroups: Q value=7.78, df(Q)=2, p value=0.02. CG, control group; IG, intervention group.

on reducing BPSD, improving QoL and other relevant outcomes among PWD. Thirty-five studies met our inclusion criteria, covering a total of 2390 participants from 16 countries/regions. The activities included in the interventions comprised physical, cognitive, music and multiple activities.

We employed meta-analysis to estimate the overall effects of tailored activities on the outcomes of BPSD, QoL, depression and engagement. Our findings on the effect sizes of tailored activities of the outcomes of interests differ from previous review studies. First, we found that tailored activities slightly reduced BPSD, consistent with previous meta-analyses targeting facilities, communities and PWD living in their own home.[10–12] Second, we found that tailored activities had a small effect on improving QoL, compared with previous reviews that found inconclusive evidence regarding QoL: no effect in facilities, and a slight improvement in both community-based and home-based settings.[10–12] Third, our findings showed that tailored activities had small effects on depression, and large effects on engagement, contradicting previous reviews reporting little or no effect on these outcomes.[11 12]

Unlike previous review studies, we further developed the rating scheme of tailoring level based on three essential components: assessment for tailoring, individualisation in intervention design and person-centred care in implementation. Based on our rating scheme, the activities with optimal tailoring conditions possess the following characteristics. In the assessment stage, systematic interviews on individuals' characteristics were conducted. In the design stage, two or more domains of individuals' characteristics were targeted in the activity plan, including capabilities, preferences, interests, life

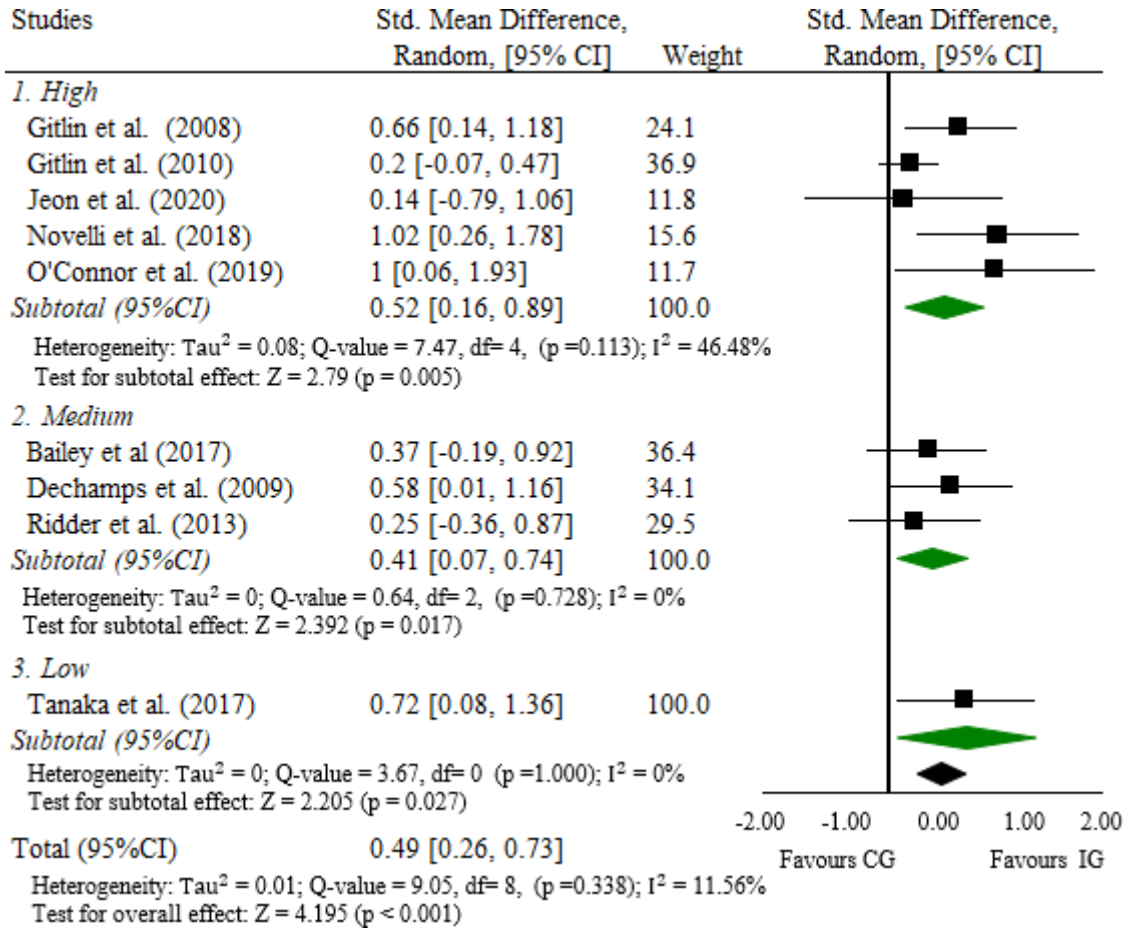

Figure 4 Subgroup analysis: effects of tailored interventions on quality of life at postintervention by level of personalisation (N=9). High group, fixed effect: SMD_{pooled}=0.39, 95% CI 0.17 to 0.60, p<0.001; middle group, fixed effect: SMD_{pooled}=0.41, 95% CI 0.07 to 0.74, p=0.017; low group, fixed effect: SMD_{pooled}=0.72, 95% CI 0.08 to 1.36, p=0.027. (2) Test for the difference across three subgroups: Q value=0.94, df(Q)=2, p value=0.626. CG, control group; IG, intervention group.

experience and external environment. In the implementation stage, interventionists were allowed high flexibility and any modifications based on their professional judgement to accommodate the spontaneous needs of PWD during the intervention. Overall, we rated only 12 studies as high level of personalisation of tailored activities, 11 as medium, 11 as low and 1 study was rated as mixed because it had three-arm IGs with one medium and two low levels of tailoring activities for comparison.

Based on our rating scheme, we extended previous review studies to investigate how the degree of tailoring influenced intervention effectiveness on the outcomes of interest. Interventions with a high level of personalisation of tailored activities had a significant and moderate effect, followed by medium (small) and low groups (trivial); the latter two groups had significant heterogeneity and marginally significant effect sizes. Interventions rated as having a high level of personalisation had a moderate effect size on improving QoL, followed by the medium group. Only one study with a low level of personalisation of tailored activities reported the outcome of QoL with moderate effect size. These findings support our rating scheme as the overall goals of tailoring activities are to reduce BPSD and improve QoL.[54 56] A similar pattern was found in the level of engagement. However, because the degree of personalisation was rated high in one study only, this should be interpreted with caution.

This systematic review has several limitations. The generalisability of our results may be limited since we included English-language studies only. The included studies had risks of bias that may undermine the quality of evidence. Furthermore, noticeable heterogeneity was found among studies with outcomes of BPSD and engagement, which may affect the conclusions synthesised from these studies. Thus, these results must be interpreted with caution. In addition, the rating scheme for the level of personalisation was subjective regarding the level of assessments for tailoring and the degree of person-centred care in implementation.

This review has implications for clinical practice. It provides new insights into non-pharmacological tailored activities by developing a rating scheme for the level of personalisation and tested its validity by investigating the effectiveness of interventions with different levels of tailoring on BPSD and QoL. Healthcare professionals and practitioners can use our findings to tailor interventions to benefit patients' outcomes. We recommend the application of structural and comprehensive assessment

approaches to identify and address two or more PWD characteristics (capacities, preferences, habits and living environment, etc) in designing tailored activities, and allow interventionists to use their professional judgement to modify the interventions to respond to spontaneous needs of PWD to develop tailored activities with a high level of personalisation.

Our systematic review has implications for future intervention research. Fourteen studies had no more than 20 participants for each arm, and only 10 RCTs were judged as low risk. Evaluation studies should adhere to current methodological standards, for example, a randomised and concealed allocation, adequate blinding (at least participants and outcome assessors), and recruitment of adequate samples.[23]

CONCLUSION

This systematic review shows that tailored activities slightly reduced BPSD and depression, had a small effect on improving QoL and had large effects on facilitating the level of engagement among PWD. Additionally, we advanced existing literature by proposing and testing the validity of a rating scheme for the level of personalisation. Additional high-quality tailored intervention studies with sufficient samples are needed.

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Contributors SL was responsible for the overall content of the systematic review. SL wrote the systematic review, performed the preliminary searches and data extraction, conducted quality assessments and drafted the systematic review paper. SL, AYZ, T Liu and JCPC designed the rating scheme for the level of personalisation. MSLM cross-checked data extraction and performed quality ratings independently. GW and T Lum made substantial contributions to the conception and design of the systematic review and assisted SL, AYZ, T Liu and JCPC to resolve any discrepancies regarding study inclusion, data extraction and quality ratings. All authors offered critical revisions for the systematic review manuscript.

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