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The impact of montessori-based programmes on individuals with dementia living in residential aged care: A systematic review

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Abstract

Objectives: This systematic review examined the effectiveness of Montessori-based programmes for individuals with dementia living in residential aged care.

Methods: Nine databases were searched between January 2010 to October 2021, including Scopus, CINAHL, MEDLINE, Web of Science, SocINDEX with Full Text, PubMed, PsycINFO, Cochrane library and Cochrane Registry. Publications were included if they used Montessori-based programmes as interventions for individuals with dementia living in residential aged care and were

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qualitative, quantitative, mixed-method, or pilot studies. The quality of eligible studies was assessed using Joanna Briggs Institute critical appraisal instruments and the Mixed Method Critical Appraisal Tool. The findings were tabulated and narratively synthesised.

Results: Fifteen studies were included in this review. The quality scores of the 15 studies ranged from 62 to 100 out of 100. Four key categories of outcomes were observed: (1) significantly improved engagement; (2) significantly improved mental health outcomes, including affect, depression, agitation, excessive eating and psychotropic medication prescriptions; (3) significantly improved feeding difficulty but mixed results regarding nutritional status; and (4) no significant changes in the activities of daily living and quality of life of individuals with dementia.

Conclusion: Cognitive capacity, personal preferences, individual care needs and the design of Montessori-based activities are pivotal to tailoring personalised Montessori-based activities for individuals with dementia in residential aged care and to maximise intervention outcomes. The synergistic effect of integrating Spaced Retrieval with Montessori-based activities in improving the eating ability and nutritional status of individuals with dementia was also noticed. The study summarised evidence about the effectiveness of Montessori-based programmes for individuals with dementia and informed healthcare professionals about how to implement individualised Montessori-based programmes.

Keywords

activities of daily living, affect, dementia, depression, long-term care, montessori, nursing homes, nutrition, quality of life, recreational activities

Introduction

Montessori-based programmes in dementia care are non-pharmacological interventions that reflect the person-centred approach to engaging individuals with dementia (Dementia Australia, 2019). The principles of Montessori-based programmes encompass respect, dignity, autonomy and equality, and the activities are tailored to match the cognitive capacity of individuals with dementia (Camp, 2010; Camp et al., 2017; Dementia Australia, 2019). By using familiar materials, task breakdowns and guided repetition from simple to complex, Montessori-based programmes enable individuals with dementia to adapt to self-paced learning and achieve success (Camp, 2010). The Montessori-based programme denotes that individuals with dementia be perceived as living with a disability rather than a disease (Camp, 2010). In addition, Montessori-based programmes encourage individuals with dementia to engage actively and connect within a social and physical environment through purposeful and meaningful activities (Camp, 2010; Camp et al., 2017).

Dementia has a significant impact on individuals' cognition, behaviour, psychology, functionality and quality of life (Alzheimer's Society, 2022b; Bessey & Walaszek, 2019; Gale et al., 2018). As the worldwide incidence of dementia increases at an alarming rate, its impact on individuals, families and the care burden must be addressed (World Health Organisation, 2022). In Australia in 2022, it is estimated that there are 487,500 individuals living with dementia with a projection of 1,076,000 by 2058. (Alzheimer's society, 2022a). Additionally, in 2018, three billion dollars of the Australian health budget were allocated to dementia care (Australian Institute of Health and Welfare, 2021). A study by Cohen-Mansfield et al. (2015) identified the top three unmet needs of individuals with dementia in residential aged care to be loneliness/need for social interaction, boredom/sensory deprivation, and need for meaningful activities. Especially for those who are in the advanced stages of dementia and needed assistance to meet their physical,

psychological and spiritual needs, such as safety, food, physical well-being and physical activities are most intense (Schmidt et al., 2018). Consequently, healthcare practitioners have a significant role to play in promoting the health and well-being of individuals with dementia in residential aged care. In addition, the ramifications of ignoring these unmet care needs of individuals with dementia do not support person-centred care and may also be associated with depression, responsive behaviours and increased dependency on caregivers and result in caregiver burden (Carvacho et al., 2021). Thus, understanding the care and support needs of individuals with dementia is crucial for enabling individuals with dementia to enjoy a meaningful life and to feel fulfilled and accomplished.

The World Health Organisation recently recognised the need for all countries to develop strategies that will improve the health and well-being of individuals with dementia and their family caregivers in their *Global action plan on the public health response to dementia 2017-2025, mDementia handbook, WHO'S iSupport programme* (World Health Organisation, 2022). Over many years in Australia, various attempts have been made to improve dementia care, such as the *Clinical Practice Guidelines and Principles of Care for People with Dementia* that provide recommendations for care. These recommendations include providing a person-centred approach, improving quality of life and using dementia-friendly language (Guideline Adaptation Committee, 2016). Therefore, prioritising the needs and preferences of individuals with dementia is a crucial way of achieving person-centred dementia care (Guideline Adaptation Committee, 2016). Most recently, the Royal Commission into Aged Care Quality and Safety (2021) emphasised the right of older Australians to receive high quality, safe and timely care from service providers. To achieve this, the national peak body of dementia care (Dementia Australia) advocated for the use of Montessori-based programmes in aged care to improve the engagement and quality of life for individuals with dementia (Dementia Australia, 2021).

Montessori-based activities are evidence-based practice that have been adopted for individuals with dementia for decades and has shown many benefits. For instance, positive effects on feeding difficulty, engagement, affect and cognition (Sheppard et al., 2016). Other aspects of dementia care such as verbal communication, quality of life, behaviour changes, relationships with family visitors and staff are also mentioned. Montessori-based activities have also been shown to reduce agitation and, therefore, reduce psychotropic medication utilisation (Booth et al., 2020; Ducak et al., 2018; Lin et al., 2009; Orsulic-Jeras et al., 2000; Runci et al., 2012). Montessori-based activities combined with Spaced Retrieval (a memory training technique) have been shown to enhance the eating abilities of individuals with dementia (Wu and Lin, 2013; Wu et al., 2014). Despite there being many studies that highlighted the value of Montessori-based programmes, there are few studies that have examined the effectiveness of Montessori-based programmes in residential aged care, including nursing homes, dementia care units and memory care units. Therefore, this systematic review aimed to synthesis the evidence from published research that focused on determining the impact of Montessori-based programmes on individuals with dementia in residential aged care.

Methods

The study design was a systematic review with narrative synthesis. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 Checklist was used to guide the review process and report results (Page et al., 2021). The review protocol was registered and published in PROSPERO (registration number CRD42021291129).

Eligibility criteria

The inclusion criteria for eligible studies were: (1) written in English; (2) published in a peer-reviewed journal between January 2010 to October 2021; (3) sample included individuals with dementia (all types and all stages) in residential aged care, such as nursing homes, dementia care units and memory care units; (4) study outcomes were relevant to the usage of Montessori-based programmes on individuals with dementia in residential aged care; and (5) qualitative, quantitative, mixed-methods and pilot studies that met the objectives of this review. The exclusion criteria included studies that only explored the effects of Montessori-based programmes on outcomes for caregivers, studies not conducted in residential aged care, review articles, case studies, study protocols, commentary articles and studies with a high risk of bias. The search was limited to abstracts and full-text available.

Information sources and search strategy

Nine databases were searched: Scopus, CINAHL, MEDLINE, Web of Science, SocINDEX with Full Text, PubMed, PsycINFO, Cochrane library and Cochrane Registry. The keywords searched were: "dementia" OR "Alzheimer*" OR "cognitive impairment" OR "cognitive decline" OR "memory loss" AND "Montessori". The primary author (ZMY) used these keywords after multiple pilot searches to test their accuracy. The university librarian was also consulted to ensure that the keywords and the target databases would generate a comprehensive search. Additional sources were searched, including Google Scholar, industry websites such as Dementia Australia (https://www.dementia.org.au/) and Alzheimer's Association (https://www.alz.org/), as well as organisations such as Bupa Aged Care (https://www.bupaagedcare.com.au/), Uniting Care Australia (https://unitingcare.org.au/) and Anglican care (https://anglicancare.com.au/residential-care/). In addition, the citations of potentially eligible studies were also examined.

Data collection process and methodological quality assessment

The primary author (ZMY) screened the titles and abstracts from the databases and saved potentially eligible studies in Mendeley. Four authors (ZMY, IA, HCC and VT) independently assessed the methodological quality of the selected papers after retrieving the full text of eligible studies. The Joanna Briggs Institute critical appraisal instruments were used to review the papers (Aromataris, & Munn, 2020In Aromataris & Munn, 2020) for randomised control trials (RCT), quasi-experimental and qualitative research, and the Mixed Method Critical Appraisal Tool was used for mixed-method studies (MMAT; Hong et al., 2018). Questions were answered with 'yes' (score 1) and 'no' (score 0) for the Joanna Briggs instruments. Scores were converted to percentages to allow for comparison across different study designs. A score of 100% indicated the highest possible score. Low-quality papers were excluded based on an agreed quality threshold of the mean minus one standard deviation (Aromataris, & Munn, 2020In Aromataris & Munn, 2020). Questions from the Mixed Method Critical Appraisal Tool were answered only as 'yes' or 'no' because the instructions for using this tool do not recommend calculating a score, and thus no percentage score was possible for the mixed method studies appraised. Discrepancies between the two reviewers were resolved through discussion with the other authors.

Data extraction

Two reviewers (ZMY and VT) worked together to extract the key data from the original empirical studies. The extracted data were tabulated to answer the research question for this study. Details such as the name of the first author, year of publication, country, aim, method, sample size, setting, characteristics of participants, intervention, measurement tools, and outcomes were extracted from the original studies. Additionally, details of the Montessori-based programme intervention were extracted, including the format, content, frequency, duration, and the role of the individual(s) who implemented the intervention. The outcomes from the included studies were grouped using the recommendations from the Health Categories of the UK Clinical Research Collaboration (n.d.). The details of the measurement tools, data collection time and method, and the presentation of key findings with statistical significance were also included.

Data synthesis

Studies varied greatly in terms of the study design, interventions and populations. Due to the heterogeneity of the studies included, meta-analysis was not the best choice for data synthesis (Munn et al., 2014). The majority of the studies in this review were observational studies and varied in terms of their study design, and included RCTs, quasi-experimental and mixed-methods. There were variations in the Montessori-based programme design and data collection, such as the duration of the programme, frequency and duration of the Montessori-based activities, role of the implementers, data collection tools and data collection points. The participants were in different stages of their dementia and thus the impact of their dementia on the intervention outcomes differed. To manage these heterogeneities, narrative synthesis was adopted to tabulate the data and outcomes from the review. According to the JBI systematic review guideline on effectiveness review, the essence of a narrative synthesis is to summarise the results of included studies using words and tables without meta-analysis, which provides a reliable source to facilitate an understating of the summarised results and enhances the robustness of the synthesised results (Aromataris, & Munn, 2020). The findings from the 15 included studies were classified into four categories: (1) engagement; (2) mental health outcomes; (3) feeding difficulty and nutritional status; and (4) activities of daily living and quality of life. The areas addressed were included study selection, critical appraisal results, characteristics of included studies, details of the intervention, measurement tools, data collection methods and the impact of Montessori-based programmes in residential aged care.

Results

Study selection

Details of the study selection are presented in Figure 1. PRISMA 2020 flow diagram (Page et al., 2021). A total of 281 records were retrieved from databases and registers, out of which 230 records were excluded after screening the titles and abstracts. After full-text retrieval, 51 records were assessed, out of which 36 were excluded for various reasons, leaving 15 studies that were eligible for inclusion. Five records were not retrieved because they did not meet the inclusion criteria. 'Other' sources were five citations from organisational websites. The 86 citations related to Montessori-based activities that were retrieved from the 15 eligible studies were all excluded, with reasons provided as shown in the PRISMA 2020 flow diagram.

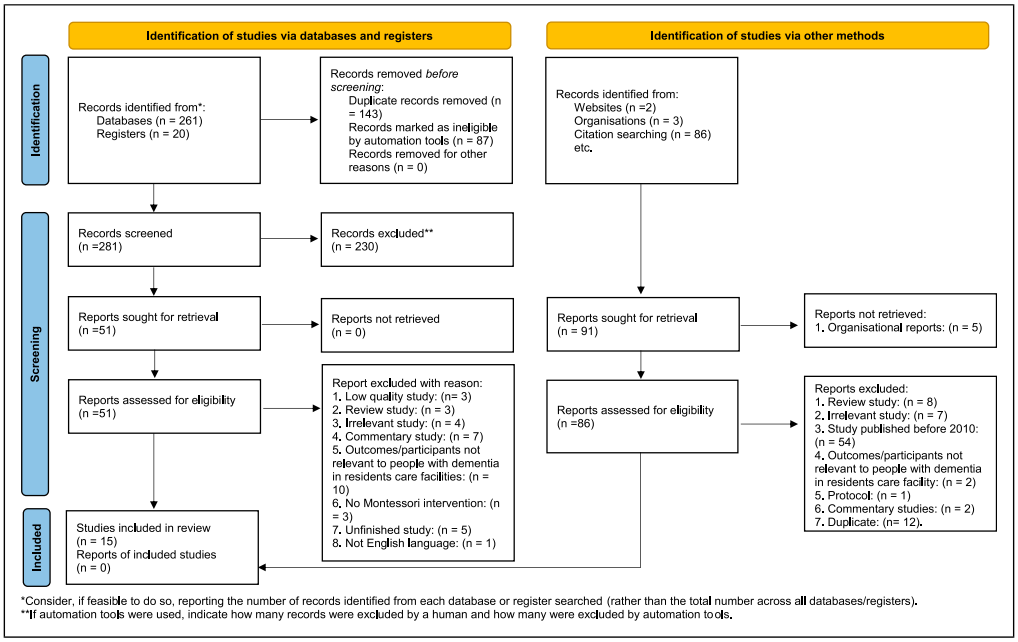

Figure 1. *Consider, if feasible to do so, reporting the number of records identified from each database or register searched (rather than the total number across all databases/registers). **If automation tools were used, indicate how many records were excluded by a human and how many were excluded by automation tools. From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ 2021;372:n71. doi: 10.1136/bmj.n71. For more information, visit: http://www.prisma-statement.org/

Critical appraisal results

Eighteen studies met the inclusion criteria and were appraised for methodological quality. Of these, six were RCTs, eight were quasi-experimental studies, two were qualitative studies, and two were mixed methods studies (for which the tool recommended scores could not be calculated). The mean (*M*) quality score for the 16 studies appraised was 70.69 out of 100 (Standard Deviation [*SD*]: 16.44). The threshold for excluding low-quality papers was determined as ≥ 54.25 (70.69–16.44 = 54.25). Of the 18 studies appraised, three studies (one RCT and two qualitative studies) were excluded due to low methodological quality, leaving 15 studies for this literature review. Of the 15 included studies, except the two mixed methods studies, the quality scores across the remaining 13 studies ranged from 62 to 100 ($M \pm SD$: 76 ± 13.77). Details of the critical appraisal results are showed in Supplement file 1: Critical appraisal results of the included studies.

Characteristics of included studies

The characteristics of the 15 included studies are presented in Table 1. Five (n = 5, 33.3%) were conducted in Taiwan (Kao et al., 2016; Lin et al., 2010, 2011; Wu and Lin, 2013; Wu et al., 2014), four (n = 4, 26.7%) in the United States (Gaspar & Westberg, 2020; Skrajner et al., 2012, 2014; Wilks et al., 2019); two (n = 2, 13.3%) in China (Chan et al., 2021; Yuen and Kwok, 2019), two (n = 2, 13.3%) in Australia (Mbakile-Mahlanza et al., 2020; Roberts et al., 2015), one (n = 1, 6.7%) in

Table 1. Characteristics of included studies.

Aim	Method, sample size, setting	Characteristics of participant	Intervention	Measurement tools	Findings
1. Chan et al., 2021, China Hong Kong Evaluate the feasibility and effects of a culturally adapted group-based Montessori Method for Dementia programme in the Chinese community.	RCT, n = 108 people with dementia, community centre, day care center and nursing home.	**Age:** 83.9 ± 7. **Gender**: females: 77; males: 31. **Stages of dementia**: mild to moderate. **Average length of stay in home**: not reported.	**Montessori group**: Memory Bingo or sorting pictures or words into categories, cutting and stringing beads, reading groups, on an individual or group basis. **Control group**: reading out newspapers, physical activities, and watching videos on a group basis.	1. **Feasibility**: attendance rate. 2. **Engagement**: The Menorah Park Engagement Scale. 3. **Affects (mood)**: The Apparent Affect Rating Scale.	**Feasibility**: Overall attendance: 79.1%. Montessori group: 81.5%; Control Group: 76.3%, not significant between groups. **Engagement**: Montessori group showed higher constructive engagement in first 10 minutes (Wald chi-square = 15.2, p = 0.033), middle 10 minutes (Wald chi-square = 19.9, p = 0.006) and lower passive engagement in the last 10 minutes (Wald chi-square = 17.61, p = 0.014) of each session cross the entire session period than control group. No difference among the three settings. **Affects**: only pleasure and interest observed; anxiety/fear and sadness rarely observed. Montessori group showed a higher pleasure in the first 10 minutes (Wald chi-square = 25.4, p < 0.001) and middle 10 minutes (Wald chi-square = 25.7, p < 0.001) as well as interest in the first 10 minutes (Wald chi-square = 21.1, p = 0.004) and middle 10 minutes of each session (Wald chi-square = 19.1, p = 0.008). No difference among the three settings.
2. Chaudhry et al., 2020, Pakistan. Evaluate feasibility and acceptability of a culturally adapted, group-based Montessori intervention.	Mixed-method, n = 12 dyads of people with dementia and care workers and researchers, nursing home.	**Age**: 68.3 ± 5.7. **Gender**: 3 females; 9 males. **Stage of dementia**: moderate. **Average length of stay in home**: not reported.	Montessori-based activities: identifying pictures of the famous building of Pakistan and the Pakistan version of the Flag puzzle.	1. **Feasibility**: recruitment rate and attrition rate. 2. **Acceptability and tolerability** of the intervention by participants. 3. **Pre-post intervention evaluation**: (1) Montreal Cognitive Assessment (MoCA); (2) Quality of Life Assessment in Dementia (DEMQOL); (3) Geriatric Depression Scale 15-item (GDS-15); (4) Cohen-Mansfield Agitation Inventory (CMAI); (5) Disability Assessment for Dementia (DAD).	**Feasibility**: 12 individuals with dementia were recruited and only one participant left, resulting in a retention rate of 83%. **Acceptability and tolerability of the intervention**: 89% of participants were feeling happy about the intervention and no adverse event happened indicating well tolerated by participants. **Pre- and post-intervention evaluation**: (1) total scores of the GDS-15 and CoMA no significant changes. However, a significant reduction in verbal/aggressive score of the CMAI subscale (p = 0.005). Slightly improved DAD on initiation domain (mean difference [MD] = 1.4, not significant) and performance domain (MD = 0.90, not significant) as well as slightly improved of DEMQOL total scores (MD = 5.45, not significant).

(continued)

Table 1. (continued)

Aim	Method, sample size, setting	Characteristics of participant	Intervention	Measurement tools	Findings
3. Gaspar and Westberg, 2020, USA. Evaluate engagement and prescribed antipsychotic medications before and after Montessori-Inspired Lifestyle (MIL) implementation.	Quasi-experimental, n = 72 people with dementia, memory care units.	**Age**: 86.08 ± 7.37. **Gender**: 53 females; 19 males. **Stage of dementia**: mild to severe, most were moderate. **Average length of stay in home**: 21 months.	**Montessori activities**: reading group, cooking, music group, and unplanned activities, individual or group discussion activities.	**Engagement**: an engagement Observation Recording Form developed by Westberg et al., in 2017.	1. **Engagement:** significantly increased during mealtimes, planned activities and unplanned activities post-intervention ($p < 0.05$). 2. Negative correlations were found between length of exposure to MIL programme and minutes of positive engagement for meals ($r^2 = -0.356$; $p = 0.01$) and unplanned activity ($r^2 = -0.27$; $p = 0.05$), with planned activity ($r^2 = -0.316$; $p = 0.02$), indicating that as time of expose to MIL increased, the minutes of positive engagement decreased. 3. Positive clinical changes: (1) number of participants not prescribed psychotropic medication (routine or PRN) increased from six to seven; (2) one participant discontinued PRN psychotropic medication; (3) number of participants on both routine and PRN psychotropic medication decreased from 11 to nine.
4. Giroux et al., 2010, Canada. Evaluate short-term effects of the Montessori approach and activities.	A quasi-experimental design, n = 14, people with dementia nursing home.	**Age**: missing. **Gender**: missing. **Stage of dementia**: moderate to severe. **Average length of stay in home**: not reported.	**Montessori group**: Montessori activities: classifying objects and fitting shapes into holes, puzzles of maps, animals, or parts of plants. **Placebo group**: regular activities: music activities singing along, clapping hands or playing various musical instruments. Group games: casinos, quiz games, sandbags, bowling, etc, **Inactivity group**: participants were in their room, on the unit, or in a sitting area but not involved in any of the activities.	1. **Affects**: The Philadelphia Geriatric Center Affect Rating Scale. 2. **Mood**: The Dementia Mood-Pictures test. 3. **Engagement**: an observation scale developed by Kovach and Magliocco in 1998.	**Gross affects score**: Montessori group: 22.3 ± 1.1, Placebo group: 21.6 ± 1.9, Inactivity group: 19.3 ± 4.8, statistically different among these groups ($p < 0.0001$). **Mood (positive)**: Montessori group: 10.1 ± 1.3, Placebo group: 10.5 ± 1.4, not significant different among different groups. **Engagement score**: Montessori group: 2.9 ± 0.8, Placebo group: 2.5 ± 0.5, statistically significant among groups ($p < 0.0001$). **Intensity of the stimulation score**: Montessori group: 1.8 ± 0.5, Placebo group: 2.3 ± 1.0, statistically significant difference in different groups ($p = 0.0026$). **The length of time of active, passive and no participation**: Montessori group: 92.4% of the time in active participation, 4.8% of the time in passive participation and 1.0% of the time in no participation at all. Placebo group: 53.1% of the time in activity participation, 41.8% in passive participation and 5.1% of the time not participating at all. Montessori group showed a significantly higher rate of active engagement than Placebo group ($p < 0.0001$). **Correlation between different variables**: a strong positive correlation was observed between global affects and engagement score ($r = 0.52$, $p < 0.0001$), more active engagement is positively associated with a more positive attitude. The intensity of stimulation had no correlation with engagement score.

(continued)

Table 1. (continued)

Aim	Method, sample size, setting	Characteristics of participant	Intervention	Measurement tools	Findings
5. Kao et al., 2016, Taiwan. Compare long-term effectiveness of spaced retrieval (SR) training and SR training combined with Montessori activities (SR + M) for improving hyperphagic behaviours.	Mixed methods: RCT and interview, n = 140 people with dementia, dementia care units.	**Age**: 82.55 ± 5.95. **Gender**: females: 41; males: 99;. **Stage of dementia**: moderate. **Average length of stay in homestay in home**: 35.98 ± 32.43 months.	**Memory training contents**: remember where the food is placed, slow down eating speed and recognise the satisfaction message. **SR group training**: recall memory training contents correctly in six times intervals. **SR + M group**: the same procedure described as SR training and engaged with real action practising in Montessori-based activities (such as gently pressing, scooping) and cognitive training of matching and identification. **Control group**: routine activities, no memory training.	1. **Hyperphagia behaviour**: the scale of hyperphagia in individuals with dementia. 2. **Pica behaviour**: 'Yes' or 'No'. 3. **The changes in eating habits**: self-developed observation form. 3. **Short meal frequency**: less than 10 min.	1. **SR + M group** showed the **hyperphagic behaviour** (β = −1.782, 95 CI% = [-3.20, −0.35], $p < 0.05$) and **pica behaviour** (β = −0.111, 95 CI% = [-0.20, −0.02], $p < 0.05$) continued to decrease for 3 months and **short meal frequency** reduction (β = −1.196, 95 CI% = [-2.09, −0.29], $p < 0.01$) lasted for 1 month after training. **Changes in eating habit** continued improve after 6 months but not significant. 2. **SR + M group** showed significant improvement in **hyperphagic behaviour** (β = −1.608, 95 CI% = [-3.13, −0.08], $p < 0.05$), **short meal frequency** (β = −1.094, 95 CI% = [-2.14, −0.04], $p < 0.05$) and **change in eating behaviour** (β = −0.287, 95 CI% = [-0.55, −0.01], $p < 0.05$) continued improvement after 6 months of training. **Pica behaviour** (β = −0.105, 95 CI% = [-0.20, −0.01], $p < 0.05$) continued improvement after 2 months of training. 3. Regarding to the **hyperphagic behaviours**, **SR +M group** showed significant reduction in intention to eat (β = −1.544, 95 CI% = [-2.63, −0.45], $p < 0.01$) and increased eating (β = −1.630, 95 CI% = [-3.06, −0.20], $p < 0.05$) in post-intervention. Significant reduction in rapid eating in post-training and the effect maintained 1 month after training (β = −1.215, 95 CI% = [-2.06, −0.36], $p < 0.01$). **SR + M group** showed rapid eating was significantly reduced after 6 months of training (β = −1.020, 95% CI = [-1.89, −0.14], $p < 0.05$), and continued reduction in increased eating after 3 months of training (β = −2.004, 95% CI = [-3.90, −0.09], $p < 0.05$). Regarding to the 6-month follow-up data of **recall scores** on MMSE, **SR + M group** had significant increase in post-training and 1 month (β = 0.334, 95% CI = [0.03, 0.63], $p < 0.05$), while **SR + M group** had significant increase in memory recall throughout the whole follow-up period (β = 0.304, 95% CI = [0.01, 0.60], $p < 0.05$).
6. Lin et al., 2010. Taiwan.					

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Table 1. (continued)

Aim	Method, sample size, setting	Characteristics of participant	Intervention	Measurement tools	Findings
Compare the effectiveness of Space Retrieval (SR) and Montessori-based activities (M) in decreasing eating difficulty.	RCT, n = 81 people with dementia, dementia care units.	**Age**: 81 ± 6.37. **Gender**: females: 45; males: 36. **Stages of dementia**: mild to moderate. **Average length of stay in home**: 25.52 ± 19.34 months.	**Space Retrieval group (SR)**: recall the 8-item eating procedures correctly at seven times intervals. **Montessori group (M)**: mainly focused on eating abilities training: hand-eye coordination, scooping, pouring, squeezing; matching and differentiating of edible and non-edible items added to the programme. **Control group:** received and participated in the daily routine normally followed by their site's schedule.	1. **Feeding difficulty**: the Chinese version of Edinburgh Feeding Evaluation in Dementia (EdFED). 2. **Nutrition status**: the Mini-Nutritional Assessment. 3. **Body Mass Index** (BMI). 4. **Self-eating time**: stopwatch. 5: **Food consumption**: the percentage of food consumed.	1. Both SR and M groups had a significant reduction in **feeding difficulty** (EdFED) score than control group post-intervention. SR group vs control group: Mean difference (MD) = −1.72, $p < 0.05$; Montessori group vs control group: MD = −1.54, $p < 0.05$. 2. **Nutrition status** (MNA): SR group showed significant increase post-intervention (MD = 3.64, $p < 0.01$) while M group showed significant decrease in nutrition post-intervention (MD = −2.58, $p < 0.01$). 3. Both SR group and M group showed no significant changes **BMI** and **Body weight** post-intervention. 4. **Self-eating time**: both SR group and M group showed a significant increase in self-eating time than control group post-intervention, $p < 0.001$. 5. **Food consumption**: M group showed significant reduction post-intervention (MD = −10.08, $p < 0.05$) while SR group showed slight increase but not significant.
7. Lin et al., 2011, Taiwan. Evaluate the efficacy of Montessori intervention to improve the eating ability and nutritional status.	Experimental crossover design, n = 29 people with dementia, dementia care units.	**Age**: 82.90±5.96. **Gender**: females: 12; males: 17. **Stage of dementia**: most were moderate to severe. **Average length of stay in home**: 25.52 ± 19.16 months.	**Montessori (M) group**: focused on eating abilities training e.g., scooping food, sensory stimulation (play Mozart music), procedural movements (hand-eye coordination) and the activity leader's ability to make conclusions and announcements for the next meeting. **Control group**: typical daily routine activities.	1. **Feeding difficulty**: the Chinese version of Edinburgh feeding evaluation in dementia (EdFED). 2. **Eating behaviour**: Eating behaviour scale. 3. **Nutrition**: The Chinese version of the Mini-nutritional assessment. 4. **Body Mass Index** (BMI). 5. **Eating time**: Stopwatch.	**Feeding difficulty** (EdFED): M group showed significant reduction of feeding difficulty score post-test (MD = −1.57 ± 3.41, $p = 0.011$), significant increase in physical assistance score ($p = 0.039$) and significant reduction fed by caregiver score ($p = 0.040$). **Eating behaviour**: both groups showed no significant changes post-test. M group showed slightly reduction in **nutrition** score post-test, not significant; but significant increase in self-eating frequency ($p = 0.06$) and **self-eating time** ($p = 0.025$). **BMI** in both groups, not significant.
8. Mbakile-Mahlanza et al., 2020, Australia. Evaluate the impact of the Montessori activities (M) implemented by family members during nursing home visits.	RCT, n = 40 people with dementia, nursing home.	**Age**: 63.6 ± 10.8. **Gender**: females: 17; males: 3. **Stages of dementia**: mild to moderate. **Average length of stay in home**: 29.9 ± 21.7 months.	**Montessori (M) group**: 3-hour training session for family carer: 0.5-hour baseline assessment, 1-hour explaining Montessori activities in dementia, 1.5-hour brainstorming and practice possible activities based on the person's ability and preference. **Control group**: 3-hour received education about dementia: half-hour baseline assessment, 1.5 hours for dementia education, and one hour in smaller groups to discuss the material just presented.	1. **Affects**: the Philadelphia Geriatric Center Affect Rating Scale. 2. **Engagement**: the Menorah Park Engagement Scale.	**Affects**: M group showed large effect size on neutral affects (Cohen's $d = 0.92$), moderate effect size on pleasure (Cohen's $d = 0.69$), interest (Cohen's $d = 0.51$) and anger (Cohen's $d = 0.62$), small effect size on contentment (Cohen's $d = 0.28$) and anxiety (Cohen's $d = 0.40$) but no effect on sadness. **Engagement**: M group showed large effect size on constructive engagement (Cohen's $d = 1.33$) and passive engagement (Cohen's $d = 1.18$), moderate effect size on non-engagement (Cohen's $d = 0.62$) and self-engagement (Cohen's $d = 0.65$).

(continued)

Table 1. (continued)

Aim	Method, sample size, setting	Characteristics of participant	Intervention	Measurement tools	Findings
9. Roberts et al., 2015, Australia. Develop a composite model of care and evaluate its impact.	A pilot study, mixed-method, n = 16 people with dementia, memory care unit.	**Age**: 85 ± 4.1. **Gender**: 12 females; 4 males. **Stage of dementia**: moderate to severe. **Average length of stay in home**: not reported.	Household activities: feeding chickens, ironing, setting the table, sweeping the floor and folding clothing. Leisure activities: reading the newspaper and playing cards.	1. **Medication usage**: anti-psychotic or sedative medications. 2. **Behavioural psychological symptoms of dementia (BPSD)**: the 29 Cohen Mansfield Agitation Inventory (CMAI).	1. **Medication usage**: substantial reductions in medication prescription. 4 (25%) individuals had no anti-psychotic or sedative medication prescribed at baseline and during the project.12 (75%), individuals had regular or PRN antipsychotic or sedative medication prescribed at baseline. 5 had a combination of both medications prescribed. At follow-up 6 months later, 7 of 12 individuals (58%) were no longer prescribed anti-psychotic or sedative medication. 9-months after baseline, an additional 2 individuals had ceased anti-psychotic medications. 18 months after baseline, no one was prescribed anti-psychotic medication and only two of the 12 individuals were still prescribed sedatives. 2. **BPSD**: A significant reduction in CMAI total scores from baseline (80.1 ± 14.3) to the 6-month follow-up (44.87 ± 13.64, $p < 0.0001$); a significant reduction in aggressive behaviour ($p = 0.01$) as well as the non-aggressive behaviour ($p < 0.001$) and verbal-agitation behaviour ($p < 0.001$).
10. Skrajner et al., 2012, USA. (1) Determine if participants could effectively lead group activities; (2) Expand number of activities available to client leaders; and (3) Evaluate the amount of staff assistance needed by RAP leaders.	Pilot study, n = 11 people with dementia, nursing home.	**Age**: Montessori (M) group: 75.8 ± 15.5; Zgola (Z) group: 88.4 ± 6.2. **Gender**: 5 females; 1 male; Z group: five females. **Stage of dementia**: mild in M group and moderate in Z group. **Average length of stay in home**: not reported.	**Two Montessori –based activities:** Memories Squared (**MS**) and Reading Roundtable (**RRT**); and one Zgola-based activity: Meet and Remember (**MR**).	1. Number of players (participants) per session. 2. Number of times staff assisted during activity preparation. 3. Number of times staff needed to assist during activity or during discussion. 4. Number of times staff needed to assist activity conclusion. 5. Number of times staff needed to assist per activity overall.	1. **MS** activity: 10.5 (±2.7) players per session, 1.2 (±0.2) times staff assisted during preparation, 1.0 (±0.8) times staff assisted during gameplay, 0.6 (±0.5) times staff assisted during conclusion and 2.8 times assisted per game overall. 2. **RRT** activity: 6.6 (±2.4) players per session, 0.7 (±0.3) times staff assisted during preparation, 0.4 (±0.4) times staff assisted during the reading story, 0.5 (±0.6) times staff assisted during the discussion, 0.5 (±0.5) times staff assisted during conclusion and 2.1 times assisted per story overall. 3. **MR** activity: 4.9 (±1.7) players per session, 4.6 (±2.2) times staff assisted during preparation, 2.9 (±2.9) times staff assisted during the introductory discussion, 8.8 (±2.9) times staff assisted during the main discussion, 3.0 (±1.7) times staff assisted during conclusion and 19.3 times assisted per session overall.

(continued)

Table 1. (continued)

Aim	Method, sample size, setting	Characteristics of participant	Intervention	Measurement tools	Findings
11. Skrajner et al., 2014, USA. (1) Evaluate the effects of activities led by clients; (2) Evaluate the effects of Montessori-based vs Zgola-based programming (ZBP); and (3) Evaluate the effects produced by researchers vs staff members.	Quasi-experimental study, n = 81, nursing home.	**Phase 1**: Montessori (M) group: n = 22; **age**: 83 ± 12; **gender**: 20 females; 2 males; **Stage of dementia**: moderate. Zgola (Z) group: n = 17, **aged**: 89 ± 5; **gender**: 17 females; **stage of dementia**: severe. **Phase 2**: M group: n = 22; **age**: 87 ± 6; **gender**: 16 females; 6 males; **stage of dementia**: moderate. Z group: n = 20, **age**: 88 ± 6; **gender**: 17 females; 3 males; **stage of dementia**: moderate. **Average length of stay in home**: not reported.	Phase 1: the activity leader (people with dementia) is trained by the researcher. Phase 2: activity leader trained by site staff trainer. **Montessori (M) group:** Memories Squared (MS) and Reading Roundtable (RRT). **Zgola (Z) group**: Meet and Remember (MR).	**Engagement** and **affects**: the Menorah Park Engagement Scale (MPES).	1. **Engagement**: ***constructive engagement*** *(CE)*: phase 1: M group: significantly reduced 'up to half' CE ($p < 0.05$) but increased 'more than half' CE ($p < 0.05$) post-intervention. While in ZG, significantly increased in 'up to half' CE ($p < 0.05$) but significantly reduced 'more than half' CE ($p < 0.01$). Phase 2: M group showed significant reductions in 'not at all' CE ($p < 0.01$) but significantly increased 'up to half' ($p < 0.01$) and 'more than half' CE ($p < 0.01$). Z group showed significantly increased in 'up to half' CE ($p < 0.01$) but also a significant reduction in 'more than half' CE ($p < 15$). ***Passive engagement*** (PE): phase 1: M group showed significant reduction 'more than half' PE ($p < 0.05$) post-intervention. Z group showed significant reduction 'up to half' PE ($p < 0.01$) and significantly increased 'more than half' PE ($p < 0.01$). Phase 2: no significant changes in M group in terms of PE. Z group showed significant reduction 'not at al' PE ($p < 0.05$) but increased in 'more than half' PE ($p < 0.01$). ***Other engagement*** (OE): phase 1: significantly increased 'not at all' OE ($p < 0.01$) but reduced 'up to half' OE post-intervention ($p < 0.01$). Z group had no significant changes pre and post-interventions. Phase 2: M group showed significantly increased in 'not at al' OE ($p < 0.01$) while reduction in 'more than half' OE ($p < 0.05$). Similarly, Zgola group showed a significant reduction in 'not at al' OE ($p < 0.05$) but increased in 'more than half' OE ($p < 0.05$). ***Non-engagement*** (NE): phase 1: M group showed a significant decrease in 'up to half' NE ($p < 0.05$). 2. **Affects**: only ***pleasure*** is often observed. M group showed no significant changes pre and post-intervention in the two phases. While in Z group, phase 1 showed significant reduction 'not at al' pleasure ($p < 0.05$) and significantly increased 'up to half' pleasure ($p < 0.05$). In phase 2, Z group also showed significant reduction in 'not at al' pleasure ($p < 0.01$) and increased in 'up to half' pleasure ($p < 0.01$).
12. Wilks et al., 2019, USA.					

(continued)

Table 1. (continued)

Aim	Method, sample size, setting	Characteristics of participant	Intervention	Measurement tools	Findings
Evaluate effects of Montessori-based activity programme.	Quasi-experimental with interrupted time series design, n = 43 people with dementia, nursing home.	**Age**: 86.3 ± 7.60. **Gender**: females: 32; males: 11. **Stage of dementia**: severe. **Average length of stay in home**: not reported.	**Montessori activities**: customized lesson planning, immediate feedback, intellectually stimulating exercises, sensory puzzles and games, group readings, and engagement in household activities.	1. **Problem behaviours**: 24-item Revised Memory + Behaviour Problems Checklist (RMBPC). 2. **Social engagement**: The six-item Index of Social Engagement. 3. **Activities of daily living**: The 20-item Bristol Activities of Daily Living Scale. 4. **Quality of life**: The Quality of Life-Alzheimer's Disease Scale. 5. **Anxiety**: The Rating for Anxiety in Dementia (Shankar, Walker, Frost, & Orrell, 1999). 6. **Psychological well-being**: The Psychological Well-Being in Cognitively Impaired Person scale (PWB-CIP).	1. **Problem behaviours**: slightly reduced but no significance. 2. **Social engagement**: significantly decreased (Interval 1: 3.0 ± 2.19, interval 3: 2.6 ± 2.24, $t = 2.197$, $p < 0.05$). 3. **Activity of daily living**: significant reduction capacity of conducting activities of daily living (Interval 1: 1.2 ± 0.79, Interval 3: 1.0 ± 0.76, $t = 2.984$, $p < 0.01$). 4. **Quality of life**: slightly increased but NS. 5. **Anxiety**: slightly decreased but NS. 6. **Psychological well-being** significantly decreased (Interval 1: 42.5 ± 8.18, Interval 2: 41.2 ± 6.90, $p < 0.01$).
13. Wu et al., 2014, Taiwan.					
Evaluate long-term effects of standardized and individualised spaced retrieval (SR) combined with Montessori-based activities on the eating ability.	Single-blind, quasi-experimental study with repeated measures, n = 90 people with dementia, nursing home.	**Age**: 82.8 ± 6.1. **Gender**: missing. **Stage of dementia**: mild to severe. **Average length of stay in home**: not reported.	**Spaced Retrieval (SR) training contents**: recall 8 items of SR eating procedures in seven interval trials. **Montessori activities (M)**: mainly focused on eating abilities training: scoping, pouring, and squeezing. **Standardised SR + M training group**: 24 sessions. **Individualised SR + M training group**: depending on the cognition of the person, minimum of 10 sessions, mild dementia 23 sessions, moderate to severe dementia 35 sessions.	1. **Eating difficulty**: Chinese version of the Edinburgh Feeding Evaluation in Dementia. 2. **Food consumption**: the percentage of food consumed. 3. **Body Weight**: Body weight scale.	**Eating difficulty score**: both groups showed significantly long-terms effect in reducing eating difficulty scores: standardised group (MD: −0.39, $p = 0.07$), individualised group (MD: −0.30, $p = 0.02$). **Food consumption**: both groups showed significantly increased food consumption: standardised group (MD: 5.80, $p < 0.001$), individualised group (MD: 3.37, $p < 0.007$). **Body weight**: both groups showed significantly increased body weight: standardised group (MD: 0.99, $p < 0.001$), individualised group (MD: 0.99, $p = 0.001$). Overall, individualised group had a better result in food consumption and body weight than standardised group, however, standardised group showed a better outcome in eating difficulties than individualised group.
14. Wu and Lin, 2013, Taiwan.					

(continued)

Table 1. (continued)

Aim	Method, sample size, setting	Characteristics of participant	Intervention	Measurement tools	Findings
Evaluate long-term effects of fixed/individualised spaced retrieval (SR) combined with Montessori-based activities (M) on nutritional status and body mass index and nutritional improvement's moderating effect on depressive symptoms.	Single-blind, quasi-experimental study with repeated measures, n = 90 people with dementia, nursing home.	**Age**: 82.8 ± 6.1. **Gender**: missing. **Stages of dementia**: mild to severe. **Average length of stay in home**: not reported.	**Spaced Retrieval (SR) training contents**: to recall 8 items of SR eating procedures in seven interval trials. **Montessori activities (M)**: mainly focused on eating abilities training: scoping, pouring, and squeezing. **Standardised SR + M training group**: 24 sessions. **Individualised SR + M training group**: depending on the cognition of the person, minimum of 10 sessions, mild dementia 23 sessions, moderate to severe dementia 35 sessions. **Control group**: routine care provided by the organisation.	1. **Nutrition status**: The Chinese version of Mini-Nutritional Assessment. 2. **Body Mass Index** (BMI): body weight (kg) divided by the square of height (m). 3. **Depression**: Chinese version of the Cornell Scale for Depression in Dementia (C-CSDD).	1. **Nutrition status**: both standardised group (slop increase: 0.84, $p = 0.001$) and individualised group (slop increase: 0.94, $p = 0.001$) showed significant improvement. The individualised group showed a medium effect size in improving nutrition status post-test (Cohen's $d = 0.75$) and the effects lasted for 3-month follow-ups (Cohen's $d = 0.55$). The individualised group showed a medium effect size in post-test (Cohen's $d = 0.67$) and the effects lasted for 6-month follow-ups (Cohen's $d = 0.27$). 2. **BMI**: the standardised group and individualised group with the slope increasing by 0.39 ($p = 0.001$) and 0.27 ($p = 0.002$). The standardised group showed no effects in post-test but a small effect size in 6-month follow-ups (Cohen's d: 0.26). The individualised group showed no effects throughout the whole period. 3. **Depression**: only individualised group showed a significant reduction of depression score, with a slope decrease by 0.41 ($p = 0.001$). The standardised group showed medium effects in reducing depression scores in post-test (Cohen's d: −0.50) and 1-month follow-up (ES: −0.76). The individualised group showed medium effects in post-test (Cohen's d: −0.52) and a larger effect size in the 6-month follow-up (Cohen's d: −0.73). **Correlation**: The changes in nutrition scores and the individualised intervention were the two important predictors of the changes in depression score ($R^2 = 0.44$, SE = 1.21, F value: 20.99, $p < 0.001$), the improved nutrition score in individualised group was associated with a significant reduction in depression score (changes in nutrition score: B: −0.44, $p < 0.001$, individualised intervention: $B = -0.32$, $p < 0.01$). The individualised group produced significantly more changes in the nutrition score (B: 0.34, $p < 0.01$).
15. Yuen and Kwok, 2019. China, Hong Kong.					

(continued)

Table 1. (continued)

Aim	Method, sample size, setting	Characteristics of participant	Intervention	Measurement tools	Findings
Evaluate effect of DementiAbility Methods: The Montessori Way (DMMW) on agitation.	RCT, n = 46 people with dementia, nursing home	**Age**: 86.17 ± 9.75. **Gender**: females: 36, Males: 10. **Stages of dementia**: moderate to severe. **Average length of stay in home**: not reported.	**Montessori group**: individualised activities participants' needs, interests, abilities, and skills. **Control group**: structured social activities: discussing newspapers and paly table games with standardized procedures.	**Agitation**: The Chinese Cohen-Mansfield agitation inventory (CMAI).	**CMAI (frequency)**: Montessori group: *Overall score* significant reduced: pre: 45.61 ± 21.97; post: 35.52 ± 15.10, $t = 3.39$, $p < 0.001$, 95% CI = [3.92–16.25], Cohen's $d = 0.71$. *Verbal aggressive behaviour* significant reduction: $p < 0.05$, Cohen's $d = 0.46$. *Physical nonaggressive behaviour* significant reduction, $p < 0.05$, Cohen's $d = 0.58$. *Physical aggressive behaviour* significant reduction: $p < 0.001$, Cohen's $d = 0.69$. *Aggressive* and *Physical nonaggressive behaviour* scores slightly increased but NS. **CMAI (disruptiveness):** Montessori group: *Overall score* significant reduction: pre: 34.26 ± 12.62, post: 27.65 ± 7.43, $t = 3.26$, $p < 0.001$, 95% CI = [2.40–10.81], Cohen's $d = 0.68$. *Verbal aggressive* score *behaviour* significant reduction: $p < 0.05$, Cohen's $d = 0.53$. *Physical nonaggressive* score significant reduction: $p < 0.05$, Cohen's $d = 0.55$. *Physical aggressive behaviour* score showed strong significant reduction: $p < 0.001$, Cohen's $d = 0.68$.

Table 2. Details of interventions of included studies.

Format of Montessori intervention	Reference	Intervention design			
		Experiment group (n)/Implementer	Placebo group (n)/Implementer	Control group (n)/Implementer	Frequency and duration
Individual	9. Roberts et al., 2015.	n = 16, Montessori-based daily life activities included feeding chickens, ironing, setting the table, sweeping the floor and folding clothing. Leisure activities included listening to music, quiet reading and reflection. **Implementer**: Nursing staff (registered nurses, enrolled nurses, assistants in nursing) and a cognitive rehabilitation therapist.	Not available	Not available	24 hours daily basis (over18 months).
	7. Lin et al., 2011	n = 15, sequence 1: Montessori-based activities mainly focused on training individual eating abilities, such as hand-eye coordination, scooping, pouring and squeezing. Each of the eating abilities had 4-5 corresponding activities, with a total of 24 specific activities, sensory stimulation (such as playing Mozart music) and also included procedural movements (such as hand-eye coordination, scooping, pouring, squeezing and matching). **Implementer**: a Montessori certificated registered nurse.	Not available	n = 14, sequence 2: routine activity. **Implementer**: site activity staff.	30 minutes per session × 24 sessions (over 8 weeks).
	8. Mbakile-Mahlanza et al., 2020.	n = 20, Montessori-based activity training session for family caregivers (3 hours): 30 minutes baseline assessment; 1 x hour for explaining the theoretical framework of Montessori-based activity for family caregivers; 1.5 hours chose up to 10 activities and practice possible Montessori-based activities based on individuals' interest and ability. 2 x training sessions per week, a total of 2 weeks. **Implementer**: family caregivers.	Not available	n = 20, Dementia training session for family caregivers (3 hours), half-hour baseline assessment; one and half hour dementia education; 1 x hour to discuss materials used for interacting with individuals with dementia (reading the new paper). **Implementer**: family caregivers.	30 minutes per session (twice a week) × 4 sessions (over 2 weeks).
	4. Giroux et al., 2010.	n = 14, Montessori-based activities included classifying objects (based on their size, shape and colour) and involved fitting shapes into holes, puzzles of maps, animals, or parts of plants and individual activities. **Implementer**: a Montessori-certificated therapist.	n = 14 (the same group of participants as the experimental group), regular activities included singing along, clapping hands or playing various musical instruments; and group games casinos, quiz games, sandbags, bowling, etc. **Implementer**: a Montessori-certificated therapist.	n = 14 (the same group of participants as the experimental group), not involved in any of the activities. **Implementer**: Not included.	20 minutes for Montessori-based activities, 1 hour for placebo program (once only).
	5. Kao et al., 2016.	n = 46, Spaced Retrieval memory training content: (1) to memorise where food is placed and can be taken (4 x sessions); (2) to memorise slowing down dining speed (7 x sessions); (3) to memorize a satiation message - a 20-second melody (8 x sessions); and (4) to memorise appropriate dining etiquette behaviours (7 x sessions). Participants need to recall the memory training content correctly in 6 times intervals: immediate, 1, 2, 4, 6, 8 and 16 minutes. **Implementer**: two Spaced Retrieval and Montessori certificated memory trainers.	n = 49, Spaced Retrieval combined with Montessori-based activities training, such as gently pressing, scooping and cognitive training of matching and identification objects. **Implementer**: the same as the experimental group.	n = 45, routine activity. **Implementer**: site activity staff.	40 minutes per session × 30 sessions (over 6 weeks).
	6. Lin et al., 2010.	n = 32, the Space Retrieval content: participants are required to recall the 8-item eating procedures correctly at 7 times intervals: immediate, 1, 2, 4, 8, 16 and 32minutes. The details of 8 items of eating procedures are listed in the note section. **Implementer**: two Spaced Retrieval and Montessori certificated researchers.	n = 29, the Montessori-based activities mainly focused on eating ability training such as hand-eye coordination, scooping, pouring, squeezing, matching and differentiating of edible and non-edible items to the program were included in the training activities. **Implementer**: two Spaced Retrieval and Montessori certificated researchers.	n = 24, routine activity. **Implementer**: site activity staff.	40 minutes per session × 24 sessions (over 8 weeks).
	13. Wu et al., 2014.	n = 25, Spaced Retrieval recall 8 items of eating procedures for 7 interval trials. Montessori-based activity training eating ability, such as scooping, pouring, squeezing and matching were included. Standardised Spaced Retrieval and Montessori-based activities training group has 24 sessions. **Implementer**: academic researchers.	n = 38, Individualised Spaced Retrieval and Montessori-based activities training depended on the dementia stage of the individual (at least 10 sessions, if the participant can recall the 8-item eating procedures correctly. Participants with mild dementia: 23 training sessions: Participants with moderate to severe dementia: 35 training sessions. **Implementer**: academic researchers.	n = 27, routine activity. Implementer: site activity staff.	40 minutes per session × 24 sessions (over 8 weeks).
	14. Wu and Lin, 2013.	n = 25, Standardise SR combined Montessori-based activities: recall 8 items of eating procedures in 7 interval trials. Montessori-based activities train eating ability, such as scooping, pouring, squeezing and matching. Individualised SR and Montessori-based activities training sessions: 24 sessions. **Implementer**: academic researchers.	n = 28, Individualised SR combined Montessori-based activities training depended on the dementia stage of the individual. Minimum 10 sessions, mild dementia 23 training sessions, moderate to severe dementia 35 sessions. **Implementer**: academic researchers.	n = 27, no treatment. Implementer: not applicable.	40 minutes per session × 24 sessions (over 8 weeks).

(continued)

Table 2. (continued)

Format of Montessori intervention	Reference	Intervention design			
		Experiment group (n)/Implementer	Placebo group (n)/Implementer	Control group (n)/Implementer	Frequency and duration
Group	2. Chaudhry et al., 2020.	n = 24, Montessori-based activities included identifying the pictures of the famous building of Pakistan and the Pakistan version of the Flag puzzle on a group basis. **Implementer**: a Montessori certificated psychologist.	Not available	Not available	60 minutes × 24 sessions (over 12 weeks).
	10. Skrajner et al., 2012.	n = 6, two Montessori-based activities included: Memories Squared (MS, a combination of bingo and trivia for encouraging reminiscence and discussion) and Reading Roundtable (RRT, book reading and discussion). **Implementer**: individuals with dementia.	Not available	n = 5, the Zgola-based activity: Meet and Remember (MR, a discussion and reminiscence-based activity). **Implementer**: individuals with dementia lead the Zgola activity (people with dementia).	2-3 times per week, did not specify length of each session and duration of program.
	11. Skrajner et al., 2014.	n = 22, phase 1: researcher trainers training individuals with dementia leading the two Montessori-based activities: Memories Squared (MS, a combination of bingo and trivia for encouraging reminiscence and discussion) and Reading Roundtable (RRT, book reading and discussion). n = 22, phase 2: site staff trainers training individuals with dementia leading the Montessori-based activities, the same activities as phase 1. **Implementer**: academic researchers and nursing staff.	Not available	n = 17, phase 1: research trainers training individuals with dementia leading Zgola activity: Meet and Remember (MR, a discussion and reminiscence-based activity). n = 20, phase 2: site staff trainers training individuals with dementia to lead the Zgola activity, the same activity as phase 1. **Implementer**: researcher and site staff.	Montessori-based activities (27 minutes for MS, 25 minutes for RRT) once a week × 12 weeks. Zgola activity (43 minutes for MR) twice a week (over 12 weeks).
	15. Yuen and Kwok, 2019.	n = 23, the Montessori-based activities were tailored according to participants' needs, interests, abilities, and skills. **Implementer**: a Montessori certificated practitioner.	Not available	n = 23, structured social activities such as discussion on newspaper topics and pictures, table game, and round-up. **Implementer**: site activity staff.	45 minutes per session × 6 sessions (over 2 weeks).
Mixed	1. Chan et al., 2021.	n = 54, Montessori-based activities such as memory bingo or sorting pictures or words into categories, fine-motor tasks such as cutting and stringing beads, and reading groups, on an individual or group basis were involved. **Implementer**: Montessori certificated nursing staff.	Not available	n = 54, conventional activities included reading out newspapers, physical activities, and watching videos on a group basis, 6 people per group. **Implementer**: Site activity staff.	60 minutes per session (3-4 sessions per week) × 30 sessions (over 8 weeks).
	3. Gaspar and Westberg, 2020.	n = 72, Montessori-based activities included planned activities (such as reading group, cooking and music group) and unplanned activities (such as 1:1 or group discussion, individual table activity). **Implementer**: Montessori certificated registered nurses, activity facilitators and dietitians.	Not available	Not available	24 hours basis (over 12 months).
	12. Wilks et al., 2019.	n = 43, individual daily life Montessori-based activities such as laundry sorting. Group activities could be flower arranging, sensory puzzles and games and group readings involved. **Implementer**: Montessori certificated nursing staff, programming and activity leaders, food and beverage staff and environmental services staff.	Not available	Not available	The time of individual and group activities varied from 30 - 60 minutes, 7 days a week (over 8 months).

Canada (Giroux et al., 2010); and one (n = 1, 6.7%) in Pakistan (Chaudhry et al., 2020). About the care settings, nine (n = 9, 60%) studies were conducted in nursing homes (Chaudhry et al., 2020; Giroux et al., 2010; Mbakile-Mahlanza et al., 2020; Skrajner et al., 2012, 2014; Wilks et al., 2019; Wu and Lin, 2013; Wu et al., 2014; Yuen and Kwok, 2019), three (n = 3, 20%) in dementia care units (Kao et al., 2016; Lin et al., 2010, 2011), two (n = 2, 13.3%) in memory care units (Gaspar and Westberg, 2020; Roberts et al., 2015); and one (n = 1, 6.7%) in a mixture of the community centre, day care and nursing home (Chan et al., 2021). Regarding study design, five (n = 5, 33.3%) studies adopted a RCT design (Chan et al., 2021; Kao et al., 2016; Lin et al., 2010; Mbakile-Mahlanza et al., 2020; Yuen and Kwok, 2019), eight (n = 8, 53.3%) were quasi-experimental design (Gaspar and Westberg, 2020; Giroux et al., 2010; Lin et al., 2011; Skrajner et al., 2012, 2014; Wilks et al., 2019; Wu and Lin, 2013; Wu et al., 2014) and two (n = 2, 13.3%) were mixed-methods (Chaudhry et al., 2020; Roberts et al., 2015).

A total of 885 individuals with dementia participated in the studies included in this review. The participants' mean age ranged from 63.6 (Mbakile-Mahlanza et al., 2020) to 89 (Skrajner et al., 2014) years. Regarding gender, 12 of the studies reported 409 females and 251 males as participants (Chan et al., 2021; Chaudhry et al., 2020; Gaspar and Westberg, 2020; Kao et al., 2016; Lin et al., 2010, 2011; Mbakile-Mahlanza et al., 2020; Roberts et al., 2015; Skrajner et al., 2012, 2014; Wilks et al., 2019; Yuen and Kwok, 2019); while three studies omitted gender (Giroux et al., 2010; Wu and Lin, 2013; Wu et al., 2014). More than half of the included studies' participants (n = 8, 53.3%) were experiencing moderate to severe dementia (Chaudhry et al., 2020; Giroux et al., 2010; Kao et al., 2016; Lin et al., 2011; Roberts et al., 2015; Skrajner et al., 2014; Wilks et al., 2019; Yuen and Kwok, 2019). Three studies (n = 3, 20%) focused on participants experiencing mild to moderate dementia (Lin et al., 2010; Mbakile-Mahlanza et al., 2020; Skrajner et al., 2012) and four (n = 4, 26.7%) on mild to severe dementia (Chan et al., 2021; Gaspar and Westberg, 2020; Wu and Lin, 2013; Wu et al., 2014). Five studies (Gaspar and Westberg, 2020; Kao et al., 2016; Lin et al., 2010, 2011; Mbakile-Mahlanza et al., 2020) reported the length of time the participants had been living in residential aged care, which ranged from 21 (Gaspar and Westberg, 2020) to 36 months (Kao et al., 2016).

Details of the intervention

Table 2 summaries the interventions in the included studies. Of the 15 studies, eight programmes (n = 8, 53.3%) employed the individual format of intervention (Giroux et al., 2010; Kao et al., 2016; Lin et al., 2010, 2011; Mbakile-Mahlanza et al., 2020; Roberts et al., 2015; Wu and Lin, 2013; Wu et al., 2014). Of the four (n = 4, 26.7%) studies adopting a group format (Chaudhry et al., 2020; Skrajner et al., 2012, 2014; Yuen and Kwok, 2019), three (n = 3, 20%) were in a mixed format of intervention (Chan et al., 2021; Gaspar and Westberg, 2020; Wilks et al., 2019). The intervention content varied from daily life activities (such as table setting and ironing), leisure activities (such as listening to music and watching movies) to purposeful training activities (memory training activities and eating ability training activities). Montessori certificated nursing staff and researchers were most often seen as the primary implementer of the Montessori-based programmes. The Montessori-based programmes were also implemented by family caregivers (Mbakile-Mahlanza et al., 2020) and individuals with dementia (Skrajner et al., 2012). Regular activities were more commonly carried out by organisational regular nursing staff. For short-term Montessori-based programmes, the majority of activities (n = 11, 73.3%) ranged from 30 minutes to one hour, two to three times a week, for two to 12 weeks (Chan et al., 2021; Chaudhry et al., 2020; Kao et al., 2016; Lin et al., 2010, 2011; Mbakile-Mahlanza et al., 2020; Skrajner et al., 2014; Wu and Lin, 2013; Wu et al., 2014; Yuen and Kwok, 2019). For long-term Montessori-based programmes (n = 3, 20%), Montessori-based

Table 3. Summary of variables, measurement tools, data collection and key findings with statistical significance.

Variables	Ref.	Measurement tools	Data collection		Key Findings
			Time (Duration)	Method	
Category 1. Engagement.					
Engagement	#1	The Menorah Park Engagement Scale: constructive engagement, passive engagement, non-engagement and other engagement.	During intervention: total of 15 hours (30 minutes × 30 observations).	Observation: videotape.	↑*
	#3	An engagement observation recording form developed by Westberg et al. (2017): items including positive engagement, neutral engagement, negative engagement and failed to engage.	Pre- and post-interventions: total of 70 minutes (10 minutes ×7 observations, in one day).	Observation: manual recording form.	↑*
	#4	An observation scale developed by Kovach and Magliocco (1998): intensity of participation and intensity of stimulation needed.	During intervention: 20 minutes, once only.	Observation: manual recording form and videotape.	Montessori group > Control group***
	#8	The Menorah Park Engagement Scale: constructive engagement, passive engagement, non-engagement and other engagement.	During intervention: total 60 of minutes (15 minutes × 4 observations).	Observation: Videotape.	↑***
	#11	The Menorah Park Engagement Scale: constructive engagement, passive engagement, other engagement, non-engagement and other items measure positive (pleasure) and negative (anxiety/agitation) affect.	During intervention: a total of 150 minutes (5 minutes × 30 observations).	Observation: manual recording form.	↑*
	#12	The six-item Index of Social Engagement (ISE): content included social engagement, mood, conflicted relationships, behaviour problems and activities of daily living.	Three intervals over 6 months: total of 3 observations, duration not reported.	Observation: manual recording form.	↓*
Category 2. Mental health.					

(continued)

Table 3. (continued)

Variables	Ref.	Measurement tools	Data collection		Key Findings
			Time (Duration)	Method	
Psychological well-being	#12	The Psychological Well-Being in Cognitively Impaired Person scale (PWB-CIP): various facial expressions and positive verbal responses.	Three intervals over 6 months: total of 3 observations, duration not reported.	Observation: manual recording form.	↓**
Affect (mood)	#1	The Apparent Affect Rating Scale: positive and negative affect, includes pleasure, anger, anxiety/fear, depression/sadness, and interest.	During intervention: total 15 of hours (30 minutes per session × 30 sessions).	Observation: videotape.	↑**
	#4	1. The Philadelphia Geriatric Center Affect Rating Scale (ARS): positive affect (pleasure, contentment, and interest), negative affect (anger, sadness, and anxiety) and neutral affect. 2. The Dementia Mood-Pictures test (DMPT): six drawings of faces representing different moods: good mood, bad mood, sad mood, angry mood, anxious mood and happy mood.	During intervention: 20 minutes, once only.	Observation: manual recording form and videotape.	1. Affect: Montessori group > placebo group > control group*** 2. Mood: Placebo group > Montessori group.
	#8	The Philadelphia Geriatric Center Affect Rating Scale (ARS): positive affect (pleasure, contentment, and interest), negative affect (anger, sadness, and anxiety) and neutral affect.	During intervention: total of 60 minutes (15 minutes × 4 observations).	Observation: videotape.	Montessori vs control: • Pleasure ↑*** • Anger ↓* • Anxiety ↓*
Depression	#14	Chinese Version of the Cornell Scale for Depression in Dementia (C-CSDD): 19 items includes mood and related signs, behavioural disturbance, cyclic function and ideational disturbance and physical signs.	Pre- and post-intervention, 1-month, 3-month and 6-month follow-ups: 5 days in total.	Observation; manual recording form and interviewing nursing assistants.	• Fixed group: ↓ • Individualised group: ↓***

(continued)

Table 3. (continued)

Variables	Ref.	Measurement tools	Data collection		Key Findings
			Time (Duration)	Method	
Agitation	#2	The Cohen-Mansfield Agitation Inventory (CMAI): measure the frequency of the 29 items of agitated behaviours, such as hitting, kicking, pushing, spitting, screaming, etc.	Pre- and post-interventions: details not reported.	Observation: manual recording form.	• Overall agitation score → • Verbal non-aggressive score $\downarrow^{**}$
	#9	The Cohen-Mansfield Agitation Inventory (CMAI): measures the frequency of the 29 items of agitated behaviours, such as hitting, kicking, pushing, spitting, screaming, etc.	Pre- and post-interventions: details not reported.	Observation: manual recording form.	$\downarrow^{***}$
	#15	The Chinese version Cohen-Mansfield agitation inventory (C-CMAI): measures the frequency of 21 items of agitated behaviours, such as physical non-aggressive behaviours, physical aggressive behaviours, verbal non-aggressive behaviours, and verbal aggressive behaviours.	Pre- and post-interventions: details not reported.	Observation: manual recording form.	• Agitation - frequency $\downarrow^{***}$ • Agitation-disruptiveness $\downarrow^{***}$
Hyperphagic behaviour	#5	The scale of hyperphagia in residents with dementia: intention to eat, rapid eating, increased eating, and inappropriate dining etiquette.	Post-intervention, 1-month, 3-month and 6-month follow-ups: at least 10 mealtime observations, duration not reported.	Observation: manual recording form.	$\downarrow^{*}$

Category 3. Feeding difficulty and nutrition status.

(continued)

Table 3. (continued)

Variables	Ref.	Measurement tools	Data collection		Key Findings
			Time (Duration)	Method	
Feeding difficulty	#6	The Chinese version of Edinburgh Feeding Evaluation in Dementia (C-EdFED): measures passivity and obstinacy, feeding difficulty, and nursing intervention.	Pre- and post-interventions: total of 6 mealtime observations, duration not reported.	Observation: manual recording form.	• Spaced Retrieval group: ↓* • Montessori group: ↓*
	#7		Pre- and post-interventions: total of 6 mealtime observations, duration not reported.	Observation: manual recording form.	↓**
	#13		Pre- and post-intervention, 1-month, 3-month and 6-month follow-ups: total of 15 observations, duration not reported.	Observation: recording form.	• Standardised Spaced Retrieval + Montessori group: ↓** • Individualised Spaced Retrieval + Montessori group: ↓*
Nutrition	#6	The Mini-Nutritional Assessment (MNA): screening eating difficulties, weight loss, mobility, Body Mass Index (BMI), psychological, physical and neuropsychological health problems.	Pre- and post-interventions: during mealtime: total of six observations, duration not reported.	Observation: manual recording form.	• Spaced Retrieval group: ↑** • Montessori group: ↓**
	#14		Pre- and post-intervention, 1-month, 3-month and 6-month follow-ups: total of 15 mealtime observations, duration not reported.	Observation: manual recording form, and interviewing participants and nursing assistants.	• Standardised Spaced Retrieval + Montessori group: ↑*** • Individual Spaced Retrieval + Montessori group: ↑***

(continued)

Table 3. (continued)

Variables	Ref.	Measurement tools	Data collection		Key Findings
			Time (Duration)	Method	
Food consumption	#6	The percentage of food consumed: 25%, 50%, 75% and 100%.	Pre- and post-interventions: total of six observations, duration not reported.	Observation: percentage of food on the plate.	• Spaced Retrieval group: ↑ • Montessori group: ↓*
	#13		Pre- and post-intervention, 1-month, 3-month and 6-month follow-ups: total of 15 mealtime observations, duration not reported.	Observation: percentage of food on the plate.	• Standardised Spaced Retrieval + Montessori group: ↑*** • Individualised Spaced Retrieval + Montessori group: ↑**
Body Mass Index (BMI)	#14	Weight scale and stadiometer.	Pre- and post-intervention, 1-month, 3-month and 6-month follow-ups.	Calculation: body weight (kg) divided by the square of the height (m).	• Standardised Spaced Retrieval + Montessori group: ↑*** • Individualised Spaced Retrieval + Montessori group: ↑***
Body weight	#13	Weight scale.	Pre- and post-intervention, 1-month, 3-month and 6-month follow-ups: 5 observations in total.	Observation: weight scale.	• Standardised Spaced Retrieval + Montessori group: ↑*** • Individualised Spaced Retrieval + Montessori group: ↑***
Category 4. The activity of daily living.					
The activity of daily living	#12	The 20-item Bristol Activities of Daily Living Scale (BADL): activities of daily living, self-care, orientation, and mobility.	3 intervals over 5 months (baseline to final interval): duration not reported.	Observation: manual recording form.	↓**

Symbol: *: $p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ↑: increase; ↓: decrease; →: no significant changes.

activities were integrated with daily life activities and ranged from 8 months to 18 months (Gaspar and Westberg, 2020; Roberts et al., 2015; Wilks et al., 2019). Only one programme examined the instant effect of the Montessori-based programme using a once only activity (Giroux et al., 2010).

Measurement tools and data collection

Table 3 presents the measurement tools and data collection methods used in the included studies. A variety of measurement tools were employed. For example, four studies measured the characteristics of engagement, such as constructive engagement, passive engagement, non-engagement and other types of engagement (Chan et al., 2021; Gaspar and Westberg, 2020; Mbakile-Mahlanza et al., 2020; Skrajner et al., 2014). One study used mood, conflicted relationships, behaviour problems and activities of daily living of individuals with dementia as outcome measures (Wilks et al., 2019). Another study measured the intensity of participation and stimulation (Giroux et al., 2010). The measurement tools used to measure mental health outcomes varied. The Philadelphia Geriatric Center Affect Rating Scale was used to measure affect (mood) in two studies (Giroux et al., 2010; Mbakile-Mahlanza et al., 2020) and the Cohen-Mansfield Agitation Inventory was used to measure agitation in three studies (Chaudhry et al., 2020; Roberts et al., 2015; Yuen and Kwok, 2019). Regarding feeding difficulty, the Chinese version of Edinburgh Feeding Evaluation in Dementia was the most widely adopted tool within Chinese communities (Lin et al., 2010, 2011; Wu et al., 2014). The 20-item Bristol Activities of Daily Living Scale (Wilks et al., 2019) and the Disability Assessment for Dementia (Chaudhry et al., 2020) were most commonly used to measure activities of daily living. Observations (structural observation charts, guided by the measurement tools) and video recordings were the two main data collection methods in the included studies.

The impacts of montessori-based programmes in residential aged care

Category 1: Engagement. Eight studies investigated the engagement, feasibility and acceptability of Montessori-based programmes (Chan et al., 2021; Chaudhry et al., 2020; Gaspar and Westberg, 2020; Giroux et al., 2010; Mbakile-Mahlanza et al., 2020; Skrajner et al., 2012, 2014; Wilks et al., 2019). Four studies showed significant improvement in engagement scores post-intervention ($p < 0.05$) (Chan et al., 2021; Gaspar and Westberg, 2020; Mbakile-Mahlanza et al., 2020; Skrajner et al., 2014). Mbakile-Mahlanza et al. (2020) reported a large effect size (Cohen's $d = 1.33$) on constructive engagement post-intervention. Giroux et al. (2010) showed the Montessori-based programme had a significantly higher overall engagement score than the control group (2.9 ± 0.8 vs. 2.5 ± 0.5, $p < 0.001$). However, Wilks et al. (2019) illustrated a significant decrease in engagement scores post-intervention (M ± SD: 3.0 ± 2.19 in the pre-test versus 2.6 ± 2.24 in the post-test, $p < 0.05$). Additionally, Chan et al. (2021) and Chaudhry et al. (2020) confirmed that overall engagement was acceptable and feasible in Chinese and Pakistanis communities. Skrajner and colleagues (2012) pilot tested the feasibility of a Montessori-based programme led by the residents (individuals with dementia) in the United States also generated positive outcomes in engagement.

Category 2: Mental health. Ten studies examined the mental health outcomes of participants (Chan et al., 2021; Chaudhry et al., 2020; Gaspar and Westberg, 2020; Giroux et al., 2010; Kao et al., 2016; Mbakile-Mahlanza et al., 2020; Roberts et al., 2015; Wilks et al., 2019; Wu and Lin, 2013; Yuen and Kwok, 2019). These mental health outcomes, include but are not limited to psychological well-being, cognition, affect (mood), depression, anxiety, agitation, behavioural and psychological

symptoms of dementia, hyperphagic behaviour, prescription rates of antipsychotic and sedative medications (Gaspar and Westberg, 2020; Roberts et al., 2015). Prior studies showed significantly positive outcomes ($p < 0.05$) on affect (mood) (Chan et al., 2021; Giroux et al., 2010; Mbakile-Mahlanza et al., 2020), agitation (Chaudhry et al., 2020; Roberts et al., 2015; Yuen and Kwok, 2019), hyperphagic behaviour (Kao et al., 2016) and psychotropic and sedation medication rates (Gaspar and Westberg, 2020; Roberts et al., 2015). Whereas there was a significant reduction in psychological well-being score post-intervention ($p < 0.01$) (Wilks et al., 2019) and a varying impact on depression post-intervention, with one Montessori-based programme reported a strong significant positive outcome ($p = 0.001$) (Wu and Lin, 2013) and another reporting no significant changes (Chaudhry et al., 2020). There was no significant change in cognition (Chaudhry et al., 2020), anxiety and responsive behaviours of individuals with dementia (Wilks et al., 2019).

Category 3: Feeding difficulty and nutritional status. Four studies explored the feeding difficulty and nutritional status of participants (Lin et al., 2010, 2011; Wu and Lin, 2013; Wu et al., 2014). Two studies examined the effectiveness of Montessori-based programmes and Spaced Retrieval alone (Lin et al., 2010, 2011), while the other two studies combined Spaced Retrieval with Montessori-based activities (Wu and Lin, 2013; Wu et al., 2014). Overall, Spaced Retrieval combined with Montessori-based activities, regardless of standardised training or individualised training, yielded better results than Montessori-based activities alone or Spaced Retrieval alone in feeding difficulty, nutritional status, body mass index, body weight and food consumption. Although Spaced Retrieval or Montessori-based activities alone can significantly reduce the feeding difficulty of individuals with dementia post-intervention ($p < 0.05$) (Lin et al., 2010, 2011; Wu et al., 2014), significant reductions in food consumption (mean difference = -10.08, $p < 0.05$) and nutrition (mean difference = -2.58, $p < 0.01$) were observed with Montessori-based activities alone, and there were no changes in body mass index and body weight (Lin et al., 2010). In contrast, significant improvements in nutrition (slop increase: 0.94, $p < 0.001$), food consumption (mean difference = 5.80, $p < 0.001$), body mass index (slope increase: 0.39, $p = 0.001$) and body weight (mean difference: 0.99, $p < 0.001$) were observed when Spaced Retrieval was combined with Montessori-based activities (Wu and Lin, 2013; Wu et al., 2014). Furthermore, improved nutritional status was associated with a significant reduction in depression among participants, and the effects on nutrition lasted six months after the intervention ($R^2 = 0.44$, $p < 0.001$) (Wu and Lin, 2013).

Category 4: activities of daily living and quality of life. Two studies reported the activities of daily living and quality of life of participants (Chaudhry et al., 2020; Wilks et al., 2019). Wilks et al. (2019) found a statistically significant reduction in activities of daily living post-intervention ($M \pm SD$: 1.2 ± 0.79 in the pre-test versus 1.0 ± 0.76 in the post-test, $p < 0.01$). While Chaudhry et al. (2020) discovered a slight increase in activities of daily living score but it was not significant. When the impact on the quality of life for individuals with dementia was measured, two Montessori-based programmes reported positive changes but these effects were not significant (Chaudhry et al., 2020; Wilks et al., 2019).

Discussion

The purpose of this systematic review was to fill a knowledge gap and summarise the evidence on the effects of Montessori-based programmes on individuals with dementia in residential aged care. The findings from this systematic review identified 15 studies and reported on four main categories of impacts for Montessori-based programmes: (1) engagement; (2) mental health; (3) feeding

difficulty and nutritional status; and (4) activities of daily living and quality of life. In the discussion section, suggestions for improving the design of Montessori-based programmes and research in this area are presented. Furthermore, when considering the format of Montessori-based activities and their intended outcomes, the individual format is best suited for specific training purposes such as reducing feeding difficulty and addressing individual mental health concerns like agitation, hyperphagia behaviours and depression. On the other hand, the group and mixed formats of Montessori-based activities have shown to be more effective in enhancing engagement and emotional well-being among individuals.

Engagement

Generally, almost all studies that are relevant to engagement reported significantly positive outcomes (Chan et al., 2021; Gaspar and Westberg, 2020; Giroux et al., 2010; Mbakile-Mahlanza et al., 2020; Skrajner et al., 2014). The only exception was Wilks et al. (2019) that showed a significant reduction in engagement due to participants being in their late-stage of dementia and requiring significant assistance with activities of daily living, including mobilisation and incontinence care as well as relying on non-verbal communication. Our findings regarding the impact of Montessori-based programmes on engagement were consistent with those from a systematic review conducted by Sheppard et al. (2016). Some helpful tips from previous studies include the duration of the programme, the timing of each training session and the format of the intervention (Chaudhry et al., 2020; Gaspar and Westberg, 2020; Giroux et al., 2010). Specifically, Gaspar and Westberg (2020) noticed a negative association between the length of the programme (more than one year) and the engagement of participants; the longer participants were exposed to the Montessori-based programme, the less positive engagement was observed. Chaudhry et al. (2020) also suggested that each training session should be less than one hour because participants can easily get tired. Future studies should monitor the duration of the programme and each training session to ensure that Montessori-based activities do not exhaust the participants. Gaspar and Westberg (2020) emphasised the importance of training staff about Montessori principles to ensure that it becomes a sustainable and commonplace intervention in dementia care. Giroux et al. (2010) argued that the individual format of Montessori-based activities would be more appropriate for those in moderate to severe stages of dementia in terms of individual cognition and personal preferences as well as more easily modified as needed. Therefore, future Montessori-based programmes design should consider the duration of the programme and the timing of each training session as well as integrating person-centred care in Montessori-based programme design that aims to generate interest among participants and actively engage them in the activities.

Choices regarding data collection tools and the timing of data collection are crucial when designing a plan to evaluate the impact of Montessori-based programmes. Data collection tools measure variables from different perspectives, so selecting the appropriate ones is essential to determine the effectiveness of the Montessori-based programmes. Some tools measure engagement characteristics and intensity, while others measure mood, relationship, and participant behaviours (Chan et al., 2021; Giroux et al., 2010; Wilks et al., 2019). It is important that researchers carefully select measurement tools to ensure that their research questions are answered accurately and precisely. Additionally, collecting data at multiple time points to measure longitudinal outcomes is beneficial. For example, in the studies reviewed, there was a focus on measuring the engagement of participants during Montessori-based activities, but details about the general engagement of participants is unknown. Therefore, increasing the diversity of data collection points could help better understand the impact of Montessori-based programmes. Two longitudinal programmes integrated

Montessori-based activities into the daily life activities of participants, but they only used limited data collection points, ranging from three observations at three-month intervals (Wikis et al., 2019) to seven observations in one day (Gaspar and Westberg, 2020). Future studies should consider carefully selecting measurement tools and expanding follow-up data collection points.

Mental health

Over the past two decades, Montessori-based programmes have been applied to address mental health problems in dementia care (Zhou et al., 2021). Our review found that Montessori-based programmes had significantly positive outcomes on affect (mood), agitation, hyperphagic behaviour and prescribing rates for antipsychotic and sedative medications, but had varying impacts on depression. Our review findings were similar to a previous review study (Sheppard et al., 2016) that found Montessori-based programmes generated positive affect (mood) on individuals with dementia. In our review, none of the included studies found significant changes in cognition and anxiety, although it is important to note that many factors could influence the mental health outcomes of individuals with dementia, making it difficult to attribute causation or isolate specific variables. These factors include the format of the intervention (Chan et al., 2021); the cognitive ability of participants (Wilks et al., 2019); the competency of implementers (Mbakile-Mahlanza et al., 2020) and the person-centred care model (Roberts et al., 2015). For instance, our review found that when Montessori-based programmes were conducted in a small groups, individuals with dementia exhibited more social interaction with peers and achieved significant improvements in positive affect (Chan et al., 2021). Additionally, positive affect and engagement had a significantly positive correlation, with more active engagement being positively correlated with more positive affect (Giroux et al., 2010). However, for individuals with late-stage dementia, our review found no significant effects on mental health outcomes like anxiety and responsive behaviours, or even worse, a significant negative effect on the psychological well-being (Wilks et al., 2019). When person-centred care was combined with Montessori-based activities there were notable significant improvements in agitation and prescribing rates of anti-psychotic and sedative medications (Roberts et al., 2015). Furthermore, studies have shown that when both formal (healthcare professionals) and informal (family caregivers) carers with Montessori training implemented Montessori-based activities, there were significant benefits in generating positive affect (Chan et al., 2021; Mbakile-Mahlanza et al., 2020). When individuals with dementia lead Montessori-based activities, with proper training and assistance from staff, they could effectively lead the activities and yield significant positive outcomes in engagement and affect, which can be even better than staff-led activities (Skrajner et al., 2012, 2014). Therefore, when designing Montessori-based programmes, it is important to acknowledge multiple factors and consider their influence on the mental health outcomes of individuals with dementia. To optimise the benefits of Montessori-based activities on the mental health outcomes of individuals with dementia, an ideal Montessori-based programme design should reflect the cognitive and physical capacity of individuals with dementia, be delivered by competent implementers and be integrated within person-centred care programmes.

Feeding difficulty and nutritional status

The review found that the combination of Spaced Retrieval and Montessori-based activities produced significantly better results in nutritional status, body mass index, body weight and food consumption than either Space Retrieval or Montessori-based activities alone (Lin et al., 2010, 2011; Wu and Lin, 2013; Wu et al., 2014). This finding is inconsistent with a previous review that found a significant reduction in eating difficulty after Montessori-based programmes training but

insufficient evidence to support an improvement in the nutritional status of participants (Sheppard et al., 2016). A possible explanation for this inconsistency is that the Montessori-based activities training, which lasted 30–40 minutes per session, three times a week for eight weeks, aimed to train the eating abilities such as scooping, squeezing and pouring. This purposeful and repetitive training was more successful in improving feeding difficulty (Lin et al., 2010, 2011; Wu and Lin, 2013; Wu et al., 2014). Interestingly, Montessori-based activities or Space Retrieval alone also had significant improvements in eating difficulty but had no impact on nutritional status, body mass index, body weight and food consumption (Lin et al., 2010, 2011). However, when Spaced Retrieval was combined with Montessori-based activities, significantly improvement in feeding difficulty, nutritional status and food consumption were observed, whether in standardised training sessions or individualised training sessions (Wu and Lin, 2013; Wu et al., 2014). Therefore, it is recommended that Montessori-based activities can be combined with spaced retrieval in future Montessori-based programmes that aimed at improving the feeding difficulty and nutritional status of individuals with dementia in residential aged care.

Activities of daily living and quality of life

Our review found that Montessori-based activities had no impact on activities of daily living and the quality of life of individuals with dementia (Chaudhry et al., 2020; Wilks et al., 2019). Chaudhry et al. (2020) suggested that the small sample size (n = 24) may have contributed to the lack of significant change in activities of daily living and quality of life. It is recommended that future studies use a larger sample size, as the recommended minimum sample size for preliminary studies is 30 (Serdar et al., 2021). Furthermore, it is common for individuals in the late stages of dementia to experience a significant deterioration of activities of daily living or quality of life after Montessori-based training (Wilks et al., 2019). It is essential to consider this when interpreting research findings. Researchers should also consider the potential impact of continuing cognitive decline on the effectiveness of Montessori-based programmes. As individuals with dementia experience ongoing cognitive decline, the effectiveness of Montessori-based programmes may be reduced. Therefore, it is crucial to develop programmes that are appropriate for individuals at different stages of dementia to ensure maximum effectiveness.

The synergistic effect of integrating Spaced Retrieval with Montessori-based activities

Four studies explored the impacts of Spaced Retrieval on the eating ability of individuals with dementia in residential aged care and three of them blended Spaced Retrieval with Montessori-based activities (Kao et al., 2016; Wu and Lin, 2013; Lin et al., 2010; Wu et al., 2014). The synergistic effect of integrated Spaced Retrieval with Montessori-based activities was previously highlighted in the mental health outcome (excessive eating behaviours), feeding difficulty and nutritional status of individuals with dementia. Spaced retrieval is an evidence-based practice that has been used for decades to train the memory of people with dementia (Camp & Schaller, 1989). It achieved positive outcomes in remember simple information (names of people or objects) and verbal cues and behaviours to improve their functional skills. For example, visual cues for safe swallowing for participants with dysphagia, and verbal cues combined with visual cues for participants with toilet orientation difficulty (Bird et al., 1995; Brush & Camp, 1998). Two recent literature reviews discovered that many factors, including the severity of dementia, design of the Spaced Retrieval training (frequency, duration and time intervals between each test), familiarity with the training content and length of staying in the organisation, could influence the outcome of Spaced Retrieval (Creighton et al., 2013; Oren et al., 2014). Specifically, the authors indicate that the earlier the individual with dementia receives Spaced Retrieval training, the better the outcome of the

intervention. Similarly, participants who are more familiar with the training content performed better during the training. Furthermore, the authors stated that participants in an increased time interval group (e.g., 1 minute, 2 minutes, 4 minutes, 8 minutes) had better outcomes than those in a fixed time interval group (e.g., 10 minutes time gap in each test). Additionally, participants in continuous days of Spaced Retrieval training (Monday through Friday) performed better than those in interrupted days of training (Monday, Wednesday, and Friday) (Creighton et al., 2013; Oren et al., 2014). To summarise, Spaced Retrieval is recommended for improving the memory, behaviours and functional skills of individuals with dementia and the synergistic effect of combining Spaced Retrieval with Montessori-based activities is also emphasised.

Limitations

There are a few limitations to this review. Firstly, the focus was on the outcomes of Montessori-based programmes for individuals with dementia, while the outcomes of care staff, family members and organisations were excluded. Future research should address these areas to provide a more comprehensive understanding of the impact of Montessori-based programmes. Additionally, some of the included studies did not report effect size or outcomes of dropouts, which reduces the quality of evidence presented in this review. Future research in this area should address these issues to enhance the quality of evidence. Lastly, due to the diversity of methodologies, interventions, and measurement tools used in the included studies, the heterogeneity prevented the possibility of a meaningful meta-analysis.

Conclusion

The systematic review with narrative synthesis summarised the impact of 15 Montessori-based programmes for individuals with dementia living in residential aged care. Of the 15 included studies, three types of Montessori-based activities were observed, conducted in three different formats. The design of Montessori-based programmes, measurement tools and data collection points varied across programmes. The findings showed that Montessori-based programmes significantly improved engagement, mental health outcomes and feeding difficulty. However, there were mixed results in nutritional status, and the synergistic effect of integrating Spaced Retrieval with Montessori-based activities in improving eating ability and nutritional status of individuals with dementia was also emphasised. There were no significant changes in activities of daily living and quality of life. Future Montessori-based programmes designers would highly recommend tailoring personalised Montessori-based activities to individual care needs, cognitive ability and personal preference. Practitioners also need to consider the purpose of their Montessori-based activities to determine whether a group or individual format will be most appropriate. More research into Montessori-based activities is needed for recreational purpose and to improve the health care outcomes of individuals with dementia living in residential aged care.

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