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ORIGINAL ARTICLE

Investigating the effects of reminiscence using smells on loneliness and depressive symptoms in community-dwelling older adults: a randomised controlled trial

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Abstract

Background: The use of a variety of sensory elements is recommended when implementing reminiscence therapy. However, there is a lack of evidence supporting this recommendation. This study aimed to examine the benefits of using smell as a memory trigger during reminiscence therapy for community-dwelling older adults, focusing on its effects on loneliness and depressive symptoms.

Methods: Seventy-nine community-dwelling older adults were randomly allocated to either an intervention or a control group. Participants in the intervention group underwent a total of eight 40-min. reminiscence therapy sessions once a week that used smell as a trigger. The control group underwent similar reminiscence therapy but only used themed conversations. Their responses were assessed pre- and post-intervention using the UCLA Loneliness Scale version 3 (UCLA LS3), which evaluates loneliness, and the Geriatric Depression Scale-15-Japanese, which measures the state of depressive symptoms.

Results: The pre-intervention comparison of the participants' characteristics and each evaluation item showed significant differences ($P = 0.030$) between the two groups' olfactory visual analogue scale (VAS) scores. Subsequently, we performed analysis of covariance via repeated measurements, using olfactory VAS as the covariate, and found significant interactions in UCLA LS3 ($P = 0.006$) alone. To identify items for consideration during interventions, we examined factors related to post-intervention UCLA LS3 scores. Our results showed that the notion of usefulness, by which participants perceived the smell triggers to be useful for inducing reminiscence ($P = 0.045$), was significantly related to pre-intervention UCLA LS3 scores ($P < 0.001$) in the intervention group.

Conclusion: These findings show that using smell as a trigger during reminiscence therapy can effectively alleviate loneliness and suggest the need to prepare appropriate odorants for facilitating reminiscence.

Key words: *aged, depressive symptoms, loneliness, memory, mental recall, olfactory perception.*

INTRODUCTION

The global population is ageing; by 2030, one person in six is predicted to be 60 or older.[1] Older adults often face physical challenges as well as mental disorders, and depressive symptoms are a leading example, with social isolation and loneliness cited as background factors.[1] Additionally, the incidence of dementia is rising, with ageing considered the most significant risk factor. Dementia prevention has become an increasingly important global challenge.[2]

The number of older adults living alone is increasing, and social isolation and loneliness can elevate the risk of mental health conditions, including depressive symptoms and cognitive function decline.[3] Social isolation predicts subsequent loneliness, which carries the risk of developing into depressive symptoms.[4] Effective psychosocial support is needed to maintain and enhance older adults' well-being under these circumstances.

Reminiscence therapy, a psychosocial approach, has been conducted with community-dwelling older adults.[5] Proposed by Butler,[6] reminiscence therapy has been practised across diverse occupations. Numerous measures and programs incorporating reminiscence have been implemented, especially those targeting older adults with dementia.[7] Recently, such programs have been applied to community-dwelling older adults.[8,9] A systematic review of reminiscence therapy's effects on community-dwelling older adults revealed short-term effects against depressive symptoms.[10] Additionally, psychological interventions such as cognitive behavioural therapy and social identity interventions have been introduced to reduce social isolation and loneliness. Among these, reminiscence therapy displayed the highest effect size,[11] although its effectiveness is under-reported and requires further investigation.[12] Few studies have examined the effects of reminiscence therapy for alleviating loneliness.[13,14] Similarly, few studies have investigated sensory stimulation or intervention factors that encourage the recall of past events, indicating the need for research to make reminiscence a more effective, evidence-based intervention method.[9]

During reminiscence therapy, researchers focus on conversation and multiple sensory elements while recommending the use of music and photos to facilitate reminiscence.[15] Subsequent reminiscence therapy uses sensory elements such as music[16] and photos/videos[17] as memory triggers, followed by an examination of their effects. However, using sensory elements as memory triggers lacks sufficient evidence, and the intervention method's ambiguity is a research concern.

Past research on sensory elements targeting older adults shows that memories recalled using smell as a trigger are more emotionally vivid than memories recalled using language.[18] An investigation using photos, music, everyday tools/items, and food examined what sensory elements were related to reminiscence and found that only smell had a significant association.[19] Subsequent research has yielded conflicting results, with some studies reporting that smell was effective for alleviating depression,[20,21] while others could not confirm such efficacy.[22] Smell is directly connected to personal memories, causes individuals to vividly recall forgotten emotions,[23] and appears to trigger nostalgia more readily than other sensory stimuli.[24] Additionally, nostalgia seems to strengthen social bonding and enhances one's awareness of receiving emotional support.[25]

Although reminiscence therapy using smell as a memory trigger may yield positive effects, few studies have investigated its effects on community-dwelling older adults, and none have investigated its effects on loneliness. Additionally, a link between sensory impairment and loneliness has been observed,[26,27] and progressive olfactory impairment may increase loneliness.[28,29]

Therefore, the present study conducted a randomised controlled trial with community-dwelling older adults to evaluate the efficacy of reminiscence therapy, which uses smell as a memory trigger, in reducing loneliness and depressive symptoms. The findings can support reminiscence therapy's use as an evidence-based psychosocial approach for older adults.

METHODS

Study design and participants

Each community centre where the reminiscence therapy was conducted was considered a block. At each centre, participants were allocated into an intervention or a control group for a single-blinded, randomised controlled trial. This experimental design was chosen to evaluate the benefits of using smell as a memory trigger during group reminiscence therapy by comparing the two groups: the intervention group using smell as a memory trigger and the control group engaging in therapy with a theme.

This study was registered in University Hospital Medical Information Network – Clinical Trials Registry (UMIN000050929 (https://www.umin.ac.jp/ctr/index-j.htm)).

We requested that the operators of regional long-term care preventive services through Community-Based Integrated Care Centres help with participant

recruitment. We explained the study and participant recruitment to the business operators. Eligible participants were: (1) individuals aged 65 years and older; (2) those living in a community; (3) those who were able to travel to the study venue by themselves; and (4) those who provided written consent to participate. Exclusion criteria were: (1) individuals receiving nursing care benefits (Care Level 1 or higher) under the long-term care insurance system; (2) those who had difficulty smelling during reminiscence therapy due to olfactory disorders; (3) those who had difficulty communicating during reminiscence therapy; and (4) those experiencing cognitive function disorder.

We calculated the sample size for a two-way analysis of variance (two-way ANOVA) via repeated measurements using G*power.[30] With an effect size of 0.25 (moderate degree), statistical significance at 0.95, and α of 0.05., we calculated a required sample size of 54 people. As 27 people were needed per group, we established the final target number as 35 participants per group, considering possible dropouts.

Procedure

We used a questionnaire to screen participants who provided informed consent and confirmed their eligibility (Fig. 1). Participants who met the inclusion criteria were randomly allocated to the intervention or control group. A replacement block method was used for each venue for implementing reminiscence therapy (community centre) as the allocation method. The staff responsible for allocation, but not analysis, assigned the participants to either group. Group reminiscence therapy was performed with both groups, using smell for the intervention group and themed discussion for the control group.

Reminiscence therapy sessions were conducted in a quiet room where all participants could sit around a table. One leader was assigned to each group, with roughly seven participants per group. Individuals registered as volunteers or licensed healthcare professionals at the venues were appointed to serve as leaders. Prior to conducting the therapy, leaders attended two 60-min basic training sessions on intervention therapy offered by either the principal investigator or co-investigator.

The Ethics Committee for Clinical Research of Hiroshima University (C-2023-0001) approved this study, which was conducted according to the principles of the Declaration of Helsinki. All participants received thorough explanations and provided written consent before participation.

Intervention method

Intervention group

Eight 40-min group reminiscence therapy sessions that used smell to evoke reminiscence were conducted once a week following physical exercise. No themes were set for the first to seventh sessions. At session commencement, each venue's leader was asked to randomly select one type of odorant out of seven types and present it to the participants. The type and quantity of each odorant were: curry sauce (House Foods; Vermont Curry Medium Hot, approx. 10 g per person); tatami rush mat material (Noguchi deodorants made of dried rush, approx. 5 g per person); roasted dry squid (Natori; shredded dry squid, approx. 1 g per person); green tea (Ito En; Premium Tea Bag of Uji Matcha Green Tea, two packs per person); bar soap (Cow Brand Soap Kyoshinsha; Red Box, approx. 8 g per person); rose (Morinokokage; Rose-Red Tea, approx. 4.5 g per person); and chocolate (Lotte; Ghana Milk, approx. 4 g per person). The amount of smell stimuli offered was adjusted and standardised by two co-researchers in advance.

Odorant selection was based on previous studies investigating the relationship between the reminiscences of community-dwelling older adults and these substances,[31] which mentioned that sex and geographical location during childhood could affect reminiscences. Therefore, we selected seven types of odorants independent of these factors, reported to readily evoke reminiscence among older adults.[31] We also selected the materials based on their ability to be obtained locally. The odorants were covered with a coffee filter made of unbleached pulp to conceal their content. They were placed in a zippered clear plastic bag (Asahi Kasei Home Products Freezer Bag, size S), tightly sealed, and distributed to each participant.

Sessions 1 to 7 comprised the following six stages. (1) The leader reviewed the previous session (except Session 1). (2) The leader distributed the preselected odorant to each participant. (3) After each participant smelled the odorant for more than 30 s, the leader asked them if it caused the recall of past events or incidents and encouraged them to describe the events and emotions they felt at the time. (4) The

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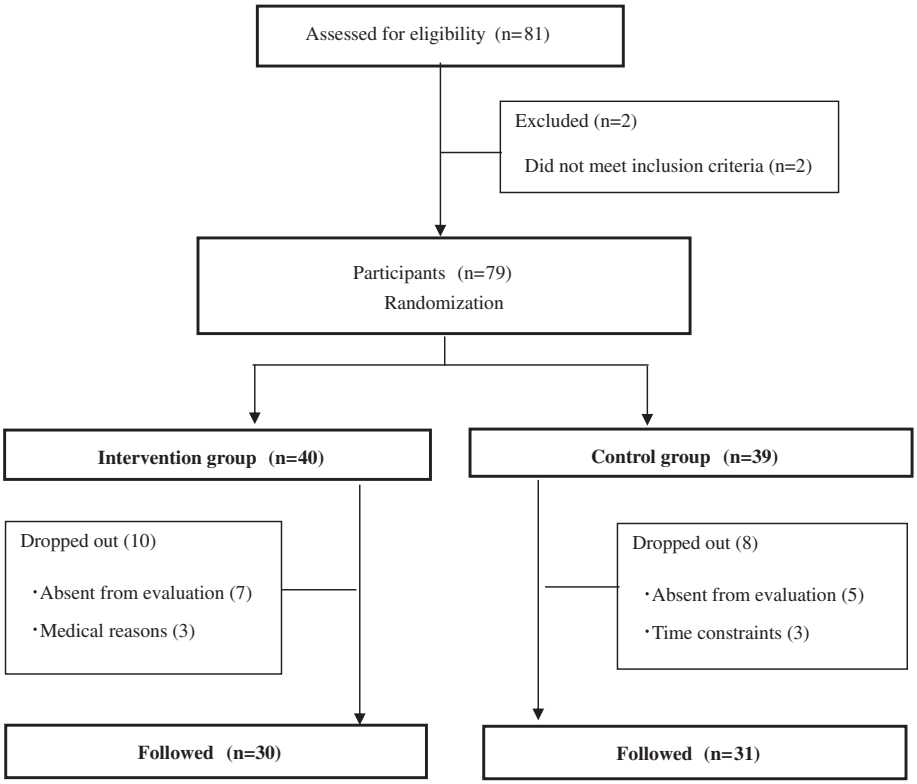

Figure 1 Study participation flow chart.

leader gave the participant who recalled a past event/incident an opportunity to speak, and the entire group shared the events and emotions felt at the time. (5) If other participants also recalled an event/incident, the leader allowed them to speak, and the entire group shared the content and emotions described, similar to the previous step. (6) The leader announced that time was almost over, asked the members for their thoughts and impressions of the session, summarised the meeting, and ended the session.

No odorants were used in the eighth session, dedicated to reviewing and summarising Sessions 1 to 7. Each participant was asked about events/incidents and feelings perceived that left a strong impression on them during reminiscence therapy, as well as their overall thoughts and impressions about the therapy. Their responses were shared with the entire group.

Control group

The duration and frequency of the sessions were identical to those for the intervention group. No special sensory elements were employed; instead, a theme was implemented for each reminiscence therapy session. Themes selected by Gibson[32] were used as a reference: namely, self-introduction and memories of childhood days, memories of school days, memories of family life, memories of dresses and clothing, memories of housework, memories of work, and memories of leisure activities in Sessions 1, 2, 3, 4, 5, 6, and 7, respectively, with a review and summary in Session 8.

The basic flow from Sessions 1 to 7 was the same as the intervention group, except for Sessions 2 and 3, which differed as follows: (2) announcement of the day's theme to the participants; (3) asking the participants if they recalled, via the announced theme, any events that happened in the past, as well as the content of the events and their feelings about them. The implementation of Session 8 was identical to the intervention group.

Measures

Participants' basic characteristics

We collected the following information using a questionnaire: age, sex (male or female), presence or absence of a spouse, living alone (yes or no), educational history (≤12 years, or ≥ 13 years), financial

status (good or poor), sense of health (good or poor), and outpatient visit (yes or no).

Olfactory visual analogue scale (VAS)

We used an olfactory VAS as a self-administered olfactory test to evaluate the degree of the participants' subjective sense of smell.[33] The left and right ends of a 10-cm scale bar were set as 'No odour at all (0%)' and 'Can clearly identify the substance (100%)', respectively, and participants were asked to mark the line. The distance from the left end to the point on the line that the participants had marked was measured in millimetres as the degree of their subjective sense of smell. This method is used in clinical settings as a simple olfactory evaluation technique.[34,35]

UCLA Loneliness Scale version 3 (UCLA LS3)

The UCLA LS3 was developed as a self-administered loneliness scale, and its reliability and validity for older adults have been confirmed.[36,37] It comprises 20 items and is commonly used to evaluate loneliness among community-dwelling older adults. Respondents provide answers on a four-point scale ranging from 'Never' to 'Always'. The higher the score, the stronger the sense of loneliness. A Japanese-language edition, with confirmed reliability and validity, was also created.[38] The Japanese version was used in the present study to assess participants' feelings of loneliness.

Geriatric Depression Scale-15-Japanese (GDS-15-J)

The GDS is a self-administered assessment scale used to evaluate depression among older adults.[39] A 15-item abridged edition (GDS-15) is commonly used, which asks respondents to answer each question with 'Yes' or 'No'. The higher the score, the more serious the depressive condition. A Japanese-language edition, with confirmed reliability and validity, was also created.[40,41] This Japanese version was used to assess participants' depressive symptoms.

Sense of usefulness

When the reminiscence therapy sessions were complete, we reviewed them and asked if smell and discussion themes had helped the participants in both groups recall past events. Participants provided their answers on a four-point scale ranging from 'Not useful at all' (1) to 'Extremely helpful' (4).

Statistical analysis

Comparison between the intervention and control groups at baseline

To compare basic characteristics and scores of various evaluation scales at baseline, we used either the Chi-squared (χ^2) test, Fisher's exact test, or the *t*-test.

Examination of the efficacy of using smell in conducting group reminiscence therapy

To examine the benefits of using group reminiscence therapy, we performed an analysis of covariance through repeated measurements, considering the time axes (baseline and post-intervention) and groups (intervention and control) as the dependent variables, and the items that showed significant differences at baseline comparisons as the covariates. If interactions were observed, a corresponding *t*-test was performed in the intervention and control groups to compare the scores of pre- and post-intervention scales.

Examination of factors related to the sense of loneliness or depressive symptoms post-intervention

Regarding evaluation items that displayed significant differences between the two groups, the relationship among the baseline factors, memory triggers, and the scores of evaluation scales post-intervention was assessed using Pearson's correlation coefficient, Spearman's rank correlation coefficient, *t*-test, or Mann–Whitney *U*-test. Next, a multiple regression analysis (forced entry method) was performed, using factors that displayed significant relationships as the independent variables and the evaluation scale scores post-intervention as the dependent variables.

The *P*-values in all the tests were two-sided, with $P < 0.05$ considered significant. SPSS 28.0 Statistics software was employed for all statistical analyses.

RESULTS

Participants

Seventy-nine individuals met the eligibility criteria for participation. Ten individuals in the intervention group

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dropped out before all sessions were completed; seven were prevented from participating due to absence from evaluation and three for medical reasons. In the control group, eight individuals dropped out, with five due to absence from evaluation and three due to insufficient participation (five or fewer sessions). Ultimately, data from 30 and 31 individuals in the intervention and control groups were used for analysis (Fig. 1).

Comparison between the intervention and control groups at baseline (Table 1)

No significant differences were observed between the two groups at baseline regarding participants' basic characteristics or any of the evaluation items in the UCLA LS3 and GDS-15-J. However, a significant difference was observed between the two groups regarding the olfactory VAS, which assessed the sense of smell ($P = 0.030$).

The participants' average age was approximately 80 and 79 years for the intervention and control groups, respectively. Both groups featured more women than men, and approximately half of the participants were married.

Examination of the efficacy of using smell during group reminiscence therapy (Table 2) (Fig. 2)

To investigate the differences between the groups regarding the changes in various evaluation scale scores pre- and post-intervention, we analyzed covariance (ANCOVA) using olfactory VAS, which showed significant differences between the two groups at baseline as the covariate. We found significant interactions only in UCLA LS3 ($F = 8.01$, $P = 0.006$) (Table 2). The interaction is considered significant ($P = 0.006$) after 'Olfactory' is assumed to be significant ($P = 0.03$), but the probability of Type I error including both is 0.0358, which is less than 0.05. Hence, there are no issues regarding multiple testing. Next, to confirm the changes in the UCLA LS3 scores that showed interactions, we performed corresponding *t*-tests on each group to compare

Table 1 Comparison of background factors between the intervention and control groups at baseline

	Intervention group ($n = 30$)		Control group ($n = 31$)		*P*-value	
Age (years)	79.60 ± 8.71		78.39 ± 8.52		0.542	a
Gender, *n* (%)					0.354	b
Male	3	(10.0)	1	(3.2)		
Female	27	(90.0)	30	(96.8)		
Presence of spouse, *n* (%)					0.699	c
Yes	16	(53.3)	15	(48.4)		
No	14	(46.7)	16	(51.6)		
Living alone, *n* (%)						
Yes	22	(73.3)	27	(87.1)	0.176	c
No	8	(26.7)	4	(12.9)		
Education, *n* (%)					0.367	c
≤12 years	18	(60.0)	22	(71.0)		
≥13 years	12	(40.0)	9	(29.0)		
Financial situation, *n* (%)					0.334	c
Good	21	(70.0)	25	(80.6)		
Poor	9	(30.0)	6	(19.4)		
Sense of health, *n* (%)					0.561	b
Good	25	(78.1)	26	(83.9)		
Poor	7	(21.9)	5	(16.1)		
Outpatient visit, *n* (%)						
Yes	19	(63.3)	22	(71.0)	0.525	b
No	11	(36.7)	9	(29.0)		
Olfactory VAS	73.93 ± 20.65		85.32 ± 19.21		0.030	a
UCLA LS3	39.63 ± 8.79		36.16 ± 8.48		0.122	a
GDS-15-J	3.83 ± 2.91		3.23 ± 2.84		0.413	a
≤6	26	(86.7)	27	(87.1)	1.000	b
≥7	4	(13.3)	4	(12.9)		

Note: a = t-test; b = Fisher's exact test; c = Chi-square test. Abbreviation: GDS-15-J, Geriatric Depression Scale-15-Japanese; UCLA LS3, UCLA Loneliness Scale version 3; VAS, visual analogue scale.

Table 2 Scores on the GDS-15-J and UCLA LS3 for the intervention and control groups

	Group	Baseline Mean ± SD	After intervention Mean ± SD	Effects			
				Factor	F^1	P	η^2
GDS-15-J	Intervention	3.83 ± 2.91	3.73 ± 2.65	Time	0.06	0.802	0.001
	Control	3.23 ± 2.84	3.29 ± 2.47	Group	0.70	0.406	0.012
				Group × Time	0.07	0.795	0.001
UCLA LS3S	Intervention	39.63 ± 8.79	36.97 ± 9.01	Time	1.17	0.285	0.020
	Control	36.16 ± 8.48	38.03 ± 8.43	Group	0.13	0.723	0.002
				Group × Time	8.01	0.006	0.121

GDS-15-J, Geriatric Depression Scale-15-Japanese; UCLA LS3, UCLA Loneliness Scale version 3. [1] F-statistics in repeated-measures analysis of covariance, with self-administered olfaction test (visual analogue scale) as the covariate.

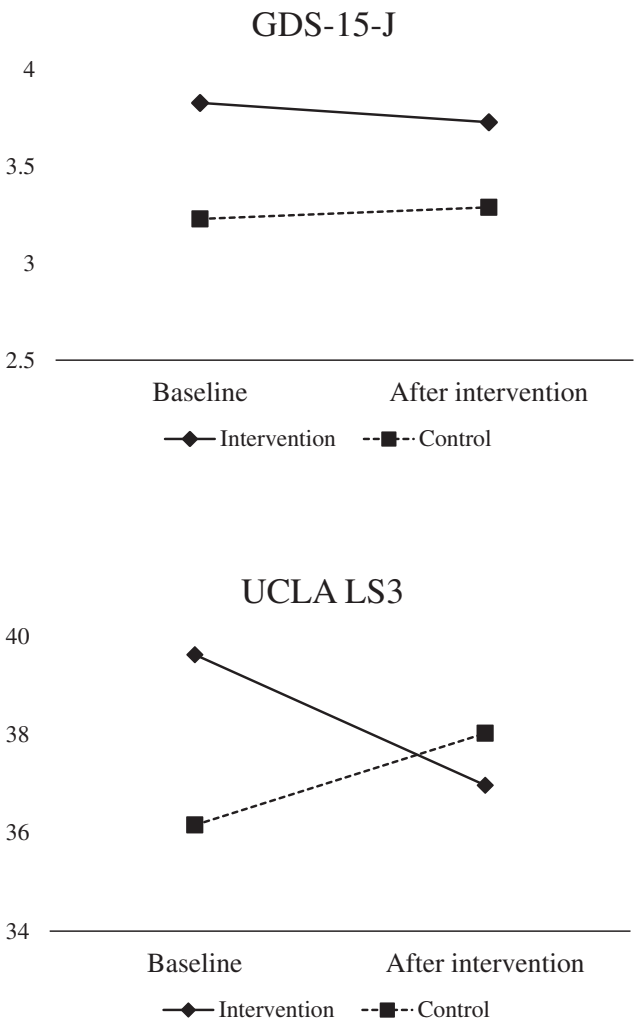

Figure 2 Intervention effects on loneliness and depressive symptoms. GDS-15-J, Geriatric Depression Scale-15-Japanese; UCLA LS3, UCLA Loneliness Scale version 3.

UCLA LS3 pre- and post-intervention. The results showed a significant difference in both the intervention ($P = 0.034$) and control ($P = 0.019$) groups.

Factors that need to be considered when designing interventions

As the UCLA LS3 showed significant interactions regarding changes in the scores of each scale, we examined what factors were related to the post-intervention UCLA LS3 scores in both groups.

For the intervention group, univariate analysis showed reminiscence stimuli and pre-intervention UCLA LS3 scores were significantly related to post-intervention UCLA LS3 scores (Table 3). Subsequently, we performed a multiple regression analysis that used these factors as independent variables and found the perceptions that memory triggers were useful ($P = 0.045$) and baseline UCLA LS3 scores ($P < 0.001$) were significantly related to post-intervention UCLA LS3 scores (Table 4). Similarly, for the control group, univariate analysis showed reminiscence stimuli and pre-intervention UCLA LS3 scores were significantly related to post-intervention UCLA LS3 scores (Table 5). We performed a multiple regression analysis using these factors as independent variables and found that only pre-intervention UCLA LS3 scores ($P < 0.001$) were significantly related (Table 6).

DISCUSSION

We focused on sensory elements to make group reminiscence therapy involving community-dwelling older adults a more evidence-based and effective psychosocial approach. We examined their effects on loneliness and depressive symptoms by comparing group reminiscence therapy using smell as a memory trigger and general group reminiscence therapy using themed discussions.

Effects on loneliness

Regarding effects on loneliness, conducting reminiscence therapy using smell as a memory trigger was

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Table 3 Factors associated with UCLA LS3 scores in the intervention group post-intervention ($n = 30$)

	Correlation coefficient	UCLA LS3 scores after completion of the intervention	*P*-value	
Age (years)	−0.197		0.298	a
Gender				
Male		43.00 ± 8.89	0.565	b
Female		36.30 ± 8.93		
Presence of spouse				
Yes		38.13 ± 9.30	0.461	b
No		35.64 ± 8.81		
Living alone				
Yes		38.25 ± 10.93	0.244	b
No		36.50 ± 8.45		
Education				
≤ 12 years		36.17 ± 8.70	0.561	b
≥ 13 years		38.17 ± 9.71		
Financial situation				
Good		36.38 ± 8.13	0.115	b
Poor		38.33 ± 11.2		
Sense of health				
Good		36.33 ± 9.70	0.451	b
Poor		39.50 ± 5.32		
Outpatient visit				
Yes		37.00 ± 9.74	0.979	b
No		36.91 ± 8.04		
Olfactory VAS	0.062		0.744	a
Perceived usefulness of clues to help with reminiscence	−0.448		0.013	c
UCLA LS3 score at baseline	0.729		<0.001	a

Note: a = Pearson's correlation coefficient; b = t-test; c = Spearman's rank correlation coefficient.
UCLA LS3, UCLA Loneliness Scale version 3; VAS, visual analogue scale.

Table 4 Multiple regression analysis of the factors associated with the UCLA LS3 in the intervention group post-intervention ($n = 30$)

	β	SE	*t*	*P*-value
Perceived usefulness of clues to help with reminiscence	−0.283	1.861	−2.102	0.045
UCLA LS3 score at baseline	0.610	0.138	4.533	<0.001
$R = 0.773$, adjusted $R^2 = 0.567$				

UCLA LS3, UCLA Loneliness Scale version 3.

shown to be more useful in alleviating loneliness than conducting reminiscence therapy using themed discussions. A recent study on reminiscence therapy targeting older adults suggests nostalgia functions as an emotion involving memories.[42] Triggers for evoking nostalgia include music, photos, and smell. Among these, smell can strongly evoke nostalgia.[42] Among different types of smell, food appears to be particularly useful for powerfully evoking nostalgia accompanied by positive emotions.[43] Nostalgia also strengthens social ties, or the function of evoking memories with intimate others, enhancing the awareness of social connections, and being supported by others, which leads to alleviating loneliness.[25] Others report that memories recalled by smell are more vivid, older in terms of time of recall, and more emotional than those recalled by language.[44] Memories recalled by smell contain more emotional and relived sensations than memories recalled using visual[45] or auditory cues.[46]

Except for the eighth and final session, the seven sessions in this study's reminiscence therapy used smell as a memory trigger, and four of the seven odorant types featured a food smell. We shortened the activity duration per session to about 40 min to avoid participant exhaustion. Despite this, since smell was used as a memory trigger, intervention group participants could simultaneously evoke memories

Table 5 Factors associated with UCLA LS3 scores in the control group post-intervention ($n = 31$)

	Correlation coefficient	UCLA LS3 scores after completion of the intervention	*P*-value	
Age (years)	2.82		0.124	a
Gender				
Male			-	
Female				
Presence of spouse				
Yes		35.27 ± 5.48	0.077	b
No		40.63 ± 9.96		
Living alone				
Yes		32.50 ± 10.91	0.163	b
No		38.85 ± 7.93		
Education				
≤12 years		39.00 ± 9.15	0.326	b
≥13 years		35.67 ± 6.14		
Financial situation				
Good		38.40 ± 8.34	0.628	b
Poor		36.50 ± 9.4		
Sense of health				
Good		37.31 ± 8.26	0.282	b
Poor		41.80 ± 9.26		
Outpatient visit				
Yes		36.23 ± 8.37	0.061	b
No		42.44 ± 7.18		
Olfactory VAS	−0.162		0.384	a
Perceived usefulness of clues to help with reminiscence	−0.532		0.002	c
UCLA LS3 score at baseline	0.877		<0.001	a

Note: a = Pearson's correlation coefficient; b = t-test; c = Spearman's rank correlation coefficient.
UCLA LS3, UCLA Loneliness Scale version 3; VAS, visual analogue scale.

Table 6 Multiple regression analysis of the factors associated with the UCLA LS3 in the control group post-intervention ($n = 31$)

	β	SE	*t*	*P*-value
Perceived usefulness of clues to help with reminiscence	−0.096	1.563	−0.916	0.368
UCLA LS3 score at baseline	0.826	0.105	7.844	<0.001
$R = 0.881$, adjusted $R^2 = 0.760$				

UCLA LS3, UCLA Loneliness Scale version 3.

and nostalgia. We were able to work on their emotions, because the activity encouraged participants' awareness of their social connections and they shared memories with others to a greater extent than in the control group. Therefore, through these processes, reminiscence therapy may have alleviated loneliness.

Effects on depressive symptoms

This study did not identify any beneficial effects of using smell in group reminiscence therapy on depressive symptoms. However, a previous study comparing reminiscence therapy that used smell corresponding to a theme and general reminiscence therapy that used conversations following a theme reported that therapy using smell could be a more effective means of alleviating depressive symptoms.[20] The following may be reasons for this difference in results.

First, the GDS-15-J scores' cutoff value pertaining to the participants' depressive states at baseline appears to be 6/7 points.[41] Roughly 13% of the participants scored 7.0 points or more, with an average GDS-15-J score of 3.8 points for the intervention group, indicating a favourable mental health state. Therefore, achieving alleviation effects through the

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intervention may have been challenging. Another reason is that the present study's intervention group used smell without themes. Reminiscence therapy appears to alleviate depressive symptoms by having participants mutually share the content recalled and express or receive sympathy regarding thoughts about past events, thereby enhancing their self-esteem and self-approval.[47]

We did not establish themes corresponding to smell in the interventions designed in this study. Memories of a particular smell varied among participants, and the process through which participants sympathised with each other regarding the content being described may have been insufficient. However, the effect of reminiscence using smells on participants with depressive symptoms as assessed by the GDS-15 and the effect of reducing depressive symptoms have been reported.[20] Therefore, this program may be effective for participants with depressive symptoms. Hence, future sessions should establish both a theme and smell.

Factors to consider during reminiscence therapy

After completing the interventions, we examined the factors related to the UCLA LS3 scores. With the intervention group, a sense of usefulness or perceiving that a trigger was helpful in reminiscence, as well as baseline UCLA LS3 scores, were related. By contrast, in the control group, only the baseline UCLA LS3 scores were related. In other words, for the intervention group, the greater a person's pre-intervention loneliness, the more intense their post-intervention loneliness. The greater the feeling that a smell trigger was helpful in reminiscence, the weaker the post-intervention loneliness tended to be. For the control group, the greater a person's pre-intervention loneliness, the greater their post-intervention loneliness. However, no relationship was observed indicating whether a theme helped participants reminisce.

During reminiscence therapy using smell, administrators should naturally consider the participants' state of loneliness pre-intervention. When a participant recalls past events, observing if they perceive a memory trigger is necessary to aid recall. During reminiscence therapy, focusing on emotions involving the senses is recommended rather than relying on verbal communication alone, as smell is useful as a memory trigger for evoking emotional memories.[48] Therefore, during reminiscence therapy using smell as a memory trigger, odorants that appropriately support a trigger for participants' reminiscence should be prepared.

Conversely, the control group displayed no relationship with a sense of usefulness or perceiving that a trigger was useful to evoke reminiscence. Umemoto[47] explains that a theme is a topic of conversation and sets a direction for the session's reminiscence therapy. Therefore, it may have been unlikely that verbal communication relying on a theme alone was singlehandedly useful for reminiscence or strongly affected emotions. Future studies should further examine memory triggers corresponding to specific themes.

Limitations

This study has several limitations. First, due to its nature, we could not conduct blinded tests. Therefore, we cannot rule out the possibility of participants being biased. Second, the study was conducted across three Japanese prefectures featuring different cultural backgrounds. Therefore, generalising the study results is challenging and necessitates continued examinations targeting older adults in varied regions. Third, as the study participants were older adults who regularly visited regional community centres to prevent the need for long-term nursing care, they had relatively favourable mental health. Fourth, we used information from the long-term care insurance system and dementia diagnoses to confirm cognitive impairment, an exclusion criterion. We did not assess cognitive function using objective indicators, accounting for the psychological burden on the participants. Finally, although smells may evoke nostalgia, this study did not include a quantitative assessment of nostalgia.

Hence, the sample may not be representative of the older adult population less concerned about its mental health. To design improved therapy using smell as a memory trigger, there is a need for psychosocial programs equipped with better practicality and efficacy for community-dwelling older adults, featuring reminiscence therapy programs combining evidence-based themes and smells to facilitate recounting past events during group sessions. There also is a need to accumulate studies on these effects

using various regions and venues and to verify the effects via post-intervention follow-up surveys.

CONCLUSION

Using this randomised controlled trial, we showed that odorants can be incorporated as a memory trigger during group reminiscence therapy to alleviate loneliness in community-dwelling older adults. As the Japanese population is ageing rapidly, coping with social isolation and loneliness has become an urgent challenge, because both are risk factors for dementia and depressive symptoms. As it is not possible to expect immediate improvements to older adults' environments, programs that solve these increasingly urgent concerns are needed. The results of this study offer meaningful proposals for designing effective reminiscence therapy interventions aimed at the psychosocial aspects of health.

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DISCLOSURE

Authors declare no conflict of interests for this article.

DATA AVAILABILITY STATEMENT

Participants in the study have consented to the collection of data but not to its publication. Hence, the data is not available.

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