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Original Research

Integrative Stress Reduction Program for Family Caregivers of Persons With Advanced Dementia: A Randomized-Controlled Trial

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Abstract

Background: Older adults with advanced dementia require significant care, leading to high stress levels in caregivers.
Objectives: The current study aimed to evaluate the effects of an Integrative Stress Reduction Program on Thai caregiver's outcomes of stress, sleep quality, and caregiver-assessed neuropsychiatric symptoms of persons with dementia.
Methods: A single-blind randomized-controlled trial was conducted. A sample of family caregivers of people with dementia was recruited from memory clinics at outpatient community health centers in Thailand and randomly assigned to the experimental and control groups. Participants in the experimental group were enrolled in 5 intervention sessions over 4 weeks, while the control group received usual care. Outcome variables were collected at baseline, 4 weeks postintervention, and 8 weeks of follow-up.
Results: Compared with the control group, caregivers in the experimental group (n = 27) had significantly decreased stress ($p < .01$) and better sleep quality ($p < .01$), and caregivers reported that their family members with dementia (n = 27) had decreased neuropsychiatric symptoms ($p < .01$) after the intervention (week 4) and at the 8-week follow-up.
Conclusions: The Integrative Stress Reduction Program improved outcomes for caregivers and decreased neuropsychiatric symptoms in people with dementia.

Keywords

dementia, caregivers, stress, sleep quality, neuropsychiatric symptoms, intervention, multicomponent, randomized-controlled trial

The older adult population is expanding in low and middle-income countries in Asia, along with age-related memory disorders, such as Alzheimer's disease. The number of people with dementia is rapidly increasing to 33 million.[1] In Thailand, a developing country in Southeast Asia, the number of people with dementia is estimated to be 2 million, and advanced dementia is a leading cause of death.[2] People with dementia suffer from difficulties with thinking, problem-solving, and language, and they often experience neuropsychiatric symptoms that reduce their quality of life. The symptoms of dementia progress from mild to moderate to severe and produce a greater need for assistance with personal care including continence, dressing, and hygiene.[3] In Thailand, this population usually lives in the community at home with their family members or relatives who assist with their increasing need for supportive care and get additional support from long-term care community health centers.[4]

Family caregivers frequently struggle to manage the care of their family members with dementia. This stress is related to (1) their roles in caring; (2) confidence in their abilities to provide care; (3) concerns about health issues; (4) isolation from others; and (5) negative emotions, such as sadness or anger toward the family member with dementia.[3] Further impacting caregiver stress are common neuropsychiatric symptoms in those with advanced dementia, such as

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agitation or wandering, sun-downing, aggression, repetitive behavior, hallucinations and delusions, and restless sleep.[3,5] Evidence suggests that caregivers who have provided care to individuals with advanced dementia for more than 3 months experience high levels of stress.[3,6]

The Stress Process Model illustrates the primary objective stressors that are embedded in dementia care, including cognitive impairment, limitations in self-care, and neuropsychiatric symptoms.[7] Over time, stress results in overload, exhaustion, loss of leisure time, and difficulty managing neuropsychiatric symptoms. These stressors of care along with the neuropsychiatric symptoms in people with dementia lead to increased stress and sleep difficulties of the caregivers.

High stress in caregivers results in decreased sleep efficiency, increased sleep disturbances, increased daytime dysfunction, and unsatisfactory subjective sleep quality.[8] As a result, long-term stress and reduced sleep quality lead to caregivers having an increased risk of health problems, such as heart disease and cognitive decline.[5,9] Caregiver stress also contributes to worsening neuropsychiatric symptoms in people with dementia from the negative emotions of caregivers that can result in frustration, irritation, and anger.[10] Thus, helping caregivers to manage their stress benefits not only their own health and sleep but also improves their interactions with family members with dementia.

Researchers have aimed to minimize caregiver stress by developing interventions to assist caregivers in managing neuropsychiatric symptoms in people with dementia and in coping with stressful situations. For example, psychoeducational programs have combined educational sessions on dementia care and skills training to deal with neuropsychiatric symptoms and decreased caregiver stress.[11,12] In another study, an intervention designed for caregivers to acquire skills to identify and understand their emotions lessened their levels of stress.[13] Interventions targeting stressors have positively affected dyadic outcomes, such as decreasing caregivers' stress and neuropsychiatric symptoms of family members with dementia. However, the programs demonstrated a small effect on decreased neuropsychiatric symptoms and had a short-term effect on reducing caregiver stress.[13-16]

Interventions are still needed to educate Thai caregivers on how to manage the challenging care for family members with dementia and reduce stress for the caregivers.[17] In response to this need, we developed the four-week Integrative Stress Reduction Program. The program was pilot-tested on a group of 12 family caregivers of people with dementia to determine its feasibility.[18] The findings showed that caregiver stress decreased significantly ($p < .05$) and sleep quality increased significantly at the posttest compared to the pretest ($p < .05$). Caregivers also identified lower neuropsychiatric symptoms in their family members with dementia ($p < .05$).

To further evaluate the Integrative Stress Reduction Program, a randomized-controlled trial on a larger sample was conducted to determine the program's effects. We hypothesized that the caregivers who received the Integrative Stress Reduction Program would experience decreased stress and enhanced sleep quality, and the persons with dementia would demonstrate fewer neuropsychiatric symptoms compared to the control group at both the end of the program and at the 8-week follow-up.

Methods

Study Design

The design was a single-blind randomized-controlled trial. Caregivers of family members with advanced dementia were randomly allocated to either the experimental or the control group. The report on this study is consistent with the CONSORT 2012 Statement.[19]

Settings and Participants

The target population was family caregivers of people with advanced dementia, including moderate to severe Alzheimer's disease or other forms of dementia. Participants were recruited from a large outpatient community health center with 3 affiliated memory clinics in Suphan Buri Province, Thailand. The eligibility criteria to participate in the study were spouses, siblings, children, grandchildren, or other relatives living with people with dementia, aged 18 years or older, providing care at home for at least 3 months of caregiving experience,[3,6] and able to read and communicate in the Thai language. They also needed to own a smartphone with internet access to use the program's messaging application (app) and be willing to participate in the program for all sessions. Nurses in the outpatient community health center clinics routinely assess patients with dementia and rate their severity using the Washington University Clinical Dementia Rating (CDR).[20] The CDR is determined based on the assessment of memory, orientation, judgment, problem-solving, community affairs, home and hobbies, and personal care. Caregivers of people with dementia who scored 2 (moderate dementia) or 3 (severe dementia) on the CDR were recruited for the study. Caregivers were excluded if they had a diagnosis of depression, psychosis, dementia, or a serious health issue such as cancer.

Sample Size

We estimated the sample size by conducting a power analysis using the G*Power software program for a repeated-measures analysis of variance and an average effect size of 0.40 calculated from previous studies.[21,22] To decrease the type 1 error, a power of 0.90 and a significance level of 0.05 were used. Although the software program indicated a minimum sample size of 46 participants, we planned to recruit at least 52 participants based on the estimated attrition rate of approximately 20%.[22]

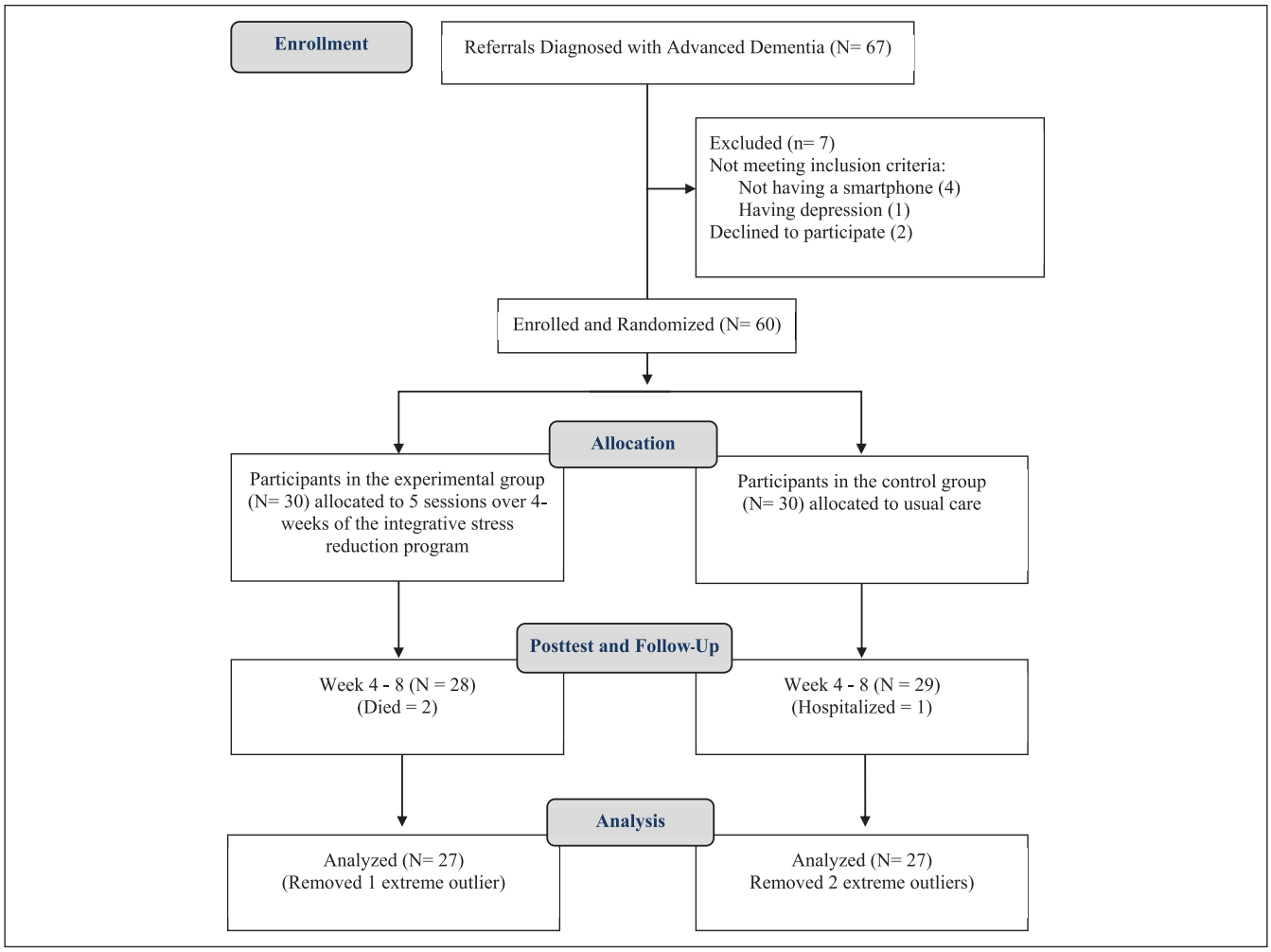

Figure 1. The consolidated standards of reporting trials diagram.

Recruitment

Participants were recruited from the outpatient community health center's memory clinics from the beginning of August 2020 to March 2021. The principal investigator (PI) distributed flyers to 3 clinic nurses who referred 67 possibly eligible participants. Four potential participants were excluded because they did not have a smartphone, 2 declined to participate, and 1 caregiver was diagnosed with depression. Of the 67 caregivers who were referred, 60 agreed to participate for a recruitment rate of 89.55%; however, 6 participants or family members died, withdrew, or were removed from the analysis, which left 27 participants in each group (see Figure 1).

Ethical Considerations

The Ethics Committee of Burapha University, Thailand, approved the study protocol and all measurements (No. G-HS 042/2563). Village health volunteers, who are similar to community health workers in other countries, worked at the outpatient memory clinics and were trained by the PI to serve as research assistants (RAs) to assist with the study. They explained the purposes of the study, data collection, risks and benefits of the study, and detailed information about the right to withdraw from the trial. If caregivers agreed to participate, they signed the informed consent.

Randomization, Allocation, and Blinding

After the processes of consent and baseline assessment (week 0, time 1), simple randomization was used. The first RA coded ballots and put them in sealed opaque envelopes; half were marked with the letter "E" for the experimental group, and the other half were marked with the letter "C" for the control group. This RA then randomly drew a ballot from a box to assign each participant to the experimental or control group in a 1:1 ratio. The RA who performed the allocation process was involved neither in the program sessions nor in the data collection. Due to the interactive nature of the program, the PI could not be blinded to intervention participants. However, the group allocation lists and assessments were concealed from a second RA who was the outcome assessor.

Intervention Group

The experimental group participated in the Integrative Stress Reduction Program, described elsewhere.[18] The program was developed based on the literature and the Stress Process Model and evaluated by a panel of 3 experts in dementia care. The program included 4 group education and discussion sessions held at the community health center and 1 home visit. The pilot findings yielded good feasibility of the program, and no dropouts or adverse events occurred.[18] As a result, we implemented the Integrative Stress Reduction Program similar to that used in the pilot.

To minimize the confounding effects of the testing environment, all of the sessions were provided at the same time at the community health center, to avoid conflict with other activities. The PI conducted the program weekly for 4 weeks. In session 1 (week 1), participants learned about dementia care and common stressors, and how to use Line, a free mobile messenger app (https://Line.me), to receive educational support from the PI. In sessions 2 and 3 (week 2), participants were trained on a 6-step process for addressing problem behaviors. In this process, they consider possible causes of the behavior, how they might alleviate the underlying causes, and ways to respond positively to the person with dementia. Furthermore, the caregivers participated in role-playing sessions to practice using the 6-step process.

In session 4 (week 3), participants were asked to join the free Line mobile messaging app to share their dementia caregiving experiences through a closed group conversation. Participants were able to seek assistance if needed and received an automatic text message on their smartphone with tips on what to do (e.g., "Don't worry. Wandering of the person with dementia can be resolved. Please adhere to the 6 steps in response to neuropsychiatric symptoms."/"As a first step, kindly relax your hand muscles for 5 seconds. Follow your breathing and loosen up a bit more."/"Check the causes of the problematic behaviors"). The text messages served to remind participants of the process. In the final session, the PI conducted individual home visits to meet with the families and discuss caregiving issues. After the end of the program at week 4 (time 2), the second RA assessor collected outcome data. Follow-up data were collected at week 8 (time 3).

Control Group

Caregivers in the control group were tested at baseline and received routine care at the community health center's memory clinics. They attended a 1-day educational session at the community health center offered regularly. The clinic nurse facilitated the educational sessions, which included an overview of dementia, its symptoms, and basic daily care for people with dementia. The second RA also assessed outcome data at week 4 (time 2) and follow-up data at week 8 (time 3).

Intervention Fidelity

The PI (first author), who has clinical and research experience with people with dementia and is certified in dementia education, administered the Integrative Stress Reduction Program. A co-PI (second author) observed the content delivery for each session using a standardized checklist to ensure that all content was delivered to participants in accordance with the protocol to assess fidelity. The PI assessed how well the caregivers understood or learned the core contents in each session during the intervention by asking questions or having them demonstrate the skills. For example, the participants were asked to discuss the steps of responding to problem behaviors to ensure that they had learned the skills.

Study Outcomes

Developed by Greene et al,[23] the Relative Stress Scale (RSS) measured stress as the primary outcome. The scale has been used to measure caregiver stress, was available in the Thai language, and was used successfully in the pilot study.[8,18] The 15-item RSS has 3 dimensions: personal distress, degree of life upset, and negative feelings toward the person with dementia. Participants rate the frequency or severity of their stress on a five-point scale scored 0 to 4 (e.g., "never," "rarely," "sometimes," "frequently," and "always"). Total scores range from 0 to 60, with a higher score indicating a higher degree of stress. The RSS was translated from the original English version to the Thai language by Sanprakhon et al.[8] They reported a content validity index of 0.92 and Cronbach's alpha coefficient of 0.87 for internal reliability. In our study, Cronbach's alpha was 0.87.

The secondary outcomes were the sleep quality of caregivers and the neuropsychiatric symptoms of the family members with dementia. Originally developed by Buysse et al,[24] the Pittsburgh Sleep Quality Index (PSQI) is a self-report measure to assess subjective sleep quality over the prior month. The 7 items are scored from 0 (no difficulty) to 3 (severe difficulty), with a summed score range of 0 to 21 points. Jirapramukpitak and Tanchaiswad[25] translated the original English version into the Thai language and reported a sensitivity and specificity of 77.78% and 93.33%, respectively, and Cronbach's alpha of 0.84. Cronbach's alpha for the PSQI in our study was 0.82.

Originally developed in English by Cummings,[26] the Neuropsychiatric Inventory (NPI) measures the frequencies of 12 behavioral symptoms, such as hallucinations, depression/dysphoria, and motor activity. In our study, the caregivers rated the symptom frequencies over the prior month from 0 (less than once per week) to 4 (very frequently), and the severity of each symptom is rated from 1 to 3, from less severe to very severe. The total score is determined by multiplying the frequency score by the severity scores (0-144). Senanarong et al[27] translated the NPI into the Thai language and reported a Cronbach's alpha of 0.97. In our study, the Cronbach's alpha was 0.81.

Statistical Analysis

Data were analyzed using the IBM SPSS statistical software version 26.0, with statistical significance set at $p < .05$. Chi-square and Fisher's exact tests were used to compare the baseline characteristics of the participants in the experimental and control groups. An independent *t*-test was used to compare the outcome variables between the experimental and control groups at baseline (pretest; week 0 [time 1]). Two-way repeated-measures analysis of variance (ANOVA; 1-way between-subjects independent variable and 1-way within-subjects independent variable) was used to analyze for differences in caregiver stress, comparing the experimental and control groups at 3 separate time points: preintervention (time 1), postintervention (time 2), and follow-up (time 3). Two-way repeated-measures analysis of covariance (ANCOVA) was also used to determine the mean differences in sleep quality and neuropsychiatric symptom outcomes, where their pretest scores were significantly different ($p < .05$) and used as control variables in the analysis. Post hoc analysis was conducted using the Bonferroni-corrected *t*-test to compare specific differences between the changes that were statistically significant. Effect sizes were calculated using partial eta-squared (η^2), which expresses the sum of squares of the effect in relation to the sum of squares of the effect and the sum of squares of the error associated with the effect. One extreme outlier in the experimental group and 2 extreme outliers in the control group were eliminated during analysis because the histogram showed non-normality. After cleaning the data, there were normal distributions in the RSS, PSQI, and NPI scores in both the experimental and control groups. Homogeneity of variance of between-subject comparison was not statistically different ($p > .05$). Mauchly's test of sphericity of all outcome variables showed significance ($p < .05$).

Results

Attendance and Attrition

Attendance at the intervention sessions was 100% in weeks 1 and 2. After week 2, 2 caregivers in the experimental group (6.67%) dropped out because their family member with dementia had died (see Figure 1). The remaining 28 participants (93.33%) completed the program and follow-up data collection. All the participants in the control group attended the single educational program. During the study, 1 person in the control group was hospitalized and dropped out, and the remaining 29 participants (96.66%) in the control group completed the study through the last measurement. The attrition rate during implementation was 0.5%. Data were analyzed for 27 participants in both the experimental and control groups.

Characteristics of the Participants

Participants in the experimental group had a mean age of 49.33 years (SD = 11.74), and participants in the control group had a mean age of 51.59 years (SD = 12.74). Family caregivers had been in their role for an average of 18.70 months (SD = 21.68) and provided an average of 13.48 hours/day (SD = 2.25) of care. There were no significant differences in characteristics between the groups (see Table 1).

Baseline

The results of the independent *t*-tests indicated there were no statistically significant differences in the RSS scores between the experimental and control groups at baseline ($t_{52} = 1.48$, $p > .05$). However, both the PSQI and NPI scores of the experimental group were statistically higher than those of the control group ($t_{52} = 3.48$, $p < .01$; and $t_{52} = 2.99$, $p < .05$, respectively).

Outcomes

Results of the two-way repeated-measures ANOVA indicated that the mean RSS scores of the experimental and control groups varied across the 3 time points: baseline (time 1, week 0), postintervention (time 2, week 4), and follow-up (time 3, week 8) ($F[1.55, 80.56] = 316.39$, $p < .01$; partial $\eta^2 = 0.859$). Results of the two-way repeated-measures ANCOVA also varied in the experimental and control groups on the PSQI and NPI scores across the baseline, postintervention, and follow-up measurements ($F[1, 51] = 24.45$, $p < .01$; partial $\eta^2 = 0.324$; and $F[1, 51] = 9.28$, $p = .004$; partial $\eta^2 = 0.154$, respectively, as shown in Table 2).

Based on Figure 2, post hoc analysis identified the Bonferroni-corrected results of the *t*-tests of the RSS mean scores of the experimental and control groups at 4-week postintervention (time 2) and 8-week follow-up (time 3). The caregivers receiving the Integrative Stress Reduction Program significantly lowered their stress levels compared to the control group at both postintervention and follow-up periods ($F[1,52] = 80.66$, $P < .01$; partial $\eta^2 = 0.61$; and $F[1,52] = 277.12$, $P < .01$; partial $\eta^2 = 0.84$, respectively). This supports the hypothesis that caregivers receiving the intervention would experience decreased stress compared to those in the control group.

The PSQI scores of the post hoc analysis of the experimental group at the 4-week (time 2) and 8-week follow-ups (time 3) showed significantly lower scores than those in the control group ($F[1,51] = 30.21$, $P < .01$; partial $\eta^2 = 0.372$; and $F[1,51] = 120.49$, $P < .01$; partial $\eta 2 = 0.703$). The results are consistent with the hypothesis that caregivers receiving the intervention would experience better sleep quality than those in the control group.

At the same time, the results of the NPI scores were also significantly reduced in the experimental group at the 4-week (time 2) and 8-week (time 3) follow-ups, compared to both time measures of the control group ($F[1,51] = 73.63$, $p < .01$; partial $\eta^2 = 0.591$; and $F[1,51] = 101.45$, $p < .01$; partial $\eta^2 = 0.665$, respectively). The results support the

Table 1. Characteristics of the Caregiver Participants and the Persons With Dementia in the Intervention and Control Groups.

	Intervention group (n = 27)		Control group (n = 27)				
Characteristic	n	%	n	%	t	χ^2	*p*
Caregiver participants							
Age (years)	M = 49.33 (SD = 11.74, range = 24-76)		M = 51.59 (SD = 12.74, range = 20-72)		−0.68		.50
Relationships							
Spouse	4	14.8	3	11.1		2.21[a]	.53
Son or daughter	19	70.4	16	59.3			
Relative	4	14.8	8	29.6			
Gender							
Male	2	7.4	1	3.7		0.35[a]	.50
Female	25	92.6	26	96.3			
Marital status							
Single	5	18.5	6	22.2		1.98[a]	.57
Married	15	55.6	18	66.7			
Widowed	2	7.4	1	3.7			
Divorced/separated	5	18.5	2	7.4			
Education							
No formal education	3	11.1	3	11.1		0.28[a]	.42
Primary school	20	74.1	19	70.4			
Secondary school and higher	4	14.8	5	18.5			
Duration of care (months)	M = 18.70 (SD = 21.68, range = 24-76)		M = 19.00 (SD = 22.00, range = 20-72)		−0.05		.96
Hours/day of care duties	M = 13.48 (SD = 2.25, range = 24-76)		M = 12.96 (SD = 2.62, range = 20-72)		0.78		.44
Persons with dementia							
Age (years)	M = 82.07 (SD = 8.04, range = 60-98		M = 83.22 (SD = 6.69, range = 71-95		−0.57		.57
Gender						0.00	1.0
Male	7 (25.59)		7 (25.59)				
Female	20 (71.4)		20 (71.4)				
CDR scores	M = 2.40 (SD = 0.50, range = 2-3		M = 2.37 (SD = 0.49, range 2-3)		−0.27		.78

Abbreviation: χ2, chi-squared tests; SD, standard deviation; CDR, clinical dementia rating.
[a]Fisher's exact test.

hypothesis that caregivers receiving the intervention would report fewer neuropsychiatric symptoms compared to the control group.

Discussion

This single-blind randomized-controlled trial provides further evidence that caregivers who participated in the Integrative Stress Reduction Program experienced decreased stress and enhanced sleep quality. In addition, people with advanced dementia exhibited decreased neuropsychiatric symptoms in the fourth week of the program and at the 8-week follow-up. In comparison, participants in the control group did not show improvements in any of the outcomes. The program offers a new option for training Thai caregivers of people with dementia to improve their health and caregiving skills that can be implemented in community settings, where few such options exist.[18]

The positive results of the study are consistent with other research conducted in Asian countries that focused on reducing caregiver stress. For example, previous studies found that participants who received education on dementia care decreased their stress.[13,15,22,28,29] In addition, a multicomponent stress reduction program improved the sleep quality of family caregivers of people with mental health conditions.[29] These findings of improved sleep are in concordance with Paller et al,[30] who reported better sleep quality among caregivers of people with Alzheimer's disease after receiving a training program targeting stress management.

Caregivers who participated in the Integrative Stress Reduction Program also reported decreased neuropsychiatric symptoms among people with dementia. The program helped educate participants to understand problem behaviors as well as to respond calmly and manage their care, which can result in decreased feelings of distress.[31] After caregivers learned skills for responding to the challenging symptoms of people

Table 2. The Interaction Effect (Time*Group) of the Mean Scores of Outcome Variables Between the Experimental Group (n = 27) and Control Group (n = 27).

		Experimental group		Control group			
Variable	Time[a]	M	SD	M	SD	F	Partial η^2
Stress (RSS)	1	50.03	4.00	48.22	4.97	316.39*	0.859
	2	38.55	3.21	48.07	4.47		
	3	33.30	3.01	48.22	4.70		
Sleep quality (PSQI)	1	11.74	2.79	9.33	2.55	24.45*	0.324
	2	8.74	2.43	8.92	1.77		
	3	5.63	1.36	8.93	1.73		
Neuropsychiatric symptoms (NPI)	1	38.21	13.65	27.89	11.90	9.28**	0.154
	2	27.21	9.19	29.61	27.77		
	3	19.93	7.74	27.77	9.69		

Abbreviations: SD, standard deviation; RSS, Relative Stress Scale; PSQI, Pittsburg Sleep Quality Index; NPI, neuropsychiatric inventory; partial η^2, partial Eta Squared.

[a]Time, measured at 3 time periods: 1, baseline (week 0, time 1); 2, postintervention (week 4, time 2); and 3, follow-up (week 8, time 3).

*$p < .01$. **$p < .05$.

with dementia, they were able to reduce neuropsychiatric symptoms and consequences, as seen in Gitlin et al.[31] Caregivers can learn to manage neuropsychiatric symptoms and reduce their impact on people with dementia.[30]

The large effect sizes in the results of our study support the success of the Integrative Stress Reduction Program in helping caregivers reduce their stress and improve sleep quality. Several factors could explain the large effect sizes. First, the program was developed based on the multidimensional Stress Process Model and reviewed literature. The program targets several stressors, including the caregiver's perceptions of dementia, acceptance of the disease, and increased skills in providing care. We found good attendance and participation in the program.

Second, the Integrative Stress Reduction Program is the first intervention in Thailand to utilize a smartphone app to assist family caregivers. Caregivers accessed the Line messaging app on their smartphones to promptly receive dementia care information, which gave them a tool to help them cope with stressful situations as they encountered them. They also could use the app to request assistance from their social network of others in the intervention group. Participants were able to join the social media smartphone group to share and discuss their care experiences, which may have helped reduce their stress. Social support has consistently been associated with improved caregiver stress.[32] While we did not collect detailed information about the use of the app, participants made positive comments to the researchers on its use.

Third, the length of the program of 4 weeks was not burdensome for the caregivers in this study nor in the pilot study.[18] Those who participated in the intervention completed the entire program, except for 2 caregivers who experienced the death of their family member, indicating a high motivation to learn about caregiving and address their stress. Overall, our results are consistent with studies of Kor et al[13] and Shata et al[12] who also reported large effects of their interventions.

We found a small but significant effect on decreased neuropsychiatric symptoms among people with dementia; the reduction of symptoms may have contributed to lowering caregiver stress levels.[33] Learning to manage these symptoms is challenging, and caregivers were able to implement changes that could improve their quality of life. Other researchers have reported reduced stress even when dementia symptoms improved a small amount. For example, Kor et al[13] indicated that people with dementia may need long-term support from their caregiver programs for stronger outcomes.

Although this study provides evidence for the program's positive outcomes, there were limitations. First, resource constraints limited follow-up to 8 weeks. Future studies should include a longer follow-up period to determine the long-term effects of the program and the possible need to include booster sessions to sustain or increase the outcomes. Second, future studies should consider ways to provide smartphones and provide training to assure a broad population of participants. In addition, we did not assess the caregivers' use of the Line app for support. Future studies might explore the frequency of the app's use and explore how the app's use impacted caregivers' satisfaction and outcomes. Additional caregiver outcomes might be included in future studies, such as role overload, social deprivation, and knowledge or confidence in caregiving. An evaluation study of the costs associated with providing the intervention and options for program delivery would be important to know. Lastly, generalizability needs to be carefully considered because the Integrative Stress Reduction Program was tested with 1 sample in 1 setting. The program's effects may differ for caregivers from more diverse social and cultural environments, as well as different healthcare systems. These caregivers attended community health center

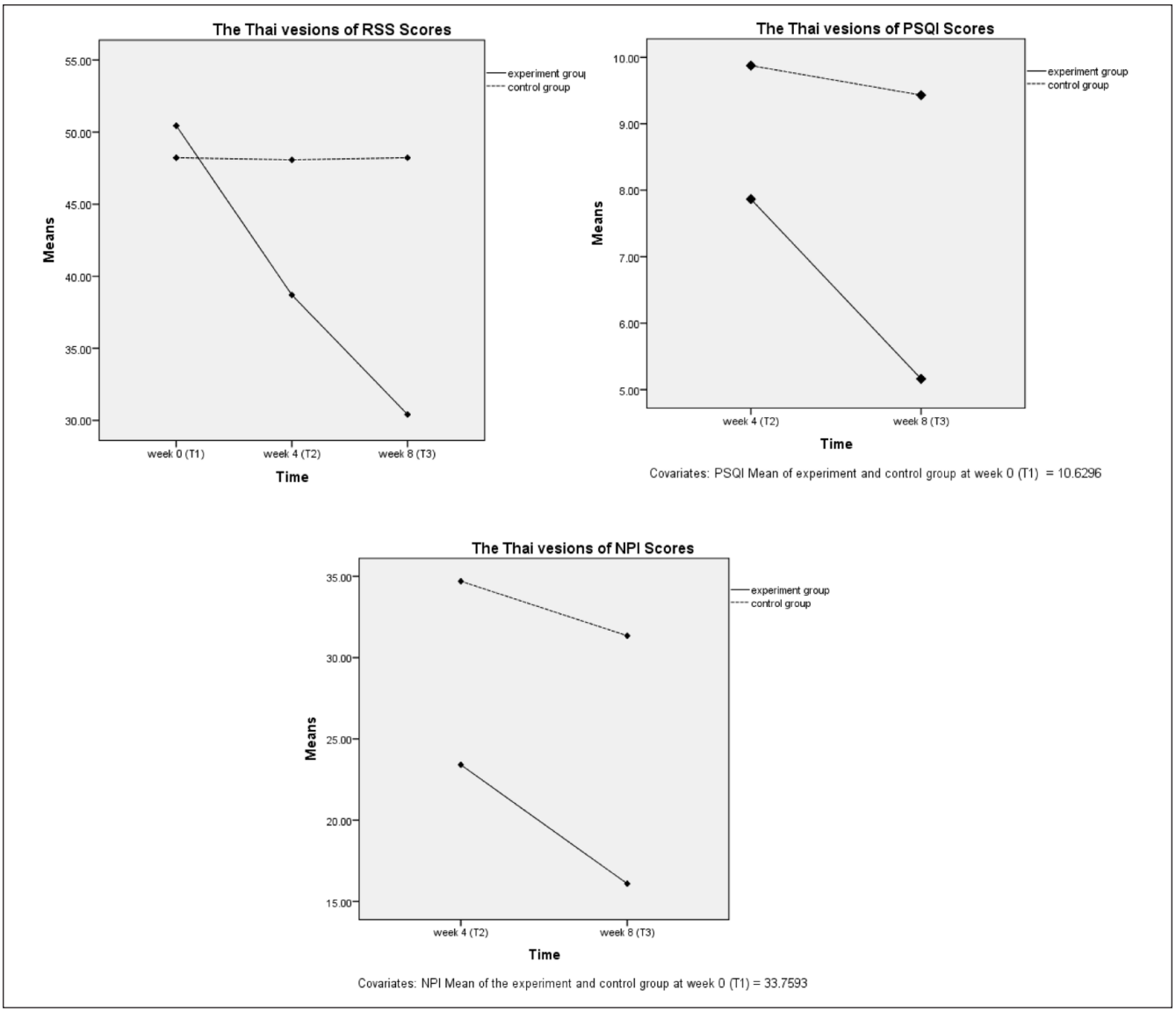

Figure 2. Comparisons of means the Thai version of RSS, PSQI, and NPI scores.
Abbreviations: RSS, Relative Stress Scale; PSQI, Pittsburgh Sleep Quality Index; NPI, neuropsychiatric inventory.

memory clinics that might not be available to everyone. Further studies should include larger sample sizes with different populations and settings to evaluate the Integrative Stress Reduction Program's effectiveness.

Conclusions

Family caregivers may experience high levels of stress when caring for people with advanced dementia due to functional limitations and neuropsychiatric symptoms. The Integrative Stress Reduction Program improved behavioral symptoms of dementia and taught the caregivers effective ways to reduce their stress which resulted in improved sleep quality. Health professionals should refer caregivers to educational programs such as the Integrative Stress Reduction Program to help them reduce stress and improve their health and quality of life.

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Declaration of Conflicting Interests

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Registration Number

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Data Availability Statement

The data set generated during and/or analyzed during the current study is available from the corresponding author on reasonable request

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