

Article

Effects of a Taiwanese Practice of Board Game Program on Cognitive Function and Loneliness Among Older Adults in Long-Term Care Facilities: A Quasi-Experimental Study

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Abstract

Stimulating leisure activities have been increasingly recognized as meaningful strategies to maintain cognitive health and reduce psychosocial risks among older adults. This study evaluated the effectiveness of a structured board game intervention in enhancing cognitive function and reducing loneliness among older adults living in long-term care facilities in Taiwan. Using a quasi-experimental design, 67 residents were assigned to either an intervention group, which participated in a six-week board game program, or a comparison group that continued with their usual activities. Data were collected at baseline and immediately after the intervention. Generalized estimating equations were used to analyze changes over time. Results indicated that the intervention group showed significantly greater improvements in cognitive function ($\beta = 3.86$, $p < 0.001$) and reductions in loneliness ($\beta = 2.31$, $p = 0.004$) at week 6 compared with the comparison group. These findings provide preliminary evidence that structured board game activities may represent a feasible, low-cost, and socially engaging approach to support cognitive and psychosocial well-being among older adults living in long-term care facilities. Implications for gerontological social work practice and activity programming are discussed.

Keywords: board game; older adults; cognitive function; loneliness; long-term care facility

1. Introduction

Rapid population aging has become a pertinent global concern due to increased life expectancy and decreased fertility. This phenomenon also exists in Taiwan, where the proportion of older adults has been growing annually, constituting 17.56% of the entire population in December 2022 (Department of Statistics, Ministry of the Interior, Taiwan [DSMI] 2022). As the body ages, memory and physical, physiological, and cognitive functions decline. Depression is a common psychological disorder among older adults (Kane et al. 2017). It is related to chronic diseases, cognitive disorders, and increased mortality rates (Alexopoulos et al. 2011). This increasing longevity has caused the number of people being diagnosed with dementia to rise. Degradation of cognitive function leads to a decrease in cognitive abilities and memory, thus affecting older adults' independence and their ability to conduct daily activities. This results in a substantial in-

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crease in global financial and social burden (Lipnicki et al. 2019). According to the World Alzheimer Report of 2022, over 50 million people live with dementia globally, and the number is expected to increase to 139 million by 2050. The annual cost of dementia is currently estimated at US\$ 1 trillion, a figure expected to double by 2030 (Alzheimer's Disease International 2022). Many studies have shown that mild cognitive impairment (MCI) is the most important risk factor for dementia, with one study reporting an approximately 60–100% progression rate of MCI to dementia within 5–10 years (Campbell et al. 2013; Dunne et al. 2021). A survey of dementia epidemiology found that the pooled prevalence of MCI in Taiwan was 18.06%; such prevalence is much higher than that in other developed countries/regions (Taiwan Alzheimer's Disease Association 2020).

In recent years, many clinical trials have been conducted on pharmacological and non-pharmacological therapies for MCI. Non-pharmacological therapy can be conveniently implemented and has fewer adverse reactions. It has become the primary treatment recommended by clinics and a research hotspot in this field (Y.-Q. Wang et al. 2020). After retirement, leisure time occupies most of the daily life of older adults. In recent decades, increasing attention has been paid to the role of leisure activities as a protective factor against impaired cognitive function in older adults. A recent study showed that participation in leisure activities, not only as a prevention strategy but also as an intervention in later life, may promote better cognitive performance through compensation or neural efficiency mechanisms (Ferrari-Díaz et al. 2022). In the field of psychosomatic medicine, playing board games is regarded as a cognitive stimulation activity, and engagement in such activities has been shown to protect against dementia and cognitive decline in elderly individuals (Nakao 2019).

Dartigues et al. recruited 3777 older adults aged 65 years and older in France to conduct a 20-year follow-up study exploring the association between participation in board game activities and cognitive outcomes. Their findings suggested that older adults who regularly played board games showed a lower observed incidence of dementia compared with those who did not participate in such activities (Dartigues et al. 2013). Similarly, Mayor conducted a 4-year follow-up study of 1929 participants aged 70 years and older and reported that more frequent participation in board game activities was associated with a lower occurrence of mild cognitive impairment (Mayor 2017). Moreover, performing cognitive stimulation activities regularly could reduce the MCI risk in healthy older adults. A meta-analysis revealed that active participation in leisure activities, particularly intellectually stimulating activities such as reading and playing board games or cards, was associated with better cognitive performance and may contribute to maintaining cognitive function in older adults. Meanwhile, playing board games or cards is a form of group entertainment, which not only plays a positive role in cognitive function but also promotes communication and social support for older adults (Ballesteros et al. 2015; R. Wang et al. 2019). Studies have shown that participating in board game activities can promote the mental health of older people by providing social communication and interaction (Zhang et al. 2020). Some studies on older adults have employed playing board games as a novel activity for cognitive stimulation. Research has found that board game activities have positive effects on older adults with depression living in nursing homes and the community, older patients with depression receiving treatment in hospitals, and older patients with cognitive impairment living in nursing homes (Griffiths et al. 2020; Noda et al. 2019; Ouyang et al. 2015; Poelke et al. 2016). In other words, few studies have employed and evaluated board game activities as interventions to improve depression-related syndromes in older adults.

The use of board games for cognitive stimulation activities has grown in recent years, drawing the attention of gerontology researchers. Previous studies have provided a great deal of epidemiological references on the association between leisure activities

and cognitive function (Yates et al. 2016). However, studies on the application of board games for the intervention and assessment of older adults are scarce; therefore, more evidence-based research is required to verify whether playing board games can be a valid non-pharmacological treatment in long-term care. Furthermore, studies in Taiwan have not investigated board game interventions focusing on older adults in long-term facilities.

Further studies are required to examine whether board game interventions are associated with short-term improvements in cognitive performance and psychosocial outcomes among older adults in long-term care settings. Therefore, it is important to study the feasibility and regional characteristics of the content design of board game activities. Such activities can be tailored to the needs, predispositions, and preferences of older adults and can improve their cognitive function and psychological well-being by promoting active engagement, enjoyment, empowerment, and creativity. This study primarily aimed to examine the effects of board game activity interventions on cognitive function and secondarily explored changes in loneliness among older adults living in long-term care facilities.

2. Methods

2.1. Study Design, Location, and Participants

This quasi-experimental study was based on a pretest-posttest design with a waiting list comparison group to evaluate the feasibility and efficacy of board game activity interventions in older adults in long-term facilities. Although participating facilities were allocated to intervention or comparison conditions using a random number generator, the study was not designed or implemented as a formal cluster randomized trial. Participants were recruited through convenience sampling within facilities, and facility-level clustering was not explicitly modeled in the primary analyses. In Taiwan, long-term care facilities are places where participants receive life support, medical care, and benefits. According to the regulations, the ratio of nurse workers to older adults is 1:15, and full-time social workers are required in long-term care facilities. Social workers help older adults with case management capacities in their daily lives. Leisure activities are provided by social workers in facilities or by volunteers from the community. The recruitment activities were conducted at both facilities on the same day. Social workers from the participating long-term care facilities assisted with participant recruitment based on the study eligibility criteria. Because recruitment relied on referrals and voluntary participation, the possibility of selection bias cannot be excluded. All the participants provided written informed consent to participate in the research, and the study was approved by the local ethics committee. The inclusion criteria were as follows: (1) living in facilities, (2) aged 65 years or older, (3) being able to communicate in Mandarin or Taiwanese, (4) scoring ≥ 5 points in the Short Portable Mental Status Questionnaire (SPMSQ), and (5) maintenance of functional ability, having scored between 61 and 90 in the Katz Activities of Daily Living Index (ADL). The exclusion criteria were hearing or visual impairment, severe depression, and severe medical conditions with physical immobility. The sample size for this study was estimated using G*Power 3.1. Assuming a significance level (α) of 0.05, statistical power of 0.80, and a medium-to-large expected effect size based on previous intervention studies on cognitive stimulation activities among older adults, the estimated total sample size required was 84 participants. Although the initial target sample size was 84, the final analyzed sample consisted of 67 participants due to attrition during the intervention period. Therefore, the findings should be interpreted with appropriate caution. This study was conducted for 3 months and involved the aforementioned intervention and comparison groups, which featured 35 participants each, for a total of 70 participants. The intervention group participated in board game activities for 120 min each for a total of 6 weeks. Each session was led by the same re-

searcher to ensure consistency in intervention measures. The scale tests were conducted before and after the program. The comparison group participated in regular activities (watching television, singing, and sports) in long-term care facilities and underwent the same scale tests at the same time points as the intervention group.

2.2. Instruments

The structured questionnaire adopted in this study comprised demographic characteristics (e.g., age, sex, marital status, and education level), the Montreal Cognitive Assessment (MoCA), and the UCLA Loneliness Scale (Version 3). These scales employ validated Chinese versions. The Montreal Cognitive Assessment (MOCA) was used to assess general cognitive functioning; specifically, it assesses functions such as short-term memory, visuospatial abilities, executive functions, attention, concentration, working memory, language, and orientation to time and place. It has a maximum total score of 30 points and is administered for approximately 10–15 min. The calculation of the scale score is convenient and simple. A score of 26 points or above is considered normal. If the participant has less than 12 years of education, one point is added to the total score. Higher scores indicate better cognitive function. The scale is widely used and psychometrically sound, with good reliability and validity (Tseng et al. 2011). Cronbach's α obtained from the pre-test data was 0.86 (Nasreddine et al. 2005).

The UCLA Loneliness Scale (Version 3), developed by psychologist Daniel Russell, is used to assess the self-perceived loneliness of older people to clarify changes in their loneliness during the therapeutic intervention (Russell 1996). This scale comprises 20 items and uses a 4-point rating scale (1 = never; 4 = always) for a total score of 20–80; a higher score indicates a more severe case of loneliness. Cronbach's α obtained from the pre-test data was 0.90. Information on depressive symptoms was extracted from the participants' medical records maintained by the long-term care facilities. These data were used only to describe baseline health conditions and were not included as outcome variables in the statistical analyses. Cognitive function and loneliness assessments were conducted one week before and after the intervention. A psychologist administered the standardized questionnaires face-to-face to ensure accurate comprehension and responses.

2.3. Intervention

The primary researcher—a therapist trained in board games—conducted the interventions. The intervener served as the leader of the board game program. The researcher is highly experienced in leading institutional activities for older adults and has completed training courses pertinent to long-term care and research ethics. To enhance intervention consistency, all sessions were conducted by the same researcher using a standardized activity structure and session procedures. A therapist conducted all board game group activities. Such activities were designed to stimulate and enhance the cognition, communication, interpersonal interactions, and well-being of older adults in long-term care facilities.

This board game program was developed from the handbook of board games for groups and Yao's study, which used board game activities with Taiwanese older people (Yao 2019). Subsequently, during an expert panel discussion involving a psychologist, nursing professor, recreational therapist, and social worker, who are all experienced in working with older adults, various board games were selected for the sessions. Different board games were intentionally incorporated to stimulate multiple domains of cognitive and psychosocial functioning, including memory, attention, logical reasoning, interpersonal interaction, and communication. Each session comprised different types of activities: (a) destined to gather together, (b) memory quiz, (c) childhood memory, (d) unity is

strength, (e) speed test, (f) brainstorming, and (g) graduation ceremony; these were used to design the sessions in the intervention. The themes of the sessions for each board game program are listed in Table 1.

Table 1. Contents of the Board Game Activities Sessions.

Session	Theme	Name of Board Game
Destined to gather together	1. Introductions, setting group norms, and expectations. 2. Introduction to board game program, materials, and principles.	
Memory quiz	1. Train group members to construct a visual space. 2. Enhance members' memories. 3. Increase opportunities for interpersonal interaction between members.	Zicke Zacke Huhnerkacke
Childhood memory	1. Enhance members' comprehension ability. 2. Strengthen members' concentration.	Hisss
Unity is strength	1. Enhance members' hand coordination. 2. Improve members' thinking ability. 3. Strengthen members' calculation ability.	Noah's ark
Speed test	1. Train members' ability to respond. 2. Enhance members' concentration. 3. Increase opportunities for interpersonal interaction.	Speed cups.
Brainstorming	1. Improve members' abstract thinking ability. 2. Train members' logical thinking abilities. 3. Strengthen members' decision analysis ability.	Rummikub
Graduation ceremony	1. Review the feelings experienced when playing board games. 2. Discuss the activity that made the deepest impression. 3. Give feedback to each member.	

A total of six 120 min board game activities were conducted once per week. Attendance was recorded throughout the intervention period to monitor participant adherence to the intervention sessions. The physiological and psychological conditions of the participants were assessed before each activity, and their safety was ensured by the researcher and institute personnel. No serious adverse events related to the board game activities were observed during the intervention period. The intervention was conducted in small groups of five or six participants. The activity sessions were conducted in a quiet, well-lit room at a long-term care facility. Each session was divided into four stages: (1) 10 min for introduction and warm-up, (2) 90 min for board game activities, (3) 15 min for sharing, and (4) 5 min to conclude the session. The comparison group received routine activities offered by the facility, which generally included watching television, singing karaoke, and exercising. Cognitive and loneliness outcomes were assessed only at baseline and after the 6-week intervention; data were not recorded separately by individual game type or session. Consequently, descriptive or inferential analyses by game type were not feasible.

2.4. Research Ethics

This study was approved by the Institutional Review Board and was conducted with the consent of all ten long-term care facilities. The researcher explained the objectives and methods of this study to the participants and obtained their written consent. The participants' anonymity and confidentiality were protected. Questionnaires were distributed to the participants before and after the six-week program. All research data were encoded to ensure the anonymity of the participants and used only for academic research purposes. The participants were permitted to withdraw from a session or quit

the study altogether during the research procedure for any reason without having their rights to receive care affected.

2.5. Data Analysis

Quantitative data were analyzed using IBM SPSS 25.0. Descriptive statistics were used to summarize the sociodemographic characteristics of participants at baseline. The homogeneity of the study groups at baseline was examined by using χ^2 for characteristics at the categorical level and independent-samples *t*-test for the continuous data. A generalized estimating equation was employed to determine the within- and between-group changes in outcomes over time. The analytical strategy followed three steps. First, descriptive statistics and *t*-tests were used to examine baseline comparability and within-group changes. Second, ANCOVA was conducted as a supplementary analysis to compare post-intervention outcomes while adjusting for baseline values. Finally, generalized estimating equations (GEE) were used as the primary model to examine the effects of time, group, and the group $\times$ time interaction while accounting for within-subject correlations in repeated measurements. All GEE models were fitted using an exchangeable working correlation structure and robust (Huber–White) standard errors. Under this approach, parameter estimates remain asymptotically consistent even if the working correlation structure is misspecified, although efficiency and the precision of standard errors may be reduced. Departures from normality primarily affect efficiency rather than consistency of estimates. Readers should interpret the results with these considerations in mind. The analysis assumed a 2-tailed distribution, reported along with 95% confidence intervals, and was considered significant at a level set at 5%. Because participants were nested within long-term care facilities, a potential cluster effect at the institutional level cannot be ruled out. However, owing to the limited number of participating facilities and the exploratory nature of this study, facility-level clustering was not explicitly modeled in the primary analyses. Therefore, the reported standard errors and significance levels should be interpreted with caution.

3. Results

3.1. Demographic Information

In this study, 70 eligible participants were allocated to either the experimental or the comparison group. After the 6-week intervention, the final sample comprised 67 participants. One participant in the comparison group did not complete the post-test evaluation due to their loss of interest, and two participants were hospitalized and did not participate in the post-test. Thus, 67 participants (35 and 32 in the intervention and the comparison groups, respectively) completed all parts of the study. Of the total, 34 participants were male, and 33 were female, with an average age of 76.35 years. In addition, 28.20% were married, and 32.75% had elementary education. The participants had an average of 1.98 types of chronic diseases, with an average cognitive function score of 17.46 points, an average loneliness score of 48.87 points, and an average depression score of 7.23 points. The chi-square and independent-samples *t*-tests showed that the two study groups were generally comparable in demographic and baseline characteristics, except for sex, which differed significantly between groups ($p = 0.010$). The demographic and baseline characteristics of the participants are presented in Table 2.

Table 2. Demographic Profiles of Participants and Baseline Comparisons between the Intervention ($n = 35$) and Comparison Groups ($n = 32$).

Variables	Intervention Group ($n = 35$)					Comparison Group ($n = 32$)					p^a/p^b
	M	SD	Range	n	%	M	SD	Range	n	%	
Sex											0.010
Male				23	65.7				11	34.4	
Female				12	34.3				21	65.6	
Marital Status											0.975
Married				11	31.4				8	25.0	
Widowed				18	51.5				18	56.3	
Single				6	17.1				6	18.7	
Education											0.080
Elementary				12	34.3				10	31.2	
Junior High School				16	45.7				15	46.9	
>Senior High School				7	20.0				7	21.9	
Age	74.60	7.40	73.02–82.84			78.10	8.50	72.03–86.58			0.076
Number of Chronic Illnesses	1.97	0.51	0.76–3.44			1.99	0.54	0.51–4.07			0.999
SPMSQ ^a	8.87	1.54	6.51–10.86			8.91	2.12	6.09–12.67			0.372
ADL ^b	68.50	5.75	60.10–75.40			66.00	4.57	60.15–74.85			0.553
Depression Level	7.32	1.21	5.13–10.65			7.14	1.26	4.49–11.26			0.278
Cognitive Function	18.17	4.15	17.20–23.30			16.75	4.94	14.90–22.50			0.206
Loneliness	49.49	4.45	43.10–55.30			48.25	3.11	43.80–55.10			0.197

Note: p^a = chi-square test; p^b = independent-sample t -test. ^a SPMSQ = Short Portable Mental Status Questionnaire. ^b ADL = Activities of Daily Living.

3.2. Intervention Effects on the Outcomes

Table 3 compares the baseline and outcome data, and their respective mean change scores at 6 weeks for the MoCA and UCLA Loneliness Scale for both the intervention and comparison groups analyzed by the paired t -test. p -values below 0.05 indicate a difference between the two phases of cognitive function and loneliness.

Table 3. Cognitive Function and Loneliness Comparison between the Intervention and Comparison Groups.

Variables	Pre-Test (T1)	Post-Test (T2)	T2–T1	p
Cognitive Function	M (SD)	M (SD)	t^a	
Intervention Group	18.17 (4.15)	21.97 (3.43) ^{ab}	7.01	<0.001 ***
Comparison Group	16.75 (4.94)	15.91 (4.22)	−1.22	0.231
t^b	1.28	6.49		
p	0.206	<0.001 ***		
Loneliness				
Intervention Group	49.49 (4.45)	45.34(5.36) ^{ab}	−3.39	<0.01 **
Comparison Group	48.25 (3.11)	52.84(6.56)	3.13	<0.01 **
t^b	1.31	−5.14		
p	0.197	<0.001 ***		

Note: t^a = paired-samples t -test; t^b = independent-samples t -test; ^a = significant difference between T2 and T1; ^b = significant difference between the intervention and comparison groups at T2. ** $p < 0.01$, *** $p < 0.001$.

The results of the independent-samples *t*-test showed that the difference between the baseline and post-intervention cognitive function scores was greater in the intervention group than in the control group. Subsequently, the pre-and post-test mean scores of the intervention group for cognitive function were 18.17 and 21.97, respectively; the cognitive function alleviation of the intervention group was significant ($t = 7.01, p < 0.001$) and improved more than that of the comparison group ($t = -1.22, p = 0.231$). In the intervention group, the results were significant and had increased, indicating that over time, the cognitive function of the elderly participants had risen. Indeed, the intervention group ($t = -3.39, p < 0.01$) also reported a significantly greater improvement in loneliness scores compared to those of the comparison group ($t = 3.13, p < 0.01$) over time, and the comparison group experienced a noticeable increase in loneliness. The board game activities appeared to be well-accepted by the participants, as the mean number of sessions attended was 11.4 (SD = 1.31), with 90% of the participants completing 5–6 sessions.

As shown in Table 4, the means in the intervention and comparison groups were not significantly different in the pre-test, but a significant increase in cognitive function and a significant decrease in loneliness were observed in the intervention group in the post-test. Analysis of Covariance (ANCOVA) was conducted as a supplementary analysis to compare post-intervention outcomes while adjusting for baseline values. ANCOVA test showed that in the pre-test scores, the board game intervention resulted in a significant difference in cognitive function ($F = 11.08, p = 0.001, \eta^2 = 0.45$) and loneliness ($F = 9.26, p = 0.001, \eta^2 = 0.39$) between the intervention and comparison groups. In addition, Cohen's *d* was calculated for within-group pre-post comparisons, with values of 0.91 for cognitive function and 0.77 for loneliness in the intervention group, suggesting moderate to large effects.

Table 4. Results of ANCOVA Test of the Intervention and Comparison Groups in Pre-test and Post-test.

	Pre-Test (T1)	Post-Test (T2)	F	Level of Significance	η^2
Variables	M (SD)	M (SD)			
Cognitive Function					
Intervention Group	18.17 (4.15)	21.97 (3.43)	11.08	0.001	0.45
Comparison Group	16.75 (4.94)	15.91 (4.22)			
Loneliness					
Intervention Group	49.49 (4.45)	45.34 (5.36)	9.26	0.001	0.39
Comparison Group	48.25 (3.11)	52.84 (6.56)			

To analyze the patterns of changes in the cognitive function and loneliness scores of the participants in the intervention and comparison groups, the researchers used a generalized estimating equation (GEE). Prior to GEE analysis, we conducted Kolmogorov–Smirnov and Shapiro–Wilk tests to examine the normality of the cognitive function and loneliness scores. The results confirmed approximate normality. This study used generalized estimating equations (GEE) for repeated-measures analysis, following standard statistical approaches reported in the literature (Wu 2011). A GEE model was employed to determine within- and between-group changes in outcomes over time. Post-and pre-test comparisons (T2 vs. T1) were conducted using the model-based variance estimator and the exchangeable covariance matrix to verify the final impact of the board game activity intervention and the interaction of time on older adults in long-term care facilities. The GEE analysis revealed a significant group $\times$ time interaction effect for cognitive function, indicating that participants in the intervention group showed greater improvement over time than those in the comparison group. The GEE model also indicated a significant group $\times$ time interaction effect for loneliness, suggesting that loneliness

decreased significantly in the intervention group compared with the comparison group over time. Based on the findings of the study, the difference between the means of the cognitive function and loneliness scores was statistically significant, suggesting that the intervention may have contributed to improvements in cognitive function and loneliness among participants in the intervention group. Moreover, the results showed that time had a significant effect (Table 5).

Table 5. Generalized Estimation Equations Analysis of Cognitive Function and Loneliness.

Predictor Variables	Estimate Parameters (β)	SE	Wald χ^2	df	p
Cognitive Function					
Intercept	9.70	1.87	26.98	1	0.000 ***
Categories (Intervention Group vs. Comparison Group)	−4.78	2.50	3.65	1	0.041 *
Time					
T2 vs. T1	−0.50	1.21	0.18	1	0.671
Categories × Time					
Intervention Group (T2 vs. T1)	3.86	1.94	3.92	1	0.000 ***
Loneliness					
Intercept	53.69	0.15	47.82	1	0.000 ***
Categories (Intervention Group vs. Comparison Group)	0.75	0.39	3.10	1	0.039 *
Time					
T2 vs. T1	−0.05	0.21	0.06	1	0.434
Categories × Time					
Intervention Group (T2 vs. T1)	2.31	0.32	21.80	1	0.004 **

Note: T1 = before intervention; T2 = after intervention. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

4. Discussion

This study explored the preliminary effects of board game interventions on cognitive function and loneliness among older adults in Taiwan's long-term care facilities. We hypothesized that board game activities for older people could not only promote the daily maintenance of a good emotional state but also effectively avoid cognitive decline. The findings indicated a more significant trend toward greater cognitive improvement among individuals who participated in the intervention group than in the control group. Moreover, our results suggest improvements in loneliness after the intervention. The findings of this study are in accordance with those of previous studies that have revealed that board game activities may contribute to improvements in cognitive function and reductions in loneliness among older adults, particularly in long-term care facilities (Dupl  a et al. 2017; Iizuka et al. 2019).

To the best of our knowledge, this is the first study to use a structured board game program for older adults in long-term care facilities in Taiwan. Additionally, this study will help build evidence based on the effectiveness of interventions to reduce cognitive impairment in older adults and provide valuable information for successful aging. The benefits of board games for older adults observed in our study are comparable to findings from other studies on short-term board game activities in patients (Estrada-Plana et al. 2021; Iizuka et al. 2018). A systematic meta-analysis has revealed that the active participation of older people in leisure activities, especially intellectual activities, such as reading, playing chess, or cards, may support cognitive reserve and maintenance of cognitive function in older adults (Qiu et al. 2019). In addition, some studies have also shown that stimulating intelligence activities (e.g., cards, chess, mahjong, and crossword puzzles) have been associated with lower observed rates of cognitive decline and de-

mentia-related outcomes (Marioni et al. 2015; Sommerlad et al. 2020). The positive results achieved in this study suggest that these stimulating intellectual activities may help support cognitive engagement and maintenance of cognitive function among older adults; subsequently, we can speculate that playing board games, which involves attention, reasoning, memory and initiative in cognitive fields, is a powerful and comprehensive stimulating activity for the brain (Stern 2012). As an alternative explanation, the cognitive reserve hypothesis can be applied to explain the beneficial effects of leisure activities on cognitive function in old age. According to this hypothesis, increasing the function or plasticity of related neural networks may delay the onset of dementia or reduce cognitive decline (Ballesteros et al. 2015). Given that older adults in long-term care facilities exhibit high cognitive plasticity, board game activities may exert a cognitive stimulation effect to improve global cognition.

Nevertheless, board game activities demonstrated a significant psychological effect in reducing loneliness among individuals engaged in long-term activities. Board game activities may reduce loneliness by providing structured opportunities for social interaction and shared meaningful engagement. Through cooperative play and group participation, older adults may experience increased interpersonal communication, perceived social support, and a greater sense of belonging. Our preliminary results suggest an improvement in loneliness after the intervention. This finding seems to have been influenced by participants' experiences during the intervention. The board game was a novel experience for most of the participants, who referred to themselves as inexperienced gamers. The participants received positive feedback from their leaders and group members during the activities and self-reflection on their life experiences. Beyond the observed statistical improvements in loneliness, the mechanisms underlying these effects warrant theoretical consideration. Board game activities in this study were designed to foster structured group interaction, mutual support, and positive social feedback. Drawing on the Social Support Theory and Group Cohesion Theory, it is plausible that such engagement created a sense of belonging and emotional connection among participants. The cooperative nature of many games likely contributed to shared goals, interdependence, and frequent communication, thereby enhancing social connectedness and reducing perceived isolation (R. Wang et al. 2019; Zhang et al. 2020). These theoretical perspectives provide insight into the observed psychological improvements. These mechanisms may explain the psychological benefits observed in the intervention group. The quantitative outcomes may be interpreted in relation to these theoretical mechanisms. Specifically, the intervention group showed a statistically significant reduction in loneliness from pre- to post-intervention, corresponding to a moderate-to-large effect size. The pattern of improvement was progressive across sessions rather than abrupt, which is consistent with the gradual accumulation of shared experiences and trust among participants. This trajectory aligns with the Social Support Theory, whereby repeated opportunities for positive interaction and mutual aid strengthen perceived support, and with Group Cohesion Theory, which posits that shared goals and interdependence enhance members' sense of belonging and social bonding. In our program, cooperative gameplay and facilitator-led reflection created conditions for collaborative problem solving, turn-taking, and encouragement from peers—behaviours that likely mediated the observed reduction in loneliness. By explicitly linking these effect sizes and change trajectories to theoretical processes, our findings provide preliminary support for the possibility that structured board game activities may help reduce loneliness through mechanisms of social bonding and interdependence rather than mere exposure to recreational activity. Studies have shown that participating in board game activities can promote the mental health of older people by providing social communication and interaction (Pardasani et al. 2018). Similar findings were evident in other studies where board

game activities using a similar approach demonstrated improvement in participants' mental health, which is also supported by our findings (Miltiades and Thatcher 2019; Narme 2016). Although this study utilized a variety of board games, the influence of individual game characteristics was not isolated. This limitation reflects the design of our study, which measured outcomes only pre- and post-intervention and did not collect repeated measures by game type. It is worth noting that different types of games—such as cooperative games that encourage collaboration, or action-based games that emphasize speed and competition—may have varied impacts on psychological outcomes like loneliness. For instance, games that require teamwork and verbal interaction might be more effective in enhancing social bonds and reducing perceived isolation. Future studies should consider investigating the differential effects of specific game features on intervention outcomes. Although we conceptually discussed how cooperative, competitive and cognitively stimulating games may differentially influence outcomes, our study design did not allow for reliable descriptive analyses by game type because only pre- and post-intervention assessments were conducted. Future research with larger samples and repeated measurements should explore the moderating role of specific game characteristics.

Overall, the findings of this study suggest that the implementation of a board game program may support improvements in cognitive function and reductions in loneliness among older adults in long-term care facilities. In order to situate our findings within a broader international context, we further examine how variations in social engagement norms, resource availability, and long-term care practices across countries may shape both the mechanisms and the magnitude of the observed effects. Older adults' responses to board game interventions may be shaped by cultural norms of social engagement, institutional resources, and long-term care practices. In Japan, for example, Go and other structured games are embedded in daily routines of many older adults, and randomized trials have shown moderate improvements in cognitive outcomes (Iizuka et al. 2018). This high baseline familiarity with cognitive games may produce smaller incremental gains (a ceiling effect) but facilitate stronger group cohesion. In contrast, European studies of community-based board game programs often take place in settings with less routine group activity and greater heterogeneity in game exposure, where structured interventions can yield larger relative improvements (Dartigues et al. 2013). Similarly, Canadian research has shown that digital or tabletop games can foster social engagement and reduce loneliness among institutionalized older populations (Dupl  a et al. 2017). These programs are typically implemented in facilities with comparatively high volunteer involvement and technology adoption, which may amplify social bonding effects but also shape feasibility and participant preferences. Taiwan's long-term care facilities, where our study was conducted, combine elements of both models: residents typically participate in daily leisure but have limited access to cognitively stimulating activities beyond television or passive entertainment. Introducing a structured board game program in this context may therefore generate both cognitive and psychosocial benefits by catalyzing new forms of social bonding and mental stimulation. These contextual differences highlight that the mechanisms of benefit—such as shared goals, interdependence, and social bonding—may operate differently across cultures and care systems. Understanding these factors can help practitioners adapt board game interventions to local norms and resources and guide future research on cross-cultural moderators of effectiveness (Zhang et al. 2020).

Furthermore, this study has presented the importance of mental health outcomes to the health and well-being of older adults. To implement board game interventions effectively in long-term care facilities, staff should receive training in game facilitation and participant engagement strategies. Sessions should be structured with a balance of stim-

ulation and rest, ideally conducted once or twice per week in small groups. Cognitive games such as memory matching or strategy-based games are recommended for individuals with early-stage cognitive decline, while more socially interactive or cooperative games may be better suited for residents with intact cognition but high levels of loneliness. Regarding scalability, many board games are low-cost and require minimal materials, making them feasible for widespread use. Involving trained volunteers or intergenerational programs can enhance sustainability. Future programs should also consider adaptive formats for residents with physical limitations or language barriers. These strategies can facilitate broader adoption of board game-based interventions in various long-term care settings.

Because subgroup-level data were unavailable in the present study, we could not empirically test heterogeneity of effects by age, sex, or education level. Nevertheless, drawing on our facilitation experience and existing literature (Ballesteros et al. 2015; Noda et al. 2019; Pardasani et al. 2018), we propose the following flexible strategies for adapting board game interventions to diverse participant profiles: (a) lower cognitive ability—use cooperative games with simple rules, clear visual cues, and stable pairings to build familiarity and reduce cognitive load; (b) higher cognitive ability—incorporate cognitively stimulating puzzles or strategy games and mild competitive elements to maintain engagement (Iizuka et al. 2018; Estrada-Plana et al. 2021); (c) lower literacy or education—prioritize icon-driven components and facilitator demonstrations rather than text-based instructions (Nakao 2019); (d) mobility limitations—offer seat-based games, adjust table height, rotate non-physical roles, and ensure easy reach of materials (Dupl  a et al. 2017). These differentiated, evidence-informed suggestions may guide practitioners in tailoring board game programs across long-term care settings and also highlight priorities for future research on subgroup-specific effectiveness.

However, this study has some limitations. First, although participating facilities were allocated to intervention or comparison conditions at the institutional level, this study was not conducted as a formal cluster randomized trial. Participants were recruited through convenience sampling, and the analyses did not explicitly account for intra-class correlation within facilities. As a result, the standard errors may have been underestimated and the statistical significance of the intervention effects may have been overstated. Therefore, the findings should be interpreted as preliminary and confirmed in future studies using fully powered cluster-randomized or multilevel designs. Although Table 2 shows no statistically significant baseline differences between the intervention and comparison groups on demographic characteristics and key outcomes, small imbalances (e.g., slightly higher baseline cognitive scores and lower loneliness scores in the intervention group) could still bias the estimated intervention effects. Such imbalances might lead to a modest overestimation of the cognitive and psychosocial benefits of the program, whereas the lower level of cognitive and social stimulation in the routine activities of the comparison group could also exaggerate contrasts. Readers should interpret our findings with these potential residual confounders in mind. Participants were not randomly assigned at the individual level, and the control group received routine activities that may lack comparable cognitive and social stimulation. These differences might have contributed to the significant improvements observed in the intervention group. Future studies should consider randomized controlled trials and active control conditions to strengthen the validity and generalizability of findings. Moreover, although GEE with robust standard errors yields consistent estimates under mild misspecification, violations of the working correlation or distributional assumptions may reduce efficiency; thus, our findings should be interpreted in light of these considerations. Second, the intervention was conducted in long-term care facilities. Therefore, the results may not be generalizable to other institutions. Third, the outcome

of this study was based only on the pre-and post-test results obtained after the sixth week of the intervention; thus, the long-term effects of the program on this population cannot be ascertained. Fourth, as this was a quasi-experimental study, only a small sample size was used. This finding suggests that further studies should explore the potential benefits of different board game activities for older adults living in long-term care facilities. Fifth, board game activities were performed only once a week for 6 continuous weeks, and the timing of this intervention may not have been adequate. Thus, it is worthwhile to consider designing a series of studies to examine the relationship between the intervention frequency and duration of board game programs. Sixth, this study did not conduct subgroup analyses by demographic characteristics such as age, gender, or education level due to the limited sample size within each category, which could result in underpowered statistical comparisons. Future studies with larger and more diverse samples are needed to explore whether these participant characteristics moderate the effects of board game interventions. We have nevertheless proposed differentiated, evidence-informed practice suggestions based on existing literature. Seventh, as this study was conducted during the COVID-19 pandemic, the loneliness of participants during this period might have fluctuated. Finally, long-term studies at different institutions are required to confirm the effectiveness of board game activities.

5. Conclusions

This study examined the preliminary effects of a structured board game intervention among older adults living in long-term care facilities in Taiwan following a six-week activity program. The findings provide preliminary evidence that board game activities may represent a feasible, low-cost, and socially engaging approach to support cognitive function and reduce loneliness among older adults in institutional settings. Therefore, this study contributes initial evidence regarding the potential psychosocial and cognitive benefits of board game activities in long-term care facilities. Regarding implications for practice, Taiwan has implemented long-term care policies in recent years to support healthy aging and maintain cognitive and psychosocial well-being among older adults. Social care professionals may consider incorporating structured board game activities into routine institutional programs to support cognitive engagement and social interaction among residents. Furthermore, board game activities may encourage older adults to participate more actively in institutional life and promote positive emotional experiences in daily living.

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