SciForschen
Open HUB for Scientific Research

Journal of Aging Studies and Therapies

Open Access

RESEARCH ARTICLE

Volume 1 - Issue 1 |

Efficacy of Computer-Assisted Cognitive Training in People with Early Dementia-A Single-Blind Randomized Controlled Trial

Natalie Yung Yung Lai[1]*, Cycbie Ching Man Mok[1], and Andrew Man Hong Siu[2]

[1]Department of Occupational Therapy, Castle Peak Hospital, Hong Kong
[2]Department of Rehabilitation Sciences, The Hong Kong Polytechnic University, Hong Kong

***Corresponding author:** Natalie Yung Yung Lai, Department of Occupational Therapy, Castle Peak Hospital, Hong Kong, E-mail: lyy542@ha.org.hk

Received: 09 May, 2019 | **Accepted:** 28 May, 2019 | **Published:** 05 Jun, 2019

Citation: Lai NYY, Mok CCM, Siu AMH (2019) Efficacy of Computer-Assisted Cognitive Training in People with Early Dementia-A Single-Blind Randomized Controlled Trial. J Aging Stud Ther 1(1): dx.doi.org/10.16966/jast.103

Abstract

Background and Objectives: With the advancement of technology, computer-assisted cognitive training specifically targeted to mild dementia has been developed and its positive effect on cognitive and affective status as well as functional performances has also been identified. The aim of our study is to verify the efficacy of computer-assisted cognitive training in people with early dementia in the local community.

Research Design and Methods: Sixty participants were recruited and randomly allocated into intervention group (n=30) and waitlist control group (n=30). The participants in intervention group had received a 6-weeks computer-assisted cognitive training program while that in waitlist control group had received usual intervention during the period. Outcome measures of their cognitive function, functional performance, self-esteem and quality of life were administered to both groups by an assessor blinded to subject randomization prior to the training (A0), immediately after (A1) and 6 weeks after the intervention (A2).

Results: Sixty patients were screened and included in the study, with thirty participants randomly allocated into intervention and waitlist control group respectively. There was a statistically significant group x time interaction effects in ADAS-cog ($F=16.51$, $p<0.001$) and CDAD scores ($F=4.37$, $p=0.015$) compared to waitlist control group. Contrast tests revealed that scores of ADAS-cog at Time A0 was significantly different from that at Time A1, while no significant difference was found between Time A1 and Time A2. Scores of CDAD in intervention group did not significantly change over the three time periods compared to the waitlist control group.

Discussion and Implications: The findings indicated that computer-assisted cognitive training was effective in improving cognitive function as well as in delaying the functional impairment of people with early dementia. This encouraging result definitely promotes the development of computer-assisted cognitive training for people with dementia in the local community.

Keywords: Cognition; Dementia; Intervention; Rehabilitation; Technology

Background and Objectives

Dementia is a global healthcare issue. According to the World Health Organization [1], the number of people living with dementia worldwide in 2015 was estimated at 47.47 million, reaching 75.63 million in 2030 and 135.46 million in 2050. This alarming expand also happened in the ageing society in Hong Kong [2]. The prevalence rate of community-dwelling dementia in local people aged 60 or above was 7.2% [3] and this number is projected to rise to 332.7 thousand people by the year 2039 [4].

Dementia is not simply a diagnosis or disease in itself. It involves progressive cognitive decline including memory and other higher cognitive functions such as orientation, language, visual-spatial ability and executive function [5]. It also contributes to gradual functional impairment in basic and instrumental activities of daily living [6,7]. With regard to the progressive nature of the disease, cognitive impairment shows different characteristic across the disease process. Hulette CM and colleagues [8] suggested that deficits in attention, memory and executive function were commonly found in people with early dementia. First, impaired attention, particularly divided and selective attention, which occurs in early Alzheimer's disease was believed to be a contributing factor of performance reduction in other cognitive and functional domains [9,10]. Second, memory difficulty is the most prominent feature of dementia which evolves with the early impairment in episodic memory followed by semantic one [11]. Third, the work of Baudic S and colleagues [12] supported the presence of executive dysfunction at the earliest stage of Alzheimer's disease and the impairment preceded the disturbance of sustained attention, language and constructional abilities.

In order to tackle the increasing challenges of dementia, there is a growing research to attenuate the cognitive decline and disease

progression. Compared with pharmacological treatments, non-pharmacological treatments are likely to be less expensive and more cost-effective with relatively no adverse effect [13-16]. The treatment effectiveness can also be enhanced with the association of anti-dementia drug therapy [17]. One of the potential non-pharmacological interventions is cognitive training. Cognitive training typically involves guided practice on a set of standard tasks designed to reflect specific cognitive functions [14]. With the advancement of technology, computer-assisted cognitive training specifically targeted to mild dementia has been developed and its positive effect on cognitive and affective status as well as functional performances has also been documented [18-23]. Furthermore, computer-assisted cognitive training demonstrates its advantages over conventional training in that they allow for graded difficulty and incorporate an interactive approach [24,25]. Despite of the encouraging findings, there exists a lot of uncertainty on its application and efficacy in the local community due to limited robust studies and a diversity of training activities adopted. The research question of our study is to evaluate the efficacy of computer-assisted cognitive training in people with early dementia in the local community.

Research Design and Method

Participants

Participants in the study were recruited from the memory clinic and psychogeriatric out-patient department of a regional mental health center by purposive sampling according to the following inclusion criteria: i) aged 65 or above; ii) clinically diagnosed as dementia according to the Diagnostic and Statistical Manual of Mental Disorders - IV criteria; iii) early stage of dementia, i.e. rated 1 in Clinical Dementia Rating Scale; iv) had a caregiver who clearly understand the participant's condition; and v) able to communicate in Cantonese. Conversely, participants were excluded from the study if they complicated with other mental illness such as depression, severe visual or hearing impairment, or major physical illness which could affect participation such as Parkinsonism [26].

Procedures

Written consent was obtained from participants and their caregivers. Participants were then randomly allocated to the intervention group and the waitlist control group. An independent blinded assessor was responsible to conduct all outcome measures, except the questionnaire on subjective training effect, for both groups before (A0) and immediately after the intervention (A1) and at 6 weeks after the intervention (A2).

A computer-assisted cognitive training program with twelve individual sessions (40 minutes each session) was offered to each participant twice per week for six weeks. Participants of the waitlist control group then received the same computer-assisted cognitive training program after reassessment at A2. The training program was mainly selected from the computer software specifically designed for the elderly, which involved the following training domains: declarative memory, selective and sustained attention, executive function, financial management, categorization, verbal fluency, digit span.

Outcome measures

Cognitive function: global cognitive function was measured by Chinese Alzheimer's Disease Assessment Scale-Cognitive Subscale (ADAS-cog) [27]. Alzheimer's disease Assessment Scale is a 21-item scale designed to assess the severity of cognitive and non-cognitive impairment in people with Alzheimer's disease. The cognitive subscale consists of 11 items which assess memory, language abilities, praxis and attention. Its total score ranges from 0 to 75, with higher score indicating greater impairment.

Functional performance: Chinese version of Disability Assessment for Dementia (CDAD) [28] was used to evaluate the functional performance of participants. It is a proxy reporting functional assessment specially designed for people with dementia. The locally validated Chinese version consists of 47 items that covers basic and instrumental activities of daily living. It demonstrates good psychometric properties and has been used in clinical trials as well as studies of people with dementia. The raw scores are expressed in percentages. The higher the percentages represents the better the functional performance.

Self-esteem: Rosenberg Self-esteem Scale is a 10-item measure of global self-esteem. The scale ranges from 0 to 30, with higher score indicating higher self-esteem. The reliability and validity of the Chinese Rosenberg Self-Esteem Scale [29] has been developed with an acceptable reliability.

Quality of life: Quality of Life in Alzheimer's Disease (QOL-AD): Patient and Caregiver Reports is a brief measure to obtain a rating of quality of life of people with Alzheimer's disease from both the patient and the caregiver. It consists of 13 items which assess individual's relationships with friends and family, concerns about finances, physical condition, mood and an overall life quality. It is rated on a 4-point scale with higher score indicating better quality of life. The translated Chinese version has been [30] validated with good psychometric properties.

Subjective training effects: A self-developed questionnaire ranging from (-3) "Not At All" to (+3) "Very Much" was used to collect subjective training effects from both the participants and caregivers. A neutral opinion was regarded as a valid attitude in this evaluation. The open-ended portion was also included to collect comments, justifications or suggestions associated with their ratings.

Results

Sixty patients were screened and included in the study, with thirty participants randomly allocated into intervention and waitlist control group respectively. Demographic characteristics, baseline cognitive function (ADAS-cog) and functional status (CDAD) were similar between the two groups (Table 1).

Two-way repeated measure ANOVA was used to examine the effects of the 6-weeks computer-assisted cognitive training program. There was a statistically significant group x time interaction effects in ADAS-cog ($F=16.51$, $p<0.001$) and CDAD scores ($F=4.37$, $p=0.015$) compared to waitlist control group (Table 2). However, no significant effect was found in the outcome measures of quality of life and self-esteem. For the statistically significant effects on ADAS-cog and CDAD, a post-hoc test was conducted using a priori Bonferroni's corrections (corrected $p=0.017$). Contrast tests revealed that scores of ADAS-cog at Time A0 was significantly different from that at Time A1 ($p<0.01$), while no significant difference was found between Time A1 and Time A2 ($p>0.017$) (Figure 1). Scores of CDAD in the intervention group did not significantly change over the three time periods compared to waitlist control group ($p>0.05$) (Figure 2).

Discussions and Implications

The 6-week computer-assisted cognitive training for people with early dementia showed encouraging results in two outcome measures. First, cognitive function of participants with early dementia significantly

Table 1: Demographics data and baseline comparisons between intervention and waitlist control group.

	Intervention group (n=30)			Waitlist-control group (n=30)			
	mean	%	SD	mean	%	SD	p value
Age (years)	77.8	-	6.7	78.3	-	6.4	0.8
Gender							
Male	-	50%		-	43.3%		
Female	-	50%		-	56.7%		
Marital Status							
Single	-	0.3%		-	0.4%		
Married	-	0.27%		-	0.13%		
Widowed	-	0.4%		-	0.47%		
Divorced	-	0.03%		-	0%		
Education (years)	5.1	-	4.0	4.4	-	3.8	0.5
MMSE	20.4	-	10.0	25.5	-	11.0	0.64
CDAD	77.9	-	16.3	71.1	-	13.8	0.1

Table 2: Group x time interaction effect in each group.

Outcome measures	Time A0	Time A1	Time A2	p
ADAS-cog				
Intervention group	20.4 (10.0)	15.6 (8.0)	14.0 (7.0)	<0.001
Waitlist-control group	25.5 (11.0)	24.7 (10.0)	25.9 (9.3)	
CDAD				
Intervention group	77.9 (15.5)	79.4 (16.7)	78.0 (15.6)	0.015
Waitlist-control group	71.1 (13.8)	68.4 (16.2)	66.0 (16.2)	
QoL-AD (patent's report)				
Intervention group	34.4 (5.2)	33.7 (5.3)	33.9 (5.8)	0.86
Waitlist-control group	32.9 (3.5)	32.3 (3.8)	32.0 (4.3)	
QoL-AD (carer's report)				
Intervention group	34.1 (4.2)	34.1 (5.0)	34.0 (5.0)	0.57
Waitlist-control group	32.5 (3.8)	33.4 (3.8)	33.4 (4.0)	
RSE				
Intervention group	27.8 (3.5)	37.4 (3.3)	27.4 (3.9)	0.95
Waitlist-control group	26.0 (3.4)	25.8 (3.5)	25.8 (3.3)	

improved after 6 weeks training and the improvements sustained over the 6 weeks follow-up period. In contrast, cognitive functions of that in waitlist control group remained relatively unchanged. The findings were consistent with previous literatures that support the efficacy of computer-assisted cognitive training on people with early dementia [18,19,23]. Compared with a local study by Lee GYY, et al. [31], positive effect on cognition on people with dementia was also consistent and our study even suggested that a 6-weeks sustainability effect on the improvements. Furthermore, a meta-analysis to review the cognitive training in dementia concluded that restorative cognitive training strategy like spaced retrieval and vanishing cues was more efficacious than compensatory strategy [32]. Although both training approaches provided evidence in cognitive training in various clinical applications, restorative strategy which involved general stimulation techniques was more practical and beneficial to people with deteriorating cognitive function than compensatory one which on the other hand involved learning of new mnemonics techniques and devices. Second, functional performance of participants receiving computer-assisted cognitive training was relatively sustainable whereas a functional decline was shown in waitlist control group. Though functional improvement cannot be promised particularly in progressive disease like dementia, the results still indicated a slower rate of decline in participants receiving computer-assisted cognitive training. In other words, computer-assisted cognitive training is effective in delaying the functional impairment in people with early dementia. In fact, few studies used performance-based outcome measures and their results were disparate. The potential explanation is the limitation in generalization effects of cognitive training to observable benefits in everyday activities [32,14].

For the quality of life and self-esteem, there was no significant improvement in participants receiving cognitive training. Quality of life and self-esteem are the subjective feeling derived from actual improvements in daily performance. Not surprisingly, the limitation in generalization of the gain in cognitive function to the daily activities restricted the quality of life and self-esteem experienced by the participants.

Positive findings of cognitive training in improving or delaying cognitive and functional outcomes of people with early dementia had already been reported in various literatures. Among previous

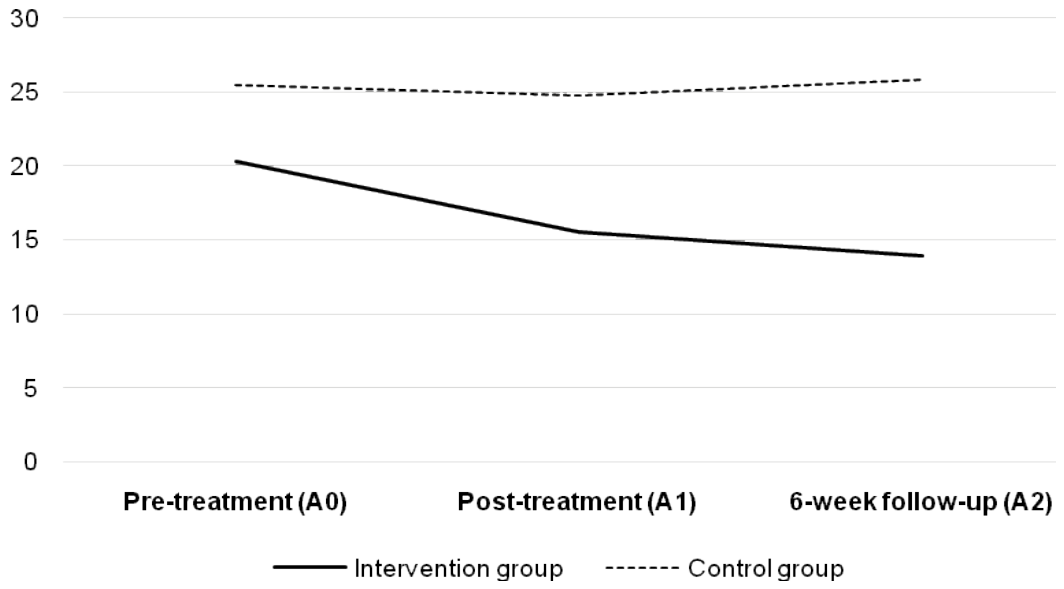

Figure 1: Mean scores of ADAS-cog administered at baseline (A0), post-treatment (A1) and 6 weeks follow-up (A2).

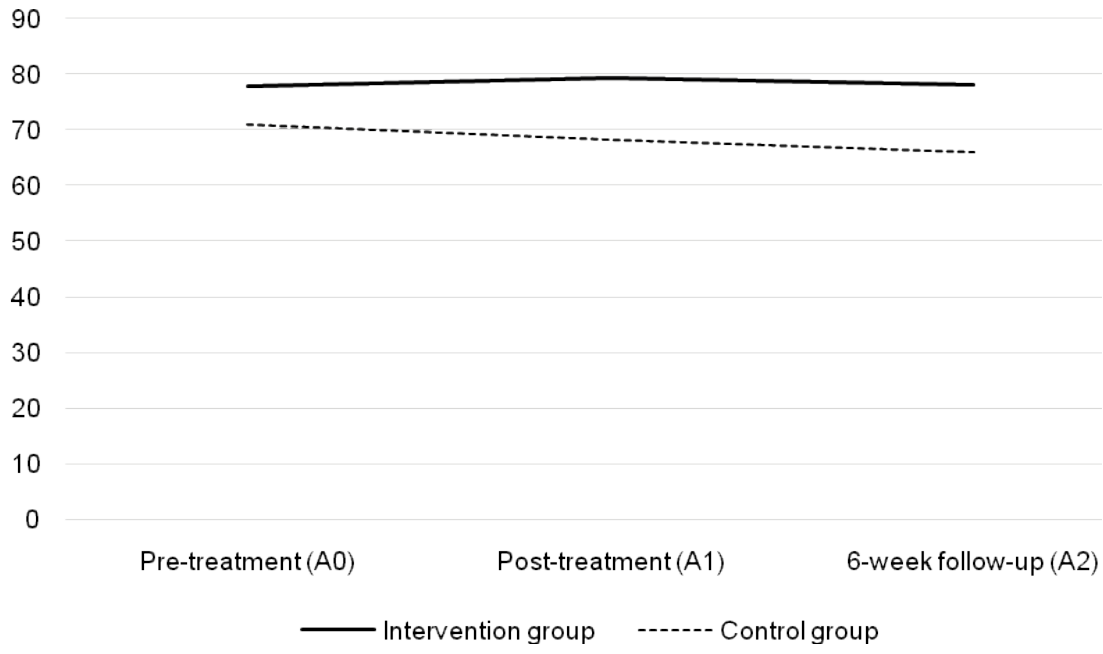

Figure 2: Mean scores of CDAD administered at baseline (A0), post-treatment (A1) and 6 weeks follow-up (A2).

similar studies, current study even is the first full single-blind RCT study in the local community. Investigators believed that it was the cognitive activity which protects against the decline. Cognitive training provides opportunity for people with dementia enhancing their cognitive activity, or cognitive reserve [25]. By maximizing the cognitive reserve, the risk and the rate of cognitive deterioration lowered. With the advancement of technology, computer-assisted cognitive training allows for graded programs in a more interactive, user-friendly and standardized approach as compared with traditional cognitive training.

There are several limitations in current study. First, types of dementia were not universal among participants. Although all of them were diagnosed as dementia, different types of dementia varied in the course of progression. Alzheimer's disease was predicted to have a rather stable deterioration while vascular dementia was more vulnerable to sudden changes in vascular system. Second, the optimal duration and intensity of computer-assisted cognitive training remained unclear. Conclusions could not been drawn from existing RCT studies due to their diversified training approaches and methodology adopted. Third, the issue of sustainability cannot

be comprehensively addressed. According to Stizer and colleagues [31], improvements for people with Alzheimer's disease after cognitive training could be maintained for four and a half months. For current study, improvements of cognitive functions could be sustained at the 6 weeks follow-up period, but it was still uncertain whether further sustainability continued as well as its benefits over traditional cognitive training.

Evidences had been indicated that computer-assisted cognitive training was effective in improving cognitive function and delaying functional decline of people with early dementia [33]. This encouraging result definitely promotes the development of computer-assisted cognitive training for people with dementia in local community. Further robust research with larger population, multi-center cooperation, longer follow-up period, universal diagnostic group were yielded to optimize the use of computer-assisted cognitive training in a standardized program.

References

1. World Health Organization (2015) The Epidemiology and Impact of dementia current state and future trends.
2. Census and Statistics Department (2010) Hong Kong Population Projections 2010-2039. Hong Kong.
3. Lam LC, Tam CW, Lui VW, Chan WC, Chan SS, et al. (2008) Prevalence of very mild and mild dementia in community-dwelling older chinese people in Hong Kong. Int Psychogeriatr 20: 135-148.
4. Yu R, Chau PH, McGhee SM, Cheung WL, Chan KC, et al. (2012) Trends in Prevalence and Mortality of Dementia in Elderly Hong Kong Population: Projections, Disease Burden, and Implications for Long-Term Care. Int J Alzheimers Dis 2012: 406852.
5. Zec RF (1993) Neuropsychological functioning in Alzheimer's disease. In: Parks RW, Zec RF, Wilson RS (eds) Neuropsychology of Alzheimer's Disease and Other Dementias. Oxford University Press, New York, USA 3-80.
6. Sauvaget C, Yamada M, Fujiwara S, Sasaki H, Mimori Y (2002) Dementia as a predictor of functional disability: a four-year follow-up study. Gerontology 48: 226-233.
7. Shiau MY, Yu L, Yuan HS, Lin JH, Liu CK (2006) Functional Performance in Alzheimer's Disease and Vascular Dementia in Southern Taiwan. Kaohsiung J Med Sci 22: 437-446.
8. Hulette CM, Welsh-Bohmer KA, Murray MG, Saunders AM, Mash DC, et al. (1998) Neuropathological and neuropsychological changes in "normal" aging: evidence for preclinical Alzheimer's disease in cognitively normal individuals. J Neuropathol Exp Neurol 57: 1168-1174.
9. Perry RJ, Watson P, Hodges JR (2000) The nature and staging of attention dysfunction in early (minimal and mild) Alzheimer's disease: relationship to episodic and semantic memory impairment. Neuropsychologia 38: 252-271.
10. Rizzo M, Anderson SW, Dawson J, Myers R, Ball K (2000) Visual attention impairments in Alzheimer's disease. Neurology 54: 1954-1959.
11. Storey E, Slavin MJ, Kinsella GJ (2002) Patterns of cognitive impairment in Alzheimer's Disease: assessment and differential diagnosis. Front Biosci 7: e155-e184.
12. Baudic S, Barba GD, Thibaudet MC, Smagghe A, Remy P, et al. (2006) Executive function deficits in early Alzheimer's disease and their relations with episodic memory. Arch Clin Neuropsychol 21: 15-21.
13. Buschert V, Bokde AL, Hampel H (2010) Cognitive intervention in Alzheimer's disease. Nat Rev Neurol 6: 508-517.
14. Clare L, Woods B, Moniz Cook ED, Orrell M, Spector A (2003) Cognitive rehabilitation and cognitive training for early-stage Alzheimer's disease and vascular dementia. Cochrane Database Syst Rev 4.
15. Knapp M, Thorgrimsen L, Patel A, Spector A, Hallam A, et al. (2006) Cognitive stimulation therapy for people with dementia: cost-effectiveness analysis. Br J Psychiatry 188: 574-580.
16. Spector A, Thorgrimsen L, Woods RT, Royan L, Davies S, et al. (2003) Efficacy of an evidence-based cognitive stimulation therapy programme for people with dementia: A randomised controlled trial. Br J Psychiatry 183: 248-254.
17. Bottino MC, Carvalho IA, Alvarez AM, Avila R, Zukauskas PR, et al. (2005) Cognitive rehabilitation combined with drug treatment in Alzheimer's disease patients: a pilot study. Clin Rehabil 19: 861-869.
18. Cipriani G, Bianchetti A, Trabucchi M (2006) Outcomes of a computer-based cognitive rehabilitation program on Alzheimer's disease patients compared with those on patients affected by mild cognitive impairment. Arch Gerontol Geriatr 43: 327-335.
19. Galante E, Venturini G, Fiaccadori C (2007) Computer-based cognitive intervention for dementia: preliminary results of a randomized clinical trial. G Ital Med Lav Ergon 29: B26-B32.
20. Hofmann M, Hock C, Muller-Spahn F (1996) Computer-based Cognitive Training in Alzheimer's Disease Patients. Ann N Y Acad Sci 777: 249-254.
21. Klimova B, Maresova P (2017) Computer-Based Training Programs for Older People with Mild Cognitive Impairment and/or Dementia. Front Hum Neurosci 11: 262.
22. Schreiber M (2010) Potential of an interactive computer-based training in the rehabilitation of dementia: An initial study. Neuropsychol Rehabil 9: 155-167.
23. Talassi E, Guerreschi M, Feriani M, Fedi V, Bianchetti A, et al. (2007) Effectiveness of a cognitive rehabilitation program in mild dementia (MD) and mild cognitive impairment (MCI): A case control study. Arch Gerontol Geriatr 44: 391-399.
24. Skilbeck C, Robertson IH (1992) Computer assistance in the management of memory and cognitive impairment. In: Wilson BA, Moffat N (eds) Clinical Management of Memory Problems. Chapman & Hall, London.
25. Mowszowski L, Batchelor J, Naismith SL (2010) Early intervention for cognitive decline: can cognitive training be used as a selective prevention technique? Int Psychogeriatr 22: 537-548.
26. Chiu HFK, Lee HC, Chung WS, Kwong PK (1994) Reliability and validity of the cantonese version of Mini Mental state examination-A preliminary study. Hong Kong Journal of Psychiatry 4: 25-28.
27. Chu LW, Chiu KC, Hui SL, Yu GK, Tsui WJ, et al. (2000) The Reliability and Validity of the Alzheimer's Disease Assessment Scale Cognitive Subscale (ADAS-Cog) among the Elderly Chinese in Hong Kong. Ann Acad Med Singapore 29: 474-485.
28. Mok CC, Siu AH, Chan WC, Yeung, KM, Pan PC, et al. (2005) Functional disabilities profile of chinese elderly people with alzheimer's disease-validation study on the chinese version of the disability assessment for dementia. Dement Geriatr Cogn Disord 20: 112-119.
29. Shek DTL (1992) 'Actual-ideal' discrepancies in the representation of self and significant-others and psychological well-being in Chinese adolescents. Department of Social Work, Chinese University of Hong Kong.

30. Chan IW, Chu LW, Lee PW, Li SW, Yu KK (2011) Effects of cognitive function and depressive mood on the quality of life in Chinese Alzheimer's disease patients in Hong Kong. Geriatr Gerontol Int 11: 69-76.

31. Lee GYY, Yip CCK, Yu ECS, Man DWK (2013) Evaluation of a computer-assisted errorless learning-based memory training program for patients with early Alzheimer's disease in Hong Kong: a pilot study. Clin Interv Aging 8: 623-633.

32. Stizer DI, Twamley EW, Jeste DV (2006) Cognitive Training in Alzheimer's disease: a meta-analysis of the literature. Acta Psychiatr Scand 114: 75-90.

33. Ferris CP, Prince M, Brayne C, Brodaty H, Fratiglioni L, et al. (2005) Global prevalence of dementia: A delphi consensus study. Lancet 366: 2112-2117.