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FACTORS ASSOCIATED WITH COGNITIVE FUNCTION AND ACTIVITY OF DAILY LIVING AMONG RESIDENTS OF LONG-TERM CARE FACILITIES IN TAIWAN

Ming-Han Chiang¹, Ching-Len Yu², Su-Hsien Chang^{*3}

¹Department of Applied Cosmetology, National Tainan Institute of Nursing, Tainan city, Taiwan ROC.

²Department of Environmental Engineering, Kun Shan University, Tainan City, Taiwan ROC.

^{3*}Department of Senior Citizen Services, National Tainan Institute of Nursing, Tainan City, Taiwan ROC.

ABSTRACT

The purpose was to identify factors in association with cognitive function and levels of activity of daily living (ADLs) among residents living in long-term care facilities. This is a cross-sectional, descriptive and correlational study. Five long-term care facilities located across southern Taiwan involving 106 residents were recruited. Result found that age, length of residence in a long-term care facility, cognitive function, depressive symptoms and behavioural problems were significant predictors of the level of ADLs. Results also showed the cognitive function was a correlated performance of feeding, washing, dressing, grooming and toileting and behavioural problems were a major significant predictor of cognitive function and level of ADLs. Further studies should examine interventions to prevent behavioural problems, consequently, to prevent cognitive function and ADL declined in older people with dementia living in long-term care facilities.

KEYWORDS

Cognition, Activities of daily living, Depression, Long-term care and Aging.

Author for Correspondence:

Su-Hsien Chang,
Department of Senior Citizen Services,
National Tainan Institute of Nursing,
Tainan City, Taiwan ROC.

Email: suhsian@yahoo.com

INTRODUCTION

The global population is ageing with a radically increasing rate. In 2015, 900 million individuals were aged 60 years and older; it was estimated that this figure will increase to 2 billion by 2050¹. Ageing people face a growing risk for dependency, due to the gradual decrease in physical capacity and cognitive function. Some ageing people even have to live in a long-term care facility.

Daily events and activities in long-term care facilities are fixed and scheduled. Given that residents experience fewer changes and social interactions, their cognitive function, physical health, depressive mood status and activities of daily living (ADLs) may decline². Owing to degeneration, pessimism, pain, idleness, stubbornness and falls, residents are more likely to become dependent with regard to performing ADLs³. Their ability to perform basic and instrumental ADLs and their psychological well-being thus have become an issue for a long-term care facility⁴.

The ability to perform ADLs is dependent upon cognitive and motor function⁵. Helvik *et al.*⁶. Conducted a 52-month prospective study to investigate functional decline among 932 nursing home residents with dementia. They observed that the subjects with severe dementia had poorer ADL performance. Gievel *et al.*⁷, examining the effects of dementia on 122 elderly individuals by observing their ADLs and quality of life across different stages of dementia, reported that bathing and dressing impairments were present in earlier stages of dementia, whereas toileting, ambulation and feeding impairments were present in the later stages of dementia.

The study by Fauth *et al.* Showed that ADL disability was a statistically significant predictor of incident dementia for 3547 subjects with an average age 74.9 years⁸. Boyle *et al.*⁹ found that apathy was a significant predictor of basic ADLs among 45 subjects with mild-to-moderate Alzheimer's disease (accounting for 15% of the variance) after considering cognitive functioning. The study by Lin and Wu¹⁰ indicated that the decline of ADLs can initiate depression and functional disability. Their observation was in agreement with that of Boström *et al.*¹¹, who suggested that dependence in mobility, transferring and dressing can have a particularly strong association with depression.

Arai and colleagues¹², who examined the prevalence of behavioural and psychological symptoms and their associated factors in individuals with dementia residing in long-term care facilities. They showed that the following four factors were significantly associated with having behavioural and

psychological symptoms: having Alzheimer's disease, imbalance between ADLs and cognitive function, poor relationships with other residents and persistent requests in daily life. Similarly, Okura and colleagues¹³ estimated the prevalence of neuropsychiatric symptoms and examined their association with functional limitation in 856 older adults aged 71 and over. They reported that depression was the most common symptom in those with mild dementia (25%), whereas apathy (42%) and agitation (41%) were most common in those with severe dementia. They also found that individuals with three or more neuropsychiatric symptoms (e.g., delusion, hallucination, agitation, depression, anxiety, elation, apathy, disinhibition, irritability and aberrant motor behaviours) had higher odds of functional limitations. Moreover, those with clinically significant depression had higher limitations in performing ADLs¹³.

In these previous investigations, age, performance of ADLs, and cognitive function have been commonly used as variables associated with independence in residents of long-term care facilities. However, cognitive function and ADLs could be affected by some factors over time.

Objective

To identify factors association with cognitive function and ADLs among residents living in long-term care facilities.

MATERIAL AND METHODS

Study design and subjects

This cross-sectional, descriptive and correlational study. Subjects selection criteria were: (1) aged 55 and over, (2) lived in a long-term care facility upon recruitment, (3) able to speak Mandarin or Taiwanese, (4) bed-ridden for less than 6 months and (5) currently dependent on staff caregivers for the performance of one or more ADLs.

Patient and public involvement

Subjects were recruited using non-probability convenience sampling at five long-term care facilities located across southern Taiwan. To identify eligible subjects, first, the head nurse of the long-term care facility (LTCF) identified eligible residents for the study. After initial identification by the head

nurse from each LTCF, the principle investigator (PI) met individually with each subject or his/her legal guardian, and verbally present a brief explanation of the purpose of the study and a statement concerning confidentiality. Subjects or their legal guardian were encouraged to ask questions about the study and called the PI for additional information at a later time. All consenting subjects were asked to sign the Human Subjects approved informed consent form. G-Power software was used to analyze power. With alpha level.05, effective size.15, 5 predictors, linear multiple regression and 106 subjects, power was .87.

Instruments

Demographic instruments assessed the residents' age, length of residence in the long-term care facility, reasons for admission into a long-term care facility, sex, marital status, education level and number of diseases or health problems.

The Mini-Mental State Exam (MMSE) is a criterion-referenced instrument with 11-items that has been used to examine the cognitive status of subjects. It measures subjects' orientation, registration, recall, attention and calculation, language and constructive capacity. Scores range from 0 to 30, with higher score indicating better cognitive function¹⁴. The following four cut-off levels was employed to classify the severity of cognitive impairment: no cognitive impairment 24-30; mild cognitive impairment 19-23; moderate cognitive impairment 10-18; and severe cognitive impairment ≤ 9 . MMSE-education adjusted cut-off scores was 22 or below in 7th grade or lower; 24 or below in 8th grade or some high school (but not a graduate of). The MMSE has been translated and widely used within Taiwan.

The Refined ADL Assessment Scale (RADL) developed by Tappen has been used to measure ADL performance among elderly individuals with Alzheimer and related disorders¹⁵. It measures five basic ADLs, including feeding, washing, grooming, dressing and toileting, each of which is broken down into two to five tasks. Each task is broken down into the sequence of steps needed for completion. The numbers of steps range from 5 to 21 depending on the task. The observer rates each step across a continuum ranging from unassisted, verbal prompt,

nonverbal prompt, physical guidance and full assistance. Content validity was examined by an expert panel. The resulting internal consistency of each sub-task in the RADL ranged from 0.89 to 0.96. This study included the following five basic ADLs: feeding, washing, grooming, dressing and toileting. The feeding activity includes three tasks-using a spoon, drinking from a glass or cup and using a napkin, with possible scores ranging from 0 to 54, 0 to 42 and 0 to 30, respectively. The washing activity includes two tasks-face-washing and hand-washing, with scores ranging from 0 to 126 and 0 to 78, respectively. Grooming activity includes teeth-brushing (included dentures) and hair combing, with scores ranging from 0 to 114 and 0 to 60, respectively. The dressing activity includes three tasks: dressing-pants, dressing shirt or blouse and putting on shoes, with scores ranging from 0 to 66, 0 to 48 and 0 to 36, respectively. The toileting activity includes two tasks: entering bathroom and toileting (defecating), with scores for these tasks ranging from 0 to 54 and 0 to 72, respectively. Summing the tasks scores of each activity provides the total score of that particular activity, which reflects the level of ADL performance. Therefore, the total score for feeding, washing, grooming, dressing and toileting activities ranged from 0 to 126, 0 to 204, 0 to 174, 0 to 150 and 0 to 126, respectively. The overall scores for the level of ADL performance therefore ranged from 0 to 780, with a higher overall score indicating a stronger independence in ADL performance.

The Clifton Assessment Procedures for the Elderly-Behaviour Rating Scale (CAPE-BRS) has been used to investigate behavioural problems of subjects with dementia. The problems included ADL performance, apathy, communication difficulties and social disturbance. This scale includes 18 items, each of which is scored from 0 to 2. The total score hence ranges from 0 to 36, with higher scores indicating greater disability¹⁶. A Chinese translation for this sale is available, with an expert content validity of 0.83 and reliability of 0.84¹⁷.

The Cornell Scale for Depression in Dementia (CSDD) has been used to measure symptoms of depression among patients with dementia, including mood ratings, behavioural disturbances, physical

signs, cyclic functioning and ideational disturbance. This scale includes 19 items, each of which can be scored from 0 to 2 [absent (0), mild or intermittent (1), severe (2)], with the total score thus ranging from 0 to 38¹⁸. The CSDD has been translated into Chinese, with an expert content validity of 0.92 and reliability of 0.84¹⁹.

The SPSS 20.0 statistical software package for window was used to analyze the data. An alpha was set .05 for level of significance.

Data collection procedures

Data were collected from November 2019 to January 2020. Demographic data were collected via medical chart review. The MMSE was conducted via individual face-to face interviews. The ADLs, CAPE-BRS and CSDD were conducted by observing the subject during morning care, lunch time and leisure time in the afternoon. However, data were collected by two research assistants. To measure inter-rater reliability of data collection, the PI had the research assistants conducted face-to-face interviews and made observations to a residents living in a long-term care facility. The resident was recruited from the other long-term care facility selected for this study. This process was repeated until 95% agreement was attained.

Data analysis

Demographic variables were analysed using descriptive statistics. Descriptive data are presented in tables including the MMSE, CSDD, CAPE-BRS, ADLs, and demographic of the sample (age, length of stay in a long-term care facility, gender, marital status, reasons for admission, and education). Pearson's correlation was used to analyse the correlation among variables. One-way ANOVA was used to examine the changes of cognitive function, according to the level of the ADLs profile. A Tukey HSD (Tukey's Honestly-Significant Difference) post-hoc test was performed to find the difference of the grading of the cognitive state. Linear and multiple regression analyses were used to reveal predictors of ADLs and cognitive function among our subjects.

RESULTS AND DISCUSSION

Sample characteristics

A total of 106 subjects with an average age of 82.75 (SD = 10.21) years old participated in this study. The average duration of residence in one of the long-term care facilities was 47.57 (SD = 38.13) months. Majority of the subjects were widows or widowers (n = 44, 41.5%). Table No.1 summarises the demographic information and MMSE, CSDD, CAPE-BRS and ADL profile scores.

Association among variables

The Kolmogorov-Smirnov test was performed to test the normality of each variable. Accordingly, our results showed that the variables in MMSE ($p < 0.05$), CSDD ($p < 0.05$), CSDD ($p < 0.05$), CAPE-BRS ($p < 0.05$) and ADL profile (including washing, grooming, dressing, feeding and toileting) ($p < 0.05$) were normally distributed. The results of Pearson correlation analysis provided in Table No.2 showed a relationship between cognitive function, ADL profile (including washing, grooming, dressing, feeding and toileting) and related factors. Accordingly, our findings revealed that that MMSE was significantly positively correlated with the ADL profile but was significantly negatively correlated with the CSDD and CAPE-BRS. Moreover, age was significantly positively correlation with length of residence in a long-term care facility.

One-way ANOVA was used to examine the severity of cognitive impairment affecting the ADL profile of residents (Table No.3). Levene's test was used to examine whether significant differences existed in the variances of the four groups. Accordingly, our results showed no significant differences ($p > 0.05$) in the levels of washing, grooming, dressing, toileting and ADL. However, a significant difference ($p < 0.05$) was observed for the level of feeding. Moreover, the severity of cognitive impairment significantly affected residents' washing ($F = 12.036, p < 0.001$), dressing ($F = 9.427, p < 0.001$), feeding ($F = 2.738, p < 0.05$), grooming ($F = 5.355, p < 0.01$), toileting ($F = 6.929, p < 0.001$) and level of ADLs ($F = 11.961, p < 0.001$). The results of Turkey's test found that subjects with severe cognitive impairment has a significantly lower score in washing, dressing, grooming, toileting, and ADLs

yield than subjects with normal cognitive function, and mild and moderate cognitive impairments. Subjects with severe cognitive impairment also has a significantly lower score in feeding than subjects with moderate cognitive impairments.

Predictors of ADLs and MMSE

Linear regression analysis was used to determine predictors of ADLs and cognitive function of participants. Accordingly, our results showed that the age, length of residence in a long-term care facility, years of education, MMSE, CSDD and CAPE-BRS explained 50% of the total variance ($R^2 = 0.533$, adjusted $R^2 = 0.504$) on ADLs, but the significant predictor of ADLs was only CAPE-BRS ($p < 0.001$). Moreover, the age, length of residence in a long-term care facility, years of education, CSDD and CAPE-BRS explained 44.0% of the total variance ($R^2 = 0.467$, adjusted $R^2 = 0.440$) on MMSE, but the significant predictor of MMSE was years of education and CAPE-BRS ($p < 0.001$).

Discussion

The present study showed that cognitive function was positive correlated with ADLs, particularly feeding, washing, dressing, grooming and toileting. Moreover, CAPE-BRS was a major significant predictor of MMSE and level of ADLs. The present findings are in agreement with those of the recent studies²⁰⁻²³. For instance, Beker and colleagues²², who conducted a cohort study to understand the association between cognitive function, physical health and other related factors among 330 cognitively healthy centenarians, found that participants' cognitive functional performance was associated with the factor of a higher Barthel index, which measured ADLs and assessed one's degree of independence. Fujita *et al*⁸, investigated the associations between cognitive function, physical functions and toilet independence in 125 patients with stroke. They reported that the interaction between trunk and cognitive function or trunk function and age was associated with toilet performance, despite that the subjects were in different health (stroke) conditions.

Tierney *et al.* examined whether apathy, which was assessed using the Frontal Systems Behavioral Scale (FrSBe), in 83 community-dwelling older

individuals was associated with their ADLs and quality of life²³. Accordingly, their results found that older individuals with higher levels of apathy had a significantly wider range of mild ADL problems, significantly lower quality of life and greater ADL problems, anxious and depressive symptomology, chronic medical conditions, global cognition and age²³. Pinazo-Hernandis *et al.*, examined the relationships between behavioural and psychological symptoms of dementia (BPSD), psychotropic drug prescription, cognitive function, depressive mood status and ADL performance among 450 institutionalised older individuals²⁴. Accordingly, they found that the level of cognitive function positively correlated with the level of ADLs and Tinetti scale's risk of falls. Moreover, BPSD was negatively correlated with the level of ADL performance and cognitive function, which indicated that those with higher BPSD had lower levels of ADL performance and more severe deterioration²⁴.

The findings of the current study are however inconsistent those presented in Wang *et al*¹⁷, and Bjork *et al*²⁵, perhaps related to the differences in measurements of cognitive function, ADL performance, sampling and sampling areas. Wang *et al*¹⁷, conducted a longitudinal ageing social survey among 2014 older individuals in China to determine the relationship between ADLs, cognitive function, social support and attitudes towards own ageing¹⁷. Their study measured ADLs and cognitive function using the Activity of Daily Living Scale of Lawton and Brody²⁶ and the Mini-Mental State Examination of Folstein *et al*²⁷, respectively. Accordingly, they found that ADLs were significantly negatively correlated with cognitive function and social support but were significantly positively correlated with attitudes towards own ageing. Moreover, they found that ADLs were a direct predictor of attitudes towards own ageing but were an indirectly predictor of attitudes toward own ageing through cognitive function and social support.

Bjork *et al*²⁵, conducted a cross-sectional study to investigate the prevalence and variance of cognitive impairment, pain, neuropsychiatric symptoms and ADL dependency among a total of 4831 residents who were randomly selected from 188 Swedish

nursing homes. Their study measured cognitive function, level of ADL and neuropsychiatric symptoms using Gottfries' cognitive scale, the Katz Index and the Neuropsychiatric Inventory-Nursing Home Version (NPI-NH), respectively. Accordingly, they reported that the prevalence of cognitive impairment, ADL dependence, pain and neuropsychiatric symptoms was 67%, 56%, 48% and 92%, respectively. Notably, their result showed that the prevalence of neuropsychiatric symptoms did not significantly differ according to sex, level of ADL performance and length of residence²⁵.

However, a male sample was a limitation of the study. In 2019, there were 1692 institution-based long-term care facilities in Taiwan. Subjects in this study were recruited from five long-term care facilities located in the southern Taiwan. Thus, it is difficult to generalize the study findings for residents living in long-term care facilities in Taiwan because characteristics of residents vary among different long-term care facilities, and among northern, middle, southern, and eastern Taiwan.

Table No.1: Demographic information

S.No	Variables	Mean (SD)/%
Gender		
1	Female	53 (50%)
2	Male	53 (50%)
Marital status		
4	Single	28 (26.4%)
5	Married	22 (20.8%)
6	Widows/widowers	44 (41.5%)
7	Divorce	12 (11.3%)
Educational		
8	No formal education	39 (36.8%)
9	≤ 6years	32 (30.2%)
10	> 6years	35 (33.0%)
Reasons for admission		
11	Living alone	52 (48.1%)
12	Poor health	33 (31.1%)
13	Family members unable to care at day time	21 (19.8%)
14	Age	82.76 (10.21)
15	length of living in a long-term care facility	47.57 (38.13) Min = 15.72, Max = 180.59
16	Number of diseases or health problems	3.13 (1.69) Min = 1, Max = 9
17	MMSE	15.38 (6.99)
18	Normal (MMSE > 24)	24 (22.6%)
19	Mild cognitive impairment (MMSE	29 (27.4%)
20	Moderate cognitive impairment	26 (24.5%)
21	Severe cognitive impairment	27 (25.5%)
22	CSDD	1.83 (2.39) Min = 0, Max = 11
23	CAPE-BRS	9.02 (5.59) Min = 0, Max = 26

24	ADLs	625.44 (155.17) Min = 170, Max = 780
25	Feeding	118.13 (22.08) Min = 0, Max = 126
26	Dressing	104.44 (41.68) Min = 19, Max = 150
27	Grooming	138.89 (46.53) Min = 0, Max = 174
28	Washing	175.74 (44.81) Min = 34, Max = 204
29	Toileting	88.25 (36.89) Min = 0, Max = 126

Note. Min = Minimum, Max = Maximum, MMSE = mini-mental status exam; CSDD = The Cornell Scale for Depression in Dementia; CAPE-BRS = The Clifton Assessment Procedures for the Elderly-Behaviour Rating Scale, ADLs = activity of daily living. ** $p < .01$

Table No.2: Testing association among variables

Variables	Age	length of living in a LTCF	MMSE	ADLs	CSDD	CAPE-BRS	Feeding	Washing	Grooming	Dressing	Toileting
Age	-	-.192*	.083	-.090	-.003	.045	.149	.045	.038	.175	-.039
Length of living in a LTCF	.192*	-	-.184	-.004	-.079	.124	.125	.077	-.022	-.043	-.111
MMSE	-.133	-.184	-	.468**	-.255**	-.586**	.213*	.516**	.268**	.424**	.401**
ADLs	.083	-.004	.468**	-	-.379**	-.711**	.723**	.908**	.754**	.875**	.763**
CSDD	-.090	-.079	-.255**	-.379**	-	.607**	-.197*	-.300**	-.335**	-.348**	-.301**
CAPE-BRS	-.003	.124	-.586**	-.711**	.607**	-	-.375**	-.618**	-.501**	-.634**	-.676**
Feeding	.149	.125	.213*	.723**	-.197*	-.375**	-	.730**	.514**	.506**	.339**
Washing	.045	.077	.516**	.908**	-.300**	-.618**	.730**	-	.620**	.710**	.591**
Grooming	.038	-.022	.268**	.754**	-.335**	-.501**	.514**	.620**	-	.444**	.352**
Dressing	.175	-.043	.424**	.875**	.348**	-.634**	.506**	.710**	.710**	-	.759**
Toileting	-.039	-.111	.401**	.763**	-.301**	-.676**	.339**	.591**	.352**	.759**	-

Note. **, $p < .01$; *, $p < .05$

Table No.3: The severity of cognitive impairment affecting the ADL profile

S.No	Variables	Mean (SD)	95% confidence interval for mean	F	p
Washing					
1	Normal	195.83 (17.54)	188.43, 203.24	12.036**	.000
	Mild CI	186.14 (35.82)	172.51, 199.76		
	Moderate CI	185.46 (29.94)	173.37, 197.55		
	Severe CI	137.33 (58.92)	114.02, 160.64		
Dressing					
2	Normal	118.79 (36.53)	103.37, 134.22	9.427**	.000
	Mild CI	116.62 (38.05)	98.15, 127.10		
	Moderate CI	116.19 (37.67)	100.98, 131.40		
	Severe CI	71.59 (37.28)	58.84, 86.34		
Feeding					
3	Normal	120.50 (20.36)	111.91, 129.09	2.738*	.047
	Mild CI	118.97 (24.36)	109.70, 128.23		
	Moderate CI	124.89 (2.58)	123.84, 125.93		
	Severe CI	108.56 (28.48)	97.29, 119.82		
Grooming					
4	Normal	144.79 (38.67)	128.46, 161.46	5.355**	.002
	Mild CI	154.52 (48.04)	136.25, 172.79		
	Moderate CI	145.58 (37.94)	130.25, 160.90		
	Severe CI	110.44 (48.59)	91.22, 129.67		
Toileting					
5	Normal	99.33 (33.03)	85.39, 113.39	6.929**	.000
	Mild CI	97.72 (28.63)	86.83, 108.62		
	Moderate CI	93.69 (36.03)	79.14, 108.24		
	Severe CI	63.00 (36.69)	48.49, 77.51		
ADLs					
6	Normal	679.25 (110.25)	632.45, 726.05	11.961**	.000
	Mild CI	669.97 (129.41)	620.74, 719.19		
	Moderate CI	665.81 (113.27)	620.06, 711.56		
	Severe CI	490.93 (175.19)	421.62, 560.23		

Note. CI = Cognitive Impairment

CONCLUSION

The current study found that cognitive function was positive correlated ADLs, including feeding, washing, dressing, grooming and toileting and that CAPE-BRS a major significant predictor of MMSE and level of ADLs. The aforementioned findings are consistent with those published in several recent studies. Apart from cognitive function and ADLs, depressive mood status has also been considered a critical variable for health behaviour of older individuals. The clinical implication of this study is

that intervention to manage behavioural problems can be an important way to prevent cognitive function and ADLs decline among residents in long-term care facilities. Further studies should design and examine interventions to prevent depressive mood status and behavioural problems, consequently, to prevent cognitive function and ADL declined in older individuals residing in long-term care facilities.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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