Hirosaki Med. J. **75**：110—117, 2025

ORIGINAL ARTICLE

Relationship between attention and activities of daily living among older people in long-term care health facility: A cross-sectional study

Maki Ogasawara[1, 2), Toshimasa Sone[2), Kazumaru Wada[1), and Takao Osanai[1)

Abstract

Objective: Attention decline affects the activities of daily living (ADL) of people with brain dysfunction. However, the association between attention and ADL in older people with Long-Term Care Insurance Certification (LTCIC) having ADL disabilities remains unexplored. This study aimed to determine the association between attention and ADL in older adults with LTCIC.

Methods: A cross-sectional study was conducted among 51 older adults with LTCIC. The care level, Barthel Index (BI),Trail Making Test part-A(TMT-A), Mini-Mental State Examination-Japanese (MMSE-J), range of motion limitation and motor paralysis were examined. Multiple regression analysis was performed to clarify the association between attention and ADL. Stratified multiple regression analysis by care level was performed to clarify the association between attention and ADL. Each analysis was set up with BI as the dependent variable, and age, TMT-A, MMSE-J, range of motion limitation and motor paralysis as independent variables.

Results: Multiple regression analysis ($\beta = -0.38$, $p<0.01$) as well as the stratified multiple regression analysis in the care level group ($\beta = -0.39$, $p=0.01$) showed that TMT-A was significantly associated with BI.

Conclusions: Attention decline affects ADL in older people with LTCIC. Therefore, it is crucial to accurately assess attention, support attention decline, and prevent its progression.

Hirosaki Med. J. **75**：110—117, 2025

Key words: Older people; Attention; General cognitive function; Activities of Daily Living; Long-Term Care Insurance Certification.

Introduction

Attention is the foundation of all cognitive functions and is the function of selecting and focusing on a required target stimulus among various stimuli[1). Previous studies have reported that attention dysfunction leads to decreased activities of daily living (ADL). Studies involving older adults with Alzheimer's disease (AD) have shown that attention impairment causes ADL disability[2-4). In a study of patients with stroke, improvements in ADL were accompanied by improvements in attention[5). Additionally, associations between attention and ADL have been reported in patients with traumatic brain injury[6). However, some studies on community-dwelling older adults have shown that attention declines with age[7-9), and it is expected that declining attention with aging affects ADL disability. Despite this, previous studies have primarily focused on specific diseases, such as major neurocognitive disorders and stroke, and the relationship between attention and ADL in older adults with diverse and complex health conditions within the Long-Term Care Insurance Certification (LTCIC) system in Japan has not

1) Graduate School of Health Sciences, Hirosaki University
2) Department of Occupational Therapy, School of Health Sciences, Fukushima Medical University

Correspondence: M. Ogasawara
Received for publication, October 31, 2024
Accepted for publication, December 2, 2024

✉：Department of Occupational Therapy, School of Health Sciences, Fukushima Medical University
E-mail: oga-maki@fmu.ac.jp

been fully explored.

In Japan, the Long-Term Care Insurance Act, enacted in 2000, established a system aimed at preventing functional decline among older adults with multiple diseases and age-related functional decline and enabling them to live independently in the community for as long as possible. The basic concepts of the Long-Term Care Insurance Act include "self-reliance," "user-oriented," and "social insurance systems," allowing applicants to receive rehabilitation as well as long-term care services. Older adults who require these services must be certified as requiring LTCIC. LTCIC is classified into seven levels: support levels I and II and care levels I, II, III, IV, and V. Support levels I and II indicate the presence of a condition that contributes to the reduction or prevention of the aggravation of the condition requiring care for ADL. The care levels I through V indicate the presence of a condition that is assumed to necessitate care for ADL[10]. The individuals classified under care levels require more care than those classified under support levels; the higher the level number, the higher the care required. Some reports have shown an association between physical and mental functions and care levels in older people. For example, Matsuda et al. reported a correlation between the Barthel Index (BI) and care levels[11]; Chen et al. showed actual standardized quantitative and qualitative geriatric functions such as ADL, quality of life (QOL), and depression at each care level[12]. However, the association between attention and ADL in older adults with LTCIC remains unclear.

The aim of this study was to elucidate attention in older adults with LTCIC and to examine the relationship between attention and ADL. This study may aid in identifying the factors that contribute to the prevention of decreased ADL in older people under the Japanese long-term care insurance system.

Methods

Study design

A cross-sectional study was conducted at a long-term care health facility. The recruitment and evaluation period of this study was from October 2020 to March 2021.

Participants

A total of 56 LTCIC participants were recruited from a long-term care health facility in Aomori Prefecture, where the author was working as an occupational therapist at the time. The exclusion criteria were severe visual or hearing impairment and specific higher brain dysfunctions, such as unilateral spatial neglect or aphasia. Five participants were excluded for the following reasons: 1 had severe hearing impairment, 2 had higher brain dysfunction, and 2 had missing data. Finally, 51 participants were included in the study.

Assessment items

Basic information on the participants, including age, sex, medical history, and care level, was collected from medical records. All participants had one of the following care levels: support levels I and II and care levels I, II, III, IV, and V. Medical history was classified as one of the following: major neurocognitive disorder, stroke, orthopedic disease, and other.

The BI[13] was used to assess ADL. It comprises scores for eating, transferring, grooming, toileting, bathing, walking, climbing stairs, dressing, and bowel and bladder control. The total score ranges from 0 to 100, with lower scores indicating more severe ADL impairments.

The Trail Making Test, Japanese edition, Part A (TMT-A)[14] was selected to assess attention. The TMT-A randomly arranges circles with numbers ranging from 1 to 25, and the participants are asked to connect the numbers in ascending order as quickly as possible. The longer the time a participant takes to complete the test, the more severe the attentional dysfunction. The TMT-A, Japanese edition, defines the cut-off value for attention dysfunction as >68 s for people in their 70's and as >69 s for people in their 80's. If the time taken to complete the TMT-A was longer than the cutoff values, the participant was assumed to have attentional dysfunction.

The Mini-Mental State Examination-Japanese (MMSE-J) [15, 16] was used to assess general cognitive function. The MMSE-J has appropriate reliability and validity for screening mild cognitive impairment and AD among older Japanese individuals. The MMSE-J assesses orientation, memory, attention and calculation, recall, naming, repetition, reading, writing, and coping. Total scores range from 0 to 30, with lower scores indicating severe general cognitive impairment.

Physical function, based on the presence or absence of range of motion limitation and motor paralysis, was collected from medical records. These variables were set to 1 for the presence of impairment and 0 for the absence of impairment.

BI, TMT-A, and MMSE-J data were obtained by evaluating the participants. These data were collected and evaluated by occupational therapists or physical therapists who had been trained to conduct such tests.

Statistical analysis

The Spearman's rank correlation coefficient was used to analyze the correlations between ADL and age, TMT-A, MMSE-J, range of motion limitation and motor paralysis. Multiple regression analysis was used to determine the association of each assessment item with ADL, with the dependent variable being BI and the independent variables being age, TMT-A, MMSE-J, range of motion limitation and motor paralysis. Standardized regression coefficients were calculated to indicate the impact of each independent variable on the dependent variable in a comparable manner. Stratified multiple regression analysis was used to determine the association of each assessment item with ADL by each group as the support and care level groups. All statistical analyses were performed using EZR for Windows Version 1.62[17], with the significance level set at <5%.

Ethical considerations

The participants were provided an overview of the study in advance. They agreed to participate after reading the overview. Informed consent was obtained from the participants' families if it was difficult for them to make a decision. This study was approved by the Ethics Committee of the Graduate School of Health Sciences at Hirosaki University (Reference No. 2020-033).

Results

Table 1 shows the characteristics of all the 51 participants. The mean age was 82.0 (standard deviation: SD, 7.6) years; 14 (27.5%) were male and 37 (72.5%) were female. The participant's care level of LTCIC was as follows: 2 and 5 participants were assigned to support level I and II, respectively; 20, 12, 9, and 3 participants were assigned to care levels I, II, III, and IV, respectively; none of the participants needed care level V. Regarding medical history, 9 participants had major neurocognitive disorders, 24 had stroke, 25 had orthopedic disease, and 10 had other disorders. The mean (SD) scores were 84.8 (14.9) for the BI, 142.2 (139.3) s for the TMT-A and 24.6 (4.9) for the MMSE-J. The mean (SD) TMT-A of the support level was 91.4 (33.6) s, and the mean (SD) TMT-A of the care level was 150.2 (148.0) s. There were 31 participants (60.8%) with range of motion limitation and 23 participants (45.1%) with Motor Paralysis.

Table 1. Characteristics of participants (n=51)

	n (%)	Mean (SD)
Age (years)		82.0 (7.6)
Sex		
Male	14 (27.5)	
Female	37 (72.5)	
LTCIC		
Support level Ⅰ	2 (3.9)	
Support level Ⅱ	5 (9.8)	
Care level Ⅰ	20 (39.2)	
Care level Ⅱ	12 (23.5)	
Care level Ⅲ	9 (17.7)	
Care level Ⅳ	3 (5.9)	
Care level Ⅴ	0 (0)	
Medical history		
Major neurocognitive disorder	9 (17.6)	
Stroke	24 (47.1)	
Orthopedic disease	25 (49.0)	
Other	10 (19.6)	
BI (point)		84.8 (14.9)
TMT-A (second)		142.2 (139.3)
TMT-A of Support level (n=7)		91.4 (33.6)
TMT-A of Care level (n=44)		150.2 (148.0)
MMSE-J (point)		24.6 (4.9)
Physical functions (present)		
Range of Motion Limitation	31 (60.8)	
Motor paralysis	23 (45.1)	

BI: Barthel Index, TMT-A: Trail Making Test Japanese part-A,
MMSE-J: Mini-Mental State Examination-Japanese

Table 2. Correlation coefficients between BI and Assessment items (n=51)

	BI	
	r	p-value
Age	−0.35	0.01
TMT-A	−0.43	<0.01
MMSE-J	0.43	<0.01
Range of Motion Limitation	−0.29	0.04
Motor paralysis	0.04	0.81

Spearman's rank correlation coefficient was used.
BI: Barthel Index, TMT-A: Trail Making Test Japanese part-A, MMSE-J: Mini-Mental State Examination-Japanese

Table 2 shows the coefficients for the correlation between BI and each assessment item. BI was significantly correlated with age ($r=-0.35$, $p=0.01$), TMT-A ($r=-0.43$, $p<0.01$), MMSE-J ($r=0.43$, $p<0.01$) and range of motion limitation ($r=-0.29$, $p=0.04$).

The association between each assessment and BI using multiple regression analysis is shown in Table 3 ($R^2=0.42$). TMT-A was significantly associated with BI ($\beta=-0.38$, $p<0.01$), indicating that attention was associated with ADL in older adults with LTCIC.

Finally, Table 4 shows the association between each assessment and BI in each support and care level group, using stratified multiple regression analysis. In the support level group,

Table 3. Association of each assessment to BI by multiple regression analysis

	β	95%CI	SE	T	p-value
Age	−0.26	−1.21 – 0.19	0.35	−1.48	0.15
TMT-A	−0.38	−0.07 – −0.01	0.01	−2.92	<0.01
MMSE-J	0.26	−0.11 – 1.66	0.44	1.76	0.08
Range of Motion Limitation	−0.23	−14.67 – 0.56	3.78	−1.87	0.07
Motor paralysis	−0.25	−17.66 – 3.04	5.14	−1.42	0.16

SE: Standard error, BI: Barthel Index, TMT-A: Trail Making Test Japanese part-A, MMSE-J: Mini-Mental State Examination-Japanese

Table 4. Association of each assessment with BI in care level group by stratified multiple regression analysis

	β	95%CI	SE	T	p-value
Support level group (n=7)					
Age	−1.13	−7.54 – 6.81	0.56	−0.65	0.63
TMT-A	0.19	−1.03 – 1.06	0.08	0.19	0.88
MMSE-J	−0.12	−11.09 – 10.86	0.86	−0.14	0.91
Range of Motion Limitation	−0.17	−60.17 – 58.35	4.66	−0.20	0.88
Motor paralysis	−1.07	−112.94 – 102.04	8.46	−0.64	0.64
Care level group (n=44)					
Age	−0.26	−1.31 – 0.27	0.39	−1.33	0.19
TMT-A	−0.39	−0.07 – −0.01	0.01	−2.68	0.01
MMSE-J	0.23	−0.32 – 1.70	0.50	1.39	0.17
Range of Motion Limitation	−0.19	−15.37 – 3.48	4.65	−1.28	0.21
Motor paralysis	−0.25	−19.39 – 4.29	5.85	−1.29	0.20

SE: Standard error, BI: Barthel Index, TMT-A: Trail Making Test Japanese part-A, MMSE-J: Mini-Mental State Examination-Japanese

no items showed a significant effect on BI (R^2=0.34). In the care level group (R^2=0.38), TMT-A was significantly associated with BI (β=−0.39, p=0.01). This indicates that attention is associated with ADL in older adults of the care level group.

Discussion

We conducted this cross-sectional survey to determine the state of attention among older adults with LTCIC and the association of attention with ADL. The following were the findings of our study. First, the state of attention in older adults with LTCIC showed a mean time to completion of 142.2 s. As noted in the assessment items, if the TMT-A time of a participant was longer than the predetermined cut-off value for the participant's age group, the participant was assumed to have attentional dysfunction. Suzuki et al. reported that the mean TMT-A time was 52.7 s in community-dwelling older people[8]; Tombaugh reported that the mean TMT-A time was 58.19 s in the group aged 80–84 years, with education of 0–12 years[9]. The TMT-A, Japanese edition, defines the cut-off value for attention dysfunction as >68 s for people in their 70's and as >69 s for people in their 80's[14]. A comparison with previous studies showed that the attention of the participants in this study declined. In addition, the TMT-A time was longer in the participants who were classified under the care levels than those classified under the support levels, suggesting that the lower the attention function, the higher the care level.

Furthermore, the correlations between ADL and assessment items were investigated, and age, TMT-A, MMSE-J and range of motion limitation showed significant correlations. Previous studies on community-dwelling older adults have reported that general cognitive function, including the MMSE-J and Hasegawa's Dementia Scale, is a crucial predictor of ADL disability[18-20]. In addition, Cohen reported that attention is the foundation of all cognitive functions[1], and Suzuki reported that attention dysfunction is associated with general cognitive dysfunction in community-dwelling older adults in Japan[8]. The association between cognitive and attentional functions and ADL was consistent with the findings of previous studies.

In the multiple regression analysis with ADL as the dependent variable and age, general cognitive function, and attention as independent variables, attention was significantly associated with ADL (Table 3). This result shows that attention is also associated with ADL in older people with LTCIC and highlights the importance of preventing attentional decline in these individuals. Attentional decline makes it challenging to focus on desirable objects as it fails to prevent attention to unnecessary stimuli as well as maintaining attention to complete a specific action[1]. This may interfere with ADL which require attention to a desired target in an environment with miscellaneous tools and information (e.g., dressing, bathing, and grooming). However, changes in attention in older people have rarely been assessed, and research on their importance is not yet widespread.

In the multiple regression analysis of ADL by level of care, including age, general cognitive function, and attention, the group of participants categorized under the support levels showed no significant association with ADL. However, among the participants classified under the care levels, attention was significantly associated with ADL (Table 4). Although previous studies have reported ADL and QOL according to care level[11, 12], the state of attention according to care level and the relationship between attention and ADL have not been examined. Our results indicate that attention is related to ADL at the care level. Therefore, it is important to assess attention at the care level and develop strategies for environmental adjustment and prevention of the progression of ADL disability, taking into consideration the impact of attention on ADL.

The TMT-A, used in this study to assess attentional function, is a quick and easy assessment that requires only a test form, pencil, and stopwatch. It can be implemented using simple guidance. The limitations of this test are that it is difficult to administer to participants with unilateral spatial neglect, those who have difficulty understanding numerical concepts owing to aphasia or intellectual disability, and those with visual impairment. Therefore, it is necessary to measure attention in such participants using assessments that are compatible with their respective residual functions.

The limitations of this study include the following: the target population was only one long-term care health facility in Aomori Prefecture, and the sample size was small. Future studies including a greater number of facilities, with larger sample sizes, and larger collection of data are warranted. The primary outcome of this study was the assessment of ADL, with the evaluation of physical function being a crucial aspect, given its impact on ADL. The physical function assessment in this study was collected only a small part of physical function, such as motor paralysis and range of motion. In order to provide a more appropriate assessment of physical function, it was necessary to use a comprehensive and detailed tool for the assessment of physical function. Data collection for the BI, TMT-A, and MMSE-J was not blinded between the evaluators of the BI and those of the cognitive function tests. In addition, the authors were involved in the evaluation of paticipants and statistical analyses, which may have caused some bias.

Conclusion

We investigated the state of attention and the relationship between attention and ADL in older adults with LTCIC. We found that older people in a long-term care health facility have attention dysfunction, as their TMT-A time was prolonged and exceeded the cut-off levels for their age. Multiple regression analysis showed that attention was significantly related to ADL. Furthermore, the results of the stratified multiple regression analysis showed a significant association between attention and ADL in the care level group. These results indicate that attention decline affects ADL in older adults with LTCIC. Therefore, it is important for occupational therapists to appropriately assess attention and prevent its decline in older adults with ADL disorders.

Declaration of conflicting interest

The authors declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Acknowledgments

I would like to thank the member of Medical Corporation Jinsenkai, Long-term Care Health Facility Heart Land for their cooperation.

References

1) Cohen RA. The neuropsychology of attention (2nd ed.). Springer. New York; 2014. p.265-80.

2) Hall JR, Vo HT, Johnson LA, Barber RC, O'Bryant SE. The link between cognitive measures and ADLs and IADL functioning in mild Alzheimer's: What has gender got to do with it? Int J Alzheimers Dis. 2011; 2011:276734. doi: 10.4061/2011/276734. (accessed 2024-10-23)

3) Martyr A, Clare L. Executive function and activities of daily living in Alzheimer's disease: A correlational meta-analysis. Dement Geriatr Cogn Disord. 2012;33(2-3):189-203.

4) Mlinac ME, Feng MC. Assessment of activities of daily living, self-care, and independence. Arch Clin Neuropsychol. 2016;31(6):506-16.

5) Choi JH, Kim BR, Han EY, Kim SM. The effect of dual-task training on balance and cognition in patients with subacute post-stroke. Ann Rehabil Med. 2015;39(1):81-90.

6) Jaywant A, Blunt E, Jamison K, Kim N, RoyChoudhury A, Schiff ND, Kuceyeski A, et al. Association between the attention network test, neuropsychological measures, and disability in post-acute traumatic brain injury. Neurotrauma Rep. 2023;4(1):318-29.

7) Specka M, Weimar C, Stang A, Jöckel KH, Scherbaum N, Hoffmann SS, Kowall B, et al. Trail making test normative data for the German older population. Arch Clin Neuropsychol. 2022;37(1): 186-98.

8) Suzuki H, Sakuma N, Kobayashi M, Ogawa S, Inagaki H, Edahiro A, Ura C, et al. Normative data of the trail making test among urban community-dwelling older adults in Japan. Front Aging Neurosci. 2022;14:832158. doi: 10.3389/fnagi.2022.832158. (accessed 2024-10-23)

9) Tombaugh TN. Trail making test A and B: normative data stratified by age and education. Arch Clin Neuropsychol. 2004;19(2):203-14.

10) Ministry of Health, Labour and Welfare. Mechanism for certification of need for long-term care in the long-term care insurance system; 2003. http://www.mhlw.go.jp/topics/kaigo/kentou/15kourei/sankou3.html. (accessed 2024-10-23)(in Japanese)

11) Matsuda T, Iwagami M, Suzuki T, Jin X, Watanabe T, Tamiya N. Correlation between the Barthel Index and care need levels in the Japanese long-term care insurance system. Geriatr Gerontol Int. 2019;19(11):1186-7.

12) Chen W, Fukutomi E, Wada T, Ishimoto Y, Kimura Y, Kasahara Y, Sakamoto R, et al. Comprehensive geriatric functional analysis of elderly populations in four categories of the long-term care insurance system in a rural, depopulated and aging town in Japan. Geriatr Gerontol Int. 2013;13(1):63-9.

13) Mahoney FI, Barthel DW. Functional evaluation: The Barthel Index. Md State Med J. 1965;14:61-5.

14) Japan Society for Higher Brain Dysfunction. Trail making test (Japanese ed.) (TMT-J). Shinkoh Igaku Shupppan, Co. Ltd. Tokyo, 2019. p.1-13. (in Japanese)

15) Sugishita M. Mini mental state examination-Japanese (MMSE-J). Nihon Bunka Kagakusha, Co., Ltd. Tokyo; 2019. p.1-22. (in Japanese)

16) Sugishita M, Hemmi I, Takeuchi T. Reexamination of the validity and reliability of the Japanese version of the mini-mental state examination (MMSE-J). Ninchi shinkei kagaku. 2016;18(3・4):168-83. (in Japanese)

17) Kanda Y. Investigation of the freely available easy-to-use software "EZR" for medical statistics. Bone Marrow Transplantation. 2013;48(3):452-8.

18) Feng L, Zin Nyunt MS, Gao Q, Feng L, Yap KB, Ng TP. Cognitive frailty and adverse health outcomes: Findings from the Singapore Longitudinal Ageing Studies (SLAS). J Am Med Dir Assoc. 2017; 18(3):252-8.

19) Macuco CR, Batistoni SS, Lopes A, Cachioni M, da Silva Falcão DV, Neri AL, Yassuda MS. Mini-mental state examination performance in frail, pre-frail, and non-frail community dwelling older adults in Ermelino Matarazzo, São Paulo, Brazil. Int Psychogeriatr. 2012;24(11):1725-31.

20) Ma Y, Li X, Pan Y, Zhao R, Wang X, Jiang X, Li S. Cognitive frailty predicting death and disability in Chinese elderly. Neurol Res. 2021;43(10):815-22.