

Table 4 Comparisons of assessments according to such items as contracture, rinsing/gargling, exhibition of signs of dysphagia, eating-related behavioral and psychological symptom of dementia and oral medications, and differences in rate of independence in eating

	Comparison of each severity of dementia						Comparison of level of severity (χ^2) <i>P</i> -value	Difference in RIE with or without each symptom (<i>t</i> -test)			
	CDR1 Applicable patients (%)	Overall (<i>n</i>)	CDR2 Applicable patients (%)	Overall (<i>n</i>)	CDR3 Applicable patients (%)	Overall (<i>n</i>)		Overall <i>P</i> -value	CDR1 <i>P</i> -value	CDR2 <i>P</i> -value	CDR3 <i>P</i> -value
Neurological examination											
Contracture	14.6%	41	1.7%	58	39.6%	48	<0.001	0.092	0.023	0.763	0.895
Facial and oral motor function test											
Difficulty in rinsing/gargling	2.4%	41	8.5%	59	49.0%	49	<0.001	<0.001	0.856	0.009	0.112
Eating-related BPSD											
Presence of dysphagia signs	12.8%	39	23.7%	59	51.0%	49	<0.001	0.003	0.697	0.805	0.026
Difficulty in beginning a meal	2.6%	39	27.1%	59	75.5%	49	<0.001	<0.001		0.045	0.037
Difficulty in proper use of utensils	5.1%	39	18.6%	59	69.4%	49	<0.001	<0.001	0.791	0.064	0.008
Difficulty in scooping the proper amount of food	2.6%	39	27.1%	59	71.4%	49	<0.001	<0.001	0.854	0.081	0.004
Difficulty in recognizing the total amount of food provided	7.7%	39	27.1%	59	71.4%	49	<0.001	<0.001	0.791	0.229	0.119
Difficulty in maintaining attention while eating	7.7%	39	37.3%	59	83.7%	49	<0.001	<0.001	0.741	0.151	0.046
Difficulty in maintaining alertness while eating	0.0%	39	22.0%	59	63.3%	49	<0.001	<0.001		0.014	0.262

Left: Applicable patients in each level of severity of dementia. Middle: Comparison of the severity of dementia was performed using the χ^2 -test. Right: Difference of rate of independence in eating (RIE) between patients with and without each symptom using Student's *t*-test. BPSD, behavioral and psychological symptom of dementia; CDR1, Clinical Dementia Rating mild; CDR2, Clinical Dementia Rating moderate; CDR3, Clinical Dementia Rating severe;

Table 5 Factors that affect hindering independence in eating confirmed using logistic regression analysis

Factor	Univariate			Multivariate		
	OR	95% CI	P-value	OR	95% CI	P-value
Age (Continuous quantity) (F = 0, M = 1)	1.029	(0.975–1.085)	0.304	0.999	(0.908–1.099)	0.977
Sex (mild = 1, moderate = 2, severe = 3)	2.222	(0.526–9.385)	0.277	0.375	(0.023–6.017)	0.489
Severity of dementia (CDR)	8.801	(3.980–19.463)	<0.001	4.538	(1.154–17.843)	0.030
Contracture (no = 0, yes = 1)	2.607	(1.016–6.691)	0.046	0.432	(0.071–2.630)	0.363
Difficulty in rinsing/gargling (easy = 0, difficult = 1)	11.611	(4.117–32.750)	<0.001	2.023	(0.274–14.937)	0.490
Presence of dysphagia signs (no = 0, yes = 1)	6.020	(2.600–13.935)	<0.001	5.214	(1.031–26.377)	0.046
Difficulty in beginning a meal (easy = 0, difficult = 1)	22.531	(8.293–61.211)	<0.001	14.498	(2.067–101.690)	0.007
Difficulty in proper use of utensils (easy = 0, difficult = 1)	11.089	(4.553–27.009)	<0.001	0.375	(0.033–4.228)	0.428
Difficulty in scooping the proper amount of food (easy = 0, difficult = 1)	19.098	(7.265–50.205)	<0.001	6.170	(0.555–68.586)	0.139
Difficulty in recognizing the total amount of food (easy = 0, difficult = 1)	9.192	(3.846–21.966)	<0.001	0.111	(0.010–1.272)	0.077
Difficulty in maintaining attention while eating (easy = 0, difficult = 1)	22.826	(7.295–71.421)	<0.001	3.538	(0.409–30.627)	0.251
Difficulty in maintaining alertness while eating (easy = 0, difficult = 1)	10.769	(4.419–26.247)	<0.001	0.737	(0.149–3.644)	0.709

"RIE = 100%" was assigned a value of 0, whereas "0–99.9%" was assigned a value of 1. Left: Univariate analysis using logistic regression analysis. Right: Multivariate analysis using logistic regression analysis. CDR, Clinical Dementia Rating; RIE, rate of independence in eating (score 0–100).

dementia. These findings are not considered to be in agreement with those of earlier reports.³⁴ The decrease in RIE that occurs after dementia reaches the CDR3 stage can be considered to be related to the disorientation, agnosia, and executive function disorder, disordered planning and correction of behavior that become marked in severe dementia.²⁶ Although RIE showed a particularly marked decrease in CDR3 patients, its mean value of $63.8 \pm 39.1\%$ was higher than predicted. This is in agreement with a report that procedural memory and motor learning are preserved even when memory is severely impaired.³⁵

E-BPSD parameters in the present study showed statistically significant correlations with RIE. It can be surmised that these relationships are influenced by the manifestation of attention disorders,³⁵ executive function disorders and apraxia as a result of the deterioration of dementia. In particular, difficulty in beginning a meal was also significantly related to RIE. This finding strongly suggests that disorders such as apraxia are also involved,³⁶ in addition to attention disorders and difficulty in maintaining alertness.

The reasons for difficulty in assisting with eating in AD can include various factors impairing independence in eating. In the present study, the application of logistic regression analysis showed that difficulty in beginning a meal, presence of dysphagia signs and the severity of dementia are factors that strongly hinder independence in eating in AD. This report is the first to objectively identify factors that affect the decrease in independence in eating in AD patients as a targeted population.

In agreement with an earlier report, the severity of dementia was a factor strongly affecting the independence in eating as a result of deterioration of dementia.¹³

In addition, we found that the presence of dysphagia signs significantly contributed to the decrease in independence in eating. This is in agreement with some clinical reports that showed that dysphagia is the most common factor in advanced AD.^{3,8,12} At the time when dysphagia becomes evident in AD, worsening of the severity of dementia, impairment of the basic physical functions,³³ such as the defense reflexes,⁴ and pseudobulbar paralysis³⁷ are usually present. In addition, buccofacial apraxia⁶ and generalized cognitive impairment are prominent. That is, it can be surmised that as a result of these various dysfunctions, the patient is already in a state where the series of actions necessary for eating cannot be carried out. Furthermore, special measures are commonly instituted for dysphagia in AD after it has become severe, including changing the texture of meals and adjusting the patient's posture.⁴ However, after a patient has actually developed severe dementia, he or she is often unable to follow the directions required to carry out a compensatory swallow maneuver or a specific therapeutic rehabilitative exercise.⁴ Because worsening of the core symptoms of AD is inevitable, it has

been considered important to implement professional training while the dementia is still mild, thereby maintaining the swallowing function and minimizing the dysfunction when the dementia becomes severe.¹²

Finally, the application of logistic regression analysis showed that difficulty in beginning a meal was an even stronger risk factor for hindrance of eating independence than worsening of the severity of dementia in AD. Many reports have investigated the background to decreased independence in eating in AD.^{12,13,32,37,38} Even when the appetite and the functions of eating are preserved, the following points requiring attention for promotion of independence in eating in AD have been reported: loss of cues to begin eating and restart eating, such as attention disorder, disorientation, agnosia, ideational apraxia,²⁹ conceptual apraxia³⁰ and executive function disorder.³⁸ When patients do not start eating by themselves, they are often found to be anorexic or akinetic, and spoon-feeding is often initiated to ensure sufficient nutritional intake.⁴ Once spoon-feeding is started, patients tend to become dependent on assistance, which can explain the rapid loss of independence. Furthermore, it becomes easier for such patients to develop further eating difficulties.⁶ Accordingly, it has been pointed out that, with the deterioration of dementia, features develop, such as apathy, in regard to loss of appetite and food³⁹ and emotions.²⁸

Even when a loss of cues to begin eating and restart eating means that the patient is unable to start eating, it is possible to aid the patient with such cues or give assistance in the form of adjusting the quality and amount of environmental stimuli that will help prevent confusion and interruption of eating.³⁸ It was thus reported that by such means it is possible to maintain, even partially, each patient's eating behavior.¹² This sort of assistance involves interactions in terms of the quality, amount and timing of environmental intervention, including the care provider.⁶ Our findings showed that not only the effects of the deterioration of dementia, but also those arising from the eating environment strongly influence the decrease in independence in eating seen in AD. In fact, in today's actual caregiving setting, assessments and responses are left in the hands of the individual care providers, and trial-and-error approaches are attempted amidst confusion.⁴

AD is a progressive disease, and inhibition of the progression of its core symptoms is difficult. The following steps can be considered important in relation to AD. Changes in the status of cognitive functions, vital functions and swallowing function that accompany each stage of dementia should be accurately comprehended. The E-BPSD that accompany the deterioration of dementia should be predicted from the stage of mild dementia, when there is still no marked manifestation of dysphagia, and suitable countermeasures should be identified. Finally, caregivers should

implement interventions that have predictability, such as the introduction of a program for maintaining swallowing function.

Maintaining eating independence in AD patients can be facilitated by identifying factors that interfere with beginning a meal by providing multidisciplinary care, eliminating environmental factors and providing assistance that promotes beginning a meal. We consider the objectively generated findings of the present study to represent basic data that will prove useful to all clinicians and care providers who are involved in providing assistance to elderly patients with AD.

The present study was primarily a survey of the actual status of eating behavior in elderly patients with AD based on observational assessments and the use of a questionnaire. Accordingly, we carried out no validation with regard to the effectiveness of providing assistance. In the future, it will be necessary to carry out prospective cohort studies that monitor the course of dementia and to undertake intervention studies. Detailed investigations aimed at establishing effective methods for assisting in the preservation of independence in eating in elderly patients with dementia are needed.

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Disclosure statement

The authors declare no conflict of interest.

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