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SELF-FEEDING ABILITY AS A PREDICTOR OF MORTALITY JAPANESE NURSING HOME RESIDENTS: A TWO-YEAR LONGITUDINAL STUDY

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Abstract: *Objectives:* To examine the ability of different elements of the Self-Feeding Assessment Tool for Elderly with Dementia (SFED) to predict mortality risk in nursing home residents. *Design and Setting*: Data from 387 residents in five nursing homes for the elderly in Japan were obtained using a baseline survey. This measure's ability to predict mortality risk was examined over a two-year observation period. *Participants and Measurement*: Demographic information (sex, age, height, weight, medical history) on 387 initial participants was gathered. A total of 10 individuals were excluded from the analysis because of the inability to eat by mouth at baseline, while 36 were excluded owing to missing mortality data during the observation period. The resulting 341 residents were divided into a death group or survival group according to whether they were still alive after two-year observation period. In addition to basic information and the SFED, the baseline survey included the Barthel Index (BI), Clinical Dementia Rating (CDR), and Mini Nutritional Assessment-Short Form (MNA®-SF). The ability of SFED to predict time-to-event mortality was examined using Cox proportional hazards regression analysis, including other measures associated with mortality as confounding variables. *Results*: In total, 129 participants (37.8%) died during the observation period, and their mean SFED score was significantly lower than that of surviving ones (11.1 ± 6.7 vs. 15.0 ± 5.6, $P<0.001$). SFED score was significantly associated with two-year mortality in the Cox proportional hazards regression analysis after adjusting for sex, age, medical history, BI, CDR, and MNA®-SF (hazard ratio = 0.941, 95% confidence interval = 0.898–0.985, $P = 0.010$). Additionally, three SFED categories were significantly associated with mortality risk: movement ("able to eat without dropping food"), concentration ("able to maintain attention to meal"), and safety ("able to swallow without choking, with no change in vocal quality after eating"). *Conclusions*: Self-feeding ability as measured by SFED score was associated with long-term mortality in elderly living in nursing homes. Accordingly, adjusting feeding assistance based on regular SFED-based assessments may help maintain self-feeding ability and enhance quality of life in this population, as well as providing evidence for end-of-life care options and greatly improving care quality.

Keywords: Self-feeding Assessment Tool for Elderly with Dementia, nutritional assessment, feeding behaviour, mortality, nursing home.

Introduction

As Japan's population continues to age at a rapid pace, the number of elderly persons who require nursing care because of difficulties in independent living has increased drastically. Admissions to long-term care facilities have risen in parallel, with residents of nursing homes requiring particularly high levels of care (1). Meals are not only essential for elderly residents' survival but also an important determinant of their quality of life (QOL) (2-4). Therefore, preserving this population's ability to feed themselves by mouth should greatly help to maintain their vitality and QOL.

Accordingly, Japan's long-term care insurance system has been designed to preserve elderly persons' ability to feed themselves by mouth; its policies are based on the assessment of multidisciplinary approaches to support oral nutrition. Oral function improvement programs are recommended for nursing home residents with feeding and swallowing difficulties, and those with significant cognitive decline affecting their feeding activities. These programs focus on residents' eating and swallowing skills (including oral functions such as mastication), and may involve processes such as mealtime observations, meal rounds, and meetings, conducted by multiple professionals involved in nursing care (5, 6).

By monitoring and evaluating residents during mealtimes and exchanging their individual perspectives, nurses, dieticians, and care workers involved in oral nutrition support can incorporate the various points of view needed to increase the effectiveness of oral function improvement programs. Research has suggested that such programs could help care workers to properly assist elderly persons with oral feeding while ensuring sufficient energy intake, increasing body weight, and preventing aspiration pneumonia, among other benefits (7, 8). However, there is currently no well-established assessment tool for effectively evaluating meal-related and swallowing functions in elderly persons in long-term care. For nursing

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home residents at the end of life, any measure of meal-related and feeding/swallowing function would ideally be associated with remaining life expectancy, to ensure that care is evidence-based and corresponds to predictable end-of-life trends. Equipment-based assessments conducted by experts can predict risk of aspiration and death (9, 10) but cannot be performed too frequently. Other assessment tools fail to directly capture the effects of interventions to promote independence in feeding behavior (11). We believe that the field needs an assessment tool that is easy to use, even for care workers, whose items directly correspond to measures relevant to nursing care, and which allows users to readily perceive changes in the condition of elderly persons receiving nursing care.

This study focuses on a candidate instrument developed by Yamada et al., the Self-Feeding Assessment Tool for Elderly with Dementia (SFED; Figure 1) (12). This instrument can be used to monitor independence in feeding behaviors, along with reductions associated with declines in intellectual and motor function, and to identify specific aspects of feeding difficulties and related support needs. In addition to being easy for care workers to use, the SFED contains assessment items that directly correspond to aspects of nursing care, and captures changes in self-feeding ability due to interventions. In the present study, we used the SFED to investigate the self-feeding ability of nursing home residents, who were followed over a two-year observation period to examine the ability of different elements of the SFED to predict mortality risk.

Figure 1
The Self-Feeding Assessment Tool for Elderly with Dementia (SFED)

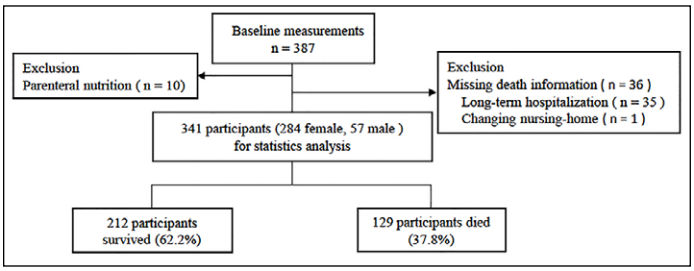
Category	Observed self-feeding	Never can do	Sometimes can do	Always can do	Score
Initiation	1. Able to initiate eating?	0	1	2	
Appropriateness	2. Appropriately using utensils?	0	1	2	
Planning	3. Able to scoop appropriate amount of food?	0	1	2	
Skilled Motor Function	4. Able to open package and to insert a straw into package?	0	1	2	
Movement	5. Able to eat without dropping some food?	0	1	2	
Cognition	6. Able to locate all food?	0	1	2	
Concentration	7. Able to maintain attention to meal?	0	1	2	
Wakefulness	8. Able to eat without sleeping?	0	1	2	
Safety	9. Able to bite, chew and swallow without choking?	0	1	2	
Nutrition	10. Able to eat the necessary daily intakes?	0	1	2	
				Total score	

Methods

Study Design and Participants

The research survey was sent to five nursing homes in two neighboring cities and one town in A Prefecture, Japan. All facilities were run by a single social welfare corporation, established with the aim of improving the welfare of the population in the region. The survey was administered after obtaining permission from the director at each nursing home. Subsequently, the research was explained to all 436 residents at the five nursing homes and their guardians. Of these, 387 elderly persons and/or their guardians gave their consent for participation, and academic use and publication of their data in manuscript form. The baseline survey was conducted in January 2013. The 377 participants who were able to eat by mouth at baseline were monitored for the following two years, and their mortality-related data collected, with the observation period ending in late December 2014. A total of 36 individuals were excluded from the analysis because of missing mortality data due to long-term hospitalization or transfer to another facility. The remaining 341 individuals (57 men, 284 women) were assigned to one of two groups for analysis: death group, containing individuals who died during the observation period, or survival group, containing all others (Figure 2). This study was approved following review by the Ethics Committee of Japan's National Center for Geriatrics and Gerontology (Approval No. 605).

Figure 2
Flowchart of the Study



Survey Items

Evaluations conducted as part of the baseline survey were standardized by providing lectures and training on survey items to attending nurses, care workers, and registered dieticians at the nursing homes. These professionals collaborated in the completion of questionnaires (one form per resident). In addition to items on basic patient information (e.g., sex, age, height, and weight) and medical history (e.g., aspiration pneumonia and cerebrovascular, respiratory, cardiovascular, neoplastic, Parkinson's, and neurological disease), the baseline survey included the Barthel Index (BI) (13) as a measure of physical function, Clinical Dementia Rating (CDR) (14) as a measure of cognitive function, Mini Nutritional Assessment®-Short Form (MNA®-SF) as a measure of nutritional status (15, 16), and the SFED as a measure of self-feeding ability. Finally, body mass index (BMI) was calculated using the obtained height and weight data.

Barthel Index (BI)

The BI is an indicator of function in activities of daily living (ADL). Each of its constituent 10 items corresponds to a specific ADL, i.e. feeding, transferring from wheelchair to bed, bathing, grooming, toilet use, bathing, mobility, climbing

stairs, dressing, bowel control, and bladder control. Each item is scored according to the level of assistance required. Item scores are summed to obtain a total score ranging between 0–100, with higher values indicating better ADL function (13).

Clinical Dementia Rating (CDR)

The CDR was performed by a doctor specializing in dementia according to the method described by Morris et al. (14). Global CDR score, indicating cognitive and functional impairment, is ranked in terms of five grades (0 [no dementia], 0.5 [questionable dementia], 1 [mild dementia], 2 [moderate dementia], and 3 [severe dementia]) and is determined by assessing cognitive performance across six independently scored domains (memory, orientation, judgment and problem-solving, community affairs, home and hobbies, and personal care), with higher values indicating greater impairment.

Mini Nutritional Assessment®-Short Form (MNA®-SF)

The MNA®-SF consists of the following six items (responses in parentheses): decrease in food intake over the past three months ([severe decrease], [moderate decrease], [no decrease]), weight loss over the past three months ([greater than 3 kg], [between 1 and 3 kg], [no weight loss], [does not know]), mobility ([bed- or chair-bound], [able to get out of bed/chair but does not go out], [goes out]), acute disease or psychological stress over the past three months ([yes] or [no]), neuropsychological problems ([severe dementia or depression], [mild dementia], [no psychological problems]), BMI ([less than 19], [19 to less than 21], [21 to less than 23], [23 or greater]). The six item scores are summed for a total score ranging between 0–14, with higher values indicating better nutritional status.

Self-Feeding Assessment Tool for Elderly with Dementia (SFED)

The SFED is an observational scale for determining the severity of feeding difficulties, which can capture reductions in self-feeding ability due to intellectual and motor dysfunction (12). As shown in Figure 1, the scale involves 10 categories: Initiation, Appropriateness, Planning, Skilled Motor Function, Movement, Cognition, Concentration, Wakefulness, Safety, and Nutrition. Each category is rated on a 3-point scale (0 [never can do], 1 [sometimes can do], 3 [always can do]). In practical terms, "never can do" means that the individual was unable perform the action even once in the past week. Elderly persons with dementia who were already receiving feeding assistance were assessed under unassisted conditions. Total scores of 0–9 are classified as severe difficulty, 10–15 as moderate difficulty, 16–19 as mild difficulty, and 20 as normal. This assessment tool is easy to use, even for care workers, as its categories directly correspond to measures relevant to nursing care. Further, it allows users to readily perceive changes in the condition of elderly persons receiving nursing care.

Statistical Analysis

Categorical variables were expressed as number of corresponding individuals (%), while continuous variables as mean ± standard deviation (SD). To avoid problems due to multicollinearity, Spearman's and Pearson's correlation coefficients were used to check all pairs of potential moderator variables, and no variable pair showed a correlation of over 0.8.

The primary outcome under investigation was mortality. Individuals were divided into two groups based on their self-feeding ability according to the criteria of Yamada et al.: "good feeding" (SFED score ≥ 16) and "poor feeding" (SFED score < 16) (12). Cumulative survival rates were analyzed using the Kaplan–Meier method, checking for differences between the two groups using the log-rank test.

Subsequently, the SFED total score was examined as a predictor of time-to-event mortality using Cox proportional hazards regression analysis, while adjusting for confounding variables previously reported to be associated with mortality risk: age, sex, medical history (i.e. aspiration pneumonia and cerebrovascular, respiratory, cardiovascular, neoplastic, Parkinson's, and neurological disease), as well as BI, CDR, and MNA®-SF scores. Since BMI is a category in the MNA®-SF, it was not included among the explanatory variables tested in this analysis. In addition, Cox proportional hazards models were constructed to examine the association of each of the 10 categories of the SFED with mortality risk, using the same confounding variables. Statistical significance was set at $P < 0.05$. All statistical analyses were performed using IBM SPSS Statistics (Version 23).

Results

Participants' baseline data from the initial survey are shown in Table 1. The survival group contained 212 individuals (62.2%) at the end of the two-year observation period, while the death group contained 129 (37.8%).

Compared with individuals in the survival group, those in the death group were significantly older, and had significantly lower height, weight, BMI, and BI, MNA®-SF, and SFED scores ($P < 0.05$). In addition, the death group contained significantly more residents with severe dementia (according to the CDR) and with a history of aspiration pneumonia ($P < 0.05$).

Kaplan–Meier survival curves are shown in Figure 3. A significant difference in survival time was observed between the poor feeding (SFED score of 16 and over) and good feeding (SFED score < 16) groups (log-rank test; $P < 0.001$).

Table 2 shows the results of the Cox proportional hazards models. The following variables were significantly associated with mortality: age (hazard ratio = 1.064, 95% confidence interval = 1.034–1.095), history of aspiration pneumonia (4.167, 2.258–7.688), history of cardiovascular disease (1.760, 1.155–2.682), MNA®-SF score (0.741, 0.661–0.832), and SFED score (0.941, 0.898–0.985).

Table 1
Baseline Characteristics and Comparison of Survival and Death Groups (n = 341)

		All (n= 341) M ± SD / n (%)	Survival (n = 212) M ± SD / n (%)	Death (n = 129) M ± SD / n (%)	*P* values
Sex	Male	57 (16.7)	37 (17.5)	20 (15.5)	0.765
	Female	284 (83.3)	175 (82.5)	109 (84.5)	
Age (years)		84.1 ± 8.5	82.4 ± 8.4	87.0 ± 8.0	< 0.001*
Observation period (days)		577.1 ± 229.2	730.0 ± 0.0	325.7 ± 192.6	< 0.001*
Height (cm)		146.2 ± 9.3	147.3 ± 9.4	144.2 ± 8.8	0.005*
Weight (kg)		43.8 ± 8.8	46.1 ± 8.7	40.0 ± 7.6	< 0.001*
BMI (kg/m^2)		20.5 ± 3.6	21.2 ± 3.5	19.3 ± 3.3	< 0.001*
Medical history					
Aspiration pneumonia		29 (8.5)	12 (5.7)	17 (13.2)	0.008*
Cerebrovascular disease		151 (44.3)	95 (44.8)	56 (43.4)	0.643
Respiratory disease		35 (10.3)	22 (10.4)	13 (10.1)	0.853
Cardiovascular disease		136 (39.9)	82 (38.7)	54 (41.9)	0.198
Neoplastic disease		27 (7.9)	18 (8.5)	9 (7.0)	1.000
Parkinson's disease		22 (6.5)	18 (8.5)	4 (3.1)	0.106
Neurological disease		28 (8.2)	22 (10.4)	6 (4.7)	0.147
Barthel Index		38.8 ± 28.1	44.4 ± 27.5	29.5 ± 26.7	< 0.001*
CDR	0	23 (6.7)	18 (8.5)	5 (3.9)	0.003*
	0.5	29 (8.5)	24 (11.3)	5 (3.9)	
	1	58 (17.0)	39 (18.4)	19 (14.7)	
	2	94 (27.6)	61 (28.8)	33 (25.6)	
	3	137 (40.2)	70 (33.0)	67 (51.9)	
MNA®-SF		8.9 ± 2.0	9.4 ±1.9	8.0 ± 1.9	< 0.001*
SFED		13.6 ± 6.3	15.0 ± 5.6	11.1 ± 6.7	< 0.001*

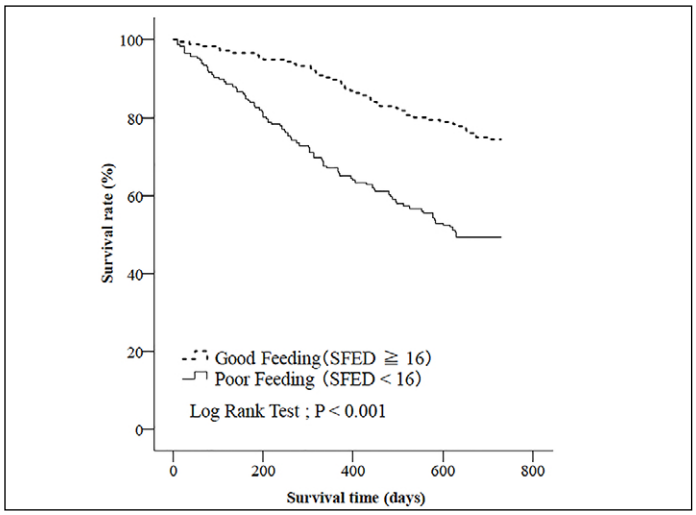
Continuous variables are expressed as mean ± standard deviation (*M* ± *SD*) and analyzed using Mann-Whitney U test; Categorical variables are expressed as number (%), and analyzed using Chi-square test; **P* < 0.05 indicates a significant difference between the survival and death groups; BMI: Body mass index; CDR: Clinical Dementia Rating; MNA®-SF: Mini Nutritional Assessment®-Short Form; SFED: Self-feeding Assessment Tool for the Elderly with Dementia

Table 3 shows the associations between scores in each of the 10 SFED categories and two-year mortality. Mortality risk was significantly lower for 'always can do' responses than for 'never can do' responses in three categories: movement (able to eat without dropping food), concentration (able to maintain attention to meal), and safety (able to swallow without choking, with no change in vocal quality after eating).

Discussion

In this study, we investigated the self-feeding ability of elderly nursing home residents using the SFED, developed by Yamada et al. This is the first study ever to examine the relationship of SFED total and category scores with two-year mortality risk in this population.

Figure 3
Survival Curve for the Self-Feeding Assessment Tool for the Elderly with Dementia Categories by Mortality Rate



SFED : Self-Feeding Assessment Tool for the Elderly with Dementia

Table 2
Association of SFED Score with Two-year Mortality

	HR 95% CI	*P* values
Sex	0.683 (0.376 – 1.240)	0.210
Age (years)	1.064 (1.034 – 1.095)	< 0.001*
Medical history		
Aspiration pneumonia	4.167 (2.258 –7.688)	< 0.001*
Cerebrovascular disease	0.674 (0.444 – 1.023)	0.064
Respiratory disease	1.071 (0.562 – 2.040)	0.836
Cardiovascular disease	1.760 (1.155 – 2.682)	0.008*
Neoplastic disease	1.180 (0.569 – 2.445)	0.656
Parkinson's disease	0.790 (0.279 – 2.237)	0.658
Neurological disease	0.544 (0.217 – 1.363)	0.194
Barthel Index	0.993 (0.981 – 1.006)	0.286
CDR		
0	1.000	Reference group
0.5	0.594 (0.149 – 2.359)	0.459
1	1.246 (0.386 – 4.020)	0.712
2	0.594 (0.192 – 1.831)	0.364
3	0.638 (0.198 – 2.058)	0.452
MNA®-SF	0.741 (0.661 – 0.832)	< 0.001*
SFED	0.941 (0.898 – 0.985)	0.010*

CI: confidence interval; HR: Hazard Ratio; CDR: Clinical Dementia Rating; MNA®-SF: Mini Nutritional Assessment®-Short Form; SFED: Self-feeding Assessment Tool for the Elderly with Dementia; Model adjusted for sex, age, aspiration pneumonia, cerebrovascular, respiratory, cardiovascular, neoplastic, Parkinson's, and neurological disease, Barthel Index, CDR, and MNA®-SF

Various methods have been developed for the assessment of eating dysfunction in order to provide effective interventions for patients with dementia at mealtimes. Major assessment methods include the 11-item Edinburgh Feeding Evaluation in Dementia Questionnaire (17), the 33-item Feeding Behavior Inventory (18), and the 6-item Eating Behavior Scale (19). These questionnaires focus on care methods and needs as perceived from the viewpoint of the care provider once spoon-feeding has been started. However, few studies have assessed self-feeding of patients prior to starting spoon-feeding.

On the other hand, it has been shown that pharmaceutical treatment to prevent aspiration pneumonia can help maintain self-feeding ability and reduce mortality risk in elderly persons requiring long-term care (20). Contrary findings have been reported in Japanese clinical research on elderly home-care patients with neurological impairment receiving artificial nutrition (e.g., parenteral nutrition or percutaneous endoscopic gastrostomy feeding). These patients showed longer survival than did elderly home-care patients who ate by mouth, irrespective of poor ADL and cognitive function, and low serum albumin levels (21). However, the study in question was retrospective, and did not adjust for factors associated with mortality risk; thus, its findings do not necessarily conflict with ours.

The SFED is used to evaluate self-feeding ability in elderly persons with dementia. Based on observations during mealtimes over the previous week, the assessor grades an individual's performance in several categories using a 3-point scale. The instrument is easy to use, even for care workers, its categories directly correspond to measures relevant to nursing care, and it allows users to readily perceive changes in the condition of elderly receiving nursing care. Our data suggests that the SFED can predict mortality in nursing home residents; accordingly, mortality risk could be reduced with the help of SFED-based assessments and adjustments to patient care provided by care workers based on their findings.

Some studies have found mortality to be associated with scores on the MNA® and its short-form version, which are

Table 3
Associations of SFED Categories with Two-year Mortality

	Never can do	Sometimes can do			Always can do		
	HR (reference)	HR	95% CI	*P* values	HR	95% CI	*P* values
1. Initiation	1.000	0.869	(0.461-1.638)	0.665	0.651	(0.364-1.166)	0.149
2. Appropriateness	1.000	0.698	(0.362-1.348)	0.285	0.711	(0.384-1.314)	0.276
3. Planning	1.000	0.804	(0.446-1.452)	0.470	0.565	(0.292-1.092)	0.089
4. Skilled motor function	1.000	1.144	(0.646-2.028)	0.645	0.468	(0.213-1.029)	0.059
5. Movement	1.000	0.700	(0.418-1.173)	0.176	0.346	(0.170-0.702)	0.003*
6. Cognition	1.000	0.815	(0.421-1.576)	0.543	0.967	(0.547-1.711)	0.909
7. Concentration	1.000	0.837	(0.490-1.430)	0.515	0.478	(0.254-0.902)	0.023*
7. Wakefulness	1.000	0.814	(0.451-1.468)	0.494	0.548	(0.293-1.028)	0.061
9. Safety	1.000	0.699	(0.389-1.257)	0.232	0.396	(0.197-0.797)	0.009*
10. Nutrition	1.000	1.045	(0.543-2.009)	0.896	0.671	(0.376-1.198)	0.177

Model adjusted for sex, age, aspiration pneumonia, cerebrovascular, respiratory, cardiovascular, neoplastic, Parkinson's, and neurological disease, Barthel Index, CDR, and MNA®-SF

frequently used to assess nutritional status (22, 23). While the assessment is simple to perform, it is difficult to infer direct relations between nutritional status and details of care provided by nursing staff. In addition, several indices are available to assess feeding and swallowing function (24-26). However, no studies have found associations between these measures and the prognosis of elderly residents of care facilities; moreover, these tools include items that need to be assessed by specific professionals, that cannot be evaluated too frequently, or that care staff are unqualified to assess.

We observed a mortality rate of 37.8% during the two-year observation period in the present study. Previous studies have reported one-, two-, and three-year mortality rates of 17.4% (23), 30.7% (27), and 50.0% (28), respectively, among elderly persons requiring nursing care. Thus, while our observed two-year mortality rate appears somewhat high, it largely agrees with literature values. Accordingly, this finding appears to show that our study participants were a typical sample of nursing home residents.

One systematic review of mortality in elderly persons receiving long-term care found it to be most strongly associated with nutritional status, and physical and cognitive function (29). In our Cox proportional hazards regression analysis, in addition to age and sex, we included individuals' medical history, and BI, CDR, and MNA®-SF scores as explanatory variables. In addition to the SFED score, age, history of aspiration pneumonia or cardiovascular disease, and MNA®-SF score were independently correlated with mortality in our sample. The fact that these factors have been identified as predictors of mortality risk in elderly persons receiving long-term care in previous research supports the validity of our findings. In our view, the independent association of SFED score with mortality, even after adjusting for MNA®-SF score, is particularly interesting, as self-feeding ability assessment not only serves to indicate nutritional and assistance needs but can also help to determine how impaired executive functioning and diminished motivation affect the underlying ability of elderly with dementia to perform the basic daily activity of eating. Moreover, this finding leads us to conjecture that the SFED can capture the level of functioning required for this population to stay alive.

On the other hand, while BI and CDR were associated with mortality risk in a previous study (13, 14), this relationship was not identified in the present study. This discrepancy may have arisen because 84.8% of our participants had a CDR score of 1 or higher, corresponding to moderate dementia or worse, and the mean BI score was 38.8, meaning that most individuals were in severe need of nursing care. However, the fact that SFED could predict mortality in these elderly individuals receiving end-of-life care and characterized by cognitive decline and reduced ADL function appears to highlight the importance of maintaining self-feeding ability in terminal care settings.

Specific SFED categories associated with mortality risk were movement ("able to eat without dropping some food"), concentration ("able to maintain attention to meal"), and safety ("able to swallow without choking, with no change in vocal quality after eating"). Functional decline in motor skills, focus, and swallow reflex latency have been associated with a decrease in life-sustaining function in patients with severe dementia (30, 31). The fact that the SFED includes items related to life-sustaining function, which the CDR does not distinguish, may allow the SFED to better predict mortality risk. It has already been shown that active approaches to promote self-feeding in elderly persons with dementia can help combat functional decline (32). In particular, intervention studies have found that disrupted feeding patterns due to impaired concentration—associated with higher mortality risk in our study—can be improved (18). Edahiro et al. found that elderly persons with moderate or severe dementia who required assistance or experienced difficulties during mealtimes were highly likely to respond to and improve following an intervention based on an assessment of feeding environment (33). Yamada et al. identified two kinds of interventions useful for reducing feeding difficulties in elderly persons with dementia: environmental assessments to promote self-care agency, and environmental assessments of physical and social factors that the individual can arrange. They also demonstrated how elderly persons with dementia can become more independent in their daily lives through such environmental-assessment-based interventions that address attention disorders and executive dysfunction (18, 34). Hereafter, we hope that the effectiveness of SFED-based assessments will be examined in interventional research, and that their use to adjust care provision will spread widely in nursing practice.

Some researchers claim that standards and practices in palliative care for the elderly are based on little evidence, and involve few strategies other than pain control (35). In Japan, there is debate around the introduction of artificial nutrition (e.g. by gastrostomy), and the importance of self-feeding by mouth is beginning to draw attention (36, 37). Our results indicate that assessments of self-feeding ability, specifically using the SFED, can predict mortality risk in elderly persons requiring long-term care. Maintaining self-feeding ability is an important issue to be addressed in order to improve QOL in this population. SFED-based assistance could provide evidence for end-of-life care options and greatly improve care quality. Further research should investigate SFED-based interventions, and whether their use is associated with improvements in QOL, nutrition, infectious disease incidence, and hospitalisation rates, as well as with reductions in mortality.

Our study has several limitations. First, we did not measure biological markers (e.g. albumin levels), some of which are known to independently predict mortality in nursing home residents (38). It may be necessary to include such markers in future studies; however, albumin might not be useful for predicting long-term mortality, given that a five-year cohort study failed to find any association with mortality risk (39).

Second, the baseline assessment may not have been consistently performed, since it was done at five different facilities, with different survey items completed by different professionals (i.e. registered dietitians, nurses, and care workers) according to their expertise. Third, the reliability of the SFED has not been fully verified (40). However, our data showed high internal consistency for the scale (Cronbach's $\alpha = 0.943$), thus suggesting that there were no issues with its inter-item reliability. Fourth, our findings may be difficult to generalize, as our analysis was limited to the residents of five nursing homes in a single region, which may differ from nursing homes in other regions. However, all the facilities were expected to have consistent policies and care philosophies, since the same corporation runs them, and have basically the same size, professional makeup and staffing, and training content. In fact, this geographical limitation could also be viewed as a benefit: since residents were living in the surrounding area before moving to the nursing home, it is highly unlike that geographical origin biased the results.

Conclusion

Self-feeding ability as measured by SFED score was associated with long-term mortality in elderly persons living in nursing homes. Accordingly, adjusting feeding assistance based on regular SFED-based assessments may help maintain self-feeding ability and enhance QOL among nursing home residents, as well as providing evidence for end-of-life care options and greatly improving care quality.

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Compliance with Ethical Standards: The protocol for this research project was approved by a suitably constituted Ethics Committee of the Institution within which the work was undertaken, and it conforms to the provisions of the Declaration of Helsinki. All study participants provided informed consent, and the study design was approved by the appropriate Ethics Review Board.

Conflicts of interest: There are no conflicts of interest to declare.

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